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Hazardous Waste Bureau

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Anita S. Reiser
Hazardous Waste Permitting and Compliance

October 14, 2014

Ms. Pam Allen
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505

Dear Ms. Allen:

On behalf of Sandia Corporation (Sandia) and the United States Department of Energy (DOE), Sandia is delivering one copy of an 8-volume set of documents for your records. The set is titled *Justification for Class 3 Permit Modification for Corrective Action Complete With Controls, Solid Waste Management Unit 76, Mixed Waste Landfill.*

Sandia is also delivering one 8-disk set containing the documents in electronic format.

Please contact me if you have any questions or need additional information.

Sincerely,

Enclosure

Copy to (w/o enclosure):
MS-0184 John Weckerle, NNSA/SFO

Sandia National Laboratories

Justification for Class 3 Permit Modification
Corrective Action Complete with Controls
Solid Waste Management Unit 76
Mixed Waste Landfill

October 2014

Volume I of VIII
Class 3 Permit Modification for Corrective Measures, Final Order, and Corrective Measures Implementation Plan

Environmental Restoration Operations

U.S. DEPARTMENT OF ENERGY

United States Department of Energy
Sandia Field Office

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Justification for Class 3 Permit Modification, Mixed Waste Landfill
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for Corrective Measures for the Mixed Waste Landfill

No. HWB 04-11(M)

From: State of NM/ Curry
To: DOE/Sandia

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STATE OF NEW MEXICO
BEFORE THE SECRETARY OF ENVIRONMENT

IN THE MATTER OF REQUEST FOR A CLASS 3 PERMIT MODIFICATION FOR CORRECTIVE MEASURES FOR THE MIXED WASTE LANDFILL SANDIA NATIONAL LABORATORIES BERNALILLO COUNTY, NEW MEXICO EPA ID NO. NM5890110518

No. HWB 04-11(M)

FINAL ORDER

This matter comes before the Secretary of Environment following a hearing before the Hearing Officer on December 2-3 and 8-9, 2004 in Albuquerque, New Mexico. Sandia Corporation and the Department of Energy ("Sandia") seek a RCRA permit modification for Sandia National Laboratories ("SNL") pursuant to the New Mexico Hazardous Waste Act, NMSA 1978 Section 74-4-1 et seq., and the New Mexico Hazardous Waste Management Regulations (20.4.1 NMAC). The proposed modification would incorporate into the RCRA permit requirements for corrective action for SNL's Mixed Waste Landfill (MWL or landfill). The New Mexico Environment Department Hazardous Waste Bureau ("NMED") supports the approval of the proposed modification with the selection of a different remedy than that chosen by Sandia.

Having considered the administrative record in its entirety, including the Hearing Officer's Report; and being otherwise fully advised regarding this matter;

THE SECRETARY HEREBY ADOPTS THE HEARING OFFICER'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW (as corrected by interlineated substitute pages) WITH CHANGES ONLY TO THE FOLLOWING:

2. The Public Notice announced the availability of the Draft Permit for public review; a 90-day period for public comment on the draft; the setting of a public

hearing on the Draft Permit beginning December 2, 2004 in Albuquerque, New Mexico; the procedures for public participation, participation as a party and providing technical testimony. NMED Exhibit 1.

15. The landfill is SWMU 76 at SNL, and regulated under 40 CFR Section 264.101 (incorporated by 20.1.4.500 NMAC) TR 968-69; AR 04-077.

20. Most of 40 CFR Part 264 does not apply to the landfill as it is not included in any Part B permit, and 40 CFR Part 265 does not apply to the landfill as it is not an interim status facility in SNL's Part A permit application. TR 969.

23. NMED proposes to modify Module IV of the permit to: a) incorporate by reference the CMS Report dated May 2003 prepared by Sandia; b) select a vegetative soil cover with bio-intrusion barrier as the remedy for the landfill; c) require a Corrective Measures Implementation ("CMI") Plan for the landfill that incorporates the final remedy and provides implementation schedules, that Sandia must submit to NMED within 180 days of final remedy selection; d) require Sandia to submit progress reports during implementation of the remedy; e) require Sandia to submit a CMI Report for the landfill to NMED for approval within 180 days after implementation of the remedy is complete; and f) require that Sandia submit a long-term monitoring and maintenance plan to NMED for approval. NMED Exhibit 3.

60. The highest tritium flux (flow of tritiated water vapor off surface soils into the atmosphere) occurred at the east boundary of the classified area. TR 55-56, 953. Sandia estimated total tritium activity released from the landfill during 1993 to be 0.294 curies (which decreased to 0.09 curies per year in 2003). TR 954.

86. Sandia subsequently closed the ISS and moved the drums off-site. As part of the closure process, Sandia analyzed risk presented by the ISS, which predicted radiological risk significantly below background levels in Albuquerque. TR 82-83.

120. For the future excavation scenario (Alternative V.e, 39 years in the future), the total dose equivalent was exceeded for a worker excavating the landfill. In NMED's opinion, although the risk assessment could have used more realistic assumptions, it is clear that excavation of the landfill in the near-term could pose substantial risk to excavation workers. TR 1041-43.

169. A bio-intrusion barrier will discourage small animals (such as mice, prairie dogs, burrowing owls) from burrowing through the cover and coming into contact with waste and contaminated soil, and from transporting wastes and contaminated soil in the landfill to the surface. A bio-barrier will not stop insects (such as ants) from burrowing into the ground, and will not prevent deep-rooted plants from penetrating the cover. Any animals or plants living on the landfill will be exposed to low levels of tritium and radon, which will penetrate a bio-barrier. TR 1070.

U. Sandia should develop a comprehensive fate and transport model for the landfill, to be used in evaluating future options, triggers, monitoring and contingencies.

IT IS THEREFORE ORDERED:

Sandia's application for RCRA permit modification is hereby granted as proposed (NMED Exhibit 2), subject to the following changes and conditions:

1. The remedy shall be a vegetative cover with bio-intrusion barrier (Alternative III.c in Sandia's Corrective Measures Study, dated May 2003);

2. As part of the Corrective Measures Implementation Plan that incorporates the final remedy (described in the draft permit modification in Paragraph V.3), Sandia shall additionally include the following:

a. a comprehensive fate and transport model that studies and predicts future movement of contaminants in the landfill and whether they will eventually move further down the vadose zone and/or to groundwater;

b. triggers for future action, that identify and detail specific monitoring results that will require additional testing or the implementation of an additional or different remedy.

3. NMED and Sandia shall provide a convenient method for the public to review Sandia's Corrective Measures Implementation Plan, Corrective Measures Implementation Report, progress reports, long-term monitoring and maintenance plan, and any other major documents developed by NMED or Sandia for the MWL ("the documents"), including but not limited to, posting the documents on a publicly-accessible website.

4. NMED and Sandia shall provide a method and schedule that allows interested members of the public to review and comment on the documents, and NMED shall review, consider and respond to these public comments prior to approving any of these documents (with the exception of any documents, such as progress reports, that NMED does not approve in the normal course of permit review and oversight).

5. Sandia shall prepare a report every 5 years, re-evaluating the feasibility of excavation and analyzing the continued effectiveness of the selected remedy. The report shall include a review of the documents, monitoring reports and any other pertinent data, and anything additional required by NMED. In each 5-year report, Sandia shall update the fate and transport model for the site with current data, and re-evaluate any likelihood of contaminants reaching groundwater. Additionally, the report shall detail all efforts to ensure any future releases or movement of contaminants are detected and addressed well before any effect on groundwater or increased risk to public health or the environment. Sandia shall make the report and supporting information readily available to the public, before it is approved by NMED. NMED shall provide a process whereby members of the public may comment on the report and its conclusions, and shall respond to those comments in its final approval of the report.

6. The Hearing Officer is granted until April 20, 2005 to submit her Report and Proposed Findings of Fact, Conclusions of Law and Proposed Order.

RON CURRY
Secretary, Environment Department

Volume I

TAB 2

Remedy Decision and Class 3 Permit Modification

Request to Incorporate into RCRA Permit Corrective Measures for

Mixed Waste Landfill (SWMU 76)

From: NMED/Kieling
To: SNL/Wagner

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State of New Mexico
ENVIRONMENT DEPARTMENT
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
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BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

DERRITH WATCHMAN-MOORE
DEPUTY SECRETARY

August 2, 2005

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
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Peter B. Davies
Director, Geoscience and Environment
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P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: REMEDY DECISION AND CLASS 3 PERMIT MODIFICATION REQUEST TO INCORPORATE INTO RCRA PERMIT CORRECTIVE MEASURES FOR MIXED WASTE LANDFILL (SWMU 76)
SANDIA NATIONAL LABORATORIES EPA ID# NM5890110518
HWB-SNL-04-021

Dear Ms. Wagner and Mr. Davies:

As you are aware, on May 26, 2005, the Secretary of the New Mexico Environment Department (NMED) approved a remedy and a Class 3 permit modification request for corrective measures for the Mixed Waste Landfill (MWL) at Sandia National Laboratories (SNL).

A public hearing was conducted on the matter on December 2-3 and 8-9, 2005; a public comment period was held from August 11, 2004 to December 2, 2004, and extended until December 9, 2004. Based on the administrative record and the Hearing Officer's Report, the NMED Secretary selected a vegetative soil cover with bio-intrusion barrier (Corrective Measures Study Alternative III.c) as the remedy for the MWL. The draft permit modification issued by NMED was revised in accordance with the Secretary's final decision. A copy of the final permit modification is enclosed. Additionally, in accordance with Section 20.4.1.901.A(9) NMAC, attached are NMED's responses to public comment, including explanations for changes made to the draft permit in preparing the final permit. These documents are also located on the NMED web page at www.nmenv.state.nm.us/hwb/snlperm.html under Mixed Waste Landfill.

Please contact Mr. William Moats of my staff at (505) 284-5086 if you have questions or comments.

Sincerely,

John E. Kieling
Manager
Permits Management Program

JEK:wpm

cc: J. Bearzi, NMED HWB
W. Moats, NMED HWB
F. Nimick, SNL, MS 1089
D. Fate, SNL, MS 1089
J. Estrada, DOE/SSO/NNSA
J. Gould, DOE/SSO/NNSA
L. King, EPA-Region 6PD-N
File: SNL HSWA OU 1289, 2004

Enclosures

AUG 0 4 2005

V. CORRECTIVE MEASURES FOR THE MIXED WASTE LANDFILL (SWMU 76)

1. The report, *Mixed Waste Landfill Corrective Measure Study Final Report*, *Sandia National Laboratories, New Mexico*, dated May 2003, is incorporated herein by reference.

2. The remedy to be implemented by Permittees for the Mixed Waste Landfill shall be as defined as Alternative III.c--Vegetative Soil Cover with Bio-Intrusion Barrier, as set forth in the report referenced in V.1 of this section.

3. A Corrective Measures Implementation (CMI) Plan that incorporates the final remedy described in Section V.2 of this section shall be submitted by the Permittees for the Mixed Waste Landfill for the Administrative Authority's approval no later than 180 days following the selection of the remedy by the Administrative Authority. The CMI Plan shall provide details on the design, construction, operation, maintenance, and performance monitoring for the selected remedy, and a schedule for implementation. The CMI Plan shall, at a minimum, include:

    a. A description of the selected remedy;

    b. A description of the remediation system objectives;

    c. An identification and description of the qualifications of key persons, consultants, and contractors that will be implementing the remedy;

    d. Detailed engineering design drawings and systems specifications for all elements of the remedy;

    e. A construction and construction quality assurance work plan;

    f. An operation and maintenance plan;

    g. The results of any remedy pilot tests, such as landfill cover test plots;

    h. A schedule for submission to the Administrative Authority of periodic progress reports;

    i. A schedule for implementation of the remedy; and

    j. A health and safety plan.

4. A CMI Report for the Mixed Waste Landfill shall be submitted by the Permittees to the Administrative Authority for approval within 180 days after implementation of the remedy is complete. The CMI Report shall, at a minimum, include:

    a. A summary of the work completed;

    b. A statement signed by a registered professional engineer, that the remedy has been completed in full satisfaction of the specifications in the CMI Plan;

    c. As-built drawings and specifications signed and stamped by a registered professional engineer;

    d. Copies of the results of all monitoring, including sampling and analysis, and other data generated during the remedy implementation, if not already submitted in a progress report; and

    e. A certification, signed by a responsible Permittee official stating: "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations".

5. The Permittees shall submit to the Administrative Authority progress reports during implementation of the remedy in accordance with a schedule approved in the CMI Plan for the Mixed Waste Landfill. Each of the progress reports shall, at a minimum, include the following information.

    a. A description of the work completed during the reporting period;

    b. A summary of all problems, potential problems, or delays encountered during the reporting period;

    c. A description of all actions taken to eliminate or mitigate problems, potential problems, or delays;

    d. A discussion of the work projected for the next reporting period, including all sampling events; and

e. Copies of the results of all monitoring, including sampling and analysis, and other data generated during the reporting period.

6. A long-term monitoring and maintenance plan, which includes all necessary physical and institutional controls to be implemented in the future shall be submitted by the Permittees to the Administrative Authority for approval within 180 days after the Administrative Authority's approval of the CMI Report. The Administrative Authority may require monitoring, maintenance, and physical and institutional controls different than those specified in the Corrective Measures Study report referenced in Section V.1 of this section. The plan shall also include contingency procedures that must be implemented by the Permittees if the remedy set forth in Section V.2 above fails to be protective of human health and the environment.

NMED Responses to Public Comments on the Sandia National Laboratories' Mixed Waste Landfill Permit Modification for Corrective Measures August 2, 2005

Commenter ID	Commenter/ Affiliation	Topic Area	Comment Number	Comment Summary	NMED Response Number	NMED Response	Revised Final Permit? Yes or No
A	For Citizen Action, Sue Dayton	Sodium	1.1	The unknown amounts of metallic sodium reportedly buried in the Mixed Waste Landfill (MWL or Landfill) (see FOIA document #20, par. 4) have been omitted from discussion in the Corrective Measures Study (CMS). Metallic sodium, used in the oxide reactor fuel experiments at Sandia National Laboratories (SNL), has not been identified as a hazardous substance in the inventory of the MWL nor has it been included in the CMS risk assessment. The commenter wants to know why it was not included.	R1	Sodium reacts with water and other oxidizers. Unknown, but likely small amounts of sodium metal may be present in canisters buried in the MWL that once held oxide reactor fuel samples. Provided that the canisters remain buried and are not exposed to water beyond normal soil moisture, chemical reaction of the sodium will not proceed at a rate that will threaten human health or the environment. See also Responses R5 and R49. The presence of sodium in the Landfill does not preclude the option of capping the MWL as a final remedy.	No
A	For Citizen Action, Sue Dayton, 2nd submittal		1.26	An interview with George Tucker, former SNL employee, 1995 (FOIA 3) indicates that explosives were not allowed in the MWL, however FOIA document #21 states that metallic sodium "may be present". The commenter asked the New Mexico Environment Department (NMED) to address this apparent discrepancy.	R2	Metallic sodium is not classified as an explosive by the U. S. Bureau of Alcohol, Tobacco, Firearms, and Explosives.	No

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A	For Citizen Action, Sue Dayton	Beryllium	1.2	The commenter indicated that the MWL contains significant amounts of beryllium (218 cubic yards total) and PCBs (251 cu. yd). The commenter indicated that there is no discussion in the CMS about the beryllium and no response from the NMED regarding clean up of this material.	R3	While the Landfill contains wastes contaminated with beryllium and PCBs, there is no evidence that such wastes are migrating from the Landfill. Therefore, there is no risk to receptors regardless of the concentrations of these contaminants in the Landfill. See also Response R6. Continued monitoring during post-closure care will be conducted to ensure that hazardous waste or hazardous waste constituents are not migrating from the Landfill. The MWL is not subject to TSCA, but instead, is regulated under the New Mexico Hazardous Waste Act (NMSA 1978 §§ 74-4-1 et seq. (Repl. Pamp. 2000)) and the New Mexico Hazardous Waste Management Regulations (20.4.1 NMAC). Accordingly, the CMS did not need to address TSCA requirements.	No
A	For Citizen Action, Sue Dayton		1.3	The commenter indicated that according to the CMS the MWL contains 251 cubic yards of PCBs. Considering this amount the commenter asked why TSCA wasn't identified and discussed in the CMS	R3	See Response 3.	No
A	For Citizen Action, Sue Dayton	Risk Assessment Inhalation Factors	1.4	The commenter indicated that on pages I-84 and I-85 of the CMS (Tables 2 and 3, "Default Non-Radiological/Radiological Exposure Parameter Values for Various Land Use Scenarios"), the inhalation factors are different for	R4	It appears that the commenter is referring to Tables 2 and 3 on pages I-88 and I-89. The difference in inhalation factors is because for the chemical risks, the Environmental Protection Agency (EPA) exposure assumptions were applied; whereas, for	No

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				radiological and non-radiological under industrial, recreational and residential scenarios. The commenter wants to know the reason for these differences.		the radiological risk, Department of Energy/ Nuclear Regulatory Commission (DOE/NRC) exposure assumptions were applied. The most notable difference is the inhalation factors used for the recreational scenario. Both assessments use a base inhalation rate for the recreational scenario of 30 cubic meters per day; however the EPA-based rate as shown in Table 2 has been modified to allow for the limited exposure time and duration for the recreational receptor. RESRAD requires input of the base rate, and the other modifying factors (exposure time and duration) are separate input parameters and are applied to the base inhalation rate during the model calculations. So while the inhalation rates appear different in these tables, the final inhalations rates for both assessments for the recreational scenario are the same.	
A	For Citizen Action, Sue Dayton, 2nd submittal	Waste Inventory	1.7	Accurate records of the MWL waste inventory before 1965 no longer exist and records from 1965 to 1976 are incomplete with regard to waste disposal. (SNL ER Program, 1993, Phase 2 RFI Work Plan (FOIA 101)). The commenter had several questions regarding this issue. First, the commenter indicates that SNL states that the lost records have been found but indicated that the files contain conflicting data, the researcher	R5	NMED understands that some MWL records have been located at the Idaho National Environmental and Engineering Laboratory (INEEL). Records are incomplete and there are some discrepancies between the known inventory and historical accounts based on interviewed witnesses. However, the NMED believes that while the inventory for the MWL is not complete, it is adequate to select a final remedy for the MWL. See also Hearing	No

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				applied a straight-line average to waste disposal from 1959-1969; and the estimated values for individual waste categories. The commenter asked if NMED believes that these statements are representative of a Cold War waste site with an "excellent" inventory.		Officer's Findings of Fact and Conclusions of Law (HO FOF/COL), ¶¶ 43-45.	
A	For Citizen Action, Sue Dayton, 2nd submittal		1.10	"Most waste from this facility should be considered mixed waste since the exact composition of the waste is uncertain and radioactive chemicals as well as classified toxic materials could be expected". The commenter asked if this was indicative of a landfill with an excellent inventory.	R5	See NMED Response R5; see also HO FOF/COL, ¶¶ 43-45.	No
A	For Citizen Action, Sue Dayton, 2nd submittal		1.28	The commenter indicates that between 1965 and 1970, before complete records were kept, there was a lot "unknown" about the final disposal of "Fission Product/Induced Activity. The commenter questions if these "unknown" statements are indicative of a landfill with an excellent inventory.	R5	See NMED Response R5; see also HO FOF/COL, ¶¶ 46-50.	No
A	For Citizen Action, Sue Dayton, 2nd submittal, Dr. Resnikoff's		1.52	The commenter stated that the purpose of RFI Phase 2 investigation was to "identify all potential or suspected sources of contamination" and "to determine thoroughly the contaminant	R5	See NMED Response R5; see also HO FOF/COL, ¶¶43-50.	No

Commenter ID	Commenter/ Affiliation	Topic Area	Comment Number	Comment Summary	NMED Response Number	NMED Response	Revised Final Permit? Yes or No
	comments			source". The commenter states that this has not been done. (pp. 6, 7)			
A	For Citizen Action, Sue Dayton, 2nd submittal, Dr. Resnikoff's comments		1.54	The commenter indicated that SNL has not fully characterized the inventory of the MWL (p. 13).	R5	See NMED Response R5; see also HO FOF/COL, ¶¶ 43-50.	No
A	For Citizen Action, Sue Dayton, 2nd submittal		1.64	Regarding the "WERC Independent Technical Peer Review of the Working Draft CMS for MWL", Executive Summary, the first comment in Section (ii. 1): the WERC states that the site operational history (section 1.0 of the draft CMS) fails to include information that the early inventory data (once believes to be lost) can now be found in microfiche at INEEL. This information was omitted from the CMS as well as the fact that the MWL was used for disposal of chemicals prior to the opening of the CWL. This information was obtained in a document found by Citizen Action under a FOIA request. The comment requests that the information be included in the CMS, that the records be released to the public, and that as complete MWL inventory as possible be prepared.	R6	The purpose of the CMS is for the facility to evaluate potential remedial options and recommend a remedy to the administrative authority (NMED). It is not necessary to include in the CMS Report detailed information concerning the operation of the Landfill, including the waste inventory, because this information is provided to the extent known in the RCRA Facility Investigation (RFI) Report(s). In the case of the MWL, most of this information is found in the Phase 1 and 2 RCRA RFI Reports, although some is located in other documents. The known waste inventory and other information have been made publicly available by both the NMED and the SNL to the extent that security classification requirements permit such a release of information. See also HO FOF/COL, ¶¶ 43-50.	No

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A	For Citizen Action, Sue Dayton, 2nd submittal	Changes to Waste Volume Estimates	1.5	The commenter provided selected statements taken from documents obtained by Citizen Action under a FOIA. Several following comments address this issue. The first comment indicated that an estimated 720,000 cubic feet of waste has been buried on site during the 28-year operation. (SNL ER Program Information Sheet, 1987 (FOIA 90)). The commenter asked why these estimated volumes continue to change.	R7	Estimates may change because the data from which SNL is working are old, incomplete, and in some cases may be inaccurate. This is a common occurrence for landfills that are as old as the MWL. The older estimates were made using the best available data at the time, and as new information became available, the volumes were modified accordingly. See also HO FOF/COL, ¶¶ 43-50. The records provided by SNL are more detailed than those of many such landfills used for disposal of hazardous and radioactive wastes during historical times. There are no waste disposal records for many old landfills. See also HO FOF/COL, ¶¶ 43-50.	No
A	For Citizen Action, Sue Dayton, 2nd submittal		1.6	Approximately 50,000 cubic feet of radioactive waste has been buried at the site (SNL Working Draft, Sampling Plan 1992 (FOIA 92)). The commenter asked why these estimated volumes continue to change.	R7	See Response R7. See also HO FOF/COL, ¶¶ 43-50.	No
A	For Citizen Action, Sue Dayton, 2nd submittal	Knowledge of Exact Waste Quantities and Locations	1.8	The commenter asked what information NMED has on the "lost records" which have been found. The files indicate that all records prior to 1964 were destroyed as part of a record purge (letter from Delacroix Davis, Jr. to James G.	R8	NMED has relied chiefly on the waste inventory submitted with the Phase 2 RFI Report and does not possess additional records that have not been made available to the public. Although the inventory lists as much detail as possible about wastes disposed of in the individual	No

Commenter ID	Commenter/ Affiliation	Topic Area	Comment Number	Comment Summary	NMED Response Number	NMED Response	Revised Final Permit? Yes or No
				Steger, 1977, p. 11 (FOIA 50))		trenches and pits, the NMED does not have records for and does not generally know the exact volumes or mass, the exact levels of radioactivity, or the exact locations of most radioactive (including TRU), mixed, or hazardous wastes in the Landfill. The NMED does not possess records from INEEL; information from these records was summarized by SNL in the inventory provided in the Phase 2 RFI Report. The NMED does not know the quantities, types, or exact locations of fuel canisters, wastes from the Nevada Test Site (NTS), wastes contaminated with multiple fission products or metals, TRU wastes, or wastes disposed of in the radioactive chemical pit beyond the information provided in the inventory. See also HO FOF/COL, ¶¶ 43-50.	
A	For Citizen Action, Sue Dayton, 2nd submittal		1.11	"…the most common metal disposed of at MWL is lead. Also, barium, beryllium and chromium were probably disposed of. No records are available on the quantities of metals disposed of…" (SNL ER Program Information Sheet, FOIA, 1987 (FOIA 90)). The commenter asked if NMED has accurate records of quantities of metals (such as lead) disposed of at MWL.	R8	See Response R8. See also HO FOF/COL, ¶¶ 43-50.	No
A	For Citizen Action, Sue Dayton, 2nd		1.14	"… MWL received a variety of radioactive and potentially radioactive/hazardous mixed	R8	See Response R8. See also HO FOF/COL, ¶¶ 43-50.	No

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	submittal			waste…" Primary radionuclides are uranium and tritium; also there is some plutonium and plutonium-contaminated material, cobalt-60, cesium-137, radioactive tracers, radionuclear waste from operating and decommissioned Sandia Pulsed Reactors and experiments at the Nevada Test Site (NTS). Radioactively contaminated oils and naphthalene scintillation vials…" The commenter asked if there was a complete inventory of each of these specific waste products, i.e., quantity, type, curies, and method used for containment.			
A	For Citizen Action, Sue Dayton, 2nd submittal		1.15	"Chemical waste including acids, solvents, TCE, carbon tetrachloride, and scintillation cocktails. Other wastes disposed of in the classified area include uranium, thorium, plutonium, enriched lithium, various facilities, and plutonium-contaminated nuclear weapons test debris". The commenter states that SNL maintains that no liquid waste was disposed of in the MWL, the term "leaky" does not typically refer to solid waste. In addition, based on SNL's reports, less than a gram of plutonium was buried in the MWL. The commenter asked if that amount took into consideration the total volume of plutonium-contaminated wastes and the	R9	The less than 1 gram of plutonium includes small amounts of plutonium that contaminate some debris in the Landfill. The NMED does not possess the INEEL records. The information in the INEEL records has been summarized in the inventory, which is adequate in the case of the MWL for the purpose of remedy selection. See also Response R8 and HO FOF/COL, ¶¶ 43-50.	No

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				plutonium reportedly contained in the 19 drums as reported in the MWL known inventory? The commenter also request that these records, apparently on microfiche and stored at INEEL, be made available to the public in order to fully characterize the content of the MWL.			
A	For Citizen Action, Sue Dayton, 2nd submittal		1.17	In an interview with former SNL employee H. Abbott (interview date unknown), he states "Possible mixed fission products went to dump. Lots of fuel in mountains stored. Only neutron activated material went to the dump. Lots, large amounts of DU (depleted uranium)." The commenter would like a list of the fission products, volumes, and curies disposed of at the MWL. The commenter asked if NMED has records of where these mixed fission products originated. The commenter also asked what "lots of fuel stored in mountains" refers to.	R10	NMED does not know where fission-product contaminated wastes were generated, although it is possible that some of the waste was generated locally at SNL. Some of the waste is from the NTS and possibly other DOE facilities in the U.S. NMED has no knowledge of any nuclear fuels stored "in mountains". Nuclear fuels are not hazardous waste, and thus are not subject to RCRA. See also Response R8.	No
A	For Citizen Action, Sue Dayton, 2nd submittal		1.22	"Records of disposal in pits from Nevada Test Site and South Pacific were examined and then disposed of at the MWL." (Interview with former SNL employee Bob Schwing, 1995(FOIA 7).) The commenter asked if there are such records, and in which section at	R8	See Response R8.	No

Commenter ID	Commenter/ Affiliation	Topic Area	Comment Number	Comment Summary	NMED Response Number	NMED Response	Revised Final Permit? Yes or No
				MWL these materials were disposed of.			
A	For Citizen Action, Sue Dayton, 2nd submittal		1.23	"…other records suggest that transuranic wastes may have been buried at the MWL; waste records did not define contents of the TRU waste before 1972, thus actual presence and quantities of these wastes cannot be accurately determined…". (SNL ER Program, 1993 Phases 2 RFI Work Plan (FOIA 101).) The commenter asked if NMED has further documentation about TRU wastes disposed of at MWL, and does NMED believe the information represents an accurate inventory of waste disposed of at the MWL.	R11	See Responses R5 and R8.	No
A	For Citizen Action, Sue Dayton, 2nd submittal		1.24	"On the order of 1000s of REM/hr [disposed of in the MWL] on contact. Truckloads were disposed of during decommissioning. Some elements of reactor exceeded 5000 rem/yr. Disposal of much material in pits-100 rem/hr" (Interview with former SNL employee Max Moms regarding disposal of nuclear reactor material in dump, 1998 (FOIA 12).) The commenter asked what "elements of reactor waste exceeded 5000 rem/hr"	R12	NMED does not know how many reactor vessel plates exist in the MWL and which of these plates specifically had radioactivity levels of greater than 5000 rem/hr.	No
A	For Citizen Action, Sue		1.25	Interview with Frank Statzula a former SNL employee (FOIA 58)	R8	See Response R8.	No

Commenter ID	Commenter/ Affiliation	Topic Area	Comment Number	Comment Summary	NMED Response Number	NMED Response	Revised Final Permit? Yes or No
	Dayton, 2nd submittal			mentions a radioactive acid pit and indicates that chemicals, radioactive materials were disposed of in the pit until 1969. The commenter indicated that this pit was not disclosed to members of the SNL/Citizens Advisory Board. The commenter asked if NMED has a complete inventory of waste disposed of in the radioactive acid pit.			
A	For Citizen Action, Sue Dayton, 2nd submittal, Dr. Resnikoff's comments		1.51	The commenter stated that pit contents (see examples, pits 35-36) do not match the gamma levels at surface taken by SNL (pp. 7, 8).	R13	That certain pit contents have gamma radiation sources in them that are not included in the inventory simply means that the inventory is incomplete. Again, NMED is aware that the inventory is incomplete; but it is adequate for remedy selection.	No
A	For Citizen Action, Sue Dayton, 2nd submittal		1.65	WERC describes the MWL inventory as: Anecdotal testimony in the records regarding disposal of non-stabilized free liquids. The location of many dangerous materials appears to be unknown such as nuclear fuel canisters and radioactive sealed sources. The amount of hazardous waste is not well understood, i.e.; inventory does not match characterization of Pit 35 and Trench B and C. Volumes of waste vary widely in different sections of the report. Meanings of words "debris" and "all waste" in the CMS are	R14	The meaning of the terms "all waste" and "debris" as used in the CMS should be taken as their ordinary meanings. See also Responses R5, R8, and R13.	No

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				uncertain. The commenter requests that NMED responds to these issues.			
M	Citizen, Steve Dapra		13.4	The commenter indicated that although SNL does not know the identity of every item in the MWL, there is a thorough inventory of the Landfill's contents. No previously unknown items have been detected, either from the soil, water, or air sampling; or by radiation detection instruments. There is no reason to believe that any of the possibly unknown items are harmful. (See also Summary of the MWL, p.2, par. 4.)	R15	NMED agrees that samples of air, ground water, surface soil, and subsurface soil were analyzed for a wide variety of chemical and radiological parameters. Hazardous or radioactive contaminants released from the MWL are few and include low levels of tritium, radon, and cadmium. However, that other hazardous or radioactive contaminants were not detected as releases does not mean that other wastes/contaminants within the Landfill are of no harm to the human health and the environment should they ever migrate from the Landfill. This is one reason why it is prudent to continue monitor the MWL. See also Response R8.	No
A	For Citizen Action, Sue Dayton, 2nd submittal	Truck Trailer	1.29	"Trailer was buried in Trench F, deeper than the picture shows. The trailer was not a flatbed, but a box-type with doors, which was backed down the trench, unhooked and the truck drove out". The commenter asked if NMED knows of any box-type trailers that were disposed of at MWL. SNL responded by stating that no box-type trailers were buried in the Landfill. The commenter believes that this raises	R16	NMED has a copy of a photograph of the truck trailer. The truck trailer is of the flat-bed variety.	No

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				questions regarding the complete inventory at the Landfill.			
A	For Citizen Action, Sue Dayton, 2nd submittal	Off site tritium monitoring and source	1.9	"They have a feel for what is in there but the numbers are questionable…use vegetation as indicator, succulent plants work best. Elevated concentrations [found] up to 5 km away. (Interview the Donna Hartzel to G.L, 1989 (FOIA).) The commenter asked if NMED has reviewed this document and if NMED has conducted any off-site radiological monitoring to detect tritium in vegetation. Does the statement in the document mean that biological transport of tritium has been occurring for years? What are the elevated concentrations of tritium referred to in this report and is this still occurring. What does the term "have a feel for" mean in terms of describing the MWL inventory?	R17	NMED has been aware for many years that vegetation growing on and near the MWL contains small amounts of tritium, as tritium moves with water and has been released from the Landfill. NMED has not reviewed this particular report and has not collected and analyzed samples of vegetation at the MWL. However, the levels of tritium flux from the Landfill do not demonstrate that an unacceptable risk to the environment occurs at the Landfill.	No
A	For Citizen Action, Sue Dayton, 2nd Submittal	Reactor vessel plates	1.12	The commenter indicated that "SP-4 contains what is purported to be reactor vessel plates. Very little is known about these plates, their origin, number, size or configuration." (Memo from Jerry Pease/SNL to Mark Jackson, John Gould/DOE/KAO, 1997 (FOIA 22).) The commenter asked if there is still little known about the reactor vessel plates.	R18	NMED is only aware of what was reported in the inventory. As indicated in the inventory, sample pieces of reactor vessel plates, with radioactivity dose levels of 2 rem/hour on contact, are buried in pit SP-4. The plates originated from a reactor that was decommissioned in 1978, which once existed at a location in the San Fernando Valley. Sample sections are reported to be 6-ft long. Reactor vessel plates not retained as	No

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						samples were disposed of at Beatty, Nevada. SP-4 is concrete lined, the only lined pit at the MWL.	
A	For Citizen Action, Sue Dayton, 2nd submittal	Liquids and Liquid Waste	1.13	"Radioactivity contaminated waste water was discharged into one of the trenches during the month of 1967; the water could potentially have increased the migration rate of contamination through the soil column towards the aquifer." (SNL ER Program Information Sheet FOIA, 1987 (FOIA 90).) The commenter indicated that SNL maintains that no liquids were disposed of in the MWL, and those that were disposed of were containerized. Does NMED agree that this statement from the FOIA document 90 refers to liquid wastewater that is not containerized?	R19	In 1967, approximately 204,000 gallons of coolant wastewater from the SNL Engineering Reactor Facility was discharged into Trench D. This wastewater, a liquid, was not containerized prior to its disposal into the MWL. There is no evidence that the disposal of this wastewater increased the migration rates of any hazardous or radioactive constituents, except possibly that for tritium, which moves readily with water. Sampling and analysis of soil beneath Trench D during the installation of ground-water monitoring well MWL-MW4 show that only small levels of tritium have been released from this trench. No other contaminants besides tritium were found below the trench. It is clear to NMED that the MWL received some liquid wastes.	No
A	For Citizen Action, Sue Dayton, 2nd submittal		1.16	"Characteristics of contamination: disposal in unlined pits and trenches; contaminated oils, liquids and solvents; solid and liquid wastes." The commenter indicated that SNL maintains that no liquid wastes were disposed of at the MWL, this statement refutes that claim. The commenter asked that NMED respond to the comment.	R19	See Response R19.	No

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A	For Citizen Action, Sue Dayton, 2nd submittal		1.27	"After 1975, SNL required liquid wastes to be solidified prior to disposal. Before this time unsolidified radioactive liquids, whether containerized or not were disposed of in the MWL. (ER Program/Site Health and safety Plan, 1992 (FOIA 115,116).) The commenter points out that this conflicts with SNL statement that no liquids were disposed of at MWL. The commenter wants NMED to comment on this.	R19	See Response R19.	No
A	For Citizen Action, Sue Dayton, 2nd submittal		1.18	In a 1989 interview with SNL employee Donna Hartzel, she states "Two summers ago workers found 5 feet of water in nearby completed trench. Workers pumped water into the trench to the west." The commenter asked if the above quote supports the DOE/SNL assertion that workers were not allowed to dispose of liquids into MWL.	R19	See Response R19.	No
A	For Citizen Action, Sue Dayton, 2nd submittal		1.20	"Organic wastes were disposed of at the MWL beginning in 1959 and continued until 1962 when the Chemical Waste Landfill (CWL) was opened." (ER Program/Site Health and Safety Plan, 1992 (FOIA 116).) Uncontainerized liquids were disposed of at the CWL ; it makes sense that liquids were disposed of at MWL prior to being sent to CWL. Why would	R20	There is abundant evidence that liquid wastes were commonly disposed of in the CWL. SNL has admitted to this practice. Although the waste disposal practices between the two landfills appear to be inconsistent, NMED does not know the reason why this was the case. Each landfill must be assessed on a site-by-site basis.	No

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				SNL indicate that liquids were solidified at MWL, and not at CWL.			
M	Citizen , Steve Dapra		13.1	The commenter indicated that there are no free liquids in the MWL. According to the Summary of MWL, Oct. 3, 2002, p. 2, par. 2: Disposal of free liquids was not allowed at the MWL. Liquids such as acids, bases, and solvents were solidified with commercially available agents such as Aquaset, Safe-T-Set, Petroset, vermiculite, marble chips, or yellow powder before containerization and disposal.	R21	The commenter is referring to information provided by the SNL, where they make a general statement that liquids were solidified prior to their disposal in the MWL. As mentioned above, it is clear to the NMED that the MWL received some liquid wastes.	No
A	For Citizen Action, Sue Dayton, 2nd submittal	Soil Gas Sampling	1.19	'Incompatible and un-neutralized ignitable and reactive gases may have been placed in pits and trenches. Subsequent reactions generate hazardous vapors which could penetrate soil caps and be released. Potential for release to air from pits 24-30 is high". (SNL ER Program Information Sheet, FOIA, 1992 (FOIA 90).) The commenter asked if it was true that no active soil gas surveys have been conducted in classified pits 24-30.	R22	Passive soil-gas surveys were done in the area of the pits. Active soil-gas surveys were conducted near the pits on all sides. The pits in the classified area of the MWL were also investigated by the sampling and analysis of soil beneath them via angled boreholes. NMED is satisfied that the SNL efforts to detect releases of contaminants from the pits in the classified area of the MWL are adequate. The only contaminants released from this area of the Landfill are low levels of tritium and radon.	No
A	For Citizen Action, Sue Dayton, 2nd submittal	Fuel Canisters	1.21	"Based on interviews with TA5 personnel there may be hazardous constituents in the canisters. As little process knowledge, there have	R23	The canisters that formerly contained samples of oxide reactor fuel may have contained hazardous components such as sodium and heavy metals. NMED has	No

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				been no controls since it was generated…." The commenter asked what those statements mean.		investigated this matter and has determined that the fuel rod samples were removed from the canisters prior to the disposal of the canisters in the MWL.	
M	Citizen, Steve Dapra		13.7	The commenter indicated that certain parties claimed that fuel rods are buried in the MWL. This claim is answered in a letter from Ron Curry, Secretary of New Mexico Environment Department to Dr. Maurice Weisberg, M.D, (August 22, 2003). The claim is both false and unreasonable. Fuel rods are extremely expensive and they would not be buried.	R23	See Response R23.	No
N	Citizen, Maurice Weisburg, M.D.		14.1	The commenter indicated that his principal concerns involve the possible presence of high-level wastes buried with metal containers that have undergone irradiation in onsite research reactors in TA-5. Related to that concern is an SNL document dated October 15,1993 "Site Team Report on Spent Fuels", which is an assessment of the vulnerability of storage of irradiated nuclear fuels, both fresh as well as previously irradiated. In only a few instances are these materials referred as spend fuels or high-level wastes. Instead the term used is "RINM" (reactor irradiated nuclear material). The statement on page 3 of the executive summary states	R24	NMED believes that many of the steel containers within the Landfill have or will rust. Any liquids contained within the steel containers could migrate from the Landfill if conditions are appropriate; however, this does not necessarily mean that any release would pose unacceptable risk to human health and the environment. Thus, NMED agrees that continued monitoring of the vadose zone and the ground water is necessary to ensure protection of human health and the environment. With respect to comments on reactor irradiated nuclear material and the Sandia Pulse Reactor, this issue is not directly related to the MWL and will not be discussed further in these responses.	No

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				that " there is no spent reactor fuel onsite [disposed in MWL] from the SNL reactors." This would seem misleading since both fresh and pre-irradiated samples were used and exposed in the core for different time periods. Storage of RINM form experiments in one instance was into 32-foot deep holes with steel sides and an open gravel filled bottom. For storage after use, Sandia Pulse Reactor had 19 such storage areas. The commenter expressed concern that 11 years later we are still talking about long-term storage, with no approved method of disposal. The commenter is concerned about leaking from the unit into the vadose zone and ground water, and is concerned about the Albuquerque sole aquifer. The commenter is also concerned about the corrosion of the metal containers. He asked about the follow-up on the Tiger Team, and what findings were presented.		See also Response R23.	
A	For Citizen Action, Sue Dayton, 2nd submittal	1984 Landfill Excavation Estimate	1.30	The commenter indicated that in 1984 George Tucker of SNL made an estimate for the clean up of the MWL. The cost estimate included protective equipment, with the waste being shipped to the Nevada Test site. The cost estimate assumed "a lot of manual labor". The total in 1984 was	R25	The risk assessment demonstrated that it is not protective of workers to excavate the Landfill at this time because of the high level of risk associated with exposure to radioactive wastes. Costs have escalated since 1984, but it would be possible to excavate the MWL in the future should it become warranted. SNL is required by the final order issued by the	No

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				$181,570,000. The commenter asked why MWL couldn't be cleaned up today based on the above excavation scenario and the cost estimates performed in 1984.		NMED Secretary to reevaluate the performance of the Landfill cover/bio-intrusion barrier and the feasibility of excavation every five years.	
A	For Citizen Action, Sue Dayton, 2nd submittal, comments by Tom Hakonson, Ph.D.	Animal/plant transport of contaminants	1.31	The commenter stated that buried waste can be mobilized to the ground surface through plant roots and animals and insect burrowing can dramatically increase infiltration of water into the Landfill with covers as thick as those proposed.	R26	NMED agrees that bio-intrusion via burrowing animals and roots can cause contaminants to migrate to the ground surface, and can create open spaces that will locally increase cover permeability. Once on the surface, contaminants can continue to migrate by the activities of other animals, and by wind erosion and surface water erosion/solution. The degree of contamination that could be brought to the surface by plant roots or burrowing animals is case specific, depending much on the size and chemical/physical characteristics of the waste, and the size and burrowing habits of the animals. Water erosion is probably the most significant threat to cover integrity in terms of creating exposure to waste over a short time frame. All of these factors form the basis for NMED to require maintenance of the cover and continued monitoring of surface soil. In the case of the MWL, bio-intrusion is not expected to play a major role in the migration of contaminants because the wastes are relatively insoluble and the debris items mostly large in size. The required bio-barrier should limit the ability of small burrowing animals to	No

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						bring contaminants/debris to the surface, and should help limit root penetration.	
A	For Citizen Action, Sue Dayton, 2nd submittal, comments by Tom Hakonson, Ph.D		1.32	The commenter indicated that vertical transport of contaminants to the ground surface by biota may be small on a short time scale, but over many decades these processes may become dominant in mobilizing buried wastes.	R26	See Response R26	No
A	For Citizen Action, Sue Dayton, 2nd submittal, comments by Tom Hakonson, Ph. D.		1.33	The commenter indicated that Dr. Hakonson cites a study by the Pacific Northwest Laboratory that suggests radiological doses that result from bio-intrusion into low level waste landfills located in arid areas can ultimately over time become as high as doses calculated from human intrusion.	R26	See Response R26.	No
A	For Citizen Action, Sue Dayton, 2nd submittal, comments by Tom Hakonson, Ph.D.		1.36	The commenter indicated that under the right conditions the roots of all types of vegetation have the ability to extend several meters into the soil and transport contaminants to the surface.	R26	See Response R26.	No
A	For Citizen Action, Sue Dayton, 2nd submittal, comments		1.39	The commenter indicated that once contaminants are transported to ground surface a complex distribution process occurs that can result in widespread transport of	R26	See Response R26.	No

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	by Tom Hakonson, Ph.D.			contaminants across the Landfill surface to off-site areas.			
A	For Citizen Action, Sue Dayton, 2nd submittal, comments by Tom Hakonson, Ph.D.		1.38	The commenter states that SNL's conclusion that the waste has not been mobilized to the ground surface by animals is poorly supported as it is 1) based on soil sampling taken (in Part) from areas of the Landfill recently backfilled; 2) sampling was coarse in resolution; 3) samples were non-random in space; and 4) samples purposely did not include disturbed areas created by burrowing animals.	R27	Although the commenter criticizes surface soil sampling at the MWL because in his opinion it was not random, he also recommends the collection of samples from biased sampling locations (animal burrows and older parts of the Landfill). There have been several surface soil sampling events conducted at the MWL and these efforts have been adequate. For future monitoring, NMED believes that the collection and analysis of soil samples from burrows and ant mounds should be done as suggested by this commenter.	No
F	Citizen, Carl White, Dept. of Biology, UNM		6.1	The commenter stated that rodents are present on the site, and that they can burrow allowing water infiltration. The rodents can also bring up materials out of the Landfill, and then they would be consumed by other animals and predators, which would distribute any contaminates. The commenter believes it is foolish to discard the bio-intrusion barrier.	R28	NMED agrees that a bio-intrusion barrier is necessary at the MWL to minimize the impact of burrowing animals and reduce the penetration of plant roots. In addition, NMED intends for the SNL to maintain the cover system and monitor animal burrows for any future migration of contaminants.	No
A	For Citizen Action, Sue Dayton, 2nd submittal, comments	Evapotranspiration Cap	1.35	The commenter indicated that both cap designs (Dwyer et, al. SNL Environmental Restoration Group) do a credible job of analyzing the evapotranspiration (ET) cover, and	R29	NMED agrees that an ET, with the addition of a bio-barrier, should provide adequate protection of ground water. NMED also agrees that it remains necessary to continue monitoring the	No

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	by Tom Hakonson, Ph.D.			in the reviewer's opinion both cap designs will provide adequate protection of ground water from contaminants assuming the site is diligently monitored and maintained throughout the post-closure monitoring period while assuming the surface pathway proves to be unimportant in contributing doses to humans.		ground water as well as the vadose zone and surface soil to ensure that any future migration of contaminants will not occur at levels that pose unacceptable risk. Monitoring of surface soil will ensure that the surface will not become an unrecognized pathway for contaminants that would threaten human health or the environment.	
A	For Citizen Action, Sue Dayton, 2nd submittal, comments by Tom Hakonson, Ph.D.	Vapor transport through evapotranspiration Cap	1.37	The commenter indicated that while an ET cap can minimize soil moisture it could contribute to vapor phase transport of volatiles.	R30	Vapor transport can occur through any ET cover. However, in the case of the MWL, active soil-gas surveys demonstrate that vapors of total volatile organic compounds within and beneath the Landfill are low, and do not threaten human health or the environment, including ground water. Tritium and radon are also present at the MWL in the form of gases. However, the levels of tritium and radon measured at the surface are also sufficiently low such that they do not threaten the environment or human health.	No
A	For Citizen Action, Sue Dayton, 2nd submittal, comments by Tom Hakonson, Ph.D.	Human Intrusion	1.40	The commenter stated that human intrusion scenarios should take a conservative approach such as the loss of institutional controls under a subsistence farmer scenario.	R31	It appears that the commenter is referring to the NRC regulation in 40 Code of Federal Regulations (CFR) Section 61.59(b), which is not applicable to RCRA. Under EPA regulations, there is no requirement that a facility must assume a loss of institutional controls and evaluate a subsistence farming scenario at some time in the future (for example 100	No

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						years in the future). Nonetheless, NMED intends to enforce institutional controls through SNL's RCRA permit as long as such controls are needed.	
A	For Citizen Action, Sue Dayton, 2nd submittal, Dr. Resnikoff's comments		1.53	The commenter suggests that SNL follow recommendation from EPA and DOE that SNL conduct a risk assessment that includes "no administrative controls in place after 100 years (pp. 12, 13).	R31	See Response R31	No
A	For Citizen Action, Sue Dayton, 2nd submittal, comments by Tom Hakonson, Ph.D.	Climate Change	1.41	The commenter stated that changes in climate could radically affect the integrity of the cap.	R32	SNL is required by order of the NMED Secretary to reevaluate the performance of the evapotranspiration cover every five years. If significant climatic changes were to occur during this period that would adversely affect the performance of the cover system, NMED can impose additional requirements or a new remedy for the MWL to ensure protection of human health and the environment.	No
A	For Citizen Action, Sue Dayton, 2nd submittal, comments by Tom Hakonson, Ph.D.	Moisture Measurements	1.42	The commenter indicated that SNL's proposed plan to use a neutron moisture gauge (NMG) are vague on how the monitoring data will be used to conclude that percolation is or is not occurring. NMG is labor intensive (data must be downloaded and managed) and the NMG must be calibrated to soil (difficult when layered soils are involved), and reliable measurements are limited to	R33	NMGs have been shown to be an effective tool to monitor soil moisture. NMED agrees that specific calibrations must be conducted and that correction factors may need to be applied to account for changes in soil bulk density. The final order issued by the NMED Secretary requires that SNL submit for MNED approval a long-term monitoring plan, and a list of "triggers" which will set in motion additional testing or the implementation of an additional or	No

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				volumetric water content above 5% the NMG integrates moisture content over a relatively large area making it difficult to pinpoint the specific zone depth being interrogated. NMG provides instantaneous estimates of soil moisture so that measuring after precipitation is critical. NMG should not be used as an early warning system.		different remedy. Finally, NMED intends to require environmental monitoring beyond that of soil moisture. Thus, NMG and soil moisture will not be used as the sole early warning system.	
A	For Citizen Action, Sue Dayton, 2nd submittal, comments by Tom Hakonson, Ph.D.	Closure/post-closure	1.34	The commenter stated that one of the more important deficiencies in Sandia National Lab's closure plan proposed for the MWL is the assumption that vertical and horizontal transport of contaminants resulting from biological processes is not an important contributor to exposure pathways.	R34	The document reviewed by Dr. Hakonson was not a closure plan, which was the reason that details concerning long-term monitoring and maintenance were not provided in the document. Instead, the document was intended to describe chiefly the design and construction quality assurance of the proposed ET cover. See also Response R36.	No
A	For Citizen Action, Sue Dayton, 2nd submittal, comments by Tom Hakonson, Ph.D.		1.43	The commenter stated that little or no planning has been done on the post-closure phase of the Mixed Waste Landfill closure and there is no contingency plan should the ET cap not perform as predicted.	R35	NMED has always intended that post-closure care, including monitoring, and maintenance, be addressed following selection of a remedy for the MWL. This is based on the fact that the details for such monitoring/maintenance are dependent on the chosen remedy. The final order issued by the NMED Secretary requires a long-term monitoring and maintenance plan (including the proposal for contingency options) to be submitted for approval by the NMED within 180	No

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						days of completion of the remedy (ET cover with bio-barrier).	
A	For Citizen Action, Sue Dayton, 2nd submittal, comments by Tom Hakonson, Ph.D.		1.44	Dr. Tom Hakonson has the following recommendations: 1) Any post-closure plan should provide measurements on all possible migration pathways that include vadose zone transport, soil sampling for surface contaminants and biological transport; 2) Soil surveys should be required in undisturbed areas closed early in the Landfill operation with comprehensive long-term sampling program after MWL is closed consisting of sampling of surface soils and biota; 3) A comprehensive sampling plan should be required that reflects the inventory of the contaminants in the Landfill, not just tritium; 4) The use of bio-intrusion barriers to keep animals from burrowing into the Landfill has had mixed reviews in terms of effectiveness, a wire mesh type barrier proposed by Dwyer is the best choice for the MWL in terms of effectiveness. The commenter would like NMED to address these recommendations.	R36	NMED agrees that a surface soil, subsurface soil, soil vapor, and ground water monitoring program must be established to ensure early detection of any future migration of contaminants. The scope of the exact program is to be detailed in the long-term monitoring and maintenance plan required by the RCRA permit as a result of the Secretary's final order. The NMED also agrees that the sampling plan should require a wide range of contaminants to be analyzed for, and not limit the analytes solely to tritium. Sampling, in part, should include the sampling of animal burrows and ant mounds. However, surface soil sampling should be conducted in every area of the MWL, and not be limited to older portions of the Landfill. The NMED prefers a rock bio-intrusion barrier to that of a wire mesh because the NMED believes that a rock barrier is likely to last longer and will not corrode and release heavy metals into the environment. Finally, NMED agrees that a bio-intrusion barrier is necessary.	No
A	For Citizen Ac For Citizen	Baseline Risk Assessment	1.45	The commenter indicated that a new baseline risk assessment for the MWL has not been conducted	R37	NMED accepts the baseline risk assessments as presented in the Phase 2 RFI and the CMS Reports. NMED	No

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	Action, Sue Dayton, 2nd submittal			by SNL due to the uncertainties of the inventory and source terms. This was verified by Tommy Tharp/SNL at a public meeting of the "WERC Independent Technical Peer Review of the Working Draft CMS for MWL", in December, 2002. This was also mentioned in the WERC Peer Review Report. The commenter would like NMED to comment on this.		acknowledges that there are some uncertainties associated with the contents of the Landfill. However, the goal of a baseline risk assessment is to assess risk to human health and the environment under current conditions, meaning contamination that has been released from the MWL. Therefore, uncertainties concerning contaminants that have not been released from the MWL do not affect the risk assessment. For additional information and the purpose of the baseline risk assessment, see EPA's Office of Solid and Hazardous Waste (OSWER) Directive No. 9355.0-30. See HO FOF/COL, ¶¶ 109-27.	
A	For Citizen Action, Sue Dayton, 2nd submittal, Dr. Resnikoff's comments	Suspect Data	1.46	Resnikoff "Risk Screening Review of SNL Risk Assessment for MWL, SWMU 76" revealed numerous problems with SNL's methodology in its risk assessment for the MWL which are addressed in several comments. First, the commenter indicated that SNL had results for measurements of plutonium at 3 different labs, and that samples with plutonium detections were discarded and those without detections were kept because they were more favorable data (p. 9).	R38	Questionable laboratory results for plutonium-238 and plutonium-239/240 were obtained from several core samples recovered during the drilling of the borehole for well MWL- MW4. In response, NMED required SNL to repeat the analysis and in addition, NMED obtained split samples for an independent analysis. Results from the split sampling effort indicated that there had not been a release of plutonium into the subsurface in the vicinity of MWL-MW4. NMED carefully scrutinized the environmental and quality control data for the MWL and considers the data to be overall of acceptable quality, as did WERC.	No

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A	For Citizen Action, Sue Dayton, 2nd submittal, Dr. Resnikoff's comments		1.47	The commenter indicated that SNL discarded samples showing high concentration of constituents of concern and kept samples concentrations with false positives (p. 9)	R38	See Response R38.	No
A	For Citizen Action, Sue Dayton, 2nd submittal, Dr. Resnikoff's comments	Risk Assessment, combining chemical and radiological risk	1.48	The commenter stated that radionuclide and cancer risk should be combined, not subtracted as SNL has done in its risk assessment (pp. 11, 12).	R39	NMED does not concur that the cancer and radiological risks were subtracted from each other, but rather the risks were evaluated independently as was the practice at the time the risk assessment was done. Currently, the EPA treats radiological contaminants as carcinogens, and calculates the risk differently as compared to the past. However, in the case of the MWL, the risk will not be sufficiently different if calculated using the newer method to require a different remedy for the Landfill. See also HO Report, ¶¶ 109-27.	No
A	For Citizen Action, Sue Dayton, 2nd submittal, Dr. Resnikoff's comments	Risk Assessment, Children vs adults	1.49	The commenter indicated that SNL's calculations apply only to an adult male and has used outdated conversion factors instead of newer dose conversion factors (DCF) that evaluate dose to children as well as adults (pp. 11, 12).	R40	NMED believes that DCFs were appropriately applied, as the site will be restricted to industrial use. The evaluation of an adult only is reasonable in this case. See also HO FOF/COL, ¶¶ 109-27.	No
A	For Citizen Action, Sue Dayton, 2nd submittal, Dr.	Filtered Water Samples	1.50	The commenter indicated there are questions which remain regarding the filtering of water samples by SNL (p. 8).	R41	NMED agrees that use of filtered water samples could result in an underestimation of the total levels of metals and radionuclides present in the ground water. However, most samples	No

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	Resnikoff's comments					were unfiltered in both the field and laboratory, and NMED has obtained and analyzed unfiltered water samples. In addition, no data from filtered water samples for either metals or radionuclides were used in the risk assessments.	
A	For Citizen Action, Sue Dayton, 2nd submittal, Dr. Resnikoff's comments	Risk Assessment, Phase 2 RFI Report	1.55	The commenter states that the RFI Phase 2 conducted by SNL concluded that MWL contaminants "present little risk to ground water or as air emissions to potential receptors". This conclusion was disputed in a memo sent to Will Moats by Barbara Toth (August 11, 1999); in that memo she noted numerous deficiencies in the SNL risk assessment. The letter states "Surface/subsurface soil erosion due to surface/subsurface water movement and windblown contaminant transport acts as the primary means for contaminant migration out of the MWL to the surrounding environment… this subsequently threatens human health and the environment". The commenter asked if NMED agrees with this assessment of the MWL by Ms. Toth.	R42	The memorandum in question was written early in Ms. Toth's evaluation of the MWL risk assessment. Ms. Toth is a former employee of the NMED. Mr. Moats was informed by Ms. Toth prior to her departure from the NMED that given the lack of appreciable contaminant releases, any changes she would recommend for the risk assessment would not change the overall outcome of the risk assessment. She concluded that the MWL did not pose unacceptable risk to human health and the environment. After Ms. Toth's departure, two other experts have reviewed the risk assessment on behalf of the NMED and have independently determined that the risk assessment is adequate. Additionally, a risk assessor working with the WERC concluded that the risk assessment was technically adequate; however, it was also overly conservative because it took into account a number of contaminants which had not been actually released into the environment. See also HO FOF/COL, pp 109-27.	No

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A	For Citizen Action, Sue Dayton, 2nd submittal, Dr. Resnikoff's comments	Risk Assessment, Cr-VI versus Cr-III	1.56	The commenter asked why the RFI Phase 2 states all chromium contamination at MWL is chromium III, the most conservative type. The commenter asked if NMED knows the type of all chromium contaminants at MWL.	R43	NMED has previously provided comments to SNL concerning hexavalent (Cr-VI) versus trivalent (Cr-III) chromium. NMED concurs that the assumption that all chromium is trivalent chrome is not a conservative assumption, but rather is the least conservative approach. The inventory for the MWL does not specifically list any Cr-VI-contaminated wastes, suggesting that little, if any, Cr-VI wastes were disposed of in the Landfill. Sampling and analysis of soil beneath the trenches and pits did not find evidence of a chromium release. Finally, there is no evidence of a release of Cr-VI in filtered samples of ground water.	No
A	For Citizen Action, Sue Dayton, 2nd submittal, Dr. Resnikoff's comments	Risk Assessment, Inhalation of metals	1.57	The commenter stated that SNL claims the inhalation pathway doesn't apply to metals due to their "lack of volatility". This was found to be incorrect as metals can attach to soil particles and be inhaled. The commenter asked if SNL's risk assessment included inhalation pathway of heavy metals.	R44	NMED agrees that inhalation of metals in soil does occur and should be evaluated using a particulate emission factor (PEF). SNL did consider the inhalation of both vapor phase and particulate airborne compounds (see Appendix I, Table 1 and the soil inhalation equation presented on page I-85).	No
A	For Citizen Action, Sue Dayton, 2nd submittal, Dr. Resnikoff's comments	Risk Assessment, sources of toxicological parameters	1.58	The commenter states that NMED recommends SNL use EPA's IRIS and HEAST or EPA's NCEA to determine toxicological parameters. The commenter asked if information from these sources	R45	Toxicity data from these databases were applied in the risk assessments (refer to Table 13, Appendix I).	No

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				been integrated into the risk assessment.			
A	For Citizen Action, Sue Dayton, 2nd submittal, Dr. Resnikoff's comments	Risk Assessment, Use of NMED risk parameters	1.59	The memo recommends SNL use exposure parameter values recommended by HRMB/NMED; the commenter asked if these have been integrated into the SNL risk assessment.	R46	The recommended exposure parameters were applied in the risk assessments. Refer to Tables 2 and 3 in Appendix I of the CMS.	No
A	For Citizen Action, Sue Dayton, 2nd submittal, Dr. Resnikoff's comments	Risk Assessment, Exposure parameters	1.60	The memo recommends exposure parameter values be used to evaluate exposure and risk from dermal contact with contaminants in soil under industrial, residential and recreational land use scenarios. The commenter asked if these had been done.	R47	SNL identified the dermal contact pathway as a potential nonradiological organic constituent pathway in all the land use scenarios. However, the exposure via this pathway was considered insignificant and excluded from the final risk analyses. However, potential risks associated with the dermal pathway were addressed in the uncertainty analysis.	No
A	For Citizen Action, Sue Dayton, 2nd submittal	Risk Assessment Risks for CMS alternatives	1.61	The commenter indicates that at a January 31, 2003 "WERC Independent Technical Peer Review of the "Working Draft CMS" for MWL it was pointed out by SNL staff that these risk assessments were only relative to the different remedies being investigated and did not relate directly to the predicted risk. This issue needs to be clarified as it only adds uncertainty to the overall remedy if the risk assessment is not modeled relative to a conservative model of the site	R48	Although several staff members were present, NMED has no recollection of the discussion mentioned in the comment. However, NMED can offer that the CMS provides a baseline risk assessment and a risk assessment for each proposed alternative. The latter assessments are done to determine the long-term and short-term risks of each of the remedial alternatives under evaluation. This is a standard procedure for conducting a CMS.	No

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				situation. The commenter asked for NMED to comment on this.			
A	For Citizen Action, Sue Dayton, 2nd submittal	Risk Assessment, waste vs releases	1.62	At the same meeting it was stated that "the risk assessment is based on known releases from the site…several questions remained unanswered during the meeting about the amount and type of waste in the MWL". The commenter would like NMED to respond to this.	R49	Pursuant to EPA Directive OSWER 9355.0-30, a risk assessment does not have to be conducted on contents of landfill but rather only on the contaminants released. See also HO FOF/COL, ¶¶ 109-27.	No
A	For Citizen Action, Sue Dayton, 2nd submittal	Risk Assessment, Sensitivity analysis	1.63	At the same meeting it was stated, "It would seem that a sensitivity analysis of the risk assessment would give some indication of the significance of this concern especially in light of the relative nature of the assessment noted above. (WERC executive summary, p.v.)	R50	A sensitively analysis of the contents of the MWL is not necessary, as direct exposure to these contents would result in unacceptable risk.	No
A	For Citizen Action, Sue Dayton, 2nd submittal		1.69	WERC addresses SNL's risk analysis and recommends that SNL conduct a sensitivity analysis. A problem is SNL's consistent "bending" of information to favor its preferred alternative. To correct this situation it would behoove the NMED to require DOE to conduct an independent sensitivity analysis. The commenter asked that the uncertainties related to the inventory of the Landfill be addressed in a risk assessment that	R50	See Response R50; see also HO FOF/COL, ¶¶ 109-27.	No

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				includes all waste products rather than the two contaminants that have been found to migrate from the Landfill.			
A	For Citizen Action, Sue Dayton, 2nd submittal	Temporary cover with future excavation	1.66	WERC strongly recommends that because the "uncertainly of the contents in the MWL could eventually lead to the requirement of excavation" SNL include an alternative that involves a temporary cap with future excavation.	R51	Although the CMS did not address this suggested remedial alternative directly, one can combine the capping and excavation alternatives presented in the CMS and obtain this information.	No
A	For Citizen Action, Sue Dayton, 2nd submittal	Onsite disposal	1.67	WERC recommends that SNL include an onsite disposal facility as an alternative for waste. SNL has buildings that could be utilized for this. WERC also recommends including an option for RCRA approved landfill and an onsite retrievable storage unit. The commenter requests that NMED require SNL to include these options as well as a scenario for the construction of a corrective action management unit (CAMU).	R52	The CMS Report addressed a RCRA cap option and onsite storage with off-site disposal. Although several buildings are located in the vicinity of the MWL, NMED does not know whether these buildings would become available to store waste in the future. Even if they were available, it seems doubtful that the existing buildings would have adequate capacity to store the volume of waste that would be generated by excavation of the MWL. Additionally, the existing buildings would have to be reconfigured for waste storage, which possibly could cost as much or more than erecting new structures to store waste. One potential problem with onsite storage of mixed waste is that RCRA prohibits the storage of such wastes beyond 1 year (with a possible extension of 1 additional year), unless the waste meets or can be	No

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						treated to meet the standards at 20.4.1.800 NMAC incorporating 40 CFR 268.40. Although a CAMU was not evaluated in the CMS, given the similar size of the CWL and the MWL, the costs and construction logistics for a CAMU would likely be on the order of that of the existing CAMU located next to the CWL.	
A	For Citizen Action, Sue Dayton, 2nd submittal	Soil Vapor Monitoring /Extraction	1.68	WERC recommends that SNL include a soil vapor extraction alternative as part of a long-term monitoring strategy.	R53	NMED agrees that a soil vapor monitoring system could be designed with the option to be convert it into a soil vapor extraction system should it become necessary in the future.	No
A	For Citizen Action, Sue Dayton, 2nd submittal	Fate and transport model	1.70	WERC recommends that SNL conduct a numerical fate and transport model for simulation of the MWL. The data from this could then be integrated into a risk assessment that considers the sensitivities of various options for the MWL. The commenter asked if NMED will require SNL to develop such a model.	R54	The final order issued by the NMED Secretary requires the SNL to submit to the NMED for approval a fate and transport model.	Yes
A	For Citizen Action, Sue Dayton, 2nd submittal	General Comments	1.71	The commenter indicated that in 2001 Citizen Action asked the Secretary of NMED to issue an order to SNL to complete a CMS for the MWL. Citizen Action believes that the plan to cover the Landfill with 3 feet of dirt was not	R55	The CMS evaluated several potential remedies, including the SNL preferred remedy of covering the Landfill and excavation. The remedy of a cover, with a bio-barrier, was shown to be protective of human health and the environment, to be cost-effective, and to offered	No

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				sufficient.		acceptable short-term and long-term risk; this remedial alternative meets the requirements of RCRA. Under RCRA, so long as the remedy is protective of human health and the environment; there is no requirement that the most protective or most expensive remedy be selected. In the case of the MWL, the fact that contaminants currently released into the environment pose no unacceptable risk, combined with the low potential for future significant releases, substantiated the cover remedy selected. See also HO FOF/COL and Report.	
A	For Citizen Action, Sue Dayton, 2nd submittal	General Comments	1.72	From the beginning SNL has downplayed the risk of the MWL. Numerous independent experts, including those who participated in WERC, have suggested that information on MWL is incomplete, biased, and disingenuous. They believe the term "Accelerated Clean Up" is misleading because it is not really a clean up.	R56	WERC as a group has agreed with NMED that data quality is acceptable and that data are sufficiently complete to make a decision on a remedy for the MWL. Split sampling results and the review of a sample of waste disposal records do not support a conclusion that the SNL has been disingenuous with data, or has held back critical data needed to make an informed decision. NMED is unaware of WERC's opinion of the term "Accelerated Clean Up". It is NMED's responsibility to ensure that the clean up is undertaken in accordance with RCRA requirements; SNL's terminology has no impact on RCRA's requirements.	No
A	For Citizen Action, Sue Dayton, 2nd	General Comments	1.73	The commenter believes that the CMS failed to present a full range of options for the waste; did not	R57	Although SNL is not required to include in the CMS recommendations of third parties, SNL did include a number of	No

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	submittal			present the true costs of an excavation scenario; failed to produce a baseline risk assessment; failed to include historical data that relates directly to risk; failed to consider the full inventory of the Landfill and numerous uncertainties associated with the Landfill; and failed to consider recommendations of independent reviews that attempt to find an appropriate solution for this waste site.		important recommendations from WERC. The CMS Report presented an adequate number of alternatives, including excavation, the preferred alternative of Citizen Action. The cost data provided in the CMS are adequate for the intended purpose; the cost data represent estimates only, and are not intended to represent detailed cost estimates in support of procuring contracts. Whether the cost estimates are precisely accurate or not, the excavation alternatives will undoubtedly be much more expensive than the capping alternatives. NMED finds that the cost estimates for the alternatives, including the excavation alternatives, are within the proper order of magnitude. See also HO FOF/COL and Report. The CMS and the Phase 2 RFI Reports include a baseline risk assessment. Uncertainties with respect to the investigation of any solid waste management unit will always exist because sampling by definition means that only a sample of soil is analyzed for contaminants not all of the soil that exists at the site. Technical expertise and professional judgment must necessarily be used to make a decision on the adequacy of site investigations. See also Responses R5, R6, R7, R8, R48, and R49.	

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A	For Citizen Action, Sue Dayton, 2nd submittal	General Comments	1.74	The commenter believes that considering the volume of scientific knowledge available at SNL, the CMS is an embarrassing and biased document, which puts the public at risk.	R58	NMED does not agree with this comment. The remedy selected by NMED was one of the alternatives evaluated as part of the CMS. The CMS Report contained considerable detail on a fair number of potential remedial alternatives, and was found by the NMED to be adequate for the purpose of selecting a remedy that is protective of human health and the environment.	No
B	Albuquerque Center for Peace and Justice and Citizens for Alternatives to Radioactive Dumping, Janet Greenwald	Above Ground Retrievable Storage	2.1	The commenter believes that the wastes in the MWL should be placed in above ground retrievable storage, located close to where the wastes are now buried.	R59	The CMS Report addressed this potential remedial alternative. Above ground retrievable storage was not selected because of the high cost, the risk to workers, and the potential that hazardous wastes would be excavated that currently have no treatment/disposal options.	No
B	Albuquerque Center for Peace and Justice and Citizens for Alternatives to Radioactive Dumping, Janet Greenwald	Long half life of plutonium	2.2	The commenter is concerned about the disposal of plutonium that has a long half-life at the Landfill, and the length of time that governments are around. The commenter is concerned that the buried plutonium will outlast the government.	R60	It is correct that plutonium isotopes have long half-lives. However, it is likely that RCRA or some successor statute will ensure protection of human health and the environment as long as the MWL exists.	No

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B	Albuquerque Center for Peace and Justice and Citizens for Alternatives to Radioactive Dumping, Janet Greenwald	Future funding for excavation	2.3	The commenter urges NMED to clean up the MWL now; she is concerned about shrinking government budgets, and that addressing the clean up later may be too late. The commenter is concerned about the contamination of the land and water and nearby communities.	R61	Current releases of contaminants and expected future releases of contaminants do not pose and are not expected to pose unacceptable risk to the land, ground water, or the community. The evidence does not presently support excavation of the Landfill in the near term due to the unacceptable risk to onsite workers and because the cover with biobarrier is protective.	No
C	Anonymous Citizen	Capping and Monitoring the MWL	3.1	The commenter believes that capping and long-term monitoring is the correct choice. The commenter is concerned about the cost, the risk to workers and the waste management issues, which the commenter believes are substantial if the Landfill is excavated at this time.	R62	NMED generally agrees with this comment. However, NMED will not allow any remedy to be implemented that is not protective of human health and the environment, regardless of costs.	No
D	Citizen, Lois Chemistruct	No Further Action (NFA)	4.1	The commenter would like to see NFA at this time and a vegetative soil cover	R63	NMED believes that granting NFA status without implementing the selected remedy does not provide adequate protection of human health and the environment. For modest additional cost and effort, the facility can provide a more protective landfill cover with a higher degree of predictable performance. Also, compared to what is proposed in the Phase 2 RFI Report, NMED believes that more robust monitoring and post-closure care of the Landfill are needed to ensure protection of human health and the environment.	No

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						The selected remedy, an evapotranspiration cap with bio-barrier, is a type of vegetative soil cover.	
E	Citizen, JoAnne Rampone	Opposed to Excavation of MWL	5.1	The commenter expressed concern about any excavation taking place. The commenter was concerned about worker exposure, and is concerned about the unknown chemicals and the worker digging them up. The commenter asked that she be kept informed.	R64	NMED agrees that excavating the MWL in the near-term poses unacceptable risk to site workers. In the final order issued by the NMED Secretary, the public will be notified and given an opportunity to comment on all important documents related to corrective action at the MWL.	Yes. The final permit requires a public participa-tion process.
H	Citizen, Thomas P. Swiler, former member of the Sandia National Laboratories, Citizen Advisory Board		8.2	The commenter agrees with NMED that removal of the contents of MWL at this time or in the foreseeable future would be a greater risk to the environment than leaving in place. Therefore he indicated that he supports this.	R64	See Response R64.	
G	Citizen, Bob Long	O & M Direct Cost (Operations and Maintenance)	7.1	The commenter had a concern regarding alternative III.b (vegetative cover) versus III.c (vegetative cover with bio-barrier). The commenter asked why the operation and maintenance (O&M) direct cost for III.c was $540,000, more than for III.b. The commenter believes they should have the same	R65	The higher elevation and somewhat larger footprint of the cover with bio-barrier increases soil erosion potential. Soil erosion of the cover and any subsidence of the Landfill will be more costly to repair because of the addition of the rock bio-barrier layer. Nonetheless, the cost difference in SNL's estimates appears to be higher than expected, even over a 30	No

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				O& M cost.		year period upon which the estimate is based. NMED does not expect a lot of maintenance of the cover to be needed over any 30 year period.	
H	Citizen, Thomas P. Swiler, former member of the Sandia National Laboratories Citizen Advisory Board	Ground Water Monitoring	8.1	The commenter does not believe there is any evidence that the Landfill is leaking contaminates that would endanger ground water or cause a plume that would increase the cost of remediation. The commenter found the indication that showed contaminates could leak from the MWL, which was provided by Dr. Mark Baskaran to be flawed.	R66	Although a few contaminants have migrated from the Landfill and occur in surface soil and subsurface soil, data show that ground water has not been impacted, nor likely is it to be impacted in the future. Thus, NMED does not agree with the assertions made by Dr. Baskaran that ground water at the MWL is contaminated. However, NMED believes that continued ground water monitoring is prudent and necessary to ensure long-term protection of human health and the environment.	No
H	Citizen, Thomas P. Swiler, former member of the Sandia National Laboratories, Citizen Advisory Board	Questioning the need to cap the MWL	8.3	The commenter does not support the capping of the MWL. He believes that the MWL already has maintenance free vegetative cover formed by nature and the passing of time and is not convinced that adding an additional layer of soil and establishing a new vegetative cover over the MWL will make it safer. He is concerned that such action will give many a false sense of closure and about the additional cost of the cover. He would like to know how the additional cover would make MWL safer in terms of reducing the percolation of water through MWL, reducing moisture	R67	The scientific evidence shows that a properly designed and constructed ET cap and bio-intrusion barrier will provide additional protection over that of the current operational cover, with only modest additional cost. Furthermore, there is almost no scientific data on the physical characteristics of the operational cover, such as the cover thickness, the material(s) from which it was constructed, or construction quality assurance. This is a concern because the future performance of the current operational cover can not be modeled with confidence. Also, the NMED is aware of one instance where a piece of radioactive debris was not buried	No

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				content in the MWL, and reducing the possibility of inadvertent human or animal intrusion into the MWL.		sufficiently deep and was exposed on the surface (this has since been corrected by the SNL). NMED agrees with the commenter that monitoring of the site should continue. NMED intends to require at least 30 years of post-closure care and monitoring, and has the authority to extend this time period as necessary to protect human health and the environment. Given the long-half lives of some of the radionuclides buried in the Landfill, monitoring and maintenance may be required as long as the Landfill exists.	
M	Citizen, Steve Dapra		13.8	The commenter does not believe that a cap or cover at MWL is necessary. He recommends that a sufficient amount of soil be spread over the area to smooth out the lumps, that the soil be given a crown to prevent low spots from forming when the dirt settles, and that native grasses be planted on the MWL, so it will have the same appearance as the surrounding terrain. The commenter believes the current regimen of air and water sampling should continue for 20 years. If the Landfill has not leaked by that time, it probably isn't going to.	R67	See Response R67.	No
M	Citizen, Steve Dapra		13.10	The commenter does not support the placement of an engineered cover or cap, however he has no	R67	See Response R67	No

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				objection if that proposal is implemented. Also, he has no objection if the monitoring time is greater than 20 years.			
I	Citizen, Craig D. Richards	Re-evaluation of Data/assumptions	9.1	The commenter is satisfied with the vegetative cover for the near further, but asked where the funding will come from and when a re-evaluation of all the data and assumptions over time will be done. The commenter indicated that the radioactivity, transport modes, technology will change rapidly over the next 30-50 years and that technical breakthroughs may offer a full-scale disposal option rather than just monitoring and storage. MWL inventory charts indicate that Co-60 and H-3 "go away" by 2039/2049; what year has been selected for future excavation? The commenter believes the cost estimates for the NFA/vegetative cover and vegetative cover/barrier seem too low (i.e. less than $2 million for monitoring the MWL for the next 70 years). He expressed concern regarding the cost estimates.	R68	Under RCRA, SNL must provide the funds to implement the remedy. The final order issued by the NMED Secretary requires SNL to reevaluate the feasibility of excavation every five years. Therefore, new technologies will be taken into account during the re-evaluations. The future excavation alternatives did not include a specific date or time period after which excavation would begin. The cost estimates for future excavation assumed the Landfill would be excavated 50 years after closure. After the initial costs of installing the monitoring devices are incurred (some actually are already in place), annual monitoring costs will not exceed a few tens of thousands of dollars. The estimated costs for the cover alternatives are in the right order of magnitude.	Yes
J	Citizen, Robert Anderson	Avoiding excavation	10.1	The commenter believes that dangerous, unknown constituents at the site should not be left in place because there are too many risks associated with them for the	R69	The remedy selected by the NMED is protective of human health and the environment. Post-closure care and monitoring will be conducted to ensure the safety of the public and the	No

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				communities and the water supply.		environment. The MWL will be tracked in SNL's RCRA permit, along with many other solid waste management units/areas of concern identified at SNL.	
K	Citizen, Diana de la Rosa, Sandia Site	Capping	11.1	The commenter encourages capping the facility. The commenter states that digging it up would create emergency issues, ALARA **(a**s low as reasonably achievable) issues and potential lawsuits.	R70	NMED agrees that capping the Landfill is appropriate, provided that the Landfill is properly monitored for future releases. NMED also agrees that excavation of the Landfill would be difficult from both a safety and regulatory perspective, and that meeting the intent of ALARA would not be easy for excavation workers. The NMED does not support current excavation of the MWL due to unacceptable risks to site workers.	No
L	Citizen, J.D. Jojola	Ground Water	12.1	The commenter stated that he was submitting a copy of the WERC academy recommendations concerning vadose zone monitoring and the ground water protection plan.	R71	NMED agrees that the site must be continually monitored, including the vadose zone and the ground water. The final permit requires SNL to submit a long-term monitoring and maintenance plan to NMED for approval.	No
M	Citizen, Steve Dapra	Ground Water Contamination	13.2	The commenter stated that the MWL has not caused contamination of ground water. See the "Department of Energy and Sandia National Laboratories" response to Dr. Baskaran's Final Report, Mixed Waste Landfill Review, and pp. 20, 22-28.	R72	NMED agrees that currently there is no ground water contamination at the MWL. However, NMED believes it is prudent to continue monitoring the ground water.	No
M	Citizen, Steve Dapra	Air Monitoring	13.3	The MWL has not caused air contamination. See "Department of Energy and Sandia Nation	R73	Air quality data provided in the Phase 2 RFI Report and a separate report of radon emissions indicate that there is no air	No

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				Laboratories', Response to Dr. Baskaran's Final Report, "Mixed Waste Landfill Review," pp. 33-35.		contamination above risk-based standards. Air quality sampling conducted by the NMED DOE Oversight Bureau at the MWL and three background stations did not detect any air contamination above risk-based standards.	
M	Citizen, Steve Dapra	Tritium	13.5	The commenter indicated that tritium contamination below or near the MWL has been studied and discussed in some detail. See the "Department of Energy and Sandia National Laboratories' Response to Dr. Baskaran's Final Report, " Mixed Waste Landfill Review," pp.19, 24, 28-29, 33-35.	R74	NMED agrees that tritium contamination in surface soil and the vadose zone has been adequately characterized by SNL. The activity levels of the tritium contamination are sufficiently low that the tritium contamination does not pose unacceptable risk to human health or the environment under an industrial land use scenario.	No
M	Citizen, Steve Dapra	Hiding Behind Classified Status	13.6	The commenter stated that certain parties have claimed that SNL or DOE has been concealing Landfill contents using classified status, but the commenter believes that these claims are unsupported. (See Memorandum from Rich Kilbury, DOE Oversight Bureau SNL/ITRI, to Roger Kennett, DOE Oversight Bureau, Program Manager, SNL/ITRI, July 21, 2000).	R75	Other than security requirements associated with classified information, NMED has no evidence or reason to suspect that SNL has intentionally withheld information on the Landfill's contents. The inventory for the Landfill was in part prepared from classified records, with the classified information removed, in order to produce an inventory that the public could review. NMED reviewed a sample of these records and was able to correlate the information with the Landfill inventory. See HO FOF/COL, ¶¶ 43-50.	No
N	Citizen, Maurice	Monitoring	14.2	The commenter believes that air monitoring and monitoring of the	R76	NMED agrees with this comment.	No

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	Weisburg, M.D			vadose zone and the ground water is a prudent requirement.			
N	Citizen, Maurice Weisburg, M.D	Pro-Excavation	14.3	The commenter is concerned about waste material being located so close to the border of a major city; he believes it would be prudent to move the wastes to a more secure location.	R77	See Responses R55, 61, and 67.	No

LIST OF ACRONYMS

ALARA – As Low As Reasonably Achievable
CAMU – Corrective Action Management Unit
CMS – Corrective Measure Study
COL – Conclusions of Law
CWL – Chemical Waste Landfill
DCF – Dose Conversion Factor
DOE – U. S. Department of Energy
DU – Depleted Uranium
EPA – U. S. Environmental Protection Agency
ER – Environmental Restoration
FOF – Findings of Fact
FOIA -- Freedom of Information Act
HEAST – Health Effects Assessment Summary Table
HO – Hearing Officer
INEEL – Idaho National Environmental and Engineering Laboratory
IRIS – Integrated Risk Information System
MWL – Mixed Waste Landfill
NCEA – National Center for Environmental Assessment
NFA – No Further Action or Corrective Action Complete
NMED – New Mexico Environment Department
NMG – Neutron Moisture Gauge
NRC – Nuclear Regulatory Commission
O&M – Operation and Maintenance
OSWER – Office of Solid Waste and Emergency Response
PCB – Polychlorinated Biphenyl
PEF – Particulate Emission Factor
RCRA – Resource Conservation and Recovery Act
RFI – RCRA Facility Investigation
SNL – Sandia National Laboratories
TSCA – Toxic Substances Control Act
TRU - Transuranic

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TAB 3

Time Extension Request Approval Regarding Mixed Waste Landfill

Corrective Measures Implementation Plan and Report

August 4, 2005

From: NMED/Bearzi
To: SNL/Wagner

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Log No. 355563

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CERTIFIED MAIL
RETURN RECEIPT REQUESTED

September 7, 2005

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Peter B. Davies
Director, Geoscience and Environment
Center (6100)
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185-0701

RE: TIME EXTENSION REQUEST REGARDING MWL CMI PLAN AND CMI REPORT, AUGUST 4, 2005
SANDIA NATIONAL LABORATORIES
EPA ID# NM5890110518

Dear Ms. Wagner and Mr. Davies:

In Ms. Wagner's letter of August 4, 2005, the U. S. Department of Energy (DOE) requests that the due dates for the Sandia National Laboratories' Mixed Waste Landfill (MWL) Corrective Measures Implementation (CMI) Plan and CMI Report be extended to November 10, 2005 and October 29, 2007, respectively. The request is being made in accordance with the Compliance Order on Consent, Section III.J.2, and is related to the need for additional time to fulfill the requirements of the final order issued by the Secretary of the NMED on May 26, 2005.

Be advised that the original due dates in the subject letter are listed incorrectly; they should be September 12, 2005 and October 28, 2006 for the CMI Plan and CMI Report, respectively.

Pursuant to Section III.J.2 of the Compliance Order on Consent, DOE and Sandia Corporation are granted the subject request. The new due dates for the CMI Plan and the CMI Report for the MWL are November 10, 2005 and October 29, 2007, respectively.

SEP 12 2005

Please contact Mr. William Moats of my staff at (505) 284-5086 if you have any questions regarding this matter.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

JPB:wpm

cc: W. Moats, NMED HWB
J. Kieling, NMED HWB
F. Nimick, SNL, MS 1089
J. Gould, SNL MS 0184
L. King, EPA-6

File: SNL HSWA OU 1289, 05

Volume I

TAB 4

Mixed Waste Landfill Corrective Measures Implementation Plan

November 2005

From: SNL/Wagner
To: NMED/Bearzi

Back of Tab 4

Notes for Volume I, Tab 4:

The "Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005," included herein has been updated to include two revisions:

1. Appendix E "Probabilistic Performance-Assessment Modeling of the Mixed Waste Landfill at Sandia National Laboratories" has been replaced by the January 2007 SAND2007-017 document, "Probabilistic Performance-Assessment Modeling of the Mixed Waste Landfill at Sandia National Laboratories (2nd Edition)," that includes revisions to address the NMED Notice of Disapproval (NOD) dated November 2006.

2. Three replacement pages;
    a. Mixed Waste Landfill (MWL) Corrective Measures Implementation Plan (CMIP) Appendix A, page 02930-4,
    b. MWL CMIP Appendix A, page 02200-6, and
    c. MWL CMIP Appendix B, page B-25,

    associated with the NMED "Conditional Approval Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005", dated December 22, 2008 (Justification Binder Volume I, Tab 16). The replacement pages were transmitted to NMED in a DOE/SNL letter dated February 12, 2009 that can be found in Justification Binder Volume I, Tab 17.

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

NOV 0 3 2005

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Rd. East, Building 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

On behalf of the Department of Energy (DOE) and Sandia Corporation (Sandia), DOE is submitting the Mixed Waste Landfill (MWL) Corrective Measures Implementation (CMI) Plan, November 2005, for planned activities at Sandia National Laboratories, New Mexico, EPA ID No. NM589011518. On May 26, 2005, the Secretary of the New Mexico Environment Department selected a vegetative soil cover with bio-intrusion barrier as the final remedy for the MWL, and approved the associated Class 3 permit modification request.

The enclosed MWL CMI Plan incorporates the final remedy described in Section V.2 of the Class 3 permit modification for the MWL. The CMI Plan documents the plans for construction of the cover for the landfill, and includes the results of a comprehensive fate and transport model that was used to assess the performance of the MWL. The CMI Plan also includes triggers for future action that identify and detail specific monitoring results that would initiate a defined evaluation process, which includes supplemental sampling, if necessary.

If you have any questions, please contact me at (505) 845-6036, or John Gould at (505) 845-6089.

Sincerely,

Patty Wagner
Manager

Enclosure

NOV _ 3 2005

cc w/enclosure:
W. Moats, NMED (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
M. Martin, NNSA/NA-56
J. Volkerding, NMED-OB (2 copies)

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T. Goering, SNL,MS 1089
C. Ho, SNL, MS 0735
M. Miller, SNL, MS 1042
M. J. Davis, SNL, MS 1089

AOP 95-45, 06

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005**

Document authors: **Tim Goering, Dept. 6147 and Jerry Peace, Dept. 6116**
Cliff Ho, Dept. 6115, and Mark Miller, Dept. 10331

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 11/3/05

Peter B. Davies
Director
Geoscience & Environment Center
Division 6100
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

Date

and

Signature: _____ 11-3-05

Patty Wagner
Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Date

Sandia National Laboratories/New Mexico
Environmental Restoration Project

MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION PLAN

November 2005

United States Department of Energy
Sandia Site Office

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Sandia National Laboratories/New Mexico
Environmental Restoration Project

MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION PLAN

November 2005

United States Department of Energy
Sandia Site Office

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

EXECUTIVE SUMMARY

Sandia National Laboratories/New Mexico (SNL) is located within the boundaries of Kirtland Air Force Base (KAFB), immediately south of the city of Albuquerque in Bernalillo County, New Mexico. KAFB occupies 52,233 acres. SNL is managed by the U.S. Department of Energy (DOE) and is operated by Sandia Corporation (Sandia), a wholly owned subsidiary of Lockheed Martin Corporation. SNL performs research and development in support of various energy and weapons programs and national security. It also performs work for the U.S. Department of Defense, the U.S. Nuclear Regulatory Commission, and other government agencies.

The Mixed Waste Landfill (MWL) is located 4 miles south of SNL's central facilities and 5 miles southeast of Albuquerque International Sunport. The landfill is a fenced, 2.6-acre compound in the north-central portion of Technical Area (TA)-3. The MWL was established in 1959 as a disposal area for low-level radioactive and mixed waste generated by SNL research facilities. The landfill accepted low-level radioactive and minor amounts of mixed waste from March 1959 through December 1988. Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies of activity were disposed of in the landfill.

The MWL consists of two distinct disposal areas. The classified area occupies 0.6 acres and the unclassified area occupies 2.0 acres. Low-level radioactive and mixed waste was disposed of in each of these areas. Classified wastes were buried in unlined, cylindrical pits in the classified area. Unclassified wastes were buried in shallow, unlined trenches in the unclassified area.

A Phase 1 Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) was conducted in 1989 and 1990 to determine if a release of RCRA contaminants had occurred at the MWL. The Phase 1 RFI indicated that tritium had been released to the environment. A Phase 2 RFI was conducted from 1992 to 1995 to determine the contaminant source, define the nature and extent of contamination, identify potential contaminant transport pathways, evaluate potential risks posed by the levels of contamination identified, and provide remedial action alternatives for the landfill.

The Phase 2 RFI confirmed that tritium is the contaminant of primary concern. Tritium has been a consistent finding at the MWL since environmental studies were initiated at SNL in 1969. Tritium occurs in surface and near-surface soil in and around the classified area of the landfill at levels ranging from 1,100 picocuries (pCi)/gram (g) in surface soil to 206 pCi/g in subsurface soil. The highest tritium levels are found within 30 feet of the surface in soil adjacent to and directly below classified area disposal pits. Below 30 feet from the ground surface, tritium levels fall off rapidly to a few pCi/g of soil. Tritium also occurs as a diffuse air emission from the landfill, releasing 0.09 curies/year to the atmosphere.

The State of New Mexico is authorized by the U.S. Environmental Protection Agency (EPA) to implement the hazardous waste management provisions of RCRA for treatment, storage, and disposal facilities within the state. On August 26, 1993, EPA Region 6 issued the Part B Hazardous and Solid Waste Amendment (HSWA) Permit Module to the DOE and Sandia. The purpose of the permit was to establish specific guidelines for assessment, characterization, and remediation of Solid Waste Management Units (SWMUs) at SNL. Under Module IV of the RCRA Part B Permit (HWSA Module), the MWL is identified as Activity Data Sheet 1289, Environmental Restoration Site No. 76, and RCRA Facility Assessment Site No. 24, 25, 26, 27,

28, 29, 30, 11, 5, and 116. The MWL is a SWMU regulated by the New Mexico Environment Department (NMED) under the corrective action provisions of the HSWA. In addition, DOE Orders provide requirements for landfill closure cover design and establish performance requirements for the closed facility.

HSWA corrective action regulations establish corrective action authority but, due to the delay in finalizing more definitive implementing provisions, do not provide prescriptive requirements. Because the HSWA regulations do not address technical specifications, such as those required for a SWMU cover, the more detailed RCRA operating unit regulations are often used as guidance. For the MWL cover design, Sandia has elected to use RCRA landfill (referred to here as "Subtitle C facilities") regulations as guidance.

The goal of the EPA-recommended design of final covers for RCRA Subtitle C facilities is to minimize the formation of leachate by minimizing the contact of water with waste, to minimize erosion and further maintenance, to promote surface runoff and drainage, and to protect human health and the environment taking into consideration the future use of the site. The EPA accepts alternative cover designs that consider site-specific conditions, such as climate and the nature of the waste, and also meet the intent of the regulations. A fundamental concern of the EPA with cover designs is that all cover components be stable, and that the cover performs as intended without posing a significant risk to human health and the environment.

On October 11, 2001, the NMED directed the DOE and Sandia to conduct a Corrective Measures Study (CMS) for the MWL. The MWL CMS Report was submitted to the NMED on May 21, 2003 for technical review and comment. The purpose of the CMS was to identify, develop, and evaluate corrective measures alternatives and recommend the corrective measure(s) to be taken at the MWL. Based upon detailed evaluation and risk assessment using guidance provided by the EPA and the NMED, the DOE and Sandia recommended that a vegetative soil cover be deployed as the preferred corrective measure for the Mixed Waste Landfill.

The NMED held a public comment period on the MWL CMS from August 11, 2004 to December 9, 2004. A public hearing was conducted on the MWL CMS on December 2-3 and 8-9, 2004. On May 26, 2005, the Secretary of the NMED selected a vegetative soil cover with bio-intrusion barrier as the remedy for the MWL. The selection was based on the administrative record and the Hearing Officer's report. The Secretary requested that a Corrective Measures Implementation Plan incorporating the final remedy be developed within 180 days following the selection of the remedy.

This Corrective Measures Implementation Plan incorporates the final remedy selected by the NMED. The document contains a description of the selected remedy, the objectives for the remedy, detailed engineering design drawings and construction specifications, and a construction quality assurance plan and health and safety plan.

The remedy, a vegetative soil cover, will consist of a thick layer of native soil. The design would rely upon soil thickness and evapotranspiration to provide long-term performance and stability, and would be inexpensive to build and maintain because of the availability of suitable soil in TA-3.

This design is hereby formally submitted to the NMED for final closure of the MWL. The cover is a 3-foot-thick, vegetated soil cover. The cover will be underlain by a 1-foot-thick biointrusion barrier and a subgrade layer up to 40 inches in thickness. The proposed cover meets the intent of RCRA Subtitle C regulations, which include the following:

- Water migration through the cover is minimized.
- Maintenance is minimized by using a monolithic soil layer.
- Cover erosion is minimized by using erosion control measures.
- Subsidence is accommodated by using a "soft" design.
- Permeability of the cover is less than or equal to that of natural subsurface soil present.

Performance of the cover will be integrated with the natural site conditions at TA-3, producing a "system performance" that will ensure that the cover protects both human health and the environment. The natural site conditions at the site include:

- Extremely low precipitation and high potential evapotranspiration
- Negligible recharge to groundwater
- An extensive vadose zone
- Groundwater approximately 500 feet below the surface
- A versatile, native flora that will persist indefinitely as a climax ecological community with little or no maintenance

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ACRONYMS AND ABBREVIATIONS

Am	americium
amsl	above mean sea level
bgs	below ground surface
Be	beryllium
CFR	Code of Federal Regulations
Ci	curie(s)
cm	centimeter(s)
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
CPN	California Pacific Nuclear
°F	degrees Fahrenheit
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
FOP	field operating procedure
g	gram
HELP-3	Hydrologic Evaluation of Landfill Performance Model, Version 3
hr	hour
HSWA	Hazardous and Solid Waste Amendment
HWB	Hazardous Waste Bureau
IP	instantaneous profile
KAFB	Kirtland Air Force Base
m	meter(s)
m^2	square meter(s)
mph	mile(s) per hour
mrem	millirem
MUSLE	modified universal soil loss equation
MWL	Mixed Waste Landfill
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NOD	Notice of Deficiency
pCi	picocurie(s)
PET	potential evapotranspiration
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RSI	request for supplemental information
s	second(s)
Sandia	Sandia Corporation
SNL	Sandia National Laboratories/New Mexico
SWMU	Solid Waste Management Unit
TA	Technical Area
TEDE	total effective dose equivalent
UNSAT-H	Unsaturated Soil Water and Heat Flow Model
USGS	U.S. Geological Survey
USLE	universal soil loss equation

ACRONYMS AND ABBREVIATIONS (Concluded)

VS2DT	Variably-Saturated 2-D Flow and Solute Transport Model
WEQ	wind erosion equation
yd^3	cubic yard(s)
yr	year

1.0 INTRODUCTION

Sandia National Laboratories/New Mexico (SNL) is located within the boundaries of Kirtland Air Force Base (KAFB), immediately south of the city of Albuquerque in Bernalillo County, New Mexico (Figure 1-1). KAFB occupies 52,233 acres. SNL research and administration facilities are divided into five technical areas (TAs), designated 1 through 5, and several additional test areas, occupying 2,842 acres. TA-1, TA-2, and TA-4 are separate research facilities in the northwestern portion of KAFB. TA-3 and TA-5 are contiguous research facilities forming a 4.5-square-mile, rectangular area in the southwestern portion of KAFB (Figure 1-2). TA-3 alone occupies 2,000 acres. The Mixed Waste Landfill (MWL) is a 2.6-acre, fenced compound located in north-central TA-3 at SNL (Figure 1-3).

The goal of the U.S. Environmental Protection Agency (EPA)-recommended design of final covers for Resource Conservation and Recovery Act (RCRA) Subtitle C facilities is to minimize the formation of leachate by minimizing the contact of water with waste, to minimize erosion and further maintenance, and to protect human health and the environment by taking into consideration the future use of the site. In general, the EPA provides the performance-based requirements for Subtitle C landfill cover design. These requirements are specified in Title 40 of the Code of Federal Regulations (CFR), Section 264.310. However, the EPA accepts alternative cover designs that consider site-specific conditions, such as climate and the nature of the waste, and also meet the intent of the regulations. A fundamental concern of the EPA with cover design is that all cover components be stable, and that the cover performs as intended without imposing a significant risk to human health and the environment.

In this Corrective Measures Implementation (CMI) Plan, the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia) have demonstrated that the MWL alternative cover meets EPA performance-based criteria in 1) minimizing infiltration of water through the cover; 2) minimizing erosion and further maintenance; 3) promoting surface runoff and drainage; 4) accommodating subsidence; and 5) having a permeability equal to or less than the MWL subsurface soil.

Sandia Corporation (Sandia), a wholly owned subsidiary of Lockheed Martin Corporation, has a Management and Operations Contract with DOE/NNSA for SNL. SNL, which is owned by the DOE, is co-operated by both the DOE and Sandia for purposes of hazardous waste management and corrective action, per Sandia's RCRA Permit. SNL performs research and development in support of various energy and weapons programs. It also performs work for the U.S. Department of Defense, the U.S Nuclear Regulatory Commission, and other government agencies.

The MWL is designated as a Soil Contamination Area and a Hazardous and Solid Waste Amendments (HSWA) Solid Waste Management Unit (SWMU) subject to corrective action under state and federal regulations. The New Mexico Environment Department (NMED), the lead regulatory agency, will oversee the corrective action process for the MWL.

On October 11, 2001, the NMED directed the DOE and Sandia to conduct a Corrective Measures Study (CMS) for the MWL. The MWL CMS Report was submitted to the NMED on May 21, 2003 for technical review and comment. The purpose of the CMS was to identify, develop, and evaluate corrective measures alternatives and recommend the corrective measure(s) to be taken at the MWL. Based upon detailed evaluation and risk assessment using

guidance provided by the EPA and the NMED, the DOE and Sandia recommended that a vegetative soil cover be deployed as the preferred corrective measure for the Mixed Waste Landfill.

The NMED held a public comment period on the MWL CMS from August 11, 2004 to December 9, 2004. A public hearing was conducted on the MWL CMS on December 2-3 and 8-9, 2004. On May 26, 2005, the Secretary of the NMED selected a vegetative soil cover with bio-intrusion barrier as the remedy for the MWL. The selection was based on the administrative record and the Hearing Officer's report. The Secretary requested that a Corrective Measures Implementation Plan incorporating the final remedy be developed within 180 days following the selection of the remedy.

This Corrective Measures Implementation Plan incorporates the final remedy selected by the NMED. The document outlines the deployment of an alternative cover at the MWL (Chapter 2), the regulatory basis (Chapter 3), MWL characteristics (Chapter 4), the technical basis for the cover (Chapter 5), the MWL alternative cover design (Chapter 6), and cover performance monitoring (Chapter 7).

This document outlines the deployment of an alternative cover at the MWL (Chapter 2), the regulatory basis (Chapter 3), MWL characteristics (Chapter 4), the technical basis for the cover (Chapter 5), the MWL alternative cover design (Chapter 6), and cover performance monitoring (Chapter 7).

Appendices include construction specifications (Appendix A), a construction quality assurance plan (Appendix B), the identification and qualifications of key persons implementing the remedy (Appendix C), a health and safety plan (Appendix D), and a comprehensive fate and transport model with triggers for monitoring (Appendix E).

1.1 Acknowledgements

The alternative cover design presented in this document is based upon fruitful collaborations with engineering firms, industry, and state and federal regulatory agencies. The authors benefited greatly from visits and discussions with the following individuals and organizations: William Moats, Rich Kilbury, and Bill McDonald of the NMED; Howard Stone, Gordon Walhood, and Sarah Ganley of Bohannan-Huston; and Paul Knight of Marron and Associates, Inc. The authors also acknowledge valuable discussions with Mike Fayer of Pacific Northwest National Laboratory. Charles Reith, Jack Caldwell, Jack Nyhan, Tom Hakonson, and Glendon Gee deserve special recognition for their pioneering work on alternative landfill covers.

2.0 ALTERNATIVE COVER FOR THE MWL

Due to the lack of specific HSWA technical requirements, Sandia has elected to use RCRA landfill regulations as guidance. The design of a final cover for RCRA Subtitle C facilities recommended by the EPA is, at a minimum, made up of three layers: (1) a vegetated or armored top layer comprised of 24 inches of soil graded at a slope of 3 to 5 percent; (2) a drainage layer, 12 inches thick, composed of a high-conductivity sand layer; and (3) a 24-inch-thick, low-conductivity compacted soil layer with a geomembrane (EPA 1991). The design of the cover elements must take into consideration failure caused by desiccation cracking, settling, and subsidence. The goal of the EPA-recommended design is to limit the formation of leachate by minimizing the contact of waste with water, minimize further maintenance, and protect human health and the environment under future land-use conditions.

The fundamental concern of the EPA with cover designs is ensuring that all cover components are stable and the cover performs as intended, without posing a risk to human health and the environment (EPA 1991). The EPA accepts alternative designs that consider site-specific conditions, such as climate and the nature of the waste, and also meet the intent of the regulations. The EPA acknowledges that in arid regions where vegetation cannot be maintained, other materials for the surface cover layer should be selected to prevent erosion and allow for surface drainage, and the middle drainage layer can be eliminated from the design.

The alternative cover for the MWL is a 3-foot-thick, vegetated soil cover underlain by a 1-foot-thick biointrusion barrier that will be built by placing subgrade fill and lifts of native soil over the existing landfill surface. The topsoil layer will be seeded with native vegetation to mitigate surface erosion and promote transpiration. During the long-term care plan period, native soil can be added to the cover as needed to correct subsidence resulting from degradation of buried waste containers and rills that result from surface erosion. If necessary, additional native soil can be added to compensate for future subsidence and erosion. Because the cover will be constructed without rigid layers, it can accommodate differential subsidence without undue impairment of its performance. This “soft” cover design provides additional assurance for adequate long-term performance of the cover.

The alternative cover meets the RCRA requirements of 40 CFR 264.310, as follows:

- Water migration is minimized through the cover. The 3-foot-thick, vegetated soil cover will minimize water migration into waste disposal cells.

- Maintenance will be minimized by using a monolithic soil layer. Individual layers, such as those used in traditional RCRA covers, are rigid and would require extensive maintenance and repair due to eventual degradation as well as tensile and shear failure.

- Cover erosion will be minimized by using erosion control measures. The cover will be centrally crowned and sloped at 2 percent. The topsoil layer will be vegetated and admixed with 25 percent 3/8-inch crushed gravel.

- Subsidence will be accommodated by using a “soft” cover. During the long-term care period, soil can be added to the cover to repair erosion and subsidence as it

occurs. At the end of this time, additional soil can be added to mitigate future erosion and subsidence.

- Permeability of the cover soil will be less than or equal to the permeability of MWL subsurface soil. The "bathtub" effect is unlikely to occur.

Performance of the cover cannot be isolated from the performance of the site itself. Natural site conditions, integrated with the cover, produce a "system performance" that will ensure that the alternative design adequately meets the regulatory requirements. The natural site conditions of TA-3 that will be relied upon as part of the system include:

- Extremely low precipitation and high potential evapotranspiration (PET).
- Negligible recharge to groundwater. Chloride data collected from boreholes at the MWL (Peace et al. 2002) indicate significant rainfall has not percolated beyond the upper 20 feet of soil for tens of thousands of years.
- An extensive vadose zone. Groundwater lies approximately 500 feet below ground surface (bgs).
- The site has low potential for volcanic and seismic activity, with low hazard potential. The Albuquerque volcanoes were active for only a short period about 190,000 years (yrs) ago (Clary et al. 1984).
- The vegetated soil cover will adapt to climatic change, will recover from severe damage (fire and drought), and will persist indefinitely with little or no maintenance.

Performance of the cover will not be impacted by natural environmental events such as flooding or earthquakes. The MWL is not located within the 100-yr or 500-yr floodplains (Figure 2-1) and the expected low recurrence interval and low expected ground motion of seismic events in the Albuquerque basin renders earthquakes of little significance (Figure 2-2).

2.1 Proposed Schedule for Implementation and Periodic Progress Reports

The DOE and Sandia anticipate initiating construction activities for the MWL alternative cover in July 2006. Completion of the alternative cover is expected within 4 months provided the project enjoys favorable weather conditions. Adverse weather conditions may extend the project 4 to 6 weeks.

The DOE and Sandia will submit quarterly progress reports to the NMED during construction of the MWL alternative cover. These reports will include a description of the work completed during the reporting period.

A CMI Report for the MWL will be submitted to the NMED within 180 days after implementation of the remedy is complete. The CMI Report will include a summary of the work completed, as-built drawings and specifications signed and stamped by a registered professional engineer, copies of the results of monitoring and sampling data generated during remedy implementation, and a legal certification that the information is true, accurate, and complete.

2.2 Waste Management

The DOE and Sandia do not anticipate generating any waste during construction of the MWL alternative cover. All construction activities will be nonintrusive and above the existing landfill surface.

2.3 Maintenance and Performance Monitoring

A long-term maintenance and monitoring plan, which contains all necessary physical and institutional controls and long-term monitoring to be implemented at the site in the future, will be submitted by the DOE and Sandia to the NMED for review and approval. The plan will be submitted after the alternative cover has been deployed, and within 180 days of the NMED's approval of the CMI Report. Planned maintenance and monitoring activities and the frequency at which these will be performed will be determined in consultation and collaboration with the NMED and described in detail in the long-term care document.

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3.0 REGULATORY BASIS

The MWL is subject to regulations governing both radioactive and hazardous waste. The DOE meets its responsibility for conducting and overseeing radioactive material operations at its contractor-operated facilities, under the Atomic Energy Act authority, through DOE Orders, which set requirements and standards for closures. DOE Orders and federal and state regulations that contain pertinent requirements for corrective action at the MWL are as follows:

- DOE Order 5400.5, "Radiation Protection of the Public and the Environment" (DOE 1993)
- DOE Order 435.1, "Radioactive Waste Management" (DOE 1999)
- DOE Order 6430.1A, "General Design Criteria" (DOE 1989)
- 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities" (used as guidance)
- 10 CFR 835 "Occupational Radiation Protection"
- New Mexico Administrative Code (NMAC), 20 NMAC 4.1, Subpart V, 40 CFR 264.101, "Corrective Action for Solid Waste Management Units"

Requirements under federal and state regulations and DOE Orders are summarized in the following sections.

3.1 Corrective Action Requirements under HSWA

The MWL was identified as a SWMU in the August 1993 issuance of the HSWA Module, the corrective action portion of the SNL RCRA operating permit. Under the corrective action program, SNL is required to investigate and remediate, if necessary, the SWMUs identified in the HSWA Module of the permit. For the MWL, SNL has completed the assessment and characterization phase and has proposed to design and deploy an alternative cover as the final remedy. The NMED selected a final remedy (a vegetative soil cover with biointrusion barrier) on May 26, 2005.

Due to both the lack of prescriptive corrective action guidance and the practical similarities of landfill corrective action and landfill closure under RCRA, SNL has elected to use the RCRA landfill closure requirements as guidance for the MWL final remedy. The purpose of closure is to contain and prevent migration of hazardous waste and hazardous constituents from MWL disposal cells. Closure includes construction of engineered controls (i.e., closure cover); the post-closure phase will include implementation of a post closure environmental monitoring and surveillance plan.

Hazardous waste landfill closure requirements are codified under 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Subpart G (Facility Closure Standards) and Subpart N (Landfills). These standards are performance-based regulations that specify performance criteria without specifying design,

construction materials, or operating parameters. The EPA has provided numerous guidance documents to aid in interpreting the level of performance required to design, construct, and operate a compliant closure system. The closure performance standard is defined in 40 CFR 264.111 as follows:

> "The owner or operator must close the facility in a manner that:
>
> (a) Minimizes the need for further maintenance; and
>
> (b) Controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere; and
>
> (c) Complies with the closure requirements of this subpart, including, but not limited to, the requirements of . . . ."

The following performance-based requirements for landfill covers are established in 40 CFR 264.310:

> "At final closure of the landfill or upon closure of any cell, the owner or operator must cover the landfill or cell with a final cover designed and constructed to:
>
> (1) Provide long-term minimization of migration of water through the closed landfill;
>
> (2) Function with minimum maintenance;
>
> (3) Promote drainage and minimize erosion or abrasion of the cover;
>
> (4) Accommodate settling and subsidence so that the cover's integrity is maintained; and
>
> (5) Have permeability less than or equal to the permeability of any bottom liner system or natural subsoil present."

The NMED, the lead regulatory agency, has adopted the federal regulations as written, which are incorporated into 20.4.1.500 New Mexico Administrative Code (NMAC), incorporating the landfill closure requirements of 40 CFR 264.111 and 264.310 as well as 40 CFR 264.101, "Corrective Action for Solid Waste Management Units."

3.2 Closure Requirements under DOE Orders

Low-level radioactive and mixed waste disposal operations at the MWL followed the requirements set by DOE Order 5820.2, "Radioactive Waste Management" (DOE 1984) and those requirements subsequently set by DOE Order 5820.2A, "Radioactive Waste Management" (DOE 1988). On July 9, 1999, DOE Order 5820.2A was cancelled and replaced by DOE Order 435.1 "Radioactive Waste Management" (DOE 1999). The objective of these

Orders is to ensure that all DOE radioactive waste is managed in a manner that protects the health and safety of both workers and the public, and the environment.

DOE Order 435.1 does not set specific closure system design criteria, but establishes performance objectives for the closed facility. The objectives and limits are as follows:

a) Doses to representative members of the public shall not exceed 25 millirem (mrem) in a year total effective dose equivalent (TEDE) from all exposure pathways, excluding the dose from radon and its progeny in air.

b) Dose to representative members of the public via the air pathway shall not exceed 10 mrem in a year TEDE, excluding the dose from radon and its progeny in air.

c) Release of radon shall be less than an average flux of 20 picocuries (pCi)/ square meters (m^2)/second (s) at the surface of the disposal facility.

3.3 Regulatory Review and Response Actions

In order to meet the challenge that came with approval and fielding of an innovative technology at the MWL, SNL Environmental Restoration (ER) Project engineering design staff met with the NMED Hazardous Waste Bureau (HWB) on a regular basis throughout the alternative cover research and design process. The design of alternative covers has to date been an isolated activity at various sites in the United States. Meetings were held with the HWB to determine both specific risks at the MWL and construction and performance requirements. The HWB reviewed 30-percent, 60-percent, and 90-percent design specifications and grading plans for appropriateness. The final design report was submitted to the NMED on September 23, 1999.

The MWL alternative cover design was reviewed internally by the NMED, and externally by TechLaw Inc., a Lakewood, Colorado, civil engineering firm under contract to the NMED. The NMED issued a formal request for supplemental information (RSI) to Sandia on June 5, 2000, to address technical comments and questions raised by TechLaw Inc. and NMED technical and regulatory staff. Sandia submitted its response to the RSI to the NMED on September 8, 2000. The NMED issued a second RSI on February 16, 2001, to clarify certain subject areas of the September 8, 2000, Sandia response. The RSI process was closed in 2001 with no further technical comments or questions.

A design similar to the MWL alternative cover design has received regulatory approval for implementation at the Chemical Waste Landfill, a landfill at SNL that closed under RCRA interim status. At the CWL, the alternative cover was reviewed by the EPA Region 6 in 2001 and 2002 and determined to be adequate for Toxic Substances Control Act substances remaining in the closed CWL. EPA approval was obtained on June 26, 2002. Deployment of the CWL alternative cover design was approved by the NMED in April 2004 as an interim measure at the CWL under the RCRA interim status closure regulations. These regulatory approvals indicate that the alternative cover design is appropriate for implementation in the semi-arid environment at SNL and that the underlying premises of the MWL design are sound.

3.4 Corrective Measures Study

On October 11, 2001, the NMED directed the DOE and Sandia to conduct a Corrective Measures Study (CMS) for the MWL. A CMS Workplan (SNL December 2001) was written by the SNL Environmental Restoration Project in accordance with requirements set forth in Module IV (Hazardous and Solid Waste Amendments) of the DOE and SNL RCRA Permit. The CMS Workplan was submitted to the NMED on December 19, 2001, and approved with conditions by the NMED on October 10, 2002.

The MWL CMS Report was submitted to the NMED on May 21, 2003 for technical review and comment. The purpose of the CMS was to identify, develop, and evaluate corrective measures alternatives and recommend the corrective measure(s) to be taken at the MWL. Based upon detailed evaluation and risk assessment using guidance provided by the EPA and the NMED, the DOE and Sandia recommended that a vegetative soil cover be deployed as the preferred corrective measure for the MWL.

The NMED issued a Notice of Deficiency (NOD) to the DOE and Sandia on November 5, 2003. The DOE and Sandia responded to the NOD on December 19, 2003. On January 5, 2004, the NMED determined that the MWL CMS Report was complete.

3.5 Remedy Selection

The NMED held a public comment period on the MWL CMS from August 11, 2004 to December 9, 2004. A public hearing was conducted on the MWL CMS on December 2-3 and 8–9, 2004. On May 26, 2005, the Secretary of the NMED selected a vegetative soil cover with bio-intrusion barrier (Corrective Measures Study Alternative III.c) as the remedy for the MWL. The selection was based on the administrative record and the Hearing Officer's report. The Secretary requested that a CMI Plan incorporating the final remedy be developed within 180 days following the selection of the remedy. The draft permit modification issued by the NMED in the matter prior to the hearing was revised by the NMED in accordance with the Secretary's final decision.

4.0 MWL CHARACTERISTICS

The weather for Albuquerque and vicinity, including SNL, is typical of high-altitude, dry continental climates. The normal daily temperature ranges from 23 to 52 degrees Fahrenheit (°F) during winter months and from 57 to 91°F during summer months. The average annual relative humidity is 46 percent; however, the relative humidity can range from as low as 5 percent to as high as 70 percent (Bonzon et al. 1974).

Under normal conditions, wind speeds seldom exceed 32 miles per hour (mph) and are generally less than 8 mph (Bonzon et al. 1974). Strong winds, often accompanied by blowing dust, occur mostly in late winter and early spring. During these months, the prevailing surface winds are from the southwest. Rapid night-time ground-cooling produces strong temperature inversions and strong winds through mountain canyons.

The average annual precipitation for the Albuquerque area is 8.5 inches (21.6 centimeters [cm]). Monthly precipitation can range from a minimum of less than 0.5 inch during winter months to 1.5 inches during summer months. Average annual snowfall in the Albuquerque area is 11 inches. Summer precipitation, particularly in July through August, is usually in the form of heavy thundershowers that typically last less than 1 hour (hr) at any given location (Williams 1986). Average annual Class A pan evaporation at Albuquerque International Sunport Station 224 is 89 inches, approximately 10 times the average annual precipitation.

TA-3 is situated within coalescing alluvial fans emanating from the Manzanita Mountains to the east that form an expansive, relatively featureless, arid mesa. TA-3 is underlain by an extensive vadose zone comprised of unconsolidated, braided channel, interchannel, flood plain, and aeolian deposits. The water table beneath TA-3 occurs within the Santa Fe Group approximately 500 feet bgs. The MWL lies in the north-central portion of TA-3. Elevations at the MWL range from 5,385 feet above mean sea level (amsl) on the east to 5,375 feet amsl on the west. Mean elevation is 5,381 feet amsl.

There are no permanent structures at the MWL. All disposal pits and trenches were excavated below grade. The only visible surface features are the earthen berms above unclassified area trenches, and security fences that surround the compound. There are no perennial streams in the immediate area of the MWL. Surface runoff is regionally controlled and generally to the west. There are no man-made surface runoff controls. Surface runoff flows from the landfill surface to dirt roads that surround the fenced compound.

The MWL accepted containerized and uncontainerized low-level radioactive and mixed waste from SNL research facilities and off-site generators from 1959 to 1988. Approximately 100,000 cubic feet of low-level radioactive and mixed waste (excluding waste containers, packaging, construction and demolition debris, and contaminated soil) containing 6,300 curies of activity (at the time of disposal) were disposed of at the MWL, which contains minor quantities of RCRA hazardous metals and solvents. Disposal cells at the landfill are unlined and have been compacted to grade with native soil.

There are two distinct disposal areas at the MWL that include the classified area (occupying 0.6 acres) and the unclassified area (occupying 2.0 acres) (Figure 1-3). Wastes in the classified area were disposed of in a series of vertical, cylindrical pits. Historical records indicate that early pits were 3 to 5 feet in diameter and 15 feet deep. Later pits were 10 feet in diameter and

25 feet deep. Once pits were filled with waste, they were backfilled with soil and capped with concrete. Wastes in the unclassified area were disposed of in a series of parallel, north-south, excavated trenches. Records indicate that the trenches were 15 to 25 feet wide, 150 to 180 feet long, and 15 to 20 feet deep. Trenches were reportedly backfilled with soil on a quarterly basis and, once filled with waste, capped with the original soil that had been excavated and locally stockpiled.

Containment and disposal of waste commonly occurred in tied, double polyethylene bags, sealed A/N cans (military ordnance metal containers of various sizes), fiberboard drums, wooden crates, cardboard boxes, 55-gallon steel and polyethylene drums. Larger items, such as glove boxes and spent fuel shipping casks, were disposed of in bulk without containment. Disposal of free liquids was not allowed at the MWL. Liquids such as acids, bases, and solvents were solidified with commercially available agents including Aquaset, Safe-T-Set, Petroset, vermiculite, marble chips, or yellow powder before containerization and disposal.

Most pits and trenches contain routine operational and miscellaneous decontamination waste including gloves, paper, mop heads, brushes, rags, tape, wire, metal and polyvinyl chloride piping, cables, towels, quartz cloth, swipes, disposable lab coats, shoes covers, coveralls, high-efficiency particulate air filters, prefilters, tygon tubing, watch glasses, polyethylene bottles, beakers, balances, pH meters, screws, bolts, saw blades, Kleenex, petri dishes, scouring pads, metal scrap and shavings, foam, plastic, glass, rubber scrap, electrical connectors, ground cloth, wooden shipping crates and pallets, wooden and lucite dosimetry holders, and expended or obsolete experimental equipment.

A detailed MWL waste inventory, by pit and trench, is provided in the Environmental Restoration Project “Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Dated September 1996” (SNL 1998).

5.0 TECHNICAL BASIS

The MWL alternative cover design is based upon federal regulations and guidance, DOE Orders and guidance, NMED regulations and guidance, an extensive review of published studies conducted over the past 20 yrs, and the geological, hydrological, and ecological conditions specific to TA-3 and the MWL. Performance of the overall "system" relies on both the cover design and natural site characteristics. The objective was to capture and condense these design "elements," as appropriate, to design a cover that meets the intent of the regulations and that improves, rather than degrades, over time as inevitable natural processes act on the system. Engineered covers must be viewed as evolving components of larger, dynamic ecosystems (Waugh 1997).

The DOE has been actively pursuing alternative cover design and construction for more than 20 yrs. Most of the research to date has been conducted in arid and semiarid regions. Much of this research was evaluated and incorporated, as appropriate, in the design proposed for the MWL. Research and published information to date is limited to short-term demonstrations and monitoring, predictive models, and natural analogs. There is little information published on the long-term performance of alternative cover systems.

5.1 Potential Evapotranspiration

PET estimates have been made for TA-3 in support of predictive modeling. The Hydrologic Evaluation of Landfill Performance Model, Version 3 (HELP-3) (Schroeder et al. 1994) was used to estimate PET data with its built-in functions and localized database for Albuquerque, New Mexico. The resulting PET data are shown along with pan evaporation data from four New Mexico National Weather Service Stations in Figure 5-1. The average annual PET modeled by HELP-3 for the 65-yr period (1932 to 1996) is 75.4 inches, approximately nine times the average annual precipitation recorded at Albuquerque International Sunport.

5.2 MWL Vadose Zone Characteristics

Extensive field investigations and analytical studies have been undertaken in TA-3 and at the MWL to address regulatory-driven assessment and characterization requirements. A comprehensive RCRA Facility Investigation (RFI) Report (Peace et al. 2002) and two NMED Notice of Deficiency submittals, including an extensive inventory of wastes disposed of at the MWL, are available for review (SNL 1998, SNL 1999). Data collected from boreholes, groundwater monitoring wells, and instantaneous profile (IP) tests were used to measure saturated and unsaturated zone characteristics, augment characterization and assessment, and support final closure of the site. These data included volumetric water content, saturated and unsaturated hydraulic conductivity, bulk density, and isotopic chloride content. The data are summarized in Goering et al. (1995), Wolford (1998), and Peace and Goering (2005).

5.2.1 Water Movement in the Unsaturated Zone under Natural Conditions

MWL Phase 2 RFI characterization data show no evidence of significant water migration past the root zone of plants or the upper 2 feet of soil. Infiltrating surface water returns to the

atmosphere via evapotranspiration. Recharge to the water table at the MWL is insignificant under current climatic and vegetative conditions.

The following characteristics summarize the vadose zone in TA-3 and at the MWL.

- The underlying alluvium, which makes up the vadose zone, is well-graded, very fine sand with occasional layers of gravel, coarse sand, silt, and clay. The relative percentages of silt and clay increase with depth, and predominate at depths greater than 250 feet bgs.

- Water content of the alluvium is very low near the surface and may decrease with depth. Soil-water contents average approximately 3 percent by weight and peak at about 13 percent by weight.

- Very little infiltration of water occurs beyond the upper 2 feet of the surface. Unsaturated hydraulic conductivities are extremely low due to low soil-water contents. The operational unsaturated hydraulic conductivities of these soils are on the order of 10^{-9} to 10^{-10} cm/s.

- Soil profiles show an enrichment of stable chloride near the surface (Figure 5-2). Chloride in the top 20 feet of soil represents the accumulation of atmospheric chloride over tens of thousands of years. The implication of this chloride accumulation is that very little water has infiltrated beyond 20 feet bgs during that period of time. Water that exists deeper in the vadose zone probably entered the system much earlier and under much wetter climatic conditions.

5.2.2 The Bathtub Effect

RCRA Subtitle C regulations, specifically 40 CFR 264.310 (a) (5), state that at final closure of a landfill, the operator must cover the landfill with a final cover designed and constructed to: "have permeability less than or equal to the permeability of any bottom liner system or natural subsoil present." This prescriptive requirement was established to prevent what is commonly referred to as the bathtub effect, which occurs when a more permeable cover is constructed over a less permeable bottom liner or natural subsurface soil. If the more permeable cover were to remain saturated during its design life, water would eventually accumulate in disposal cells, filling pits and trenches as if they were basins. Such an event could accelerate deterioration of waste containers, initiate subsidence of the cover, and mobilize hazardous constituents.

The cover has been carefully designed using native soil selected from appropriate borrow areas to prevent the bathtub effect. This section presents the permeability (hydraulic conductivity) data for MWL subsurface soil and for the soil that will be used to construct the cover. These data demonstrate that the MWL alternative cover meets the permeability requirements of 40 CFR 264.310, and that the bathtub effect is unlikely to occur.

5.2.2.1 MWL Subsurface Soil Hydraulic Conductivities

During the MWL Phase 2 RFI and in subsequent hydrologic studies, the permeability of MWL subsurface soil was determined by directly measuring the saturated hydraulic conductivity in the field, and by measuring the hydraulic conductivity of core samples in the laboratory.

5.2.2.1.1 Field measurements of Subsurface Soil Hydraulic Conductivity

The most representative measurement of saturated hydraulic conductivity is obtained in situ in the field, because the sampled areas are undisturbed and the area tested is considerably larger than the cross-sectional area of a core sample analyzed in the laboratory. In addition, field conductivity values reflect the presence of naturally occurring macropores (or channels of preferential flow), which may significantly affect the saturated hydraulic conductivity. Two in situ tests were conducted on surface soil west of the MWL to obtain measurements of the saturated hydraulic conductivity. The results from these tests are summarized in Table 5-1.

The first test was an IP test conducted on a 16- by-16-foot area that was flooded with more than 5,000 gallons of water. Water infiltration through the upper 6 feet of soil was monitored and measured over 890 days. The saturated hydraulic conductivity determined from steady-state flow is 4.0×10^{-4} cm/s.

The second in situ test was conducted on an adjacent 10- by-10-foot area. This site was flooded to emulate a rainfall event, and the saturated hydraulic conductivity was determined to be 5.3×10^{-4} cm/s. The average (geometric mean) hydraulic conductivity from these two in situ tests is 4.6×10^{-4} cm/s.

5.2.2.1.2 Laboratory Measurements of Subsurface Soil Hydraulic Conductivity

During the MWL Phase 2 RFI, laboratory measurements of saturated hydraulic conductivity were obtained from 18 core samples collected from subsurface soil directly below the MWL at depths ranging from 10 to 104 feet bgs. Core samples were collected ahead of the drill bit using a California split-spoon sampler and brass rings. Laboratory measurements of hydraulic conductivity were also obtained from six core samples collected from the IP test site at depths ranging from 1 to 6 feet bgs. The IP test core samples were collected with a sliding hammer core sampler and brass rings. Hydraulic conductivities for core samples obtained from Phase 2 RFI drilling and from the IP test site were measured using the relatively undisturbed soil samples, without remolding. Two additional hydraulic conductivity measurements were obtained by remolding soil from the IP test site. The results from these tests are summarized in Table 5-1.

The average (geometric mean) of the 26 laboratory measurements of hydraulic conductivity is 1.1×10^{-4} cm/s. These results are very similar to the results obtained from the in situ hydraulic conductivity test at the IP test site west of the MWL, which yielded an average hydraulic conductivity of 4.6×10^{-4} cm/s.

5.2.2.2 MWL Alternative Cover Hydraulic Conductivity

Nine composite soil samples were collected from borrow areas west of the MWL and from existing Corrective Action Management Unit (TA-3 borrow pits) soil stockpiles in TA-3. The cover will be constructed of soil from each of these borrow areas. Borrow soil was analyzed for a full suite of geotechnical parameters, including saturated hydraulic conductivity, moisture-density relationships, Atterberg Limits, grain-size analysis, and shear strength.

Saturated hydraulic conductivities were obtained at 90 percent of the maximum dry bulk density to satisfy earthwork specifications for percent (relative) compaction. Hydraulic conductivity data for the cover soil are presented in Table 5-2. The saturated hydraulic conductivity for borrow soil from areas west of the MWL averaged 3.6×10^{-5} cm/s, while the saturated hydraulic conductivity for the soil in the TA-3 borrow pits averaged 1.6×10^{-5} cm/s. Fill for the subgrade layer, the native soil layer, and the topsoil layer will come from the TA-3 borrow pits. The average (geometric mean) hydraulic conductivity of all soil samples from both borrow areas is 2.1×10^{-5} cm/s, which is a realistic estimate of the saturated hydraulic conductivity of the final cover.

These data demonstrate that the saturated hydraulic conductivity of the cover will be lower than the saturated hydraulic conductivity of the underlying natural subsurface soil. The estimated saturated hydraulic conductivity of the natural subsurface soil is 4.6×10^{-4} cm/s. The estimated saturated hydraulic conductivity of the final cover is 2.1×10^{-5} cm/s. Thus, the bathtub effect is unlikely to occur.

5.2.2.3 Natural Analog of the MWL Cover

The most convincing evidence that the bathtub effect will not occur at the MWL lies in the analog of natural moisture conditions in soil in the vicinity of the MWL. Existing moisture contents in this soil provide an excellent natural analog for predicting moisture contents in the cover. Soil moisture content at the MWL averages 3 percent by weight. Although the upper few inches of soil may become saturated briefly following rainfall events, evapotranspiration causes the soil to dry rapidly. Even during winter months, when plants are dormant and transpiration is low, saturated conditions rarely occur.

The vegetated soil cover for the MWL is designed to simulate natural conditions, utilizing evapotranspiration to remove excess moisture. When excess moisture is removed, water is no longer available to percolate downward into waste disposal cells. Because the alternative cover was designed to simulate natural site conditions, the cover is predicted to be unsaturated during most of its design life, which is consistent with the cover performance modeling results presented in Section 5.3.

Under these unsaturated conditions, the “operational hydraulic conductivity” of the cover will be orders of magnitude lower than the saturated hydraulic conductivity of both the cover and the natural subsurface soil. The operational hydraulic conductivity of the MWL cover is equal to the average flux through the cover, assuming a unit gradient. Performance modeling at the MWL using the Unsaturated Soil Water and Heat Flow Model (UNSAT-H) (Fayer and Jones 1990) predicted an average flux through the 3-foot cover to be 4.1×10^{-9} cm/s (see Section 5.3.3). HELP-3 and Variably-Saturated 2-D Flow and Solute Transport Model (VS2DT) (Healy 1990) predicted this value to be 7.1×10^{-11} cm/s and 2.1×10^{-10} cm/s, respectively. Thus, the operational hydraulic conductivity of the final cover is conservatively estimated to be 4.1×10^{-9} cm/s, five orders of magnitude lower than the estimated saturated hydraulic conductivity of the MWL subsurface soil (4.6×10^{-4} cm/s), and four orders of magnitude lower than the predicted saturated hydraulic conductivity of the cover (2.1×10^{-5} cm/s).

5.3 Cover Performance

Alteration of the MWL natural site conditions by grading the land surface and removing the established native vegetative cover, deploying an engineered cover, and building drainage swales will alter the site's hydrologic response. The long-range plan is to establish soil and vegetative conditions similar to existing natural conditions. Both the long-term as well as the short-term responses of the cover must be considered in its design. Engineering designs are analyzed under hypothetical scenarios that have a reasonable chance of future occurrence to demonstrate that the potential for infiltration and contaminant migration from waste disposal cells to the vadose zone and groundwater is unlikely, and to ensure that the intent of federal and state regulations and DOE orders is met.

The regulatory requirements for closure and post-closure of landfills are provided in several EPA guidance documents (EPA 1989, EPA 1991, EPA 1994). The primary closure requirement is that the owner must design and construct a low-permeability cover over the landfill to minimize infiltration of water into waste disposal cells and provide long-term care and maintenance in order to prevent releases of hazardous constituents to the environment.

5.3.1 Cover Performance Modeling

In order to demonstrate that the MWL alternative cover design complies with the regulatory guidance, it is necessary to model the hydrologic performance of the cover. The EPA (EPA 1994) suggests that the water-balance model, HELP, be used for these demonstrations. Performance of the cover was evaluated using HELP-3 (Schroeder et al. 1994) and two additional unsaturated flow models, UNSAT-H (Fayer and Jones 1990) and VS2DT (Healy 1990). Although HELP-3 is commonly used to predict infiltration through landfill covers and is widely accepted by the regulatory community, UNSAT-H and VS2DT are more rigorous and were used for comparison with the HELP-3 modeling results.

Performance modeling results were used to predict infiltration through the cover and to determine optimal cover thickness. Because construction costs are directly proportional to the thickness of a cover, the optimal cover design is one that meets the performance criteria with the least amount of thickness. Inherent in the determination of optimal cover thickness is the ability of the cover design to limit infiltration of water into waste disposal cells. In order to model the hydrologic performance of the cover, historical rainfall records from Albuquerque International Sunport, dating from 1919 to 1996, were used. This historical record provides data for assessing both the short- and long-term responses of the cover design as well as determining the performance criteria for the post-closure care and maintenance period.

HELP-3 (Schroeder et al. 1994) was specifically developed for designing landfill covers, but lacks rigorous mathematical flow calculations. This water-balance model uses simplified schemes to model both the infiltration of water through soil layers and the removal of water by evapotranspiration and overland flow. HELP-3 contains databases describing soil parameters, meteorological conditions, and vegetation; however, site-specific data for the MWL were used wherever possible to more accurately model the performance of the cover.

UNSAT-H (Fayer and Jones 1990) was designed to predict performance of waste burial sites at Hanford, Washington, an area with low rainfall and relatively dry soil, conditions similar to Albuquerque, New Mexico. UNSAT-H uses a finite-difference implementation of a modified form of Richards' equation to predict unsaturated liquid and vapor flow in soil layers as well as

water removal through plant roots (transpiration). UNSAT-H employs many of the best procedures for simulating the hydrology of soil covers (EPA 2002, Albright et al. 2002) and was used in this analysis to complement HELP-3 results.

VS2DT (Healy 1990) is a U.S. Geological Survey (USGS) code used to model flow and solute transport in variably-saturated, single-phase flow in porous media. VS2DT uses a finite-difference approximation to solve Richards' equation for flow, and the advection-dispersion equation for transport. While it offers rigorous unsaturated flow mathematics, VS2DT is designed more specifically for transport estimation than for landfill cover design, and does not include flows past a particular depth among its output files. VS2DT is the least user-friendly of the three codes, but was used in this analysis primarily because it is a well-validated USGS code commonly used to predict flow and transport of water in the vadose zone.

5.3.2 Model Input Parameters

Input parameters for the models included precipitation and climate data, evapotranspiration data, soil hydrologic properties, thickness, and miscellaneous model-dependent input parameters such as evaporative zone depth and leaf area index. Table 5-3 summarizes the input parameters specific to HELP-3, UNSAT-H, and VS2DT. HELP-3 is the most popular code in use for evaluating landfill covers. UNSAT-H generally provides the most accurate predictions of infiltration (Albright et al. 2002). Input parameters vary between models depending on whether the code is a water-balance model (HELP-3) or a Richards' equation-based model (UNSAT-H).

Numerous preliminary modeling studies of the MWL alternative cover were conducted prior to the formulation of the final results presented in this report. These studies focused on the sensitivity of the selected models to various input parameters. The results of these sensitivity analyses are presented in "Preliminary Unsaturated Flow Modeling and Related Work Performed in Support of the Design of a Closure Cover for the MWL" (Wolford 1998). The modeling results presented in this design report vary slightly from preliminary modeling results, reflecting more consistent use of input parameters between models. During the early modeling efforts for the proposed MWL alternative cover, slight variations existed between the models in parameters including rooting depth, atmospheric tension, and nodal spacing. The modeling results presented in this report used more consistent input parameters between each model to ensure compatibility between models and to facilitate comparison of the results. Modeling results were corroborated in 2004 using UNSAT-H Version 3.0 (Fayer 2000) and conservative site-specific input parameters. These modeling data are provided in Peace and Goering 2005.

5.3.2.1 Precipitation Data

All three models were run using two discrete sets of precipitation data. The first set, the "Historical Precipitation Data," included 65 yrs of daily rainfall recorded from 1932 to 1996 at Albuquerque International Sunport. The second set, the "Maximum Precipitation Data," included the eight heaviest years' rainfall between 1919 and 1996, repeated eight times for a total of 64 yrs. The heaviest rainfall years were 1919, 1929, 1940, 1941, 1982, 1986, 1988, and 1992. These rainfall data are representative of a significant climate change, and would have the greatest influence on the long-term performance of any cover system. Precipitation during these years ranged from 12 inches to more than 15 inches (30.5 to 38.1 cm/yr). These annual

totals contrast markedly with the current average annual precipitation for the Albuquerque area of 8.5 inches/yr (21.6 cm/yr).

Ecological studies performed by Waugh (1997), using proxy paleoclimate data (tree rings, packrat middens, lake sediment pollen, and archeological records) indicate bounding conditions for future climate states of twice the current precipitation at Monticello, Utah. This 64-yr (artificial) rainfall data set adequately approximates and addresses a similar climate change in New Mexico for the cover.

5.3.2.2 Soil Parameters

The soil parameters for the models were selected based upon the results from field and laboratory tests conducted in soil near the MWL. Several large-scale infiltration tests were conducted in soil west of the MWL to measure water movement through the soil and the effects of evapotranspiration and unsaturated flow. Data collected during these tests were used to select the most applicable soil parameters and to calibrate the HELP-3, UNSAT-H, and VS2DT models.

5.3.2.3 Evapotranspiration Data

Each model used synthetic PET data generated separately by the HELP-3 code for both the 65-yr historical rainfall and the 64-yr maximum rainfall runs.

5.3.2.4 Lower Boundary Conditions

HELP-3 does not require lower boundary conditions, so it was not necessary to include soil beneath the cover with the HELP-3 model. The UNSAT-H and VS2DT models, however, include soil beneath the cover. This was done to limit the potential for lower boundary conditions to influence predicted infiltration through upper soil layers. The lower boundary condition for the UNSAT-H model was a unit gradient, simulating drainage by gravity. The VS2DT model does not have a unit gradient option for a lower boundary condition. Instead, a coarse sand layer with an initial water content of 0.036 cubic centimeters was used for its lower boundary condition. This water content remained constant during the model runs.

5.3.2.5 Leaf Area Index.

A maximum leaf area index of 1.0 was used in the HELP-3 model and a maximum leaf area index of 0.8 was used in the UNSAT-H model. VS2DT does not use the leaf-area index parameter.

5.3.2.6 Model Calibration and Sensitivity Analysis

Model input parameters were tested by modeling three field infiltration experiments conducted in soil west of the MWL. The data from these infiltration experiments were used to calibrate the three models.

5.3.3 Model Results

HELP-3, UNSAT-H, and VS2DT predicted minimal infiltration through vegetated soil covers of 1, 2, 3, 4, and 5 feet in thickness, with infiltration varying as a function of cover thickness, the precipitation data set, and the model used. In each case, the models predicted an average infiltration rate of less than 4 percent of the total precipitation, regardless of cover thickness or the model used. The modeling results are discussed in detail below.

5.3.3.1 Modeling Results Using Historical Precipitation Data

During the 65-yr historical record (1932 to 1996), a total of 561.2 inches (1,425.6 cm) of precipitation was measured at Albuquerque International Sunport. The average annual precipitation during this period was 8.5 inches/yr (21.6 cm/yr). Daily precipitation values measured during the 65-yr period were input into the three models (HELP-3, UNSAT-H, and VS2DT) and the total infiltration through soil covers varying in thickness from 1 to 5 feet was predicted. These results are summarized in Table 5-4, which presents the cumulative infiltration in cm predicted through each cover during the 65-yr period, as well as the average flux in cm/s and the average infiltration rate in cm/yr. The maximum volumetric moisture content (θ) predicted for the 65-yr period is also presented in Table 5-5.

5.3.3.2 Average Annual Infiltration

The HELP-3 modeling using historical precipitation data predicted average annual infiltration ranging from 0.43 cm/yr for a 1-foot cover to 0 cm/yr for 4- and 5-foot covers (Figure 5-3). The HELP-3 modeling results indicate that average annual predicted infiltration is less than 2 percent of the total precipitation, regardless of cover thickness.

The modeling results for UNSAT-H and VS2DT (Figures 5-4 and 5-5) were similar to the results for HELP-3. In each case, the predicted average annual infiltration through the various covers modeled was only a small percentage of the total precipitation. All three models show a significant decrease in the average annual infiltration as the cover thickness is increased from 1 to 3 feet (Figures 5-3 through 5-5).

5.3.3.3 Cumulative Infiltration

Figures 5-6 and 5-7 present the cumulative infiltration predicted by UNSAT-H and VS2DT using historical precipitation data. The cumulative infiltration through a 1-foot cover over the 65-yr period of record varied from 41.5 cm (UNSAT-H) to 37.5 cm (VS2DT). HELP-3 predicted a cumulative infiltration of 28.0 cm through a 1-foot cover (see Table 5-3). A plot of cumulative infiltration versus time could not be generated for HELP-3 due to the limitations of the code.

For comparison, the total precipitation measured at Albuquerque International Sunport during 1932 to 1996 was 561.2 inches (1,425.6 cm). The cumulative infiltration through a 1-foot cover predicted by HELP-3, VS2DT or UNSAT-H during this 65-yr period was less than 3 percent of

the total precipitation, regardless of the model used, and was even less for covers of greater thickness.

5.3.3.4 Predicted Annual Infiltration through the Covers

The performance of the cover was also evaluated on a year-to-year basis to compare infiltration rates between wetter and drier years. During the years of higher precipitation, the moisture content of the cover increases, and as a result, the hydraulic conductivity of the cover, which is a function of percent saturation, increases. Consequently, infiltration is greater during the wetter years. Similarly, during drier years, the lower moisture content of the cover results in a lower hydraulic conductivity and, therefore, lower infiltration.

Annual infiltration predicted by UNSAT-H through each cover using historical precipitation data is shown in Figures 5-8 through 5-12, which demonstrate cover performance under current climatic conditions, with higher infiltration during the wetter years, and lower infiltration during the drier years. Maximum infiltration during wetter years falls significantly as cover thickness is increased from 1 to 3 feet, but less significantly as cover thickness is increased to 4 and 5 feet. Negative infiltration values shown during several years for the 1- and 2-foot covers (Figures 5-8 and 5-9) indicate net upward flux during dry years, as evapotranspiration removes moisture from the soil below the cover.

Figures 5-13 through 5-17 show the corresponding annual flux through each cover in cm/s. The maximum annual flux through a 1-foot cover is predicted to be 8.1×10^{-8} cm/s. The maximum annual flux through a 3-foot cover is significantly lower, at 1.9×10^{-8} cm/s. As cover thickness is increased to 4 and 5 feet, maximum annual flux decreases only slightly, to 1.5×10^{-8} cm/s and 0.8×10^{-8} cm/s, respectively. Thus, the most significant performance is achieved by increasing cover thickness from 1 to 3 feet, with rapidly diminishing performance improvement achieved by increasing cover thickness to 4 and 5 feet.

5.3.3.5 Predicted Moisture Contents at Various Depths within the Cover

Figures 5-18 through 5-22 show predicted moisture contents at various depths in a 5-foot cover. These moisture contents were predicted by UNSAT-H using the historical precipitation data. Moisture contents in the upper few feet of the cover fluctuate dramatically (Figures 5-18 and 5-19), with increases due to precipitation, and decreases due to evapotranspiration. These fluctuations diminish with increasing depth, indicating that precipitation is stored primarily in the upper few feet of the cover, and is rapidly removed by evapotranspiration. Lower water contents at depth and the limited fluctuations of these water contents result in a unit gradient and a very low unsaturated hydraulic conductivity, which limits infiltration to very minute levels.

5.3.3.6 Modeling Results Using Maximum Precipitation Data

To be conservative and to approximate reasonable bounding conditions for future climate states, a second set of precipitation data was modeled. These data included daily rainfall from Albuquerque International Sunport for the eight highest years on record. Precipitation during these years ranged from 12 inches to more than 15 inches (30.5 to 38.1 cm/yr). Maximum precipitation data was constructed by placing these 8 yrs of unusually high rainfall back-to-back,

and repeating this procedure eight times for a total of 64 yrs of (artificial) record. The total precipitation applied to the models in the maximum precipitation data was 855.9 inches (2,174.1 cm), approximately 50 percent greater than the precipitation applied in historical precipitation data. The results are summarized in Table 5-5 and discussed below.

5.3.3.7 Average Annual Infiltration.

The HELP-3 model using the maximum precipitation data predicted average annual infiltration ranging from 0.55 cm/yr for a 1-foot cover to less than 0.02 cm/yr for covers ranging from 2 to 5 feet in thickness (Figure 5-23). Thus, even with the maximum precipitation data, average annual infiltration through the soil cover is still less than 2 percent of the total precipitation.

The modeling results for UNSAT-H and VS2DT (Figures 5-24 and 5-25) were similar using the maximum precipitation data. In each case, the average annual infiltration through the various covers was only a small percentage of the total precipitation. All three models showed a significant decrease in average annual infiltration as the cover thickness was increased from 1 to 3 feet (Figures 5-23 through 5-25).

5.3.3.8 Cumulative Infiltration

Figures 5-26 and 5-27 present the cumulative infiltration predicted by UNSAT-H and VS2DT using the maximum precipitation data. All soil covers ranging in thickness from 1 to 5 feet proved to be effective in minimizing infiltration, with cumulative infiltration predicted to be no more than 77.7 cm during the 64-yr period. This corresponds to less than 3.6 percent of the 855.9 inches (2,174.1 cm) of precipitation applied using the maximum precipitation data. These results indicate that even if the climate changes dramatically and precipitation increases by 50 percent, a vegetated soil cover would significantly reduce infiltration.

5.3.3.9 Predicted Annual Infiltration through the Covers

The performance of the cover using maximum precipitation data was also evaluated on a year-to-year basis using the results from UNSAT-H. Figures 5-28 through 5-32 present the predicted annual infiltration through covers of varying thicknesses under significantly wetter climatic conditions. Using maximum precipitation data, infiltration exceeds 2.5 cm/yr through a 1-foot cover. Peak annual infiltration rates decrease to 1 cm/yr for a 3-foot cover and approximately 0.75 cm/yr for a 5-foot cover.

Figures 5-33 through 5-37 show the corresponding annual flux through each cover in cm/s under the maximum precipitation scenario. The maximum annual flux through a 1-foot cover is predicted to be 8.8×10^{-8} cm/s. The maximum annual flux through a 3-foot cover is predicted to be 3.1×10^{-8} cm/s, while the maximum annual flux through a 5-foot cover is 2.3×10^{-8} cm/s. Again, the most significant performance improvements are achieved by increasing cover thickness from 1 to 3 feet, with performance improvements rapidly diminishing when increasing cover thickness to 4 and 5 feet.

5.3.3.10 Performance Modeling Summary

As recommended by the EPA, performance modeling was conducted in order to demonstrate that the cover minimizes infiltration and complies with the minimum 30-yr performance criteria. The water-balance model, HELP-3, along with two additional models, UNSAT-H and VS2DT, were used to predict the performance of soil covers ranging in thickness from 1 to 5 feet. All three models demonstrate that deployment of a vegetated soil cover for final closure of the MWL will reduce infiltration into the landfill to a small percentage of the total precipitation. The models also demonstrate that a 3-foot-thick vegetated soil cover is the optimum design thickness based on predicted performance. It is evident that additional cover thickness does not lead to significantly better performance.

Although the modeling suggests that a 1- or 2-foot-thick cover will significantly limit the average rate of infiltration, "spikes" or peaks may occur during years with higher precipitation. These infiltration spikes are fewer and lower in magnitude as the cover thickness is increased to 3 feet, and as the storage capacity of the cover increases. The storage capacity of a 3-foot cover is 50 percent greater than the storage capacity of a 2-foot cover, and would provide an additional degree of conservatism should there be extreme precipitation events or significant, long-term climatic changes.

Increasing cover thickness to 4 or 5 feet results in limited improvement in cover performance yet increases construction costs. Cover construction costs are directly proportional to the thickness of the cover, and the optimal cover design is one that meets the performance criteria with the least cover thickness (Ankeny et al. 1997). A reduced finished elevation above grade would provide additional environmental benefits, reducing the cover's exposure to wind and water erosion.

Under current climatic conditions, annual infiltration through a 3-foot cover is typically less than 0.3 cm and rarely exceeds 0.5 cm (Figure 5-10). The cover's performance will actually approximate that of a 4- or 5-foot cover due to the placement of subgrade fill. Up to 40 inches of compacted fill will be placed over the existing landfill surface prior to construction of the actual cover to provide a stable, uniform subgrade for the cover (see Plate 5—Final Cover Cross Sections).

5.4 Biointrusion

Burrowing by small and large mammals is a potential pathway for transfer of hazardous constituents to the accessible environment (Kennedy et al. 1985, Hakonson et al. 1992, Gee and Ward 1997). Burrowing animals may physically transfer subsurface contaminated soil and waste to the surface and increase water infiltration by decreasing the bulk density of the soil or creating pathways of preferential flow. Burrows of small mammals have been observed at the MWL and are a potential pathway for transfer of hazardous constituents from waste disposal cells to the accessible environment.

The presence of small and large animal burrows and their effect on cover performance has been a concern for scientists and engineers at the Hanford site in Washington for many years (Gee and Ward 1997). Gee summarizes observations at Hanford as follows:

> From the results of lysimeter tests performed at the Animal Intrusion Lysimeter Facility, the presence of small mammal burrows does not appear to have a

> significant influence on the deep percolation of water. During the summer months, more water is lost from plots with animal burrows than from plots with no animal burrows. During winter months, plots with animal burrows and plots without animal burrows gain water. In addition, water does not infiltrate below 36 in., even though burrow depth exceeds 48 in. The lack of significant infiltration at depth and the overall loss of water in the lysimeters occurs even though 1) no vegetative cover exists, 2) no runoff is allowed, 3) burrow densities in the lysimeter are greater than burrow densities found in natural settings, 4) extreme rainfall events are applied frequently, and 5) animal burrows are deeper in the lysimeter than in natural settings. The overall water loss from soils with small mammal burrows appears to be enhanced by a combination of soil turnover and subsequent drying, ventilation effects, and high ambient temperature.

Similar water loss results have been observed at the Arid Land Ecology Reserve at the Hanford site for large mammal burrows excavated by coyotes and badgers in search of prey. Large mammals do appear to cause increased deep infiltration but much of this water is removed by co-located, dense vegetation. The density of vegetation near large mammal burrows was significantly greater than in adjacent, undisturbed areas away from the burrows (Gee and Ward 1997).

A biointrusion barrier consisting of crushed rock could be placed at depth within a cover to mitigate burrowing mammals. Plant root growth also may be restricted to soil above the biointrusion barrier. If roots are restricted to the soil above the biointrusion barrier, the net transpiration and effective water storage capacity of the cover system could be significantly reduced. In this case, depth of emplacement of a biological intrusion barrier within the soil profile is paramount.

In 1993, researchers at Idaho State University and the Environmental Research Foundation initiated a large-scale experiment to compare the performance of two soil-plant cover designs that included biological intrusion barriers at depths of 0.5 and 1.0 meters (m) (Anderson 1997). The objectives of the study were to examine the effects that placing a rock intrusion layer in a soil cap would have on water infiltration, water storage capacity, and plant rooting depths. Anderson (1997) summarizes their observations as follows:

> Biobarriers are clearly an impediment to root growth. We have only seen extraction below the biobarriers when volumetric water content below the barrier was initially at least 25 percent. There may be a threshold of water content below which plants are unable to detect the presence of extractable water below a biobarrier. Plants can, however, penetrate biobarriers and extract water from the soil if water content is sufficiently high.

Another study performed by Anderson (Anderson and Forman 2002) determined that if a biointrusion barrier is used, a 0.5-m gravel/cobble barrier should be placed at the bottom of a 1.2-m homogeneous soil reservoir.

The final phase of nearly two decades of research on biointrusion by Idaho State University at Idaho National Engineering and Environmental Laboratory (INEEL) was published in 2002 (Anderson and Forman 2002). Two cap configurations were recommended including a soil-only cap consisting of a 2-m depth of homogenous soil or a cap of a 1.2-m depth of homogenous soil overlying a 0.5-m thick gravel/cobble intrusion barrier. Caps constructed according to either of

these configurations should preclude virtually any precipitation from reaching interred waste. A major advantage of the soil-only cap is simplicity of construction. Anderson and Forman (2002) recommend that if a biobarrier is used, it should be placed at the bottom of the soil reservoir.

Field studies at the MWL have shown that maximum root density of dominant species occurs in the upper 12 inches (30 cm) of the soil profile (Peace et al. 2004). Lesser root density has been observed to depths of 31 inches (80 cm), and root growth rarely exceeds 39 inches (1 m).

Emplacement of a woven steel mesh at a shallow depth (e.g., below the topsoil layer) would discourage small and large mammals from burrowing deep into the cover and would have little effect on root density and depth or the effective water storage capacity of the cover system. The cost of a woven steel mesh could be significant, however, and the durability of metal biointrusion barriers has not been established. A crushed rock biointrusion barrier placed at the bottom of the soil reservoir would be a more cost-effective approach. Rock is less expensive, readily available from off-site suppliers, and more durable. The size of the crushed rock and the requirements for placement (e.g., thickness) are usually determined in collaboration with the regulatory authority.

5.5 Subsidence

Waste in disposal cells at the MWL may contain voids resulting from incomplete filling of waste containers, limited internal compaction of contents, and voids between containers. These voids may induce subsidence as waste containers deteriorate and/or collapse over time. Rates of decay will vary for different containers. Although subsidence has the potential to damage a landfill cover, predicting subsidence effects is very difficult because of the heterogeneous nature of the waste forms, backfill materials, and local climatic conditions.

Cover designs that include compacted clay soil, flexible membrane liners, and geosynthetic clay liners would not function as intended when subject to tensile and shear stresses during subsidence. These common liners, geomembranes, and geosynthetic materials require rigorous quality control during manufacture and are easily damaged during installation on an operational scale. The MWL alternative cover design, consisting of a thick layer of native soil, is constructed without liners, and thus will accommodate differential subsidence without undue impairment of its performance. During the long-term care period, soil readily available in TA-3 will be added to the cover as needed to correct subsidence resulting from degradation of buried waste containers. Topsoil will be replaced according to original construction specifications. This provides additional assurance for adequate long-term performance of the cover system.

5.6 Runoff and Run-On Control

The amount of water available for infiltration is a function of the amount of precipitation that falls on the cover surface less the amount of water that runs off and away from the cover surface. The surface of the cover has been designed with a central crown and a 2-percent slope to promote runoff of surface water while minimizing erosion of the topsoil layer.

A design requirement of RCRA is that the cover withstands a 25-yr, 24-hr storm event. Storm water run-on will be prevented from impacting the cover by constructing an earthen swale along the eastern perimeter of the site. Run-on will be diverted at the perimeter and directed to the south and the north toward the surrounding landscape. Cover surface erosion from storm water

runoff will be mitigated by native vegetation and admixed gravel in the topsoil layer. Cover surface runoff will be directed toward the surrounding landscape.

For the Albuquerque area, the rainfall amount for a 25-yr, 24-hr storm is 2.5 inches (City of Albuquerque 1993).

5.7 Erosion Control

Erosion of the cover by wind and water is a significant design consideration. The design should minimize the effects of wind and water erosion of the surface, side slopes, and toe of the cover. The cover has been designed to have native vegetation growing over the surface, side-slopes, and toe throughout the design life. The presence of vegetation on the cover surface combined with the presence of gravel admixed with the topsoil layer will significantly reduce the amount of fine soil lost from wind and water erosion.

Wind erosion studies by Ligotke and Klopfer (1990) and Ligotke (1993, 1994) at the Pacific Northwest National Laboratory Aerosol Wind Tunnel Research Facility have demonstrated that soil and gravel admixtures with particle sizes of 3 to 7 millimeters provide superior surface protection. The best gravel admixtures reduced surface deflation rates by greater than 96 percent compared to unprotected surfaces. Water erosion studies by Walters et al. (1990) and Gilmore and Walters (1993) determined that the most dominant factor in reducing runoff and sediment yield was the presence of a vegetated cover.

Erosion studies by Finley et al. (1985) and soil water balance studies by Waugh et al. (1994) and Sackschewsky et al. (1995) demonstrate that moderate amounts of gravel mixed into cover topsoil will control both water and wind erosion with little effect on plant growth or soil-water balance. As wind and water pass over the surface, some winnowing of fines from the admixture occurs, leaving a vegetated erosion-resistant pavement (Waugh 1997). The amount of gravel used in the admixture is a major design consideration. If too much gravel is used, plant transpiration and surface evaporation could be significantly reduced which would increase the potential for water infiltration. Overall, the presence of a 15 to 30 percent gravel admixture is effective in reducing the deflation of fine soil from a cover surface by wind and water erosion (Ligotke 1994).

5.7.1 The Universal Soil Loss Equation

The empirical equation known as the universal soil loss equation (USLE) was devised by Wischmeier and Smith in 1965. The EPA recommends use of the equation to estimate average annual soil loss from a cover. The equation is as follows:

$$A = R\ K\ LS\ C\ P$$

where

- A = Estimated average annual soil loss in tons/acre/yr;
- R = Rainfall erosivity factor;
- K = Soil erodibility factor;

LS = Topographic factor;
C = Surface-cover factor; and
P = Management factor.

A modified version of the USLE (EPA 1980) was employed to estimate the soil erosion potential from the surface and side slopes of the cover by overland runoff. The modified universal soil loss equation (MUSLE) is

$$A = R K (LS) (VM)$$

where

A = Estimated average annual soil loss in tons/acre/yr;
R = Rainfall factor;
K = Soil erodibility factor;
LS = Topographic factor; and
VM = Erosion control factor.

Soil loss was calculated using the MUSLE for: 1) no vegetation yet established, straw mulch applied to cover and side slopes at 2 tons/acre, and 2) vegetation partially established over cover and side slopes 12 months after seeding, one-half of the straw mulch remaining. The estimated average annual soil loss from the cover surface and side slopes is 0.77 tons/acre/yr and 0.08 tons/acre/yr, respectively. These losses are well below the design requirement recommended by the EPA (EPA 1989) of less than 2 tons/acre/yr.

The MUSLE contains inherent limitations. In general, erosion is not a steady, orderly, easily predictable process. Much of it takes place episodically. A single torrential rainfall striking a barren soil may cause more soil loss in a few hours than a whole season's "normal" rainfall over a fully vegetated cover. Inherent limitations include:

- The MUSLE is not intended for estimating erosion in a particular year, but rather estimating long-term averages.
- The condition of the cover is not static over time, so the erosion will vary from year to year. For example, the cover will initially have little vegetation and will be more susceptible to erosion. After initial erosion, remaining soil may be less susceptible than the initial surface, because the more susceptible fractions are lost first.
- The slope factor, LS, assumes that the central, gently sloping portion of the cover surface does not increase the amount of runoff that occurs down the side slopes, i.e., all rain falling on the cover surface infiltrates rather than running off the surface. This assumption may not be valid for the most intense storms.
- Wind may cause erosion from the cover that is not accounted for by the MUSLE.

5.7.2 The Wind Erosion Equation

The wind erosion equation (WEQ) was used to estimate the soil erosion potential from the surface and side slopes of the cover by wind. The WEQ was introduced in 1963 because it was recognized that wind could be a major geological phenomenon for erosion. In 1997, the WEQ

was modified by the U.S. Department of Agriculture (USDA 1997) in the National Agronomy Manual.

The WEQ is

$$E = f\,[(IKC)\,LV]$$

where

E = Estimated average annual soil loss in tons/acre/yr;
I = Soil erodibility index;
K = Ridge roughness factor;
C = Climatic factor;
L = Unsheltered distance; and
V = Vegetative factor.

Soil loss was calculated using the WEQ for: 1) no vegetation yet established, straw mulch applied to cover and side slopes at 2 tons/acre, and 2) vegetation partially established over cover and side slopes 12 months after seeding, one-half of the straw mulch remaining. In both cases, the estimated average annual soil loss from the cover surface and side slopes is 0 tons/acre/yr.

A number of inherent limitations are also present in the WEQ. These limitations include:

- When the unsheltered distance, L, is sufficiently long, the transport capacity of the wind for saltation and creep is reached. If the wind is transporting all of the soil it can carry across a given surface, the inflow into the downwind is equal to the outflow for saltation and creep. The net soil loss is then only the suspension component. This does not imply a reduced soil erosion problem because theoretically there is still the estimated amount of soil loss in creep, saltation, and suspension leaving the downwind edge of the surface.

- Surface armoring by nonerodible gravel, snow cover, and inherent seasonal change is not addressed in the soil erodibility factor, I.

- The WEQ does not estimate soil erosion from single storm events.

5.8 Slope Stability

A common problem leading to cover failure is slope failure at barrier interfaces caused by excessive soil moisture, especially on steep side slopes. Documented slope failures have been attributed to slip planes created at synthetic layer interfaces (Daniel and Gross 1995). Covers usually contain multiple layers of earthen and synthetic materials. Performance usually depends upon maintaining discrete boundaries between earthen layers and synthetic materials during construction and throughout the design life of the cover system. Interfaces between layers are susceptible to lateral flow of infiltrating water that leads to reduced friction and subsequent failure. Layer interfaces are also susceptible to root and animal intrusion and soil illuviation.

The cover has been designed to mitigate all such potential failure mechanisms. The cover is centrally crowned and sloped at 2 percent to the side slopes that, in turn, are tied to the surrounding landscape at 6:1. The monolithic cover will not be susceptible to failures common to conventional, multi-layer, multi-component designs.

5.9 Vegetated Cover

The influence of vegetation on the hydrologic relationships of the cover cannot be overemphasized. Vegetation will play a key role in stabilizing the newly constructed surface by mitigating wind and water erosion. Vegetation will also play a key role in maintaining the cover's water balance, significantly reducing the amount of water available for contact with disposal cell waste and subsequent contaminant transport. Vegetated covers are also extremely versatile, adapting to climatic change through natural selection and severe disturbance (fire and drought). Once native flora is established, it will persist indefinitely with little or no maintenance.

The flora in the TA-3 area is predominantly Mesa and Desert Grassland and, to a lesser degree, Sandsage and Chihuahuan Desert Shrubland. Flora exhibit influences from the Great Basin Desert, Rocky Mountains, Chihuahuan Desert, and the Great Plains. Typical plant species occurring in the area include grasses (black grama, dropseed, galleta, burrograss, bush and ring muhly), wildflowers (globemallow, aster, spectacle pod), and shrubs (sandsage, winterfat, mormon tea, yuccas, prickly pear, snakeweed) (Sullivan and Knight 1992; Peace et al. 2004).

The vast majority of TA-3 is dominated by grassland vegetation. Specifically, it represents the Mesa and Desert Grassland habitat types. The extreme western portion of the TA-3 area falls into the Sandsage Shrubland vegetation habitat. Most of the vegetation at the MWL is composed of elements of the Black Grama Grass Series. This series includes black grama, dropseed, threeawn, galleta, Indian ricegrass, and burrograss.

The desired plant community for the MWL vegetated cover is desert grassland. Grasses root at shallower depths than shrubs and, when they do root deeply, the roots are fibrous, thinner, and less damaging to the cover than the woody roots of shrubs and trees. Grass roots form a dense and interwoven fibrous network that binds the soil. Grasses concentrate their biomass close to the surface, forming a protective mat that provides protection against wind and water erosion.

5.10 Radon Gas Emission

Emission of radon gas from the MWL was investigated in 1997 by SNL Environmental Management. No significant difference between the MWL and the background measurements in terms of median, mean, and standard deviation was observed. The radon flux measurement technique employed for this study was capable of detecting radon flux in the range of 1 to 2 percent of the 20 $pCi/m^2/s$ limit listed in 10 CFR 834.

5.11 Tritium Flux Measurements

Sandia conducted studies in 1992/1993 and in 2003 to measure the tritium flux emitted from the MWL to the atmosphere. During each study, emission isolation flux chambers were deployed at various locations across the landfill to measure the tritium flux to the atmosphere. The data collected show that the overall tritium emissions from the MWL were significantly lower in 2003

than in 1992/1993. The estimated tritium emitted from the MWL to the atmosphere in 2003 was 0.090 curies (Ci)/yr, whereas the estimated tritium emitted from the MWL in 1993 was 0.486 Ci/yr. This 82 percent reduction reflects the natural radioactive decay of tritium, and its relatively short half-life of 12.3 yrs.

6.0 MWL ALTERNATIVE COVER DESIGN

The MWL alternative cover design drawings are provided on Plates 1 through 6. The construction specifications and the construction quality assurance plan are included in Appendices A and B, respectively. The qualifications of persons implementing the CMI plan and the health and safety plan are included in Appendices C and D, respectively. The design drawings include plates showing the MWL existing site plan, subgrade grading plan, final cover grading plan, final cover cross-sections, and miscellaneous details. The cover will be placed over the original 2.6-acre landfill surface and tied to the surrounding landscape. A vegetated topsoil layer admixed with 25 percent 3/8-inch crushed gravel will be applied to maintain water balance and mitigate water and wind erosion. The components of the cover are shown in Figure 6-1 and are discussed in the following sections.

6.1 Existing Landfill Surface

The existing landfill surface will be prepared for cover construction by clearing and grubbing. Perimeter fences will be removed and the landfill surface cleared of vegetation and rock. Grubbing will not exceed 6 inches in depth to minimize disturbance to surface soil and conform to radioactive area soil contamination requirements. Grubbed material will be disposed of according to SNL waste management policy and procedures. The landfill surface will be compacted to achieve the appropriate density in preparation for subgrade fill.

6.2 Subgrade Layer

Subgrade fill will be obtained from the TA-3 borrow pits located approximately 1.5 miles south of the MWL. Soil from the TA-3 borrow pits has been tested to verify engineering properties specified in the design. Subgrade fill will be placed in lifts of uniform thickness, moisture conditioned, and compacted by spreading and compacting equipment. Approximately 6,500 cubic yards (yd^3) of subgrade fill will be placed and graded to establish a central crown and uniform 2-percent slope in preparation for the biointrusion barrier.

6.3 Biointrusion Barrier

A crushed rock biointrusion barrier will be placed on the subgrade layer. This bio-barrier will be composed of approximately 4,900 yd^3 of rock fragments 1 to 6 inches in dimension. The rock will be highly siliceous in nature and have 100 percent fracture face. The crushed rock will be placed in a single lift of uniform thickness and compacted until the crushed rock fragments are firmly locked in place.

6.4 Native Soil Layer

Native soil layer fill will be obtained from the TA-3 borrow pits. Approximately 13,200 yd^3 will be placed and graded to construct the native soil layer, which will act as a water storage reservoir, retaining and storing water that infiltrates through the topsoil layer until it can be removed by

evapotranspiration. Native soil layer fill will be placed in lifts of uniform thickness, moisture conditioned, and compacted by spreading and compacting equipment. The native soil layer will be graded to maintain the central crown and the uniform 2-percent slope. Any grade stakes used on the project will be removed and backfilled with cover material to meet design specifications.

6.5 Topsoil Layer

Topsoil layer fill will be obtained from the TA-3 borrow pits. Approximately 3,900 yd^3 of surface soil will be obtained from TA-3 borrow pits. The topsoil layer will serve as the vegetative cover and erosion protection layer. A 25-percent (by volume) 3/8-inch crushed gravel will be admixed into the topsoil layer to control erosion without adversely affecting desirable vegetation and soil-water balance. The topsoil layer will be minimally compacted to facilitate plant growth and root development.

6.6 Vegetation

Following installation of the topsoil layer, reclamation seeding activities will take place. The designated native vegetative seed mix will be applied to the cover, lay-down areas, and any other areas disturbed by construction operations. The surface will be fertilized, drill-seeded, mulched and crimped. The native seed mixture is based upon on biological assessments of TA-3 (Sullivan and Knight 1992, Peace et al. 2004). The mixture will consist of black grama, spike dropseed, galleta grass, and ring muhly. The initial plant community is designed to approximate the dominant and subdominant species and will gradually develop into a climax community indistinguishable from the natural analog.

7.0 VADOSE ZONE MOISTURE MONITORING

The MWL alternative cover will incorporate a shallow vadose zone monitoring system deployed directly beneath the landfill. The shallow vadose zone monitoring system will consist of three neutron probe access holes drilled at a 30 degree angle directly below waste disposal cells. The shallow vadose zone monitoring system will function as an "early warning system." Early detection of a potential threat to groundwater will allow corrective action to be initiated before significant contaminant migration occurs. This monitoring approach was designed to protect groundwater resources and is proposed for the MWL because of its simplicity, low cost, and long-term viability.

The shallow vadose zone monitoring system will provide water infiltration and performance information, early detection of potential contaminant migration from the landfill, as well as establishing background and trend analysis information. The shallow vadose zone monitoring system is a simple system designed to meet the intent of long-term RCRA and DOE performance requirements. The shallow vadose zone monitoring system will be monitored regularly once the alternative cover has been deployed. The frequency and duration of long-term monitoring will be established in consultation with the NMED and formally documented in the MWL Long-Term Monitoring and Maintenance Plan.

7.1 Shallow Vadose Zone Moisture Monitoring

Three angled, 4.5-inch-outside-diameter, 3.75-inch-inside-diameter access holes will be installed in the shallow vadose zone directly beneath the MWL: two to the west and one to the east of the cover (Figure 7-1). The vadose zone access holes will be spaced at equal increments, with the east access hole bisecting the two west access holes. The holes will be installed using the Resonant Sonic drilling technique. Resonant Sonic is the preferred drilling technique because it literally fluidizes and displaces the surrounding soil as the drill-string advances, creating a very tight fit between the drill-string and the formation.

Each access hole will be collared approximately 10 feet outside the projected toe of the cover side slopes. Each access hole will be drilled 200 linear feet at 30 degrees to a true vertical depth of 173 feet (Figure 7-2). As each access hole is completed, the 4.5-inch sonic drill-string will be left in place and uncoupled at the surface leaving about 2 feet of drill pipe above grade. Each pipe will remain open to the vadose zone for future vadose zone soil gas sampling. A 3- by-3-foot concrete pad will be placed around each protective cover to prevent preferential flow down the annulus. Protective stanchions, 4 inches in diameter, will be placed at the outer corners of the concrete pad. The stanchions will be set 2 feet below grade and 3 feet above grade.

7.1.1 Neutron Moisture Monitoring

Neutron moisture probes take advantage of the neutron moderation process in which high-energy neutrons emitted from a radioactive source are moderated, or slowed, by collisions with surrounding atoms. Slowed neutrons, also called thermalized neutrons, emit a pulse of detectable energy, which is counted in a neutron detector contained in the neutron probe.

The neutron moderation process is dominated by neutron-hydrogen collisions that result in appreciable neutron moderation. Thus, relatively high hydrogen density (near the source) results in rapid neutron moderation. Hydrogen in geologic materials occurs as water, mineralogically bound H^+, organic soil components, and organic liquids (solvents, petroleum fuels). Water is nearly always the greatest source of hydrogen in soil. Therefore, as dry soil becomes wet, the thermalized neutron density near a neutron source and detector increases. The radius of influence for neutron moisture probes depends upon source strength, hydrogen density, soil density, and chemistry. Practical limits are from 6 to 24 inches from the point between probe source and detector. The cloud of thermalized neutrons is compact in wet and/or dense soil, and expanded in dry and/or loose soil (Jury et al. 1991).

A neutron probe consists of a compact americium (Am)-beryllium (Be) source and a thermal neutron detector that can be lowered into an access hole for readings at discrete footage intervals. The Am-Be source emits high-energy neutrons that collide with hydrogen nuclei (moisture) in the surrounding soil. Hydrogen nuclei substantially slow the neutrons, and thus the neutron counts by the detector are linearly increased with the amount of hydrogen in the soil. A California Pacific Nuclear (CPN) Model 503DR Hydroprobe containing a 50-millicuries Am-241:Be neutron source has been used to date for monitoring the shallow vadose zone.

The neutron moisture probe is increasingly being applied to address characterization and infiltration issues at environmental sites undergoing long-term care. Neutron moisture measurement was established in agriculture in the 1960s before environmental monitoring needs were identified (Kramer et al. 1992). Neutron moisture monitoring has become the industry standard for soil moisture measurement and its operation and data interpretation is well established. The technique's principal advantage is repeatability, precision, and long-term viability. The access-hole casings are not permanently installed, which allows for periodic calibration of the neutron probe.

The number and location of neutron probe access holes is guided by practical considerations and knowledge of vadose zone hydrologic processes. The number and location of shallow vadose zone neutron probe access holes was determined in consultation with the NMED HWB and the Oversight Bureau staff. Neutron moisture monitoring and data collection will follow field operating procedures (FOP) as outlined in SNL ER FOP 95-21, "Use of the CPN Model 503 Hydroprobe for Subsurface Moisture Measurement."

8.0 CONCLUSIONS

The EPA has established performance-based criteria for RCRA Subtitle C covers for hazardous and radioactive waste landfills, but allows for alternative designs based upon a demonstration that the alternative design, together with natural site conditions, prevents the future migration of hazardous constituents into the groundwater or surface water. The NMED, the lead regulatory agency, has adopted EPA's 40 CFR 264 regulations and likewise accepts alternative cover designs as long as the design meets the intent of the regulations.

In this report, Sandia has demonstrated that the MWL alternative cover meets the performance-based criteria in 1) minimizing infiltration of water through the cover; 2) minimizing maintenance and erosion; 3) promoting surface drainage; 4) accommodating subsidence; and 5) having a permeability equal to or less than the MWL subsurface soil.

Performance modeling indicates that a 3-foot-thick, vegetated soil cover is the most propitious design for the MWL. The vegetated soil cover is a simple, elegant, and effective design that takes advantage of TA-3 native soil and natural hydrological processes. The cover adequately protects groundwater resources under historical and projected future climatic conditions.

The 3-foot-thick, vegetated soil cover with a 1-foot-thick biointrusion barrier, integrated with natural site conditions, produces a "system" performance that will ensure that federal and state regulatory requirements and DOE Orders are met. Specifically, the vegetated soil cover will:

- Minimize water infiltration through the closure cover. The combined cover/subgrade with native vegetation will minimize water infiltration into waste disposal cells. Modeling data indicates that water does not migrate significantly past a 3-foot-thick layer of native soil.

- Function with minimum maintenance. Maintenance will be minimized by using a monolithic soil layer. Multi-layer, multi-component covers, such as those used in conventional designs, would require continuous maintenance and are more susceptible to failure.

- Promote drainage and minimize erosion of the cover surface. The cover will be centrally crowned and sloped at 2 percent to the edge of the side slopes which, in turn, tie into the surrounding landscape at a slope of 6:1. Native vegetation will minimize wind and water erosion while promoting water removal from the cover through evapotranspiration.

- Accommodate settling and subsidence so that the integrity of the cover is maintained. Subsidence will be accommodated using a "soft" design. During the cover's design life, soil can be added to the cover to correct subsidence and erosion as it occurs.

- Have a permeability less than or equal to the permeability of the MWL subsurface soil. The cover will be constructed with soil native to TA-3. Evaluation of the bathtub effect demonstrates that the permeability of the cover soil is equal to or less than that of the natural subsurface soil present.

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FIGURES

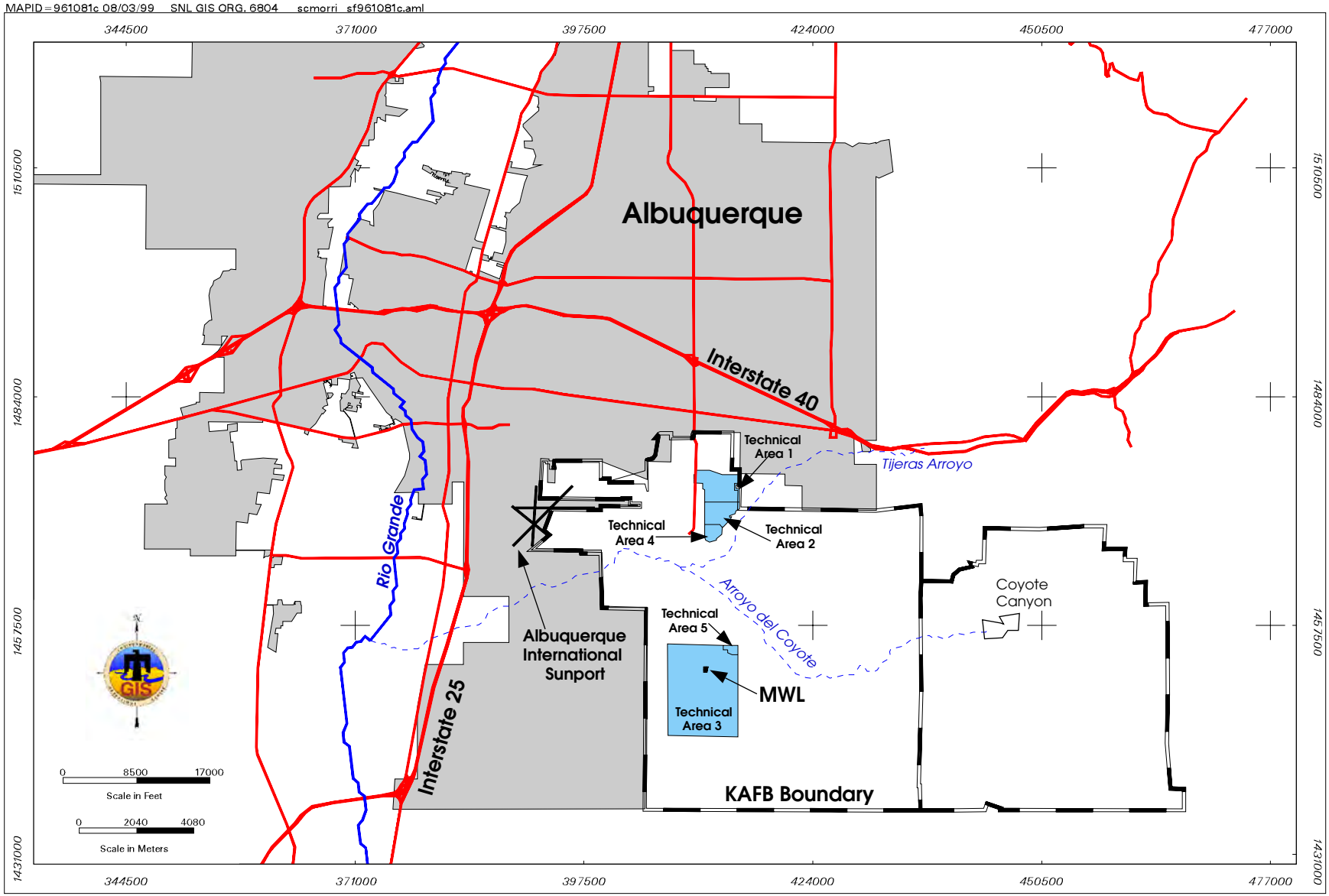

Figure 1-1 Location of Kirtland Air Force Base and Sandia National Laboratories, New Mexico

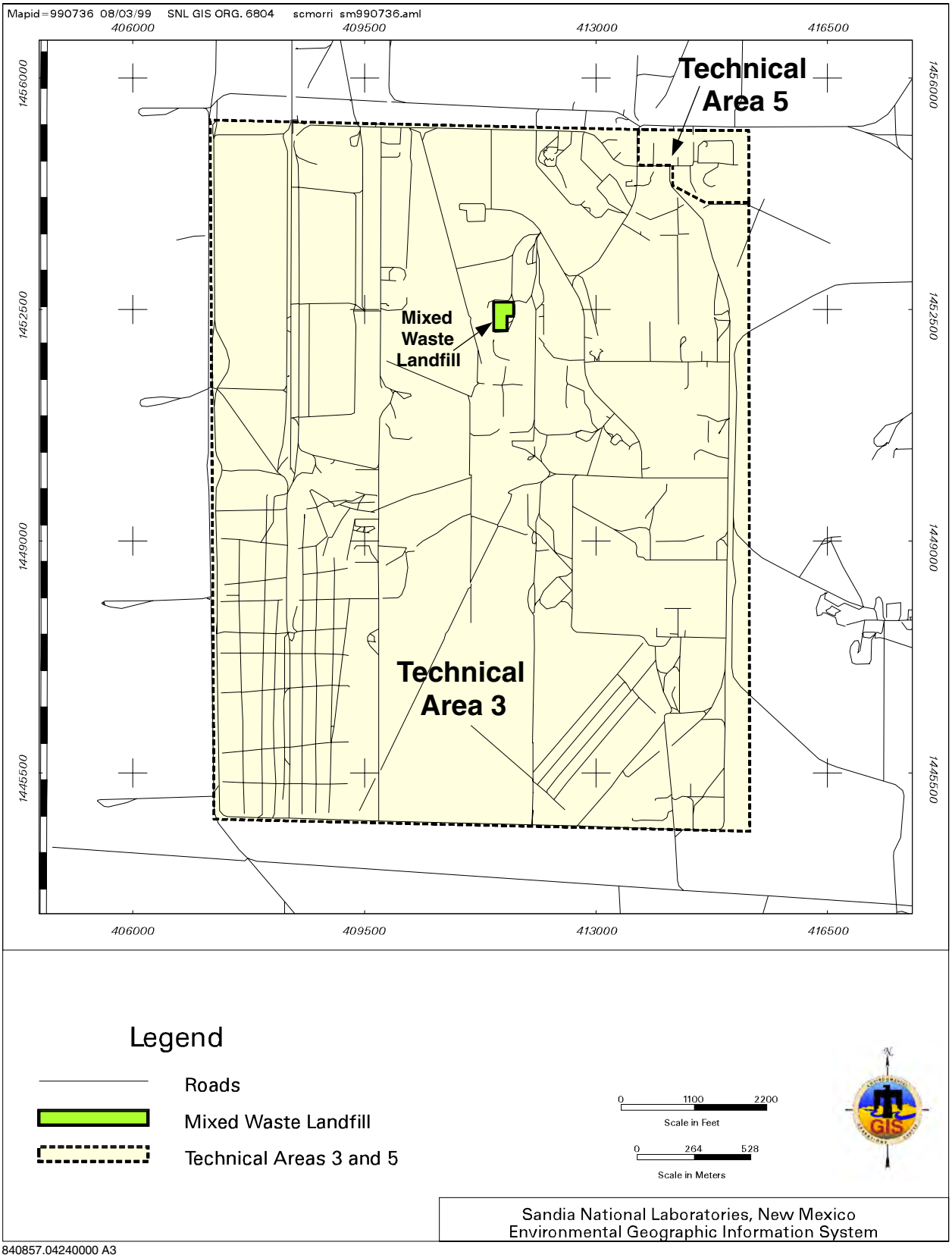

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Figure 1-2 Location of Technical Areas 3 and 5 and the Mixed Waste Landfill

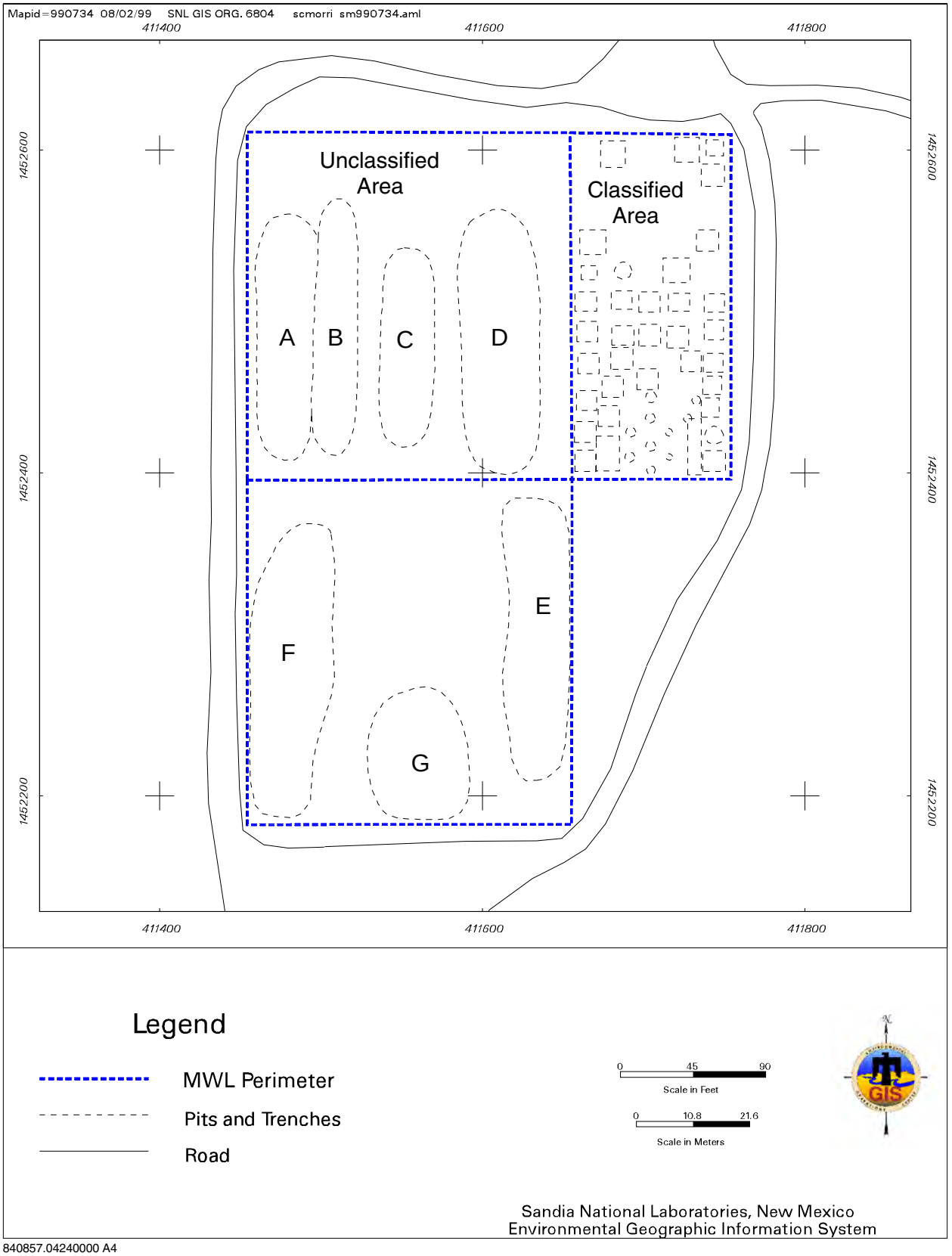

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Figure 1-3 Map of the Mixed Waste Landfill

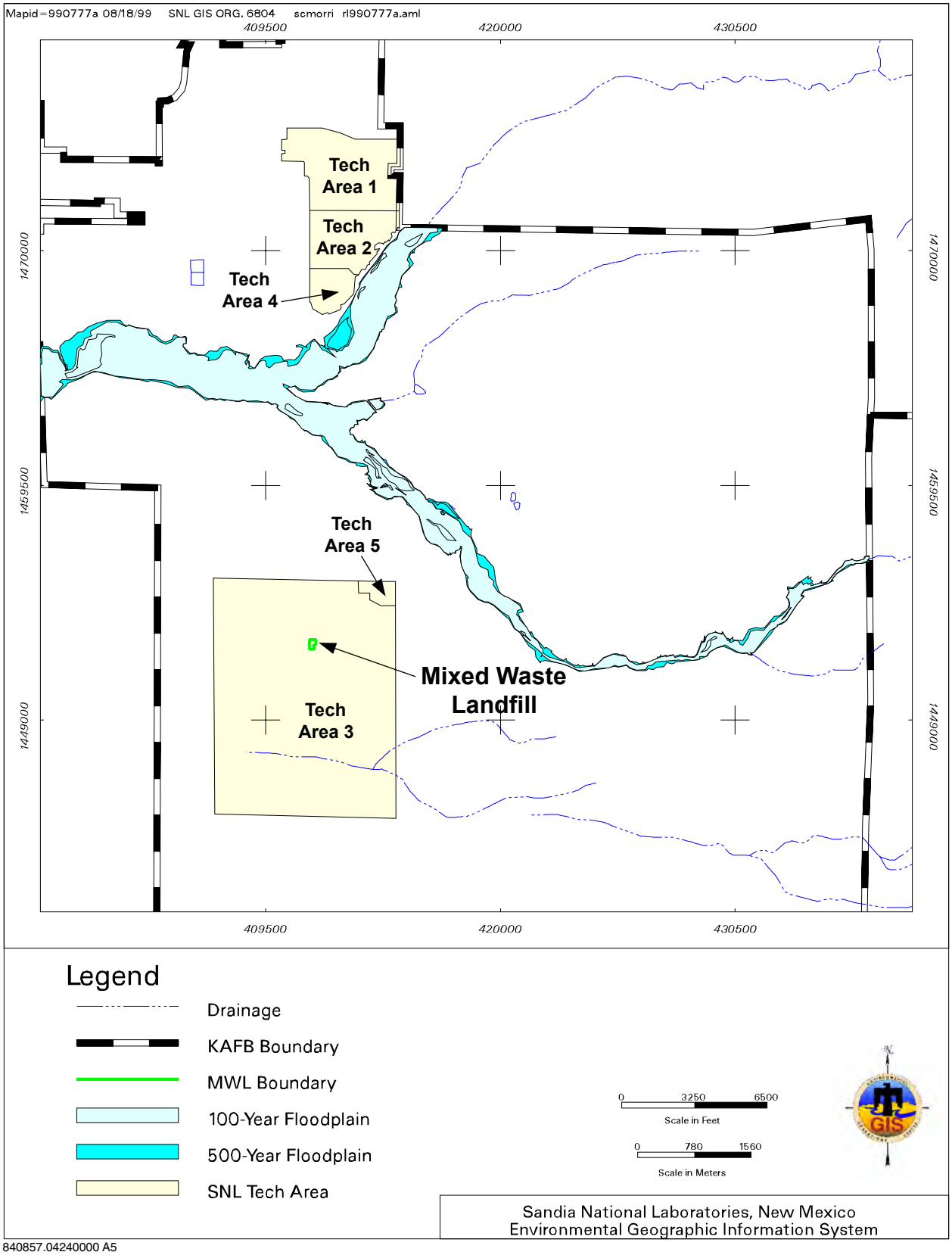

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Figure 2-1 Location of the 100–Year and 500–Year Floodplains at Kirtland Air Force Base

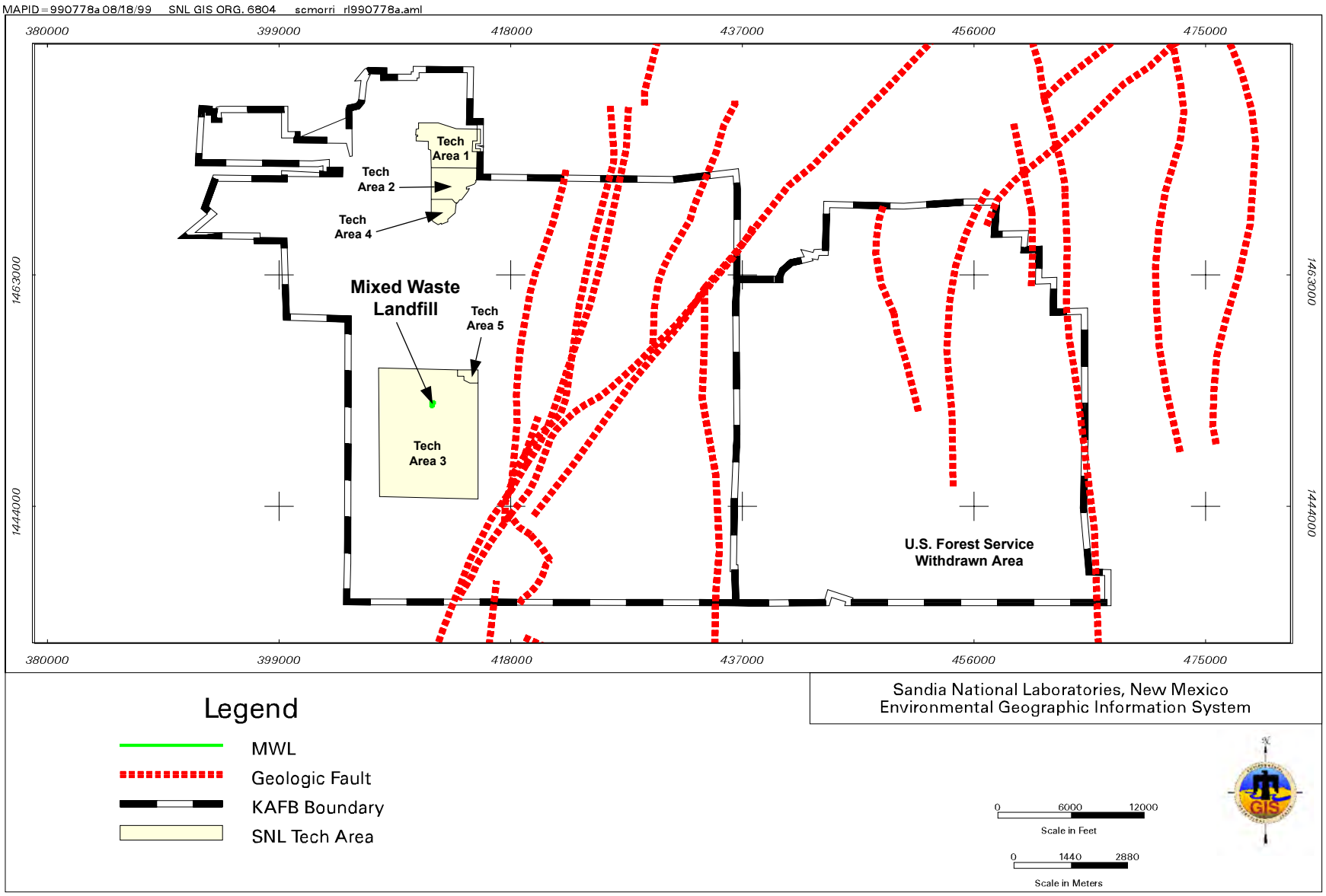

Figure 2-2 Location of Geologic Faults at Kirtland Air Force Base

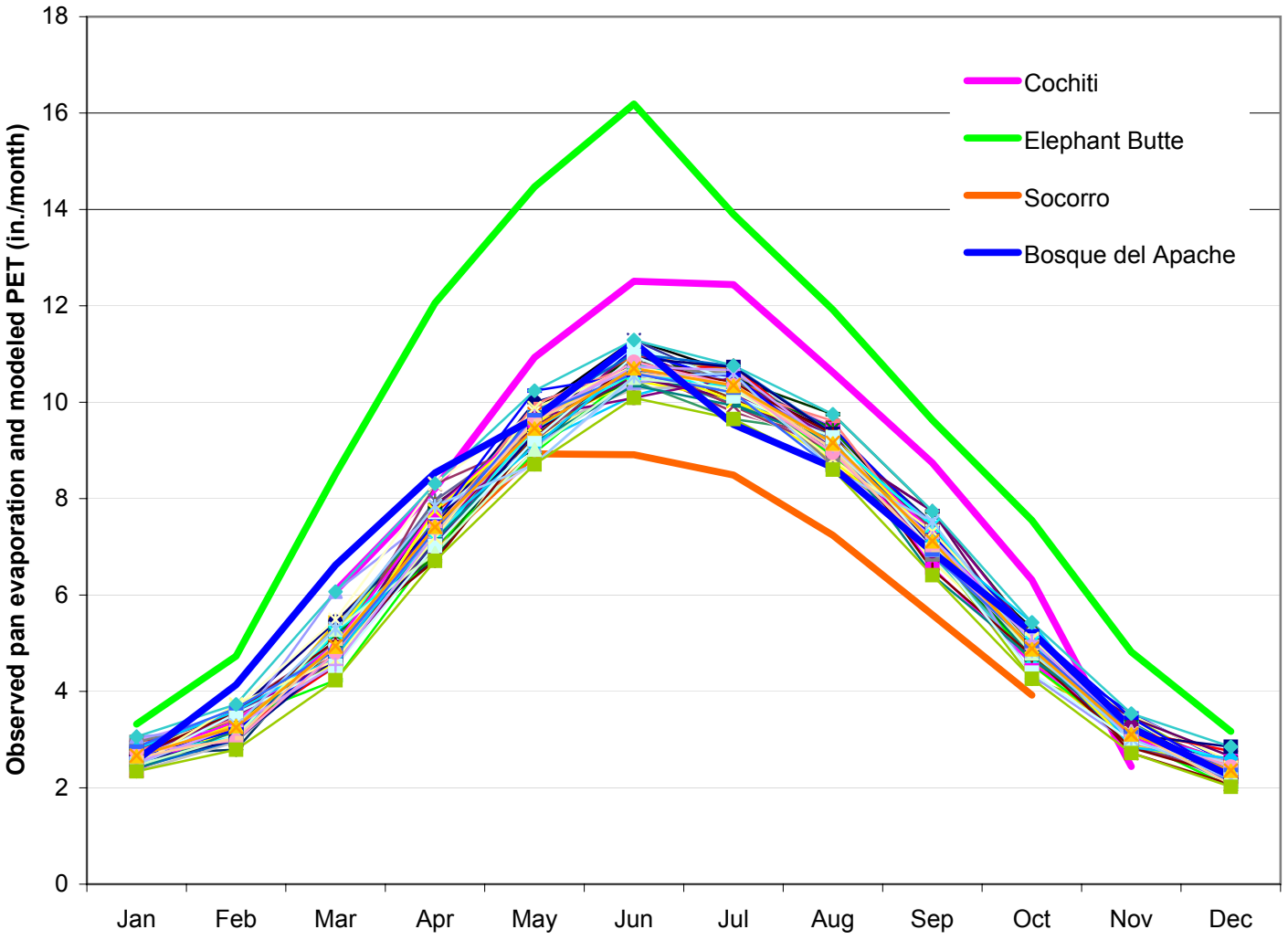

Figure 5-1 65 Years of Monthly PET Predicted by HELP-3 Shown with Average Monthly Pan Evaporation from Four National Weather Service Stations in New Mexico

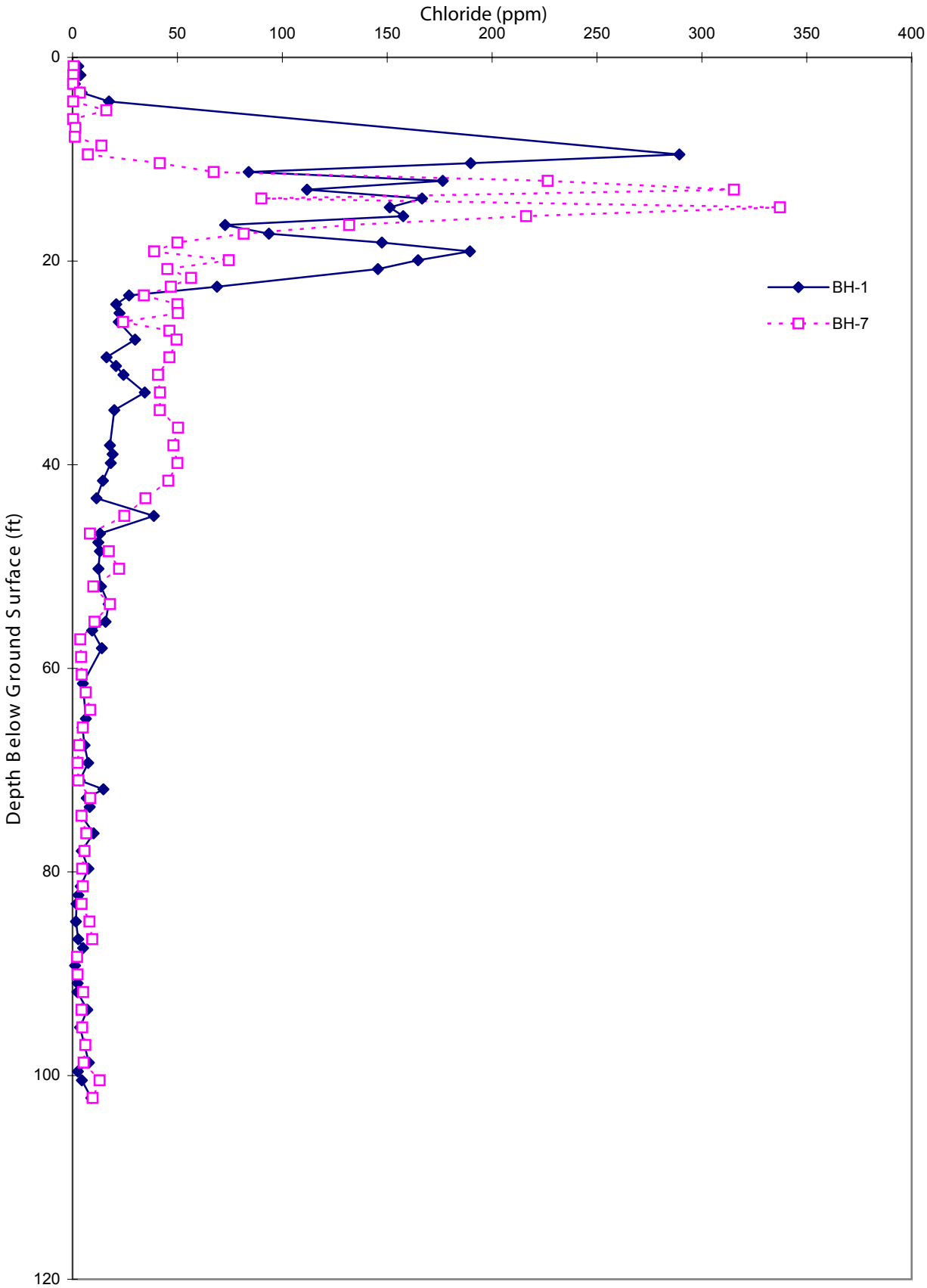

Figure 5-2 Chloride Concentration Profiles in Subsurface Soil at the Mixed Waste Landfill

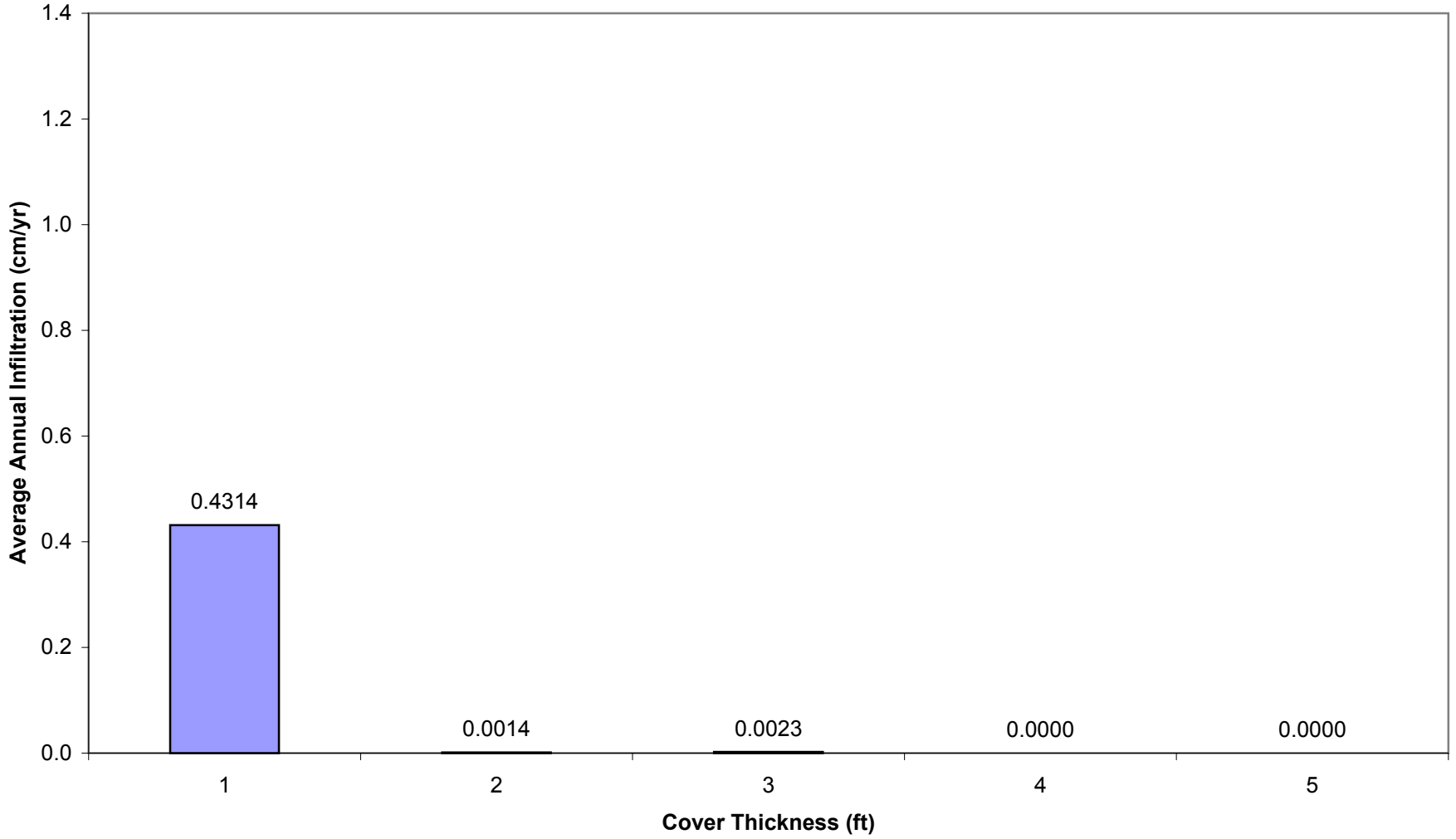

Figure 5-3 Average Annual Infiltration Predicted by HELP-3 Using Historical Precipitation Data

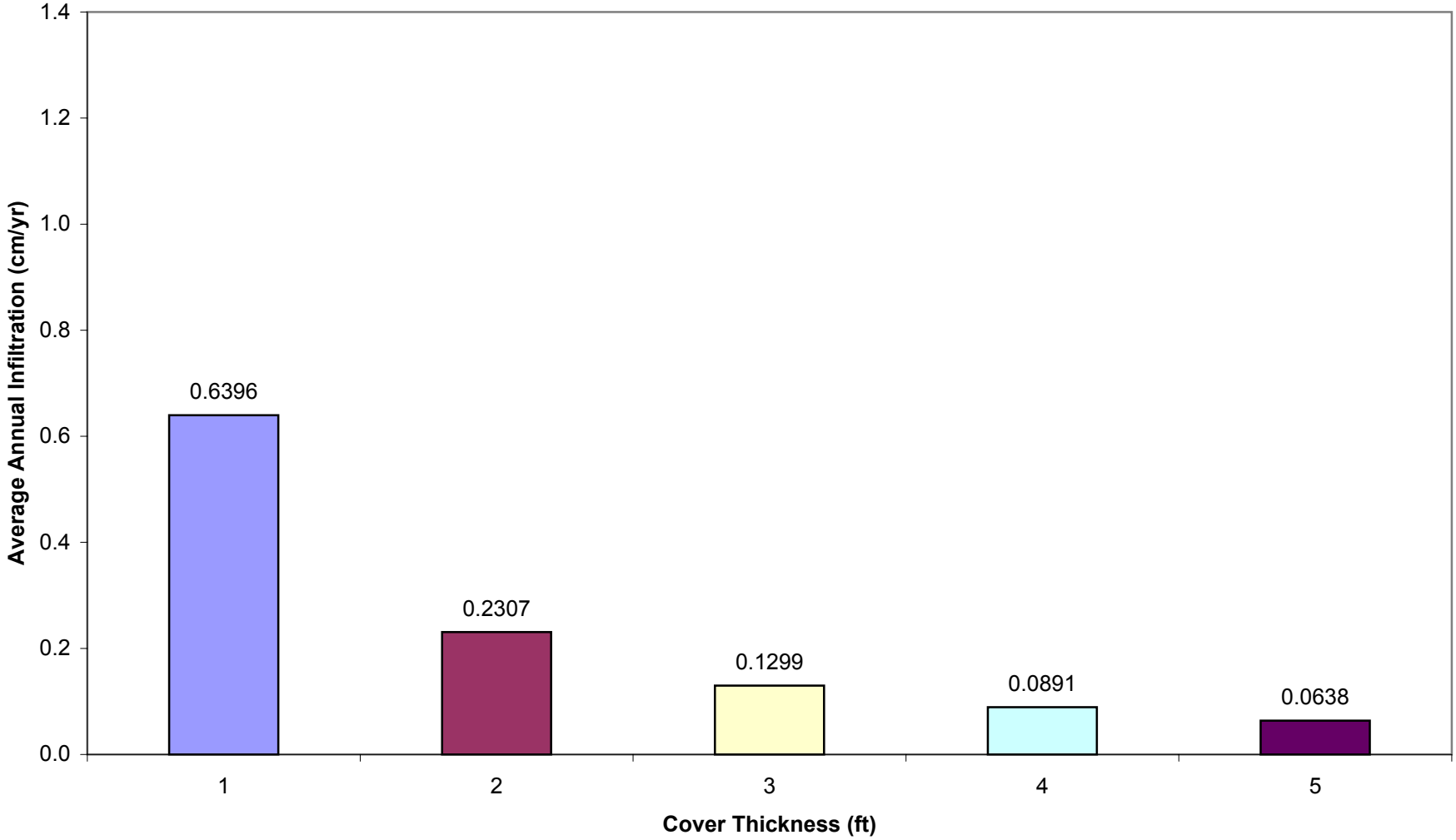

Figure 5-4 Average Annual Infiltration Predicted by UNSAT-H Using Historical Preciptiation Data

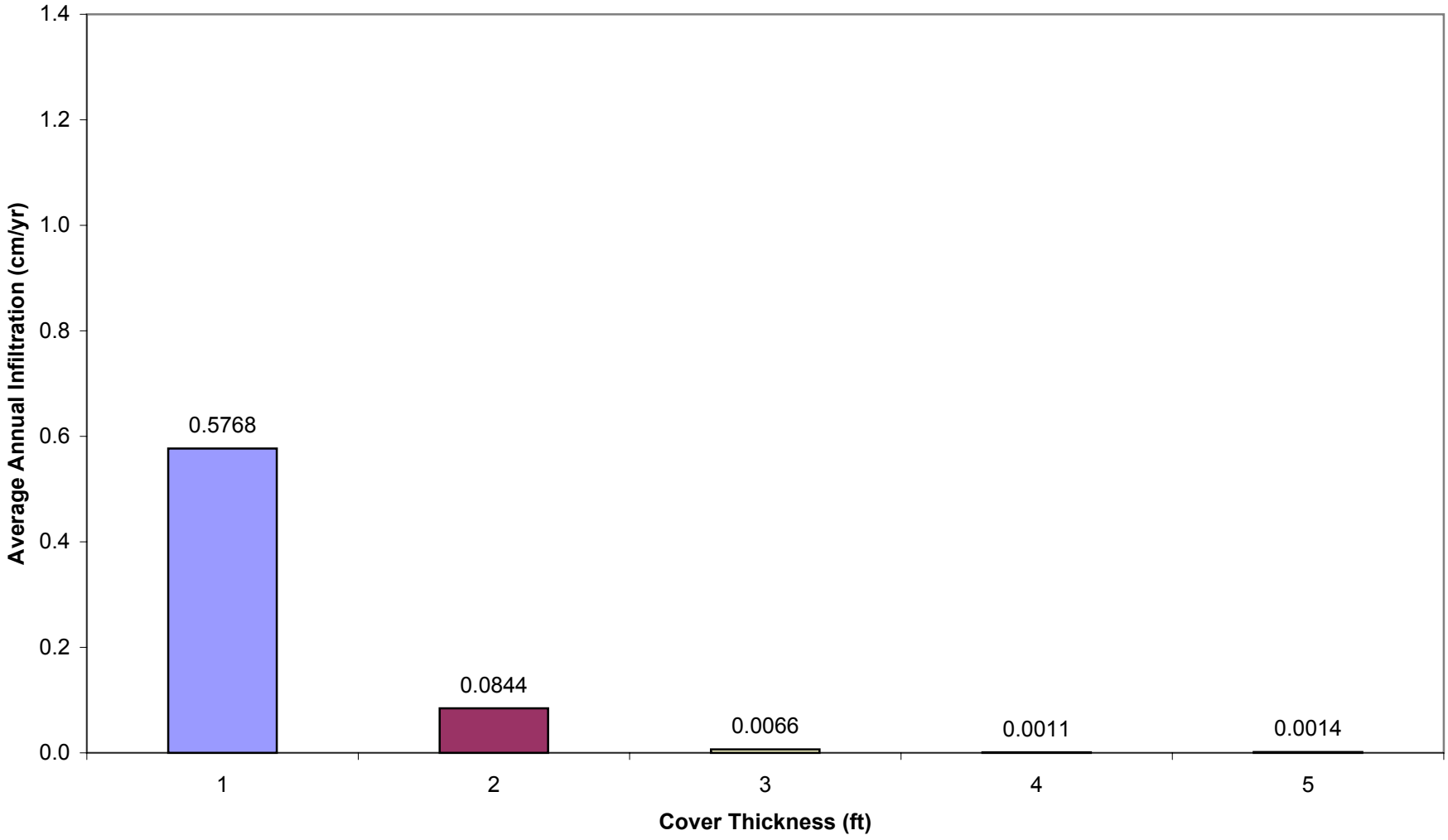

Figure 5-5 Average Annual Infiltration Predicted by VS2DT Using Historical Precipitation Data

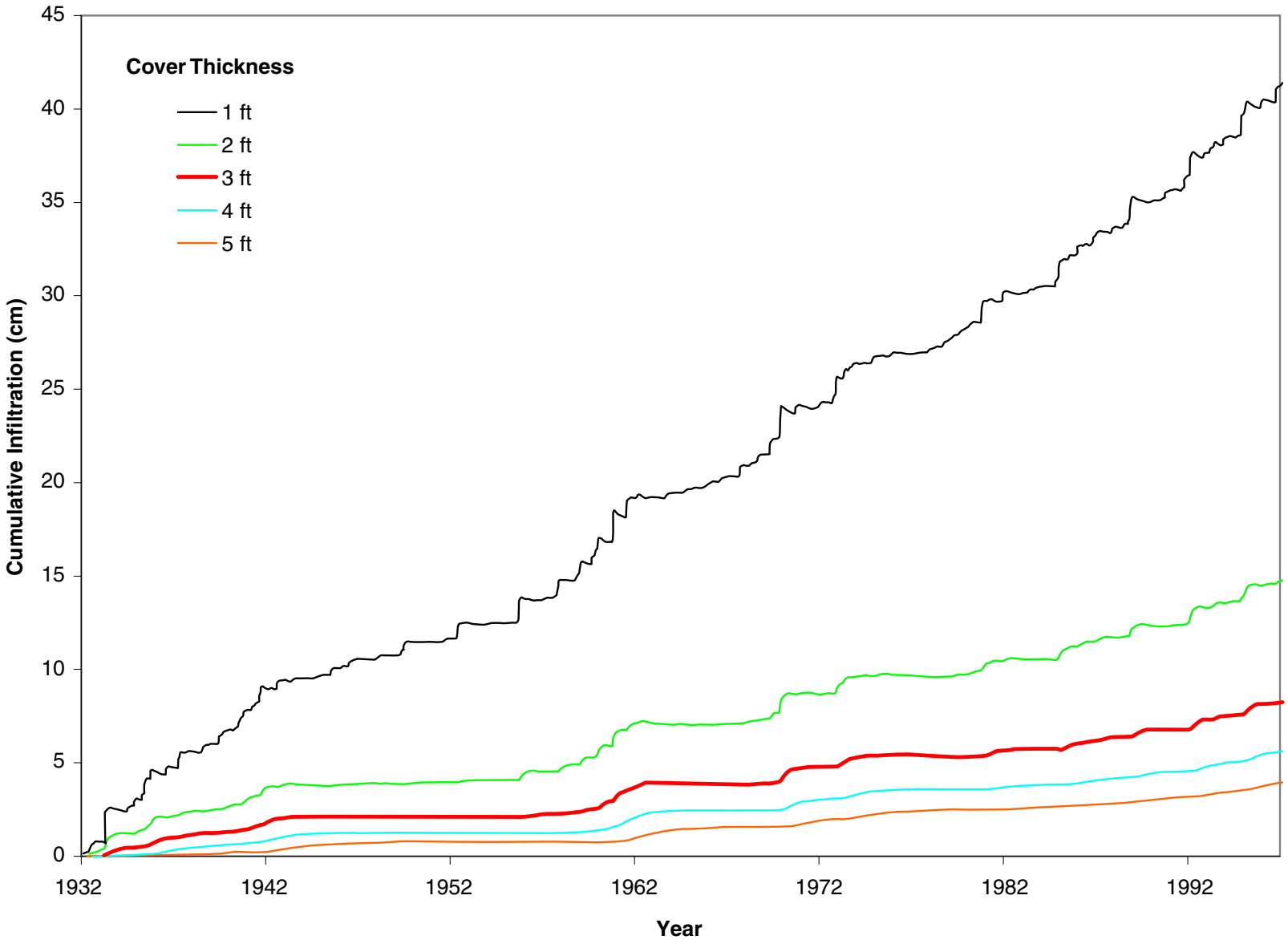

Figure 5-6 Cumulative Infiltration Predicted by UNSAT-H Using Historical Precipitation Data

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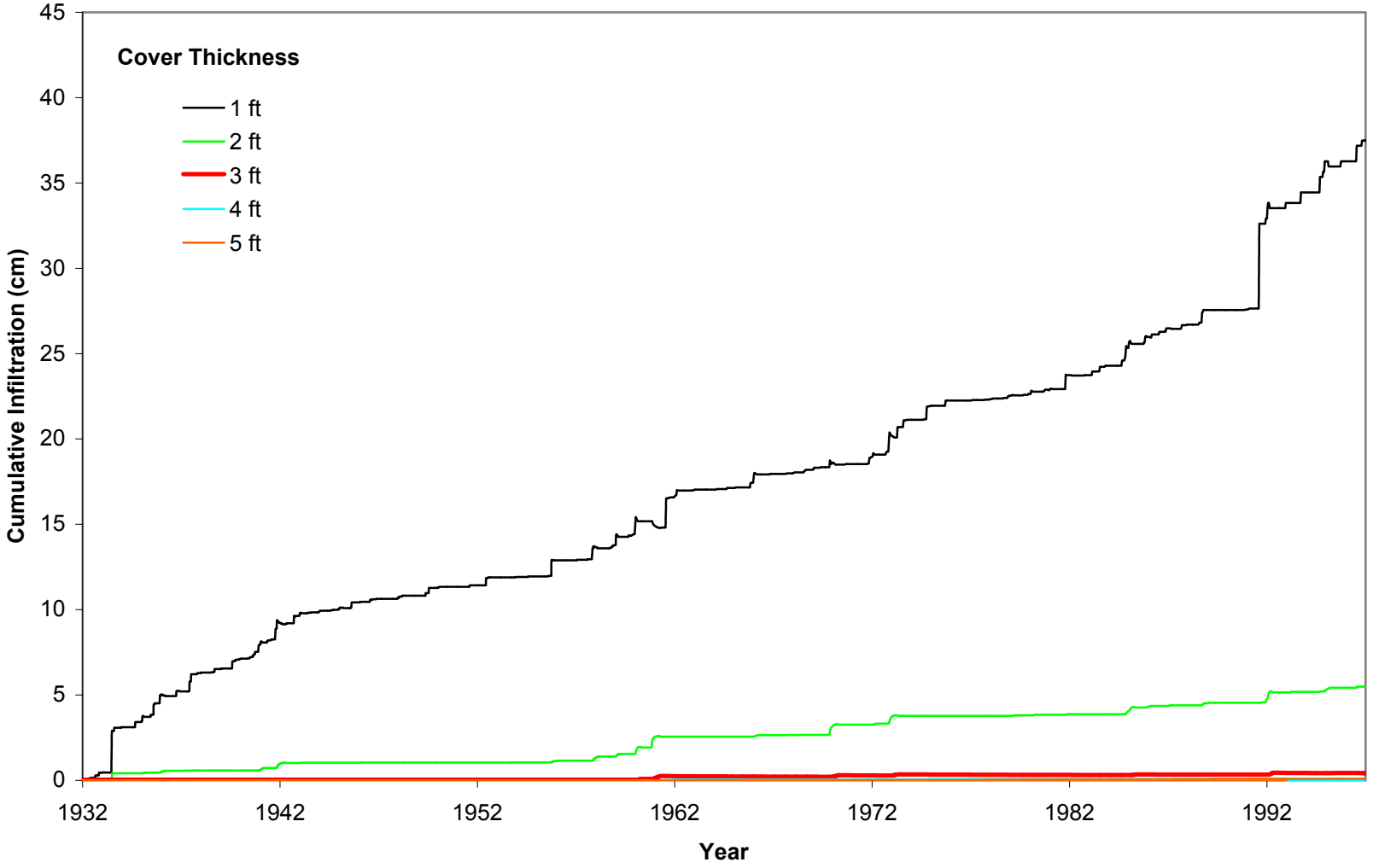

Figure 5-7 Cumulative Infiltration Predicted by VS2DT Using Historical Precipitation Data

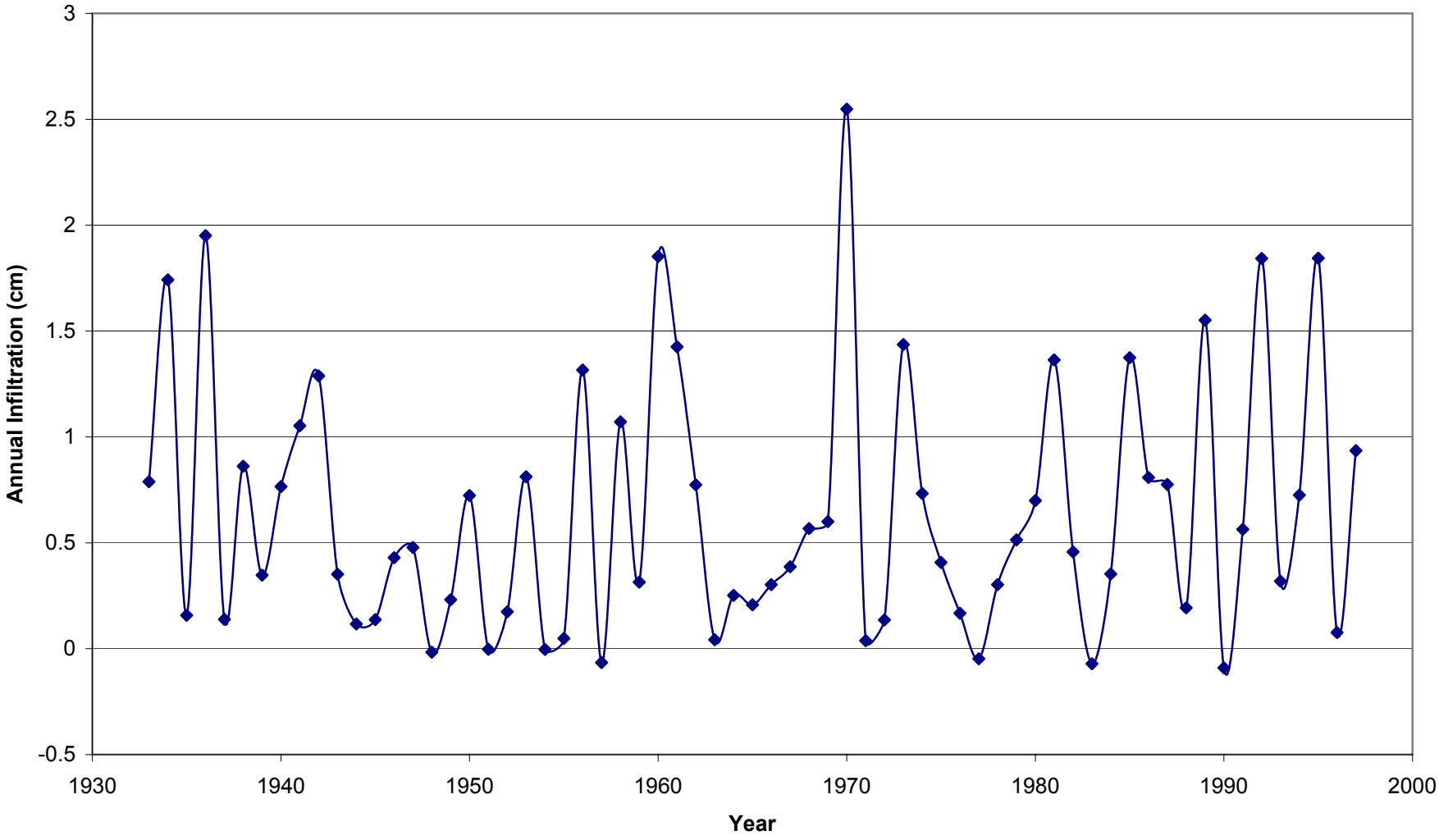

Figure 5-8 Annual Infiltration Through a 1-Ft Cover Predicted by UNSAT-H Using Historical Precipitation Data

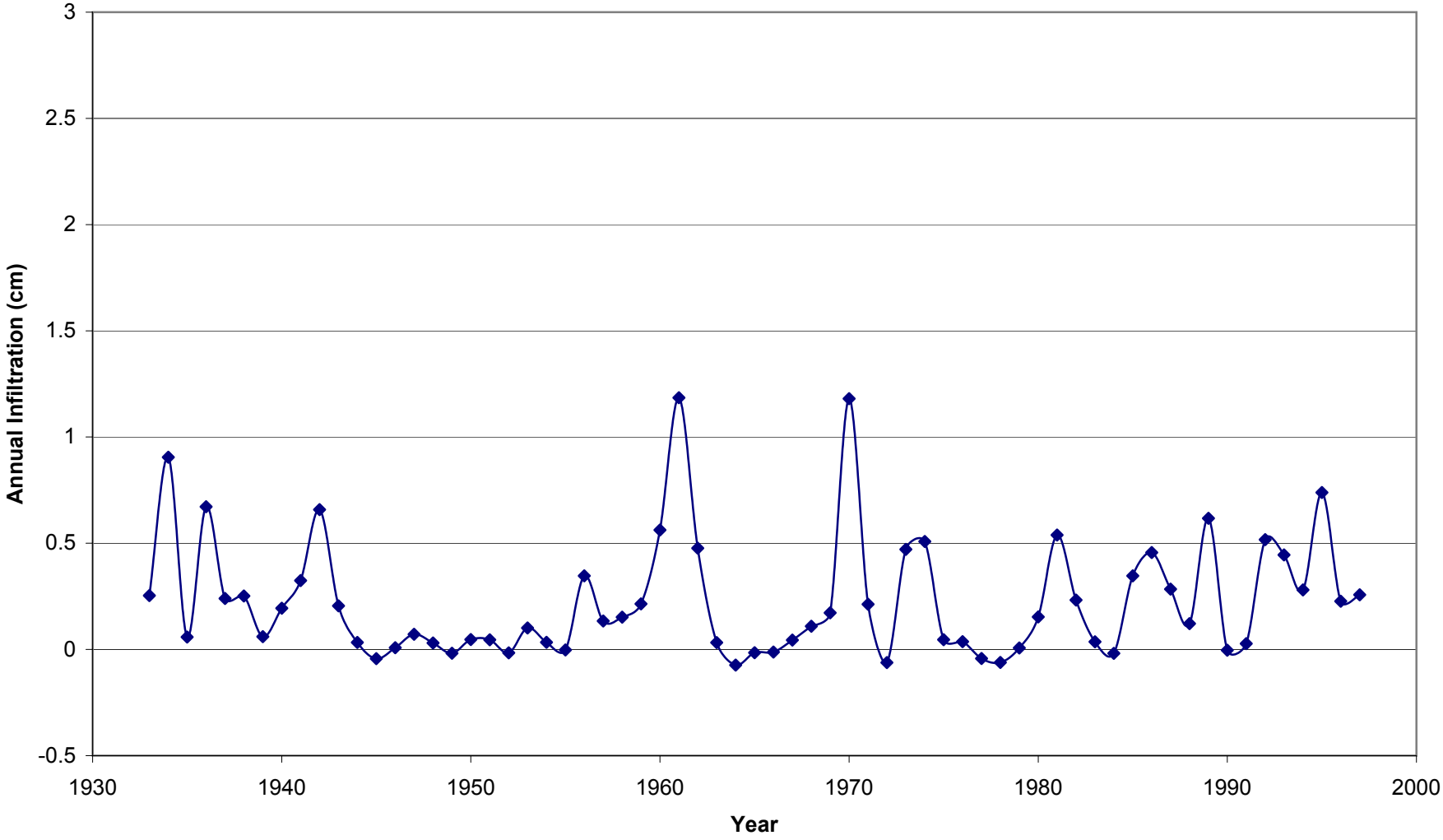

Figure 5-9 Annual Infiltration Through a 2-Ft Cover Predicted by UNSAT-H Using Historical Precipitation Data

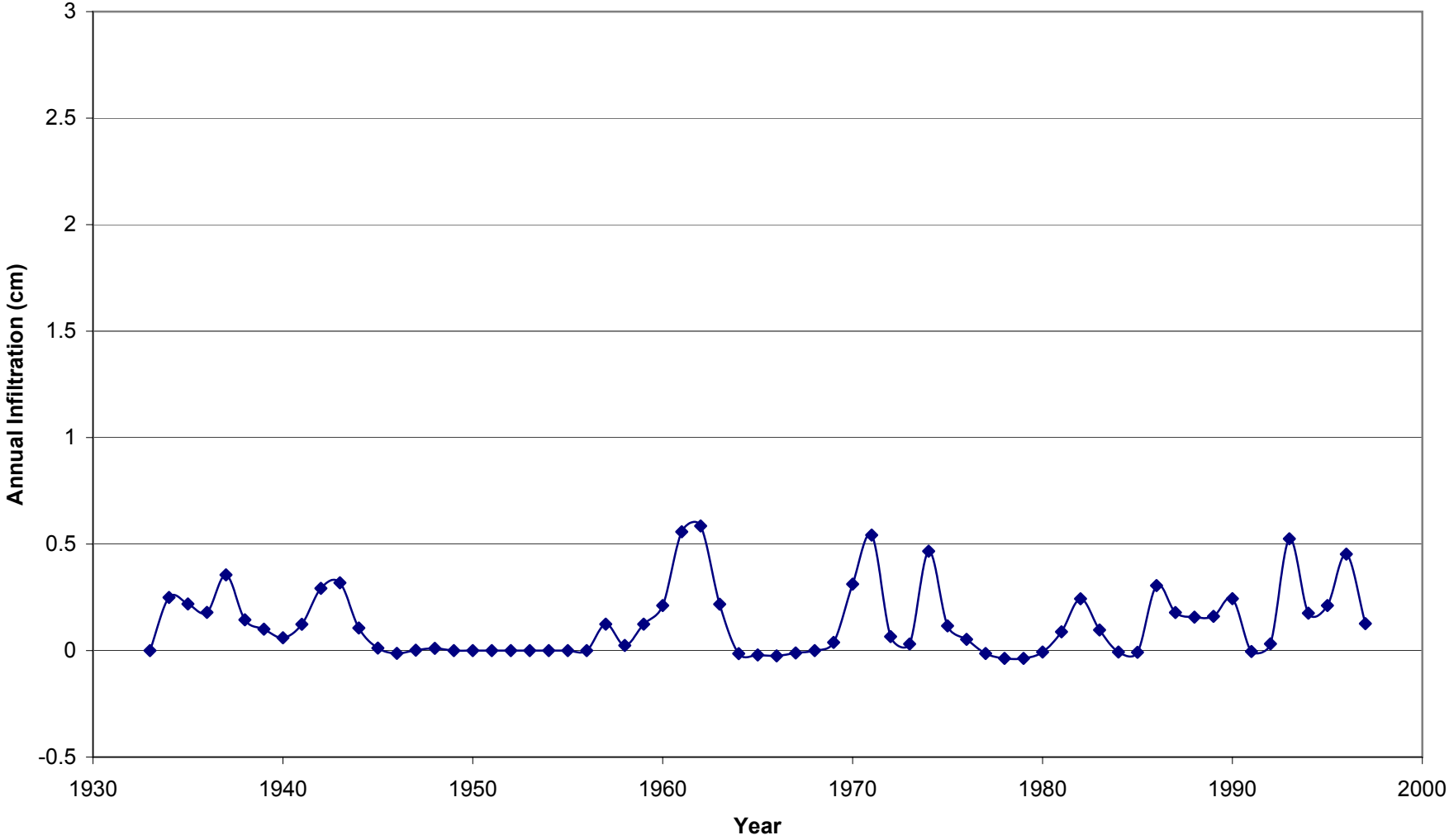

Figure 5-10 Annual Infiltration Through a 3-Ft Cover Predicted by UNSAT-H Using Historical Precipitation Data

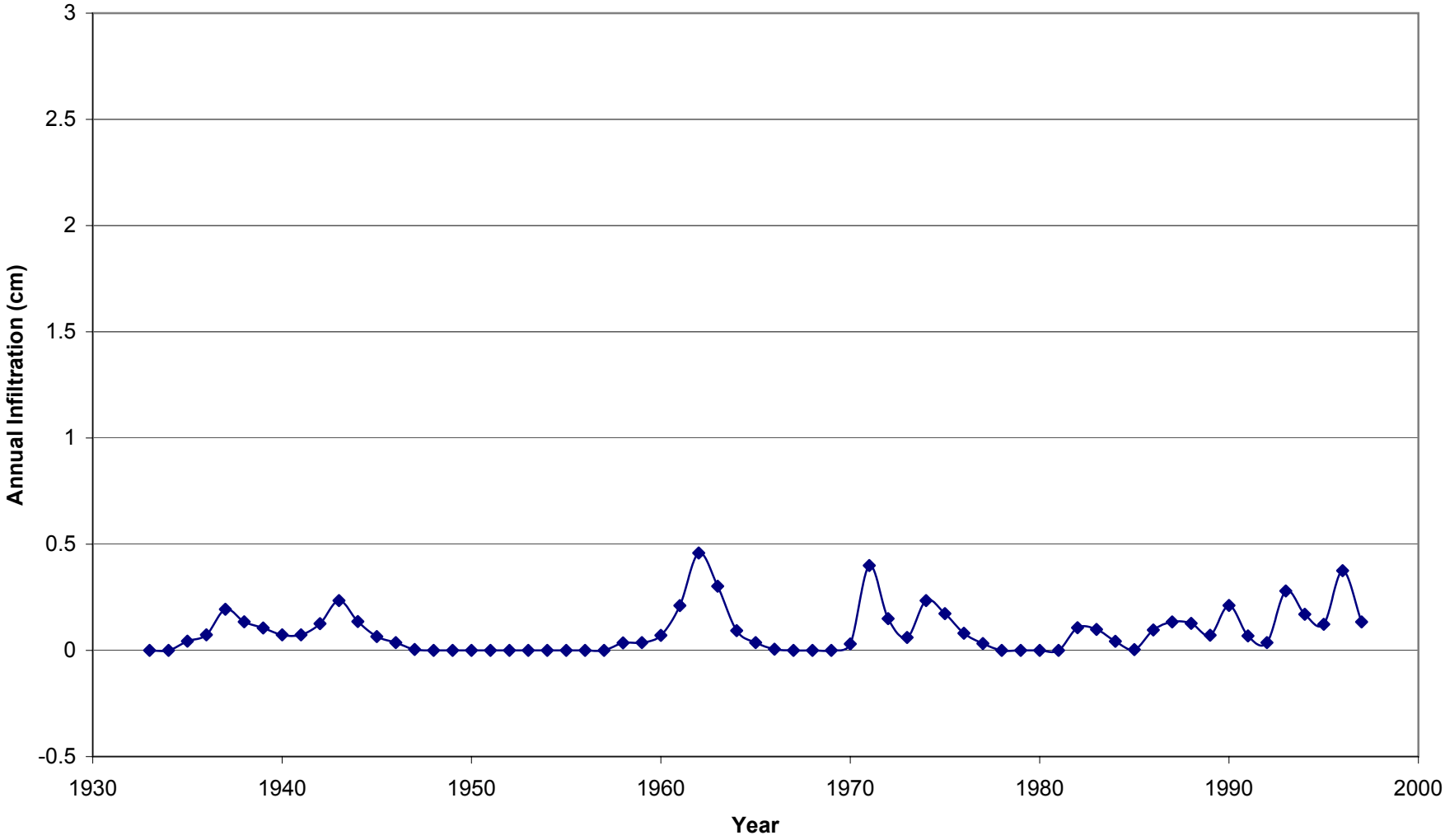

Figure 5-11 Annual Infiltration Through a 4-Ft Cover Predicted by UNSAT-H Using Historical Precipitation Data

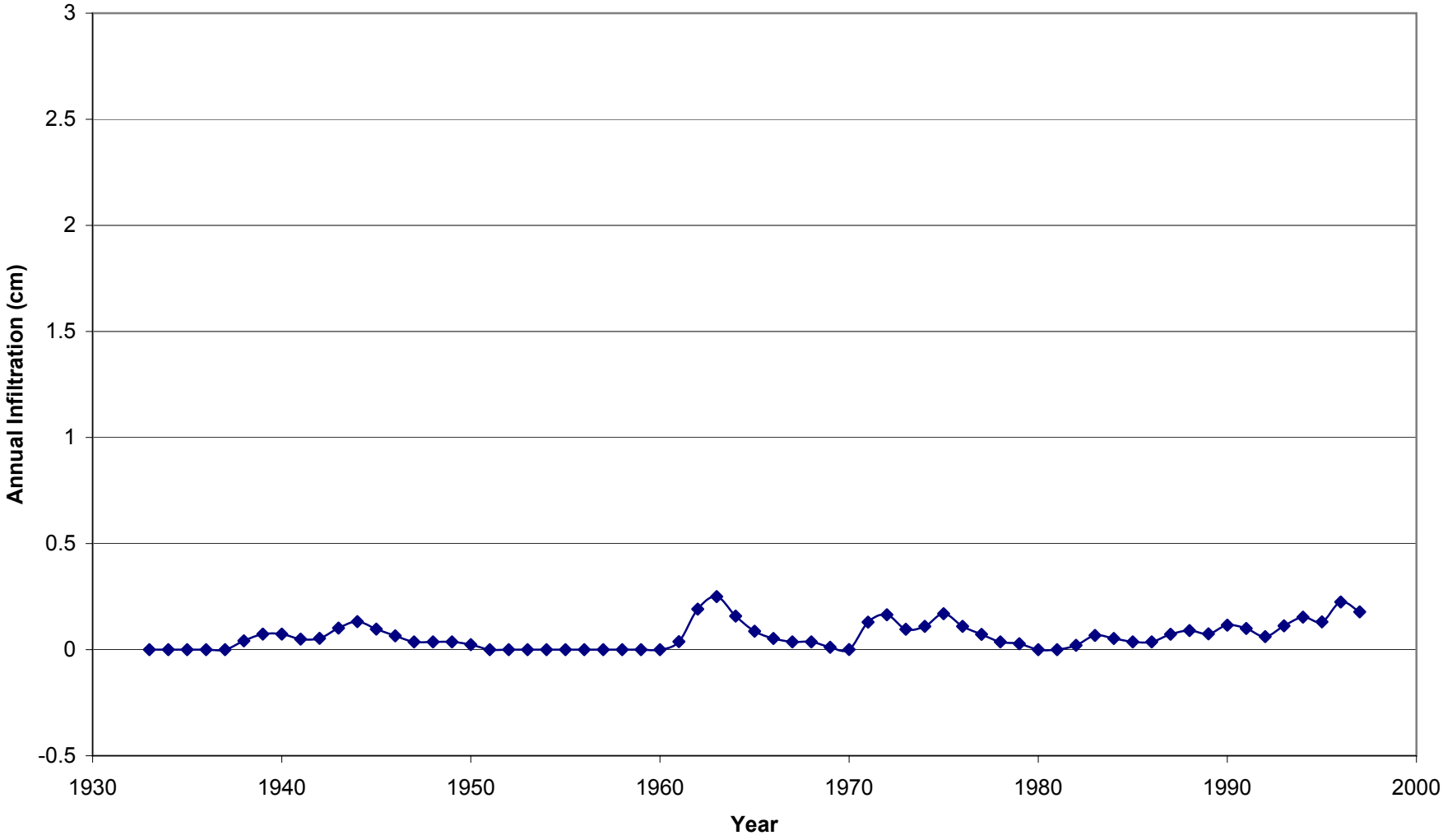

Figure 5-12 Annual Infiltration Through a 5-Ft Cover Predicted by UNSAT-H Using Historical Precipitation Data

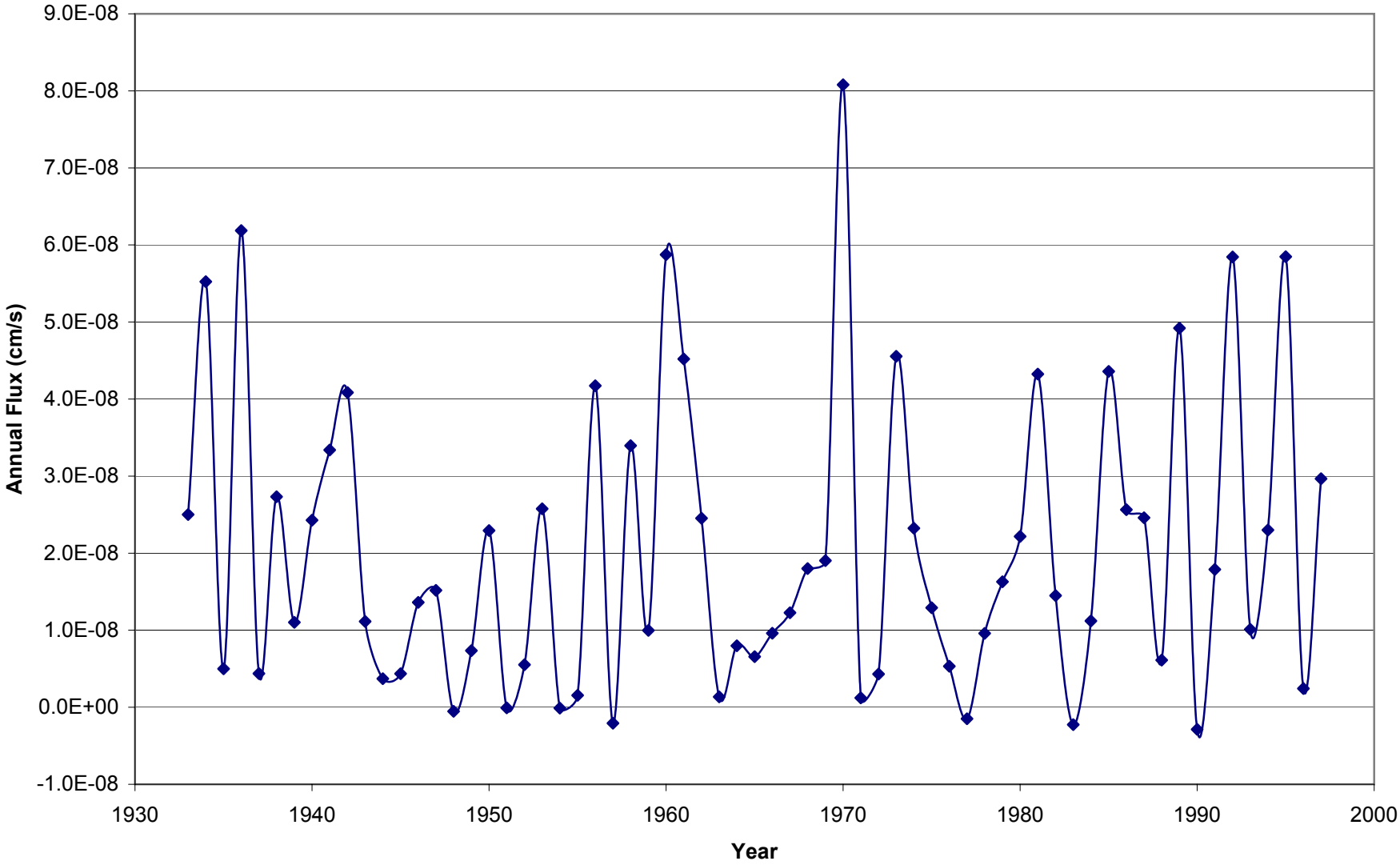

Figure 5-13 Annual Flux Through a 1-Ft Cover Predicted by UNSAT-H Using Historical Precipitation Data

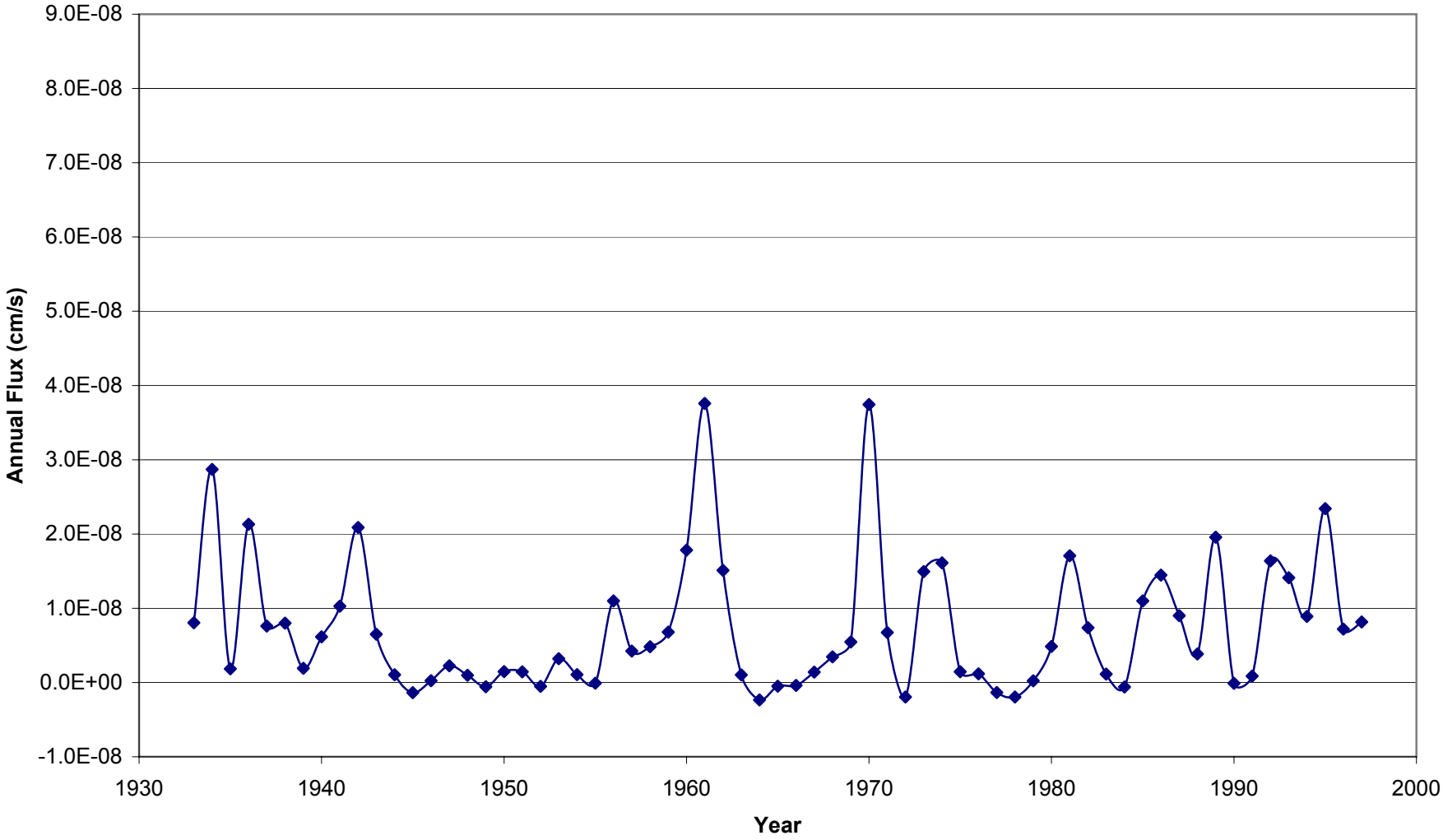

Figure 5-14 Annual Flux Through a 2-Ft Cover Predicted by UNSAT-H Using Historical Precipitation Data

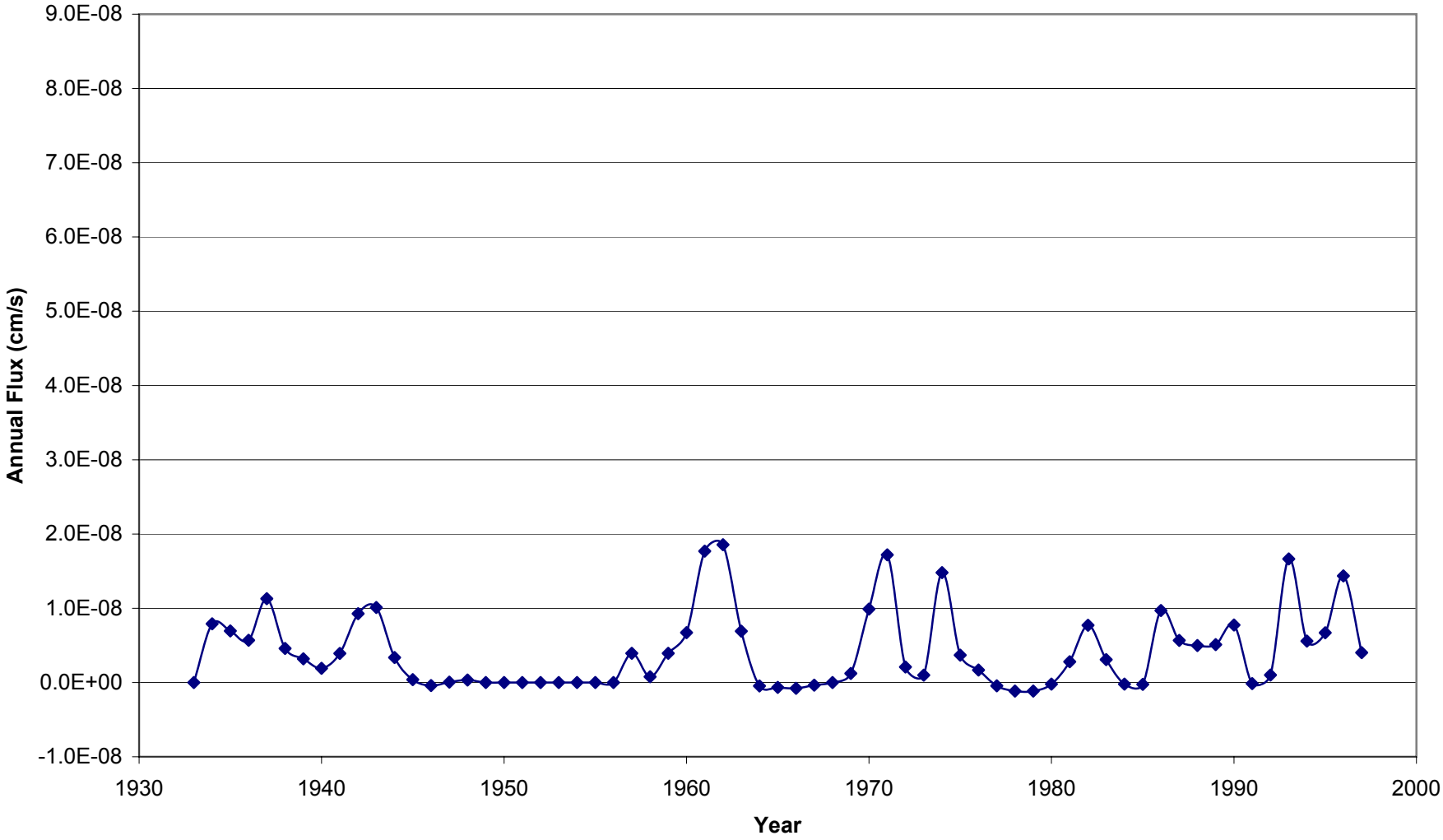

Figure 5-15 Annual Flux Through a 3-Ft Cover Predicted by UNSAT-H Using Historical Precipitation Data

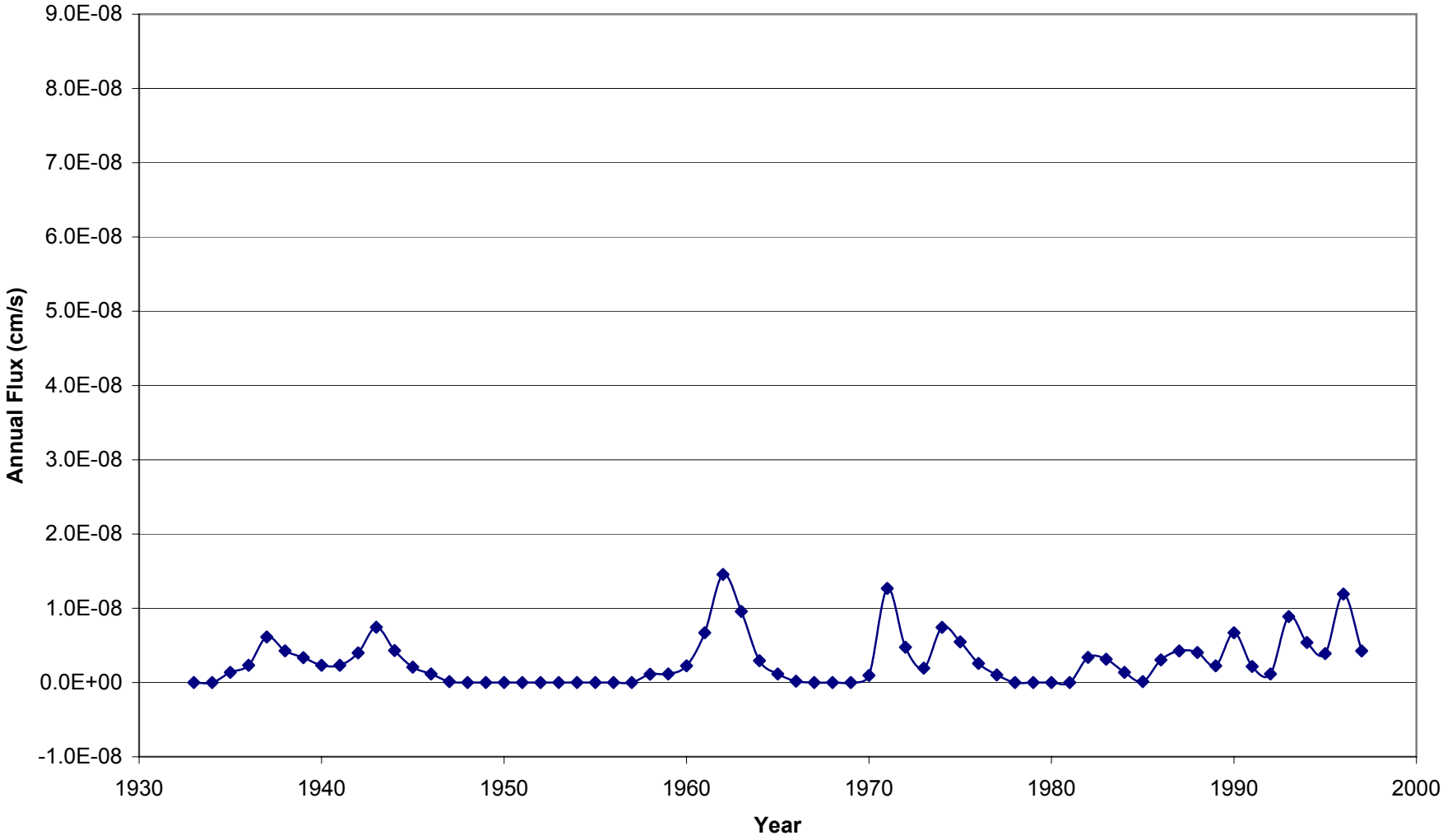

Figure 5-16 Annual Flux Through a 4-Ft Cover Predicted by UNSAT-H Using Historical Precipitation Data

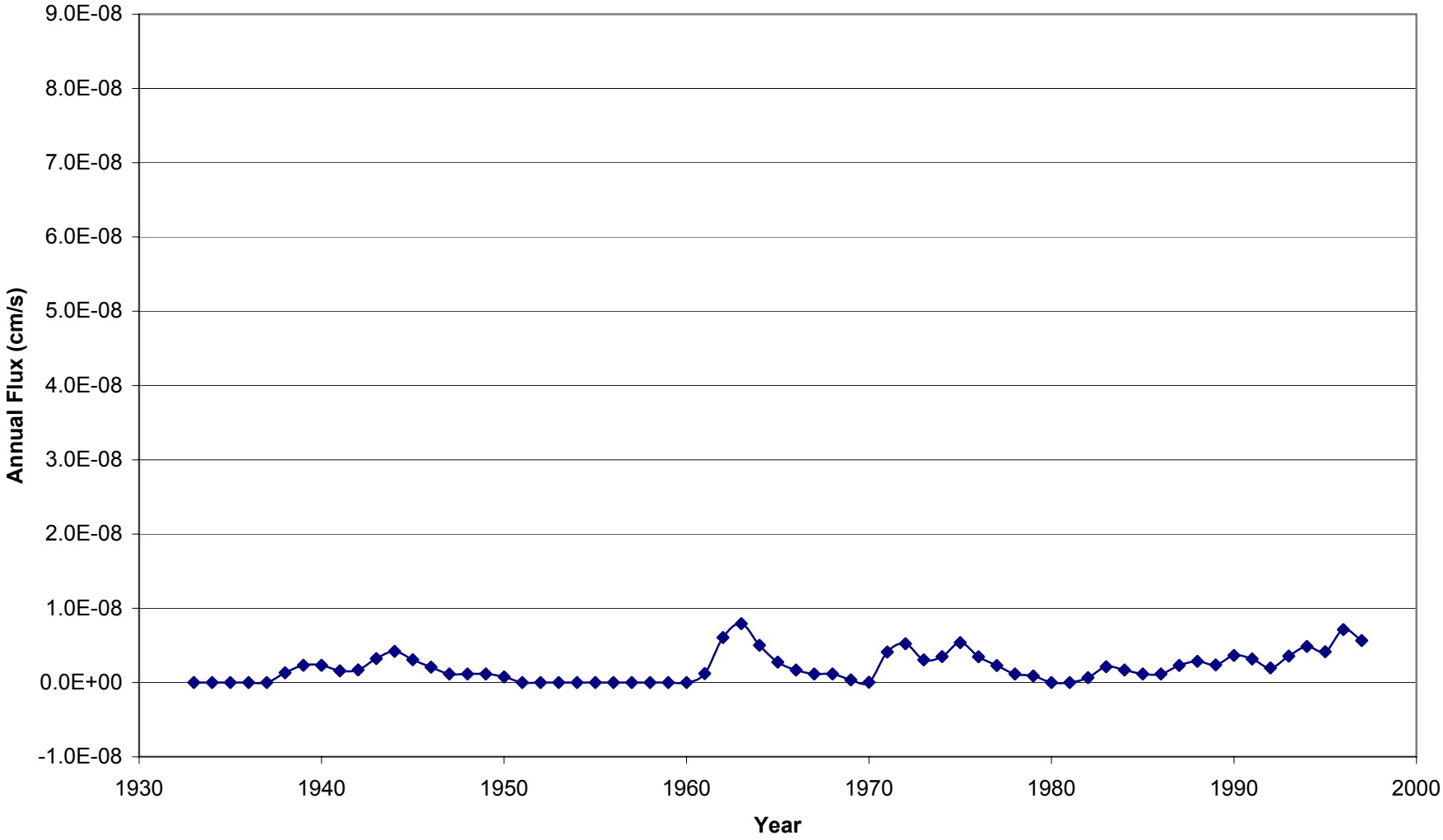

Figure 5-17 Annual Flux Through a 5-Ft Cover Predicted by UNSAT-H Using Historical Precipitation Data

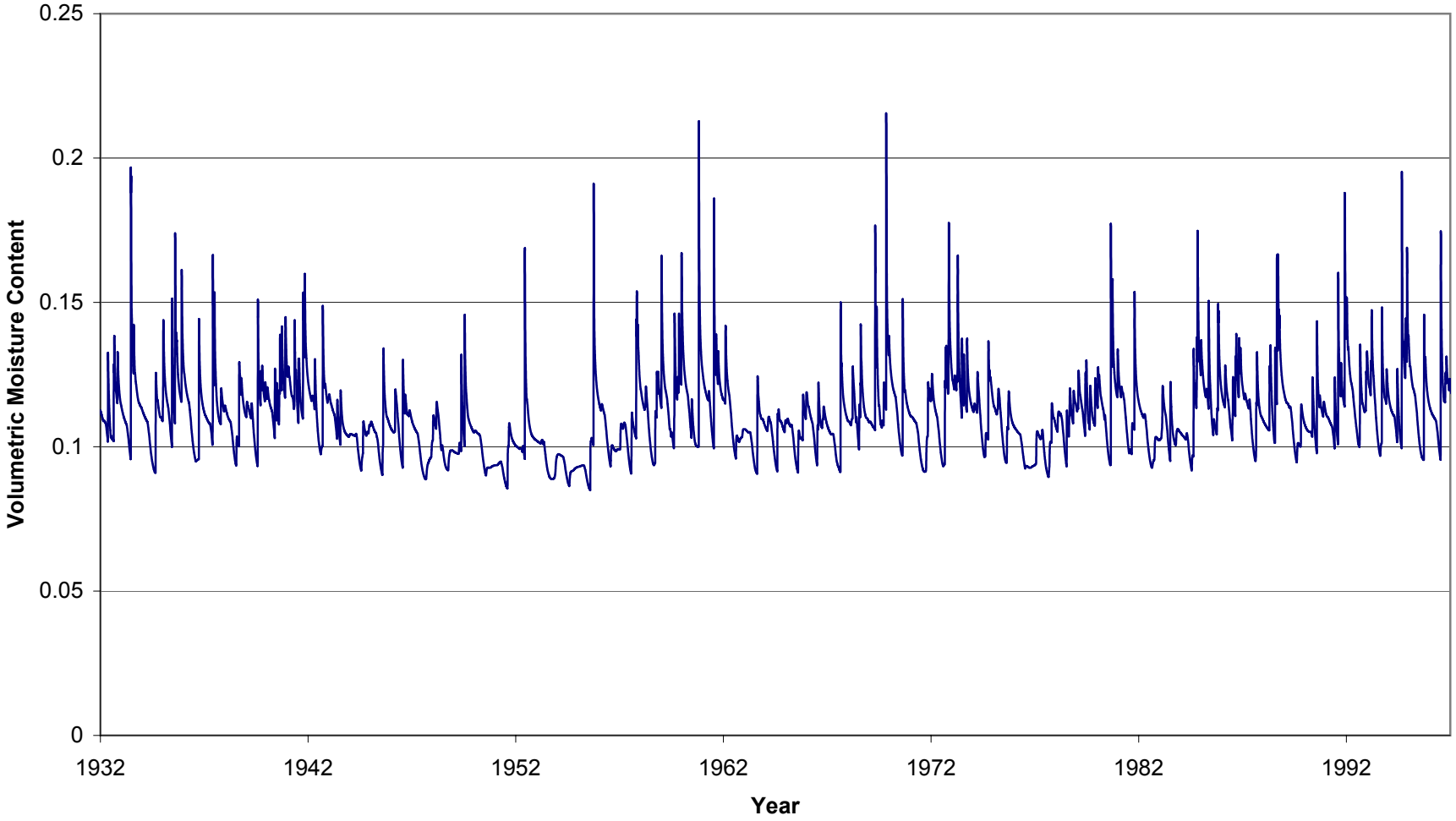

Figure 5-18 Moisture Content at 1-Ft Depth Predicted by UNSAT-H Using Historical Precipitation Data

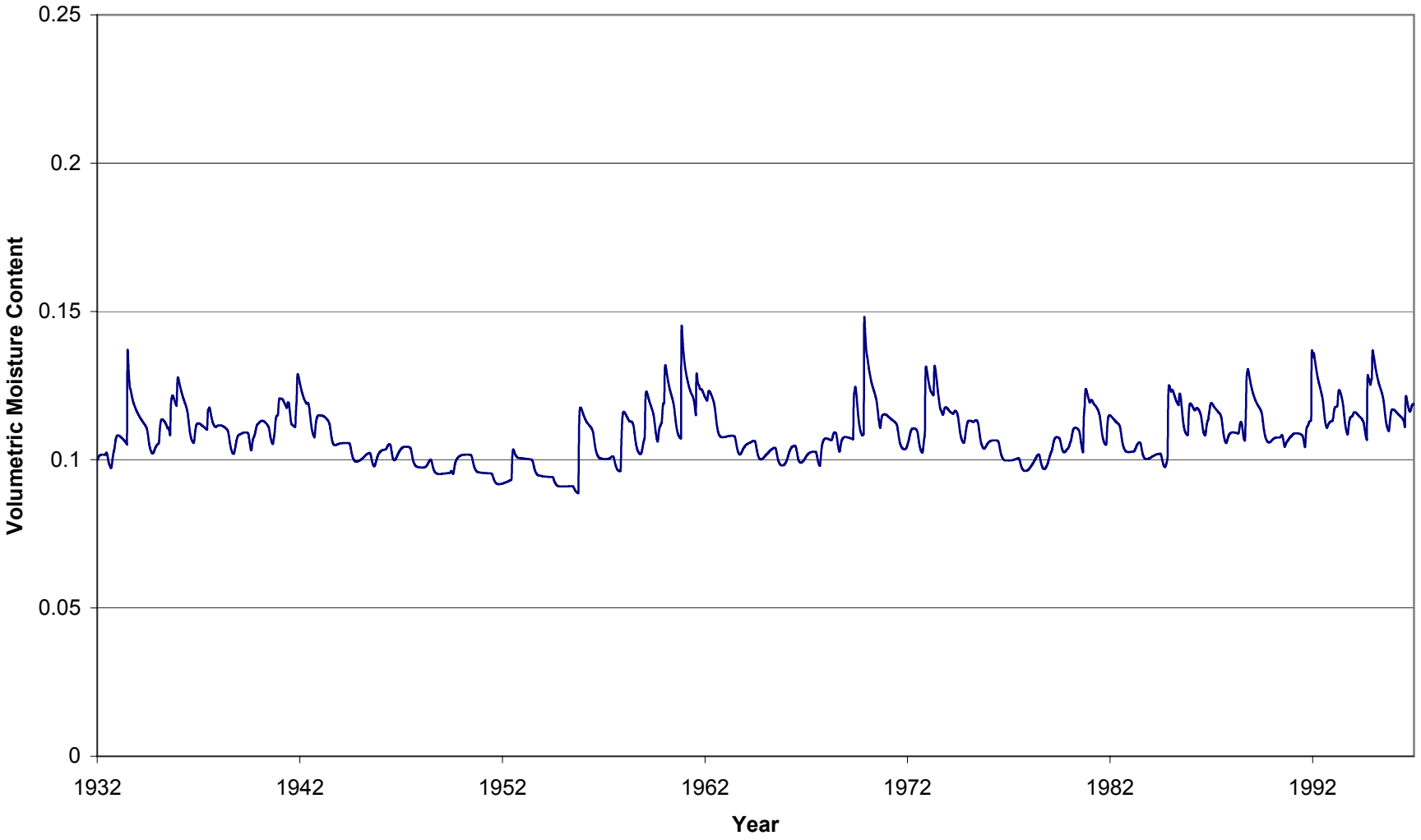

Figure 5-19 Moisture Content at 2-Ft Depth Predicted by UNSAT-H Using Historical Precipitation Data

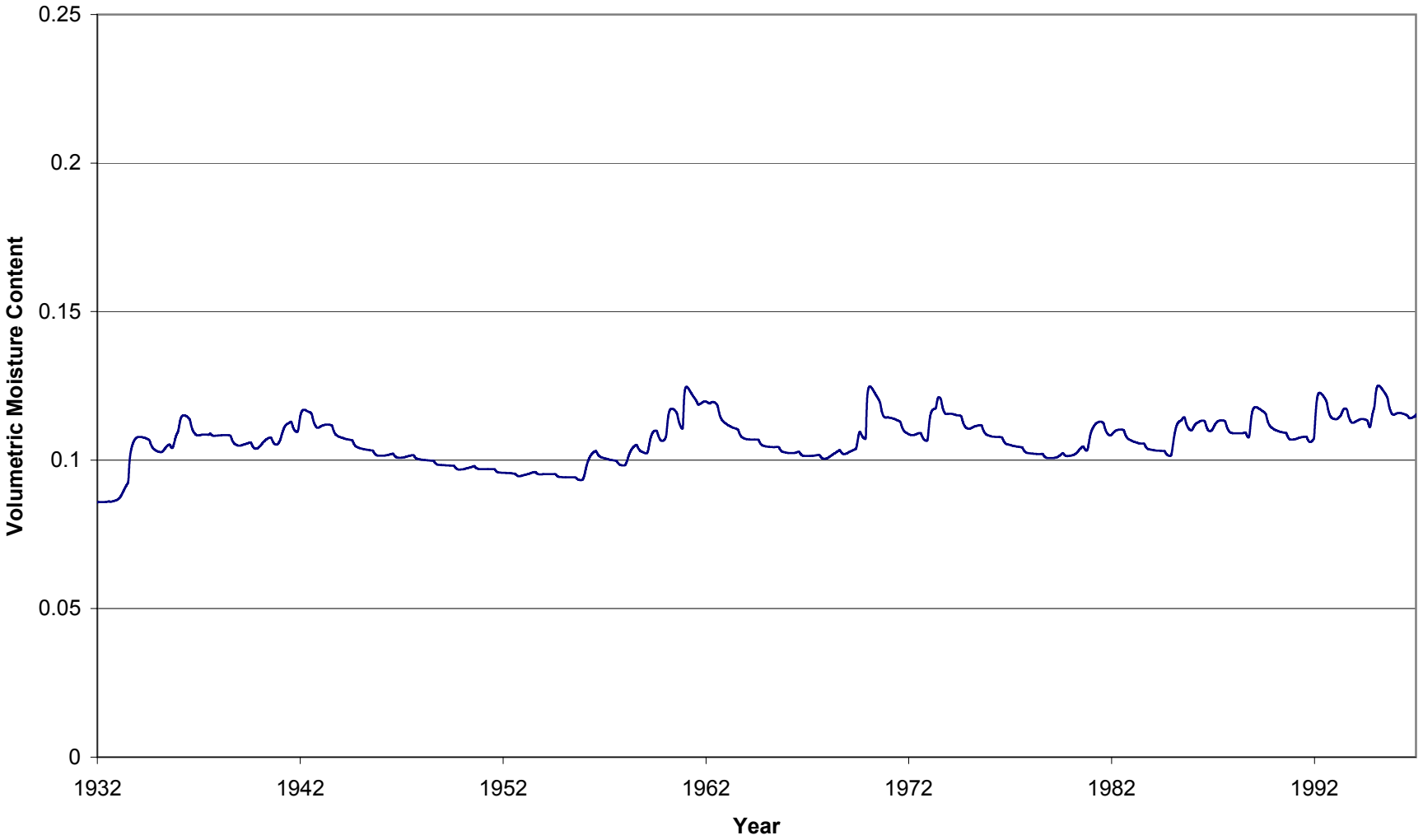

Figure 5-20 Moisture Content at 3-Ft Depth Predicted by UNSAT-H Using Historical Precipitation Data

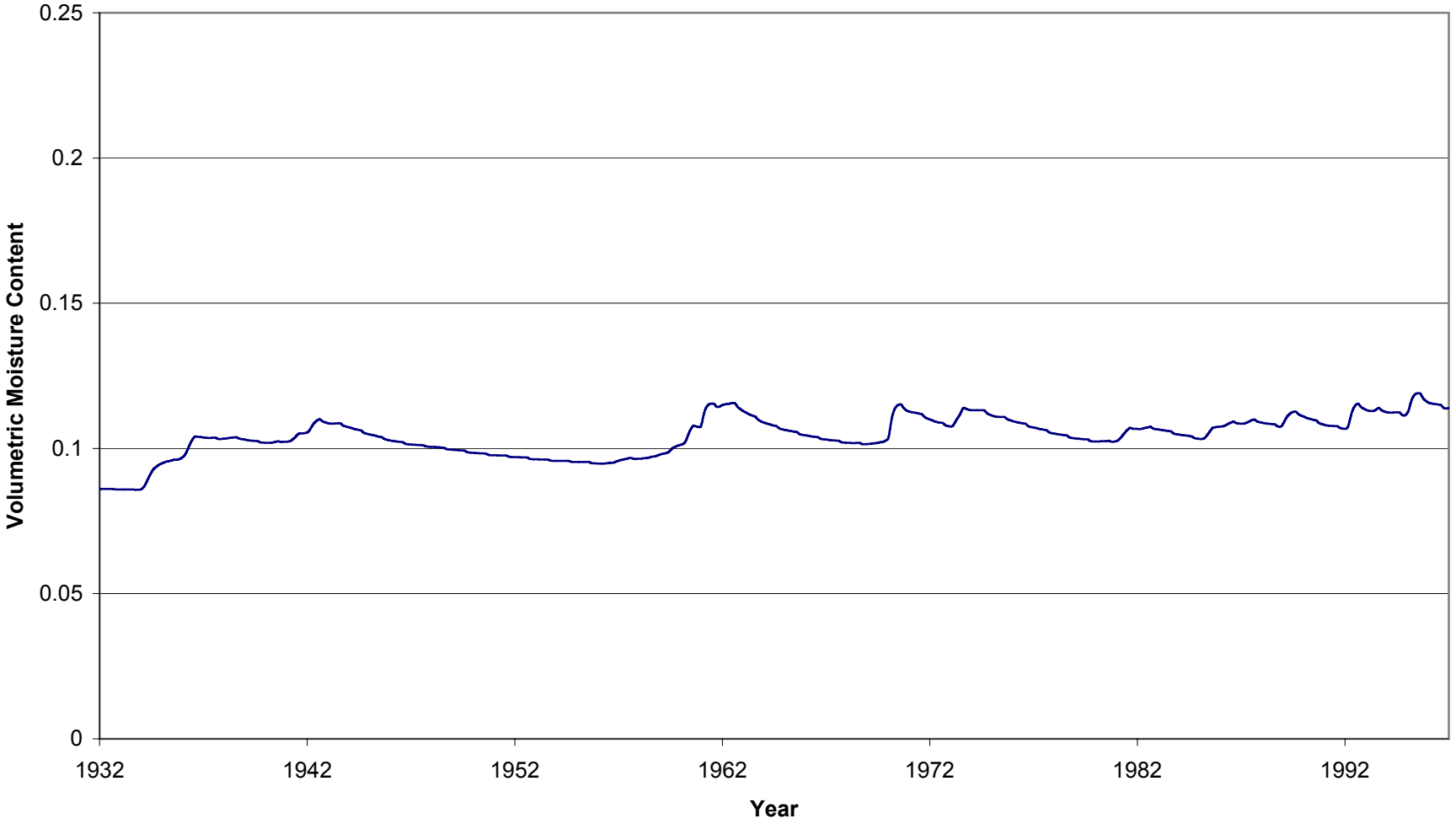

Figure 5-21 Moisture Content at 4-Ft Depth Predicted by UNSAT-H Using Historical Precipitation Data

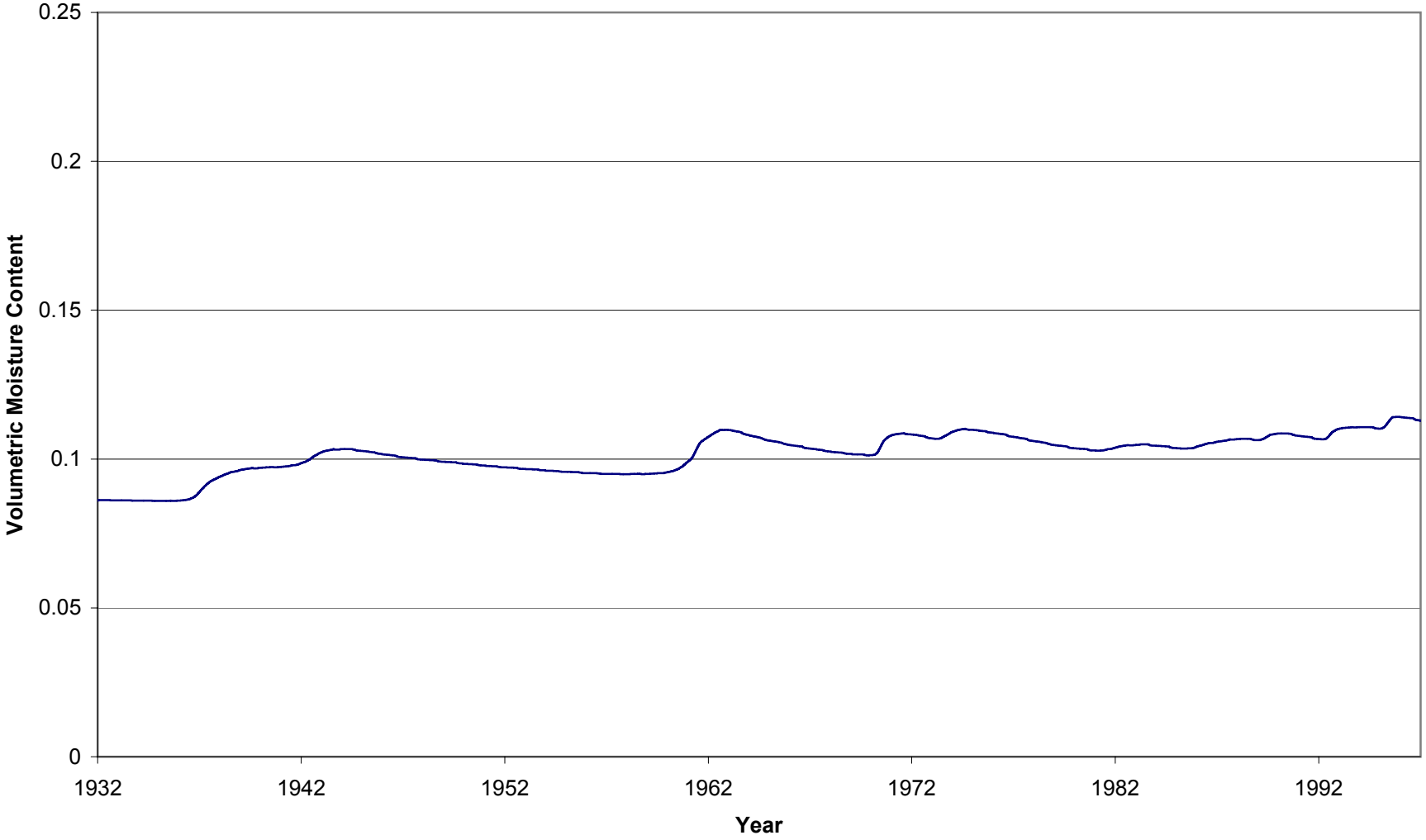

Figure 5-22 Moisture Content at 5-Ft Depth Predicted by UNSAT-H Using Historical Precipitation Data

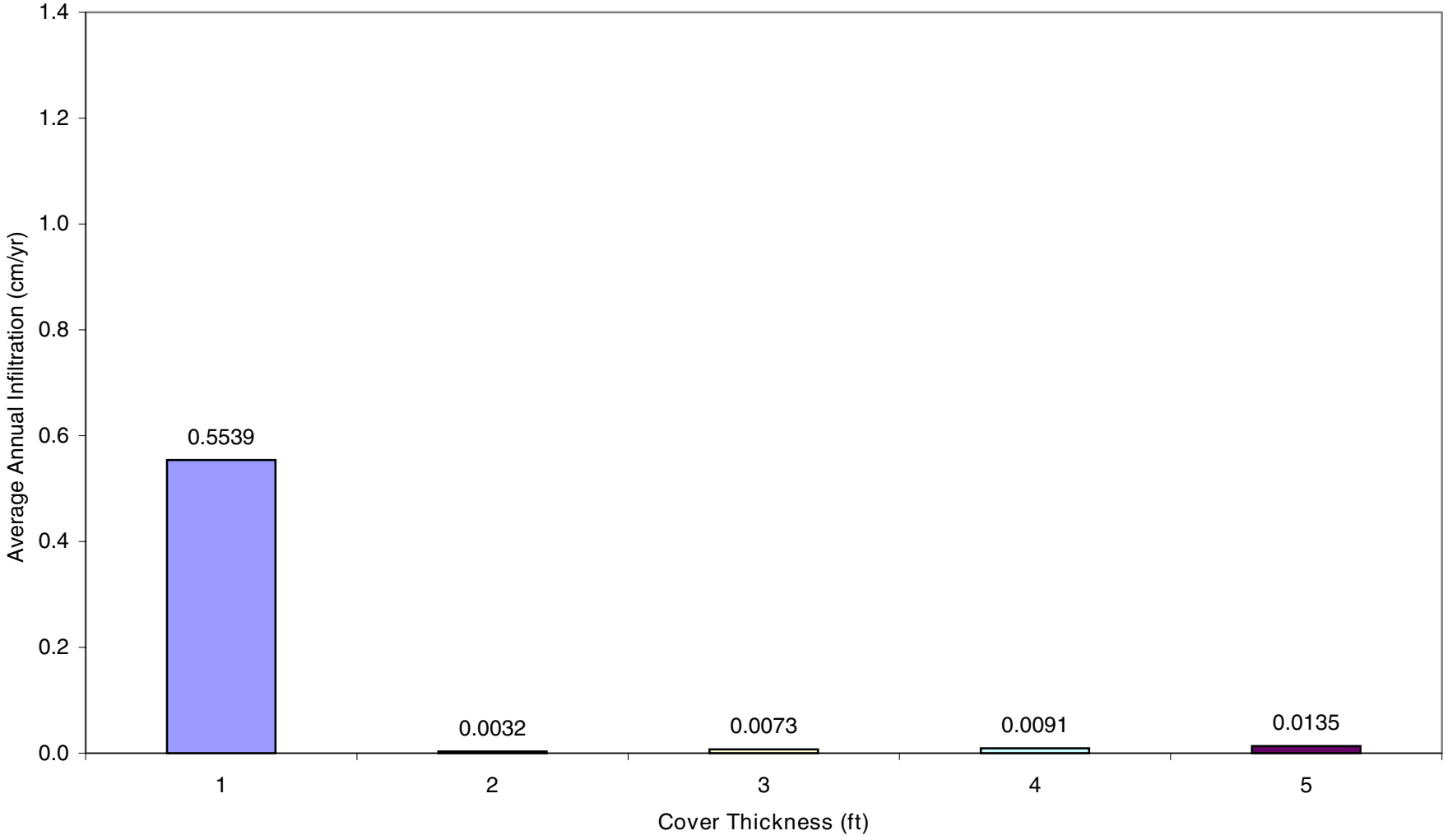

Figure 5-23 Average Annual Infiltration Rates Predicted by HELP-3 Using Maximum Precipitation Data

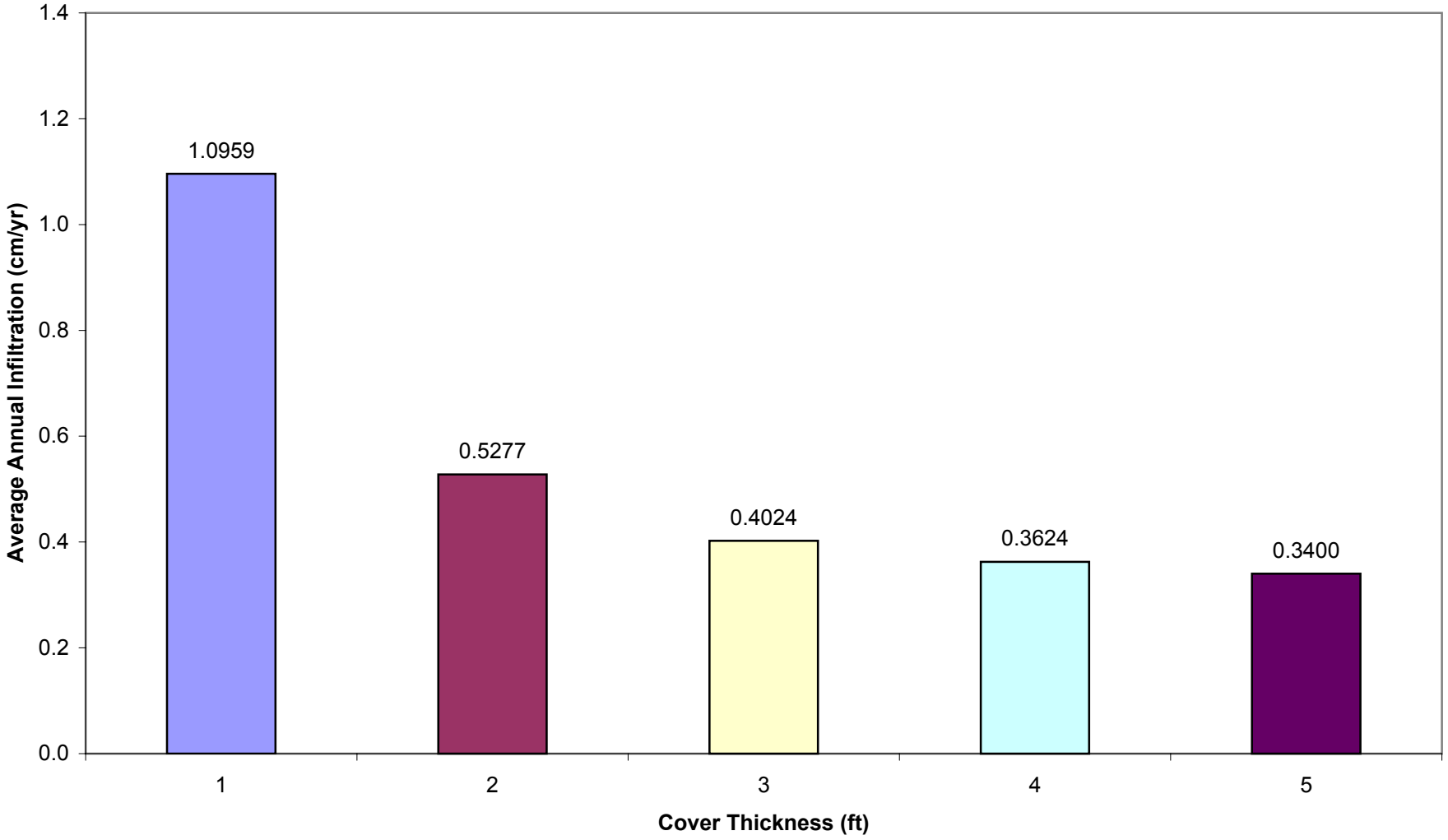

Figure 5-24 Average Annual Infiltration Predicted by UNSAT-H Using Maximum Precipitation Data

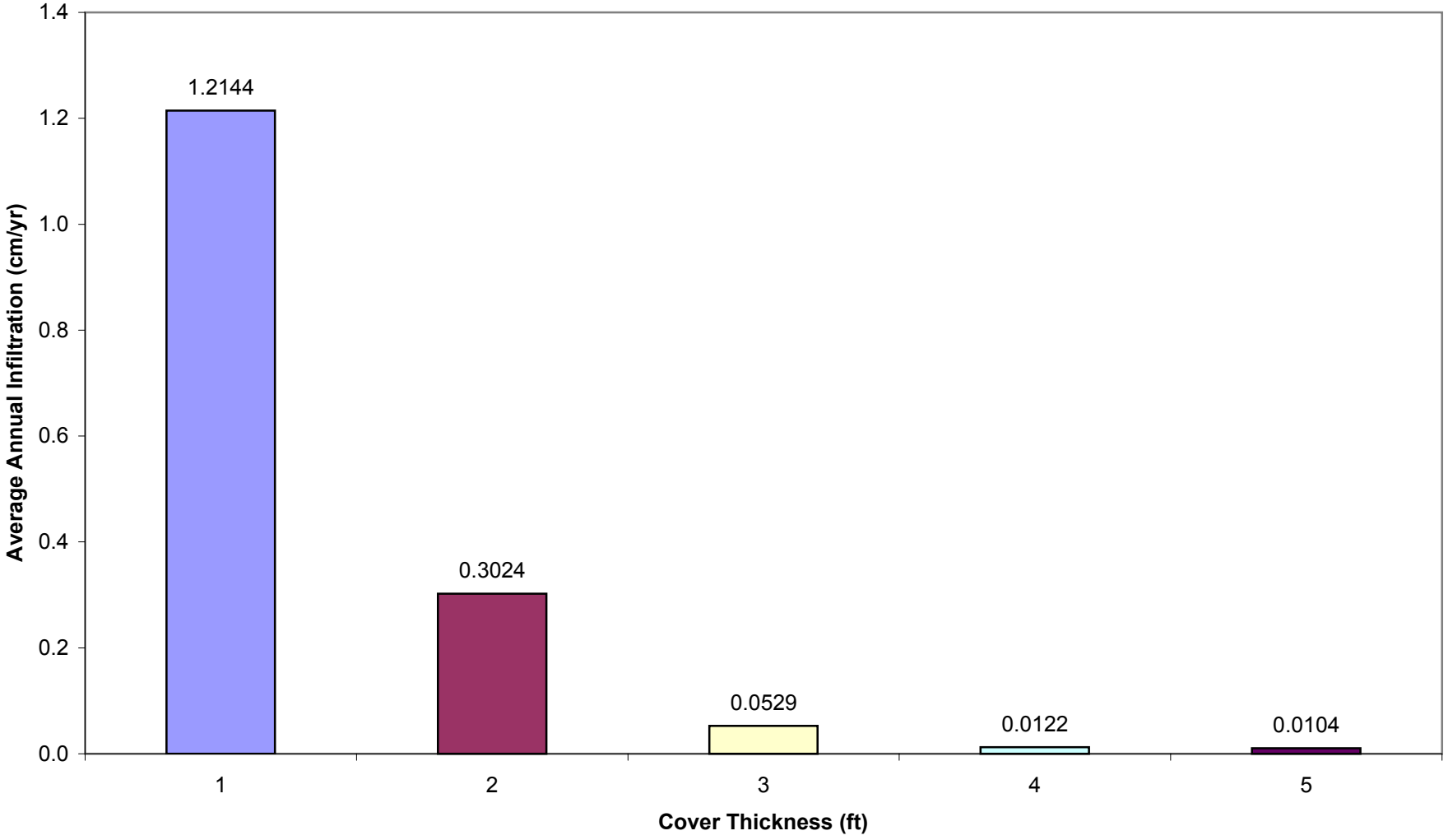

Figure 5-25 Average Annual Infiltration Rates Predicted by VS2DT Using Maximum Precipitation Data

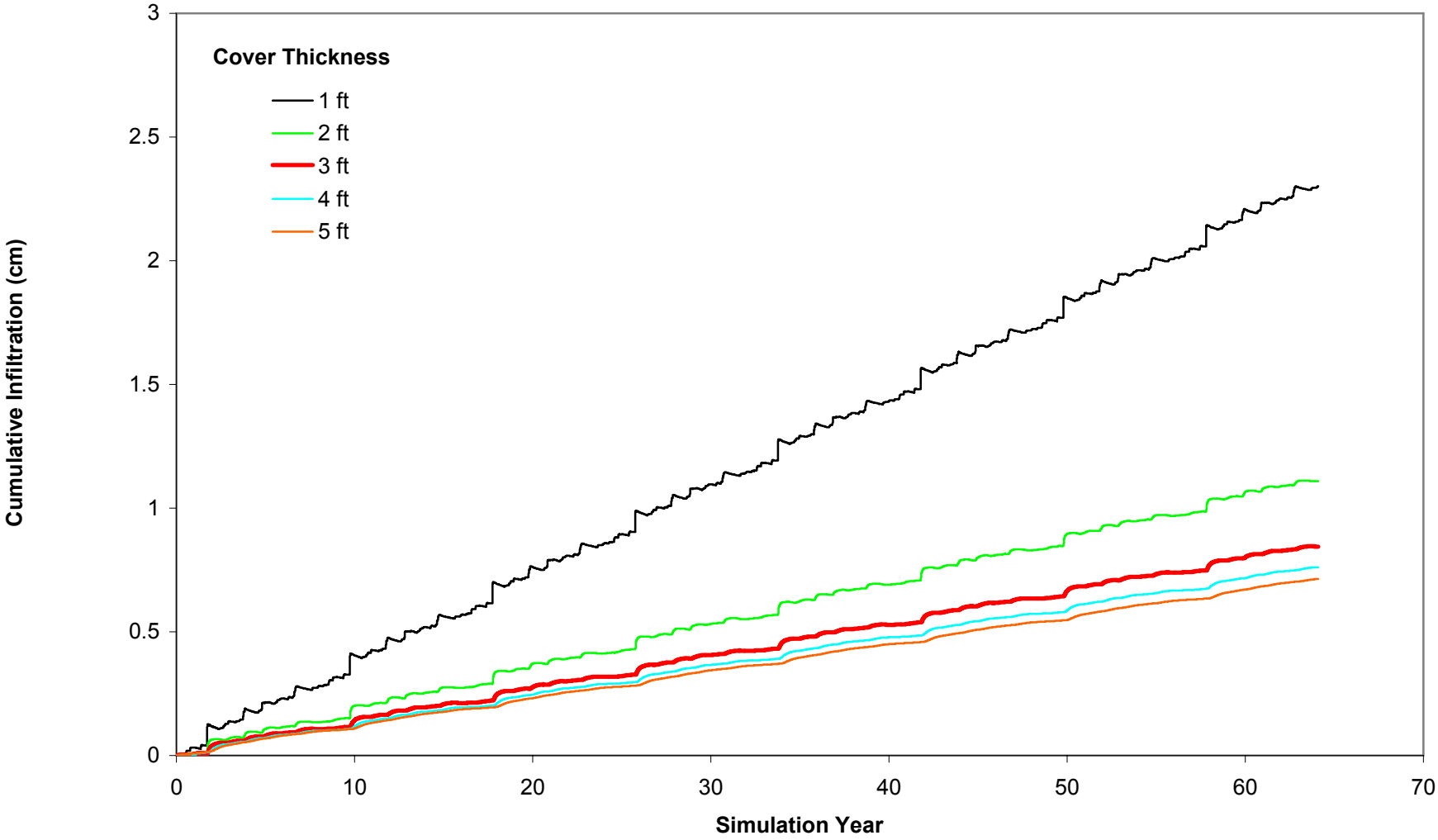

Figure 5-26 Cumulative Infiltration Predicted by UNSAT-H Using Maximum Precipitation Data

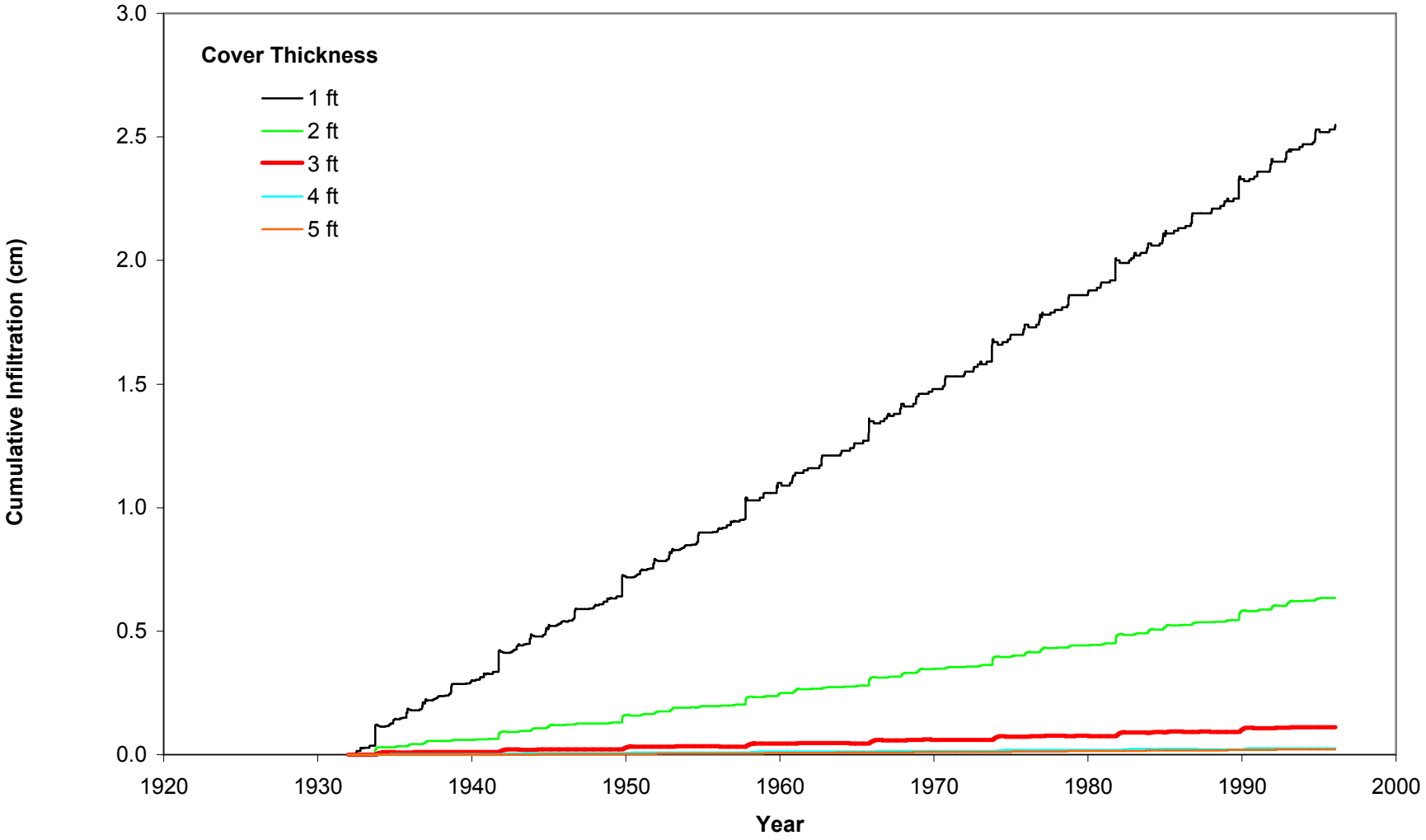

Figure 5-27 Cumulative Infiltration Predicted by VS2DT Using Maximum Precipitation Data

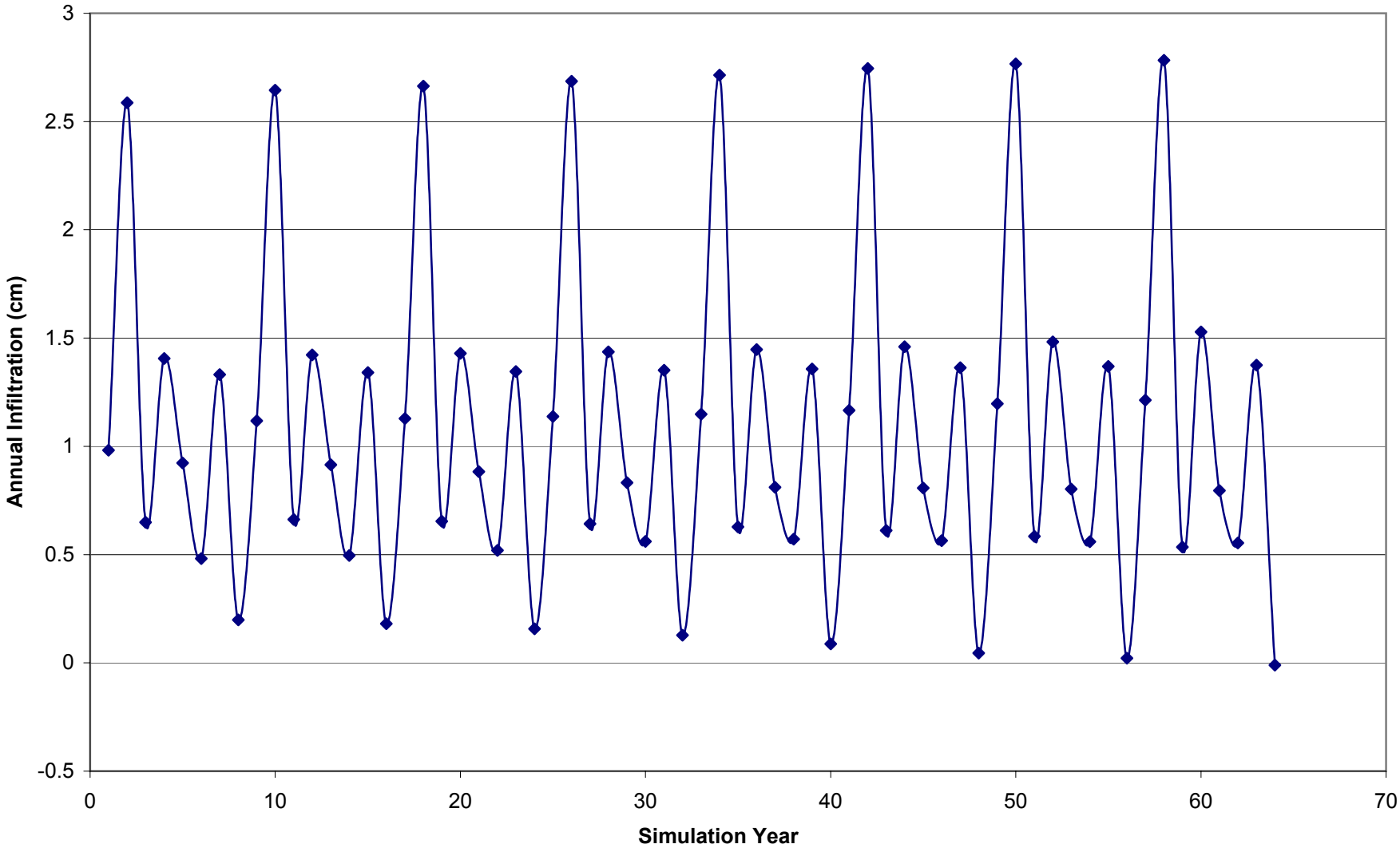

Figure 5-28 Annual Infiltration Through a 1-Ft Cover Predicted by UNSAT-H Using Maximum Precipitation Data

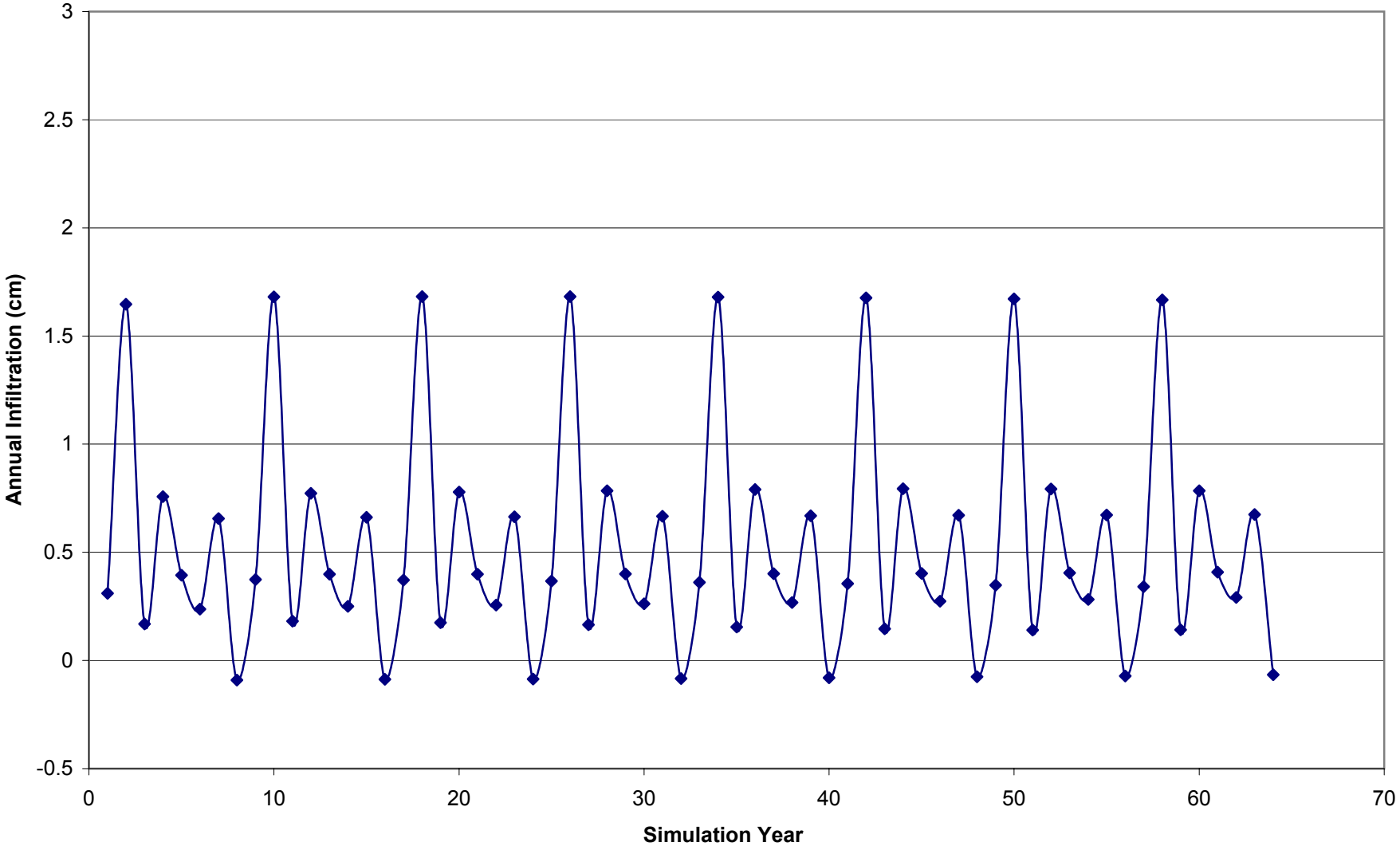

Figure 5-29 Annual Infiltration Through a 2-Ft Cover Predicted by UNSAT-H Using Maximum Precipitation Data

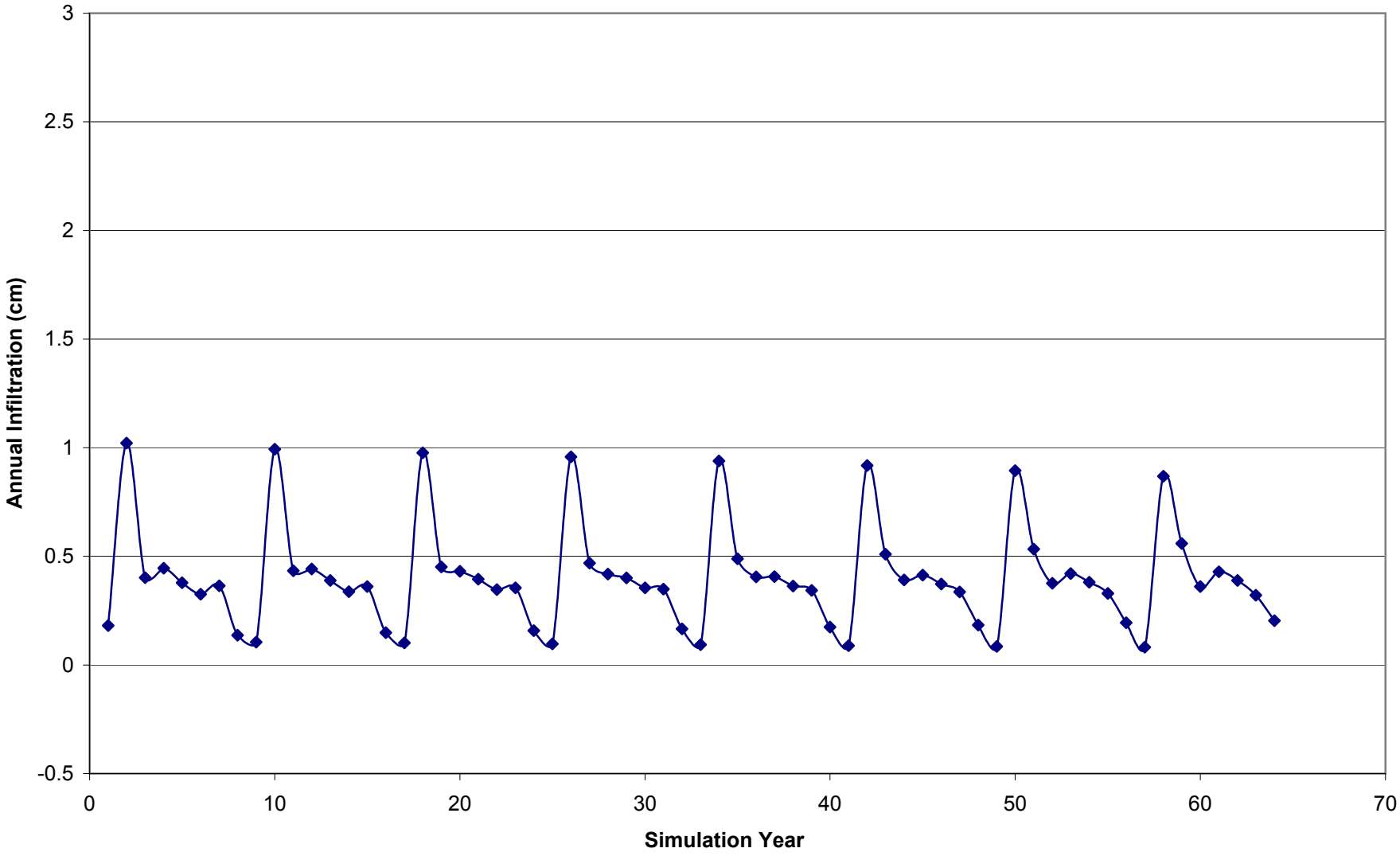

Figure 5-30 Annual Infiltration Through a 3-Ft Cover Predicted by UNSAT-H Using Maximum Precipitation Data

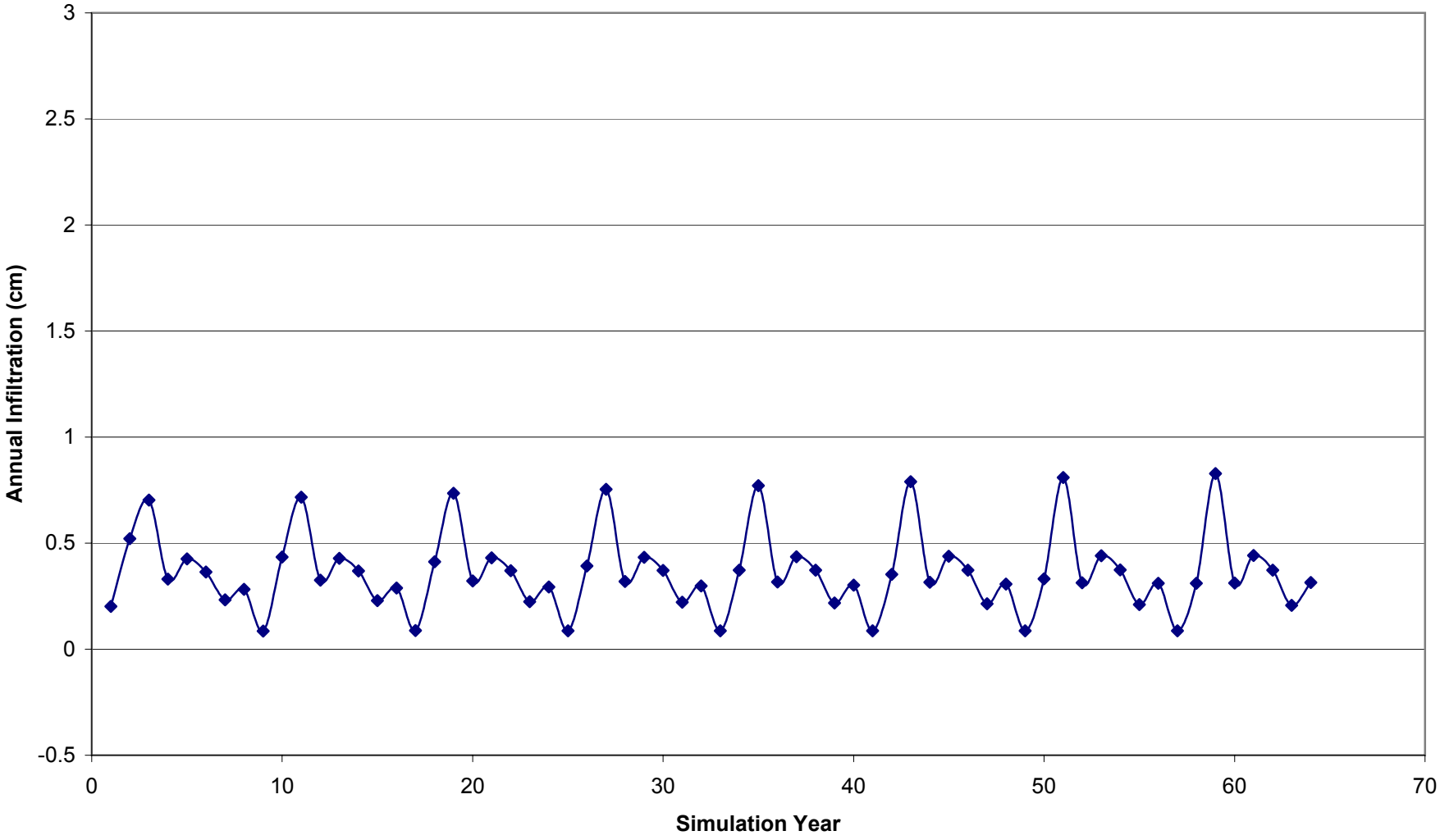

Figure 5-31 Annual Infiltration Through a 4-Ft Cover Predicted by UNSAT-H Using Maximum Precipitation Data

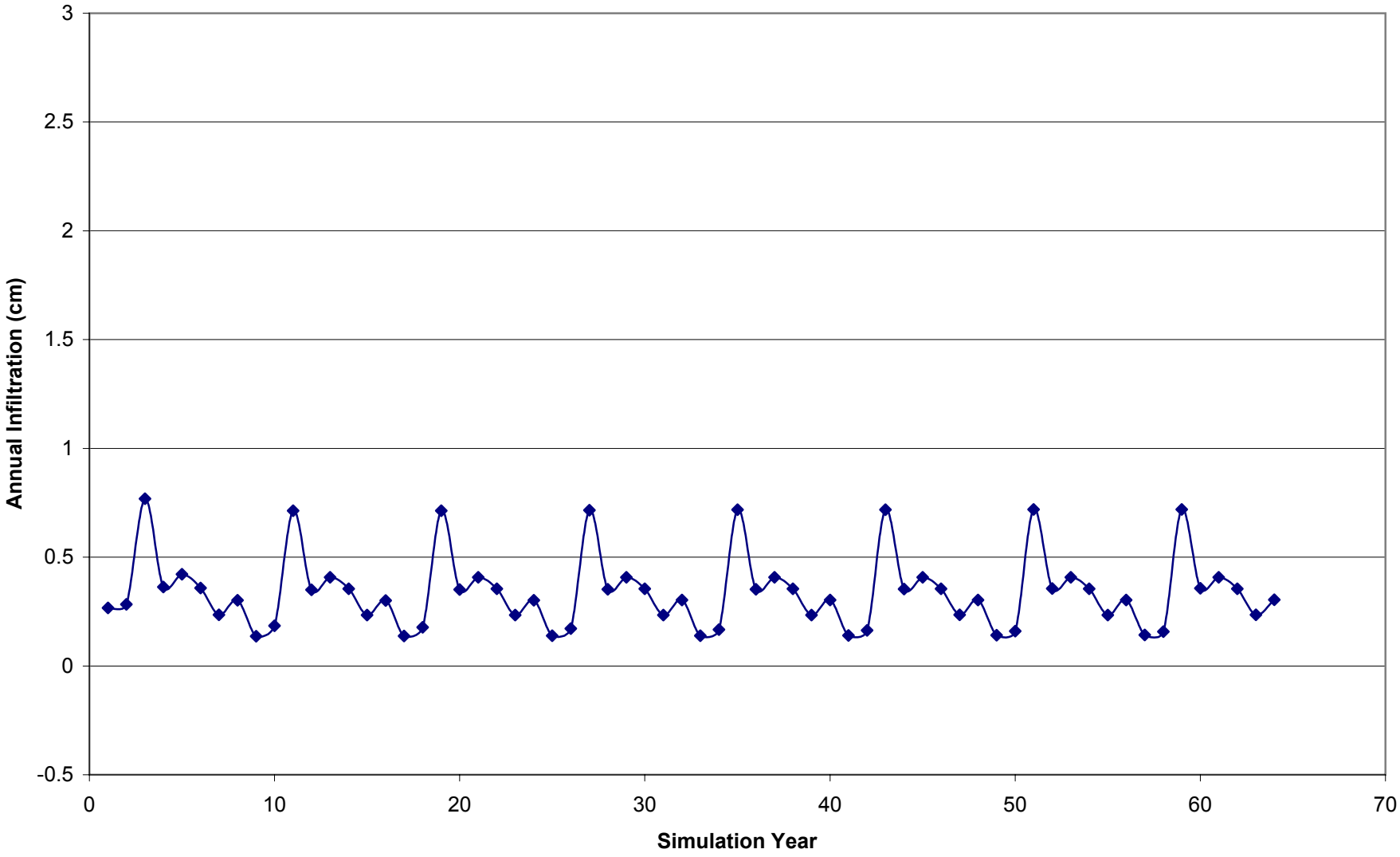

Figure 5-32 Annual Infiltration Through a 5-Ft Cover Predicted by UNSAT-H Using Maximum Precipitation Data

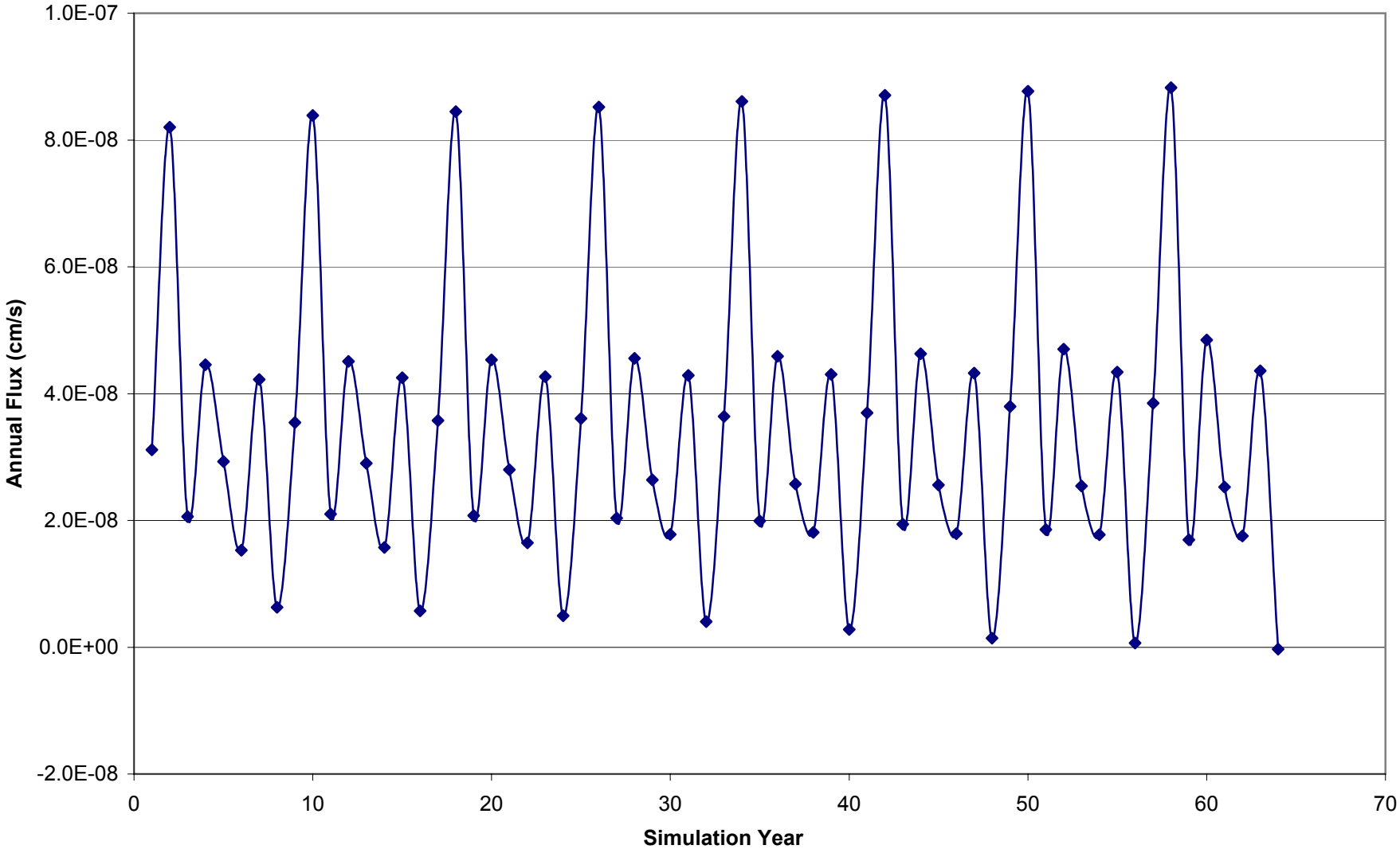

Figure 5-33 Annual Flux Through a 1-Ft Cover Predicted by UNSAT-H Using Maximum Precipitation Data

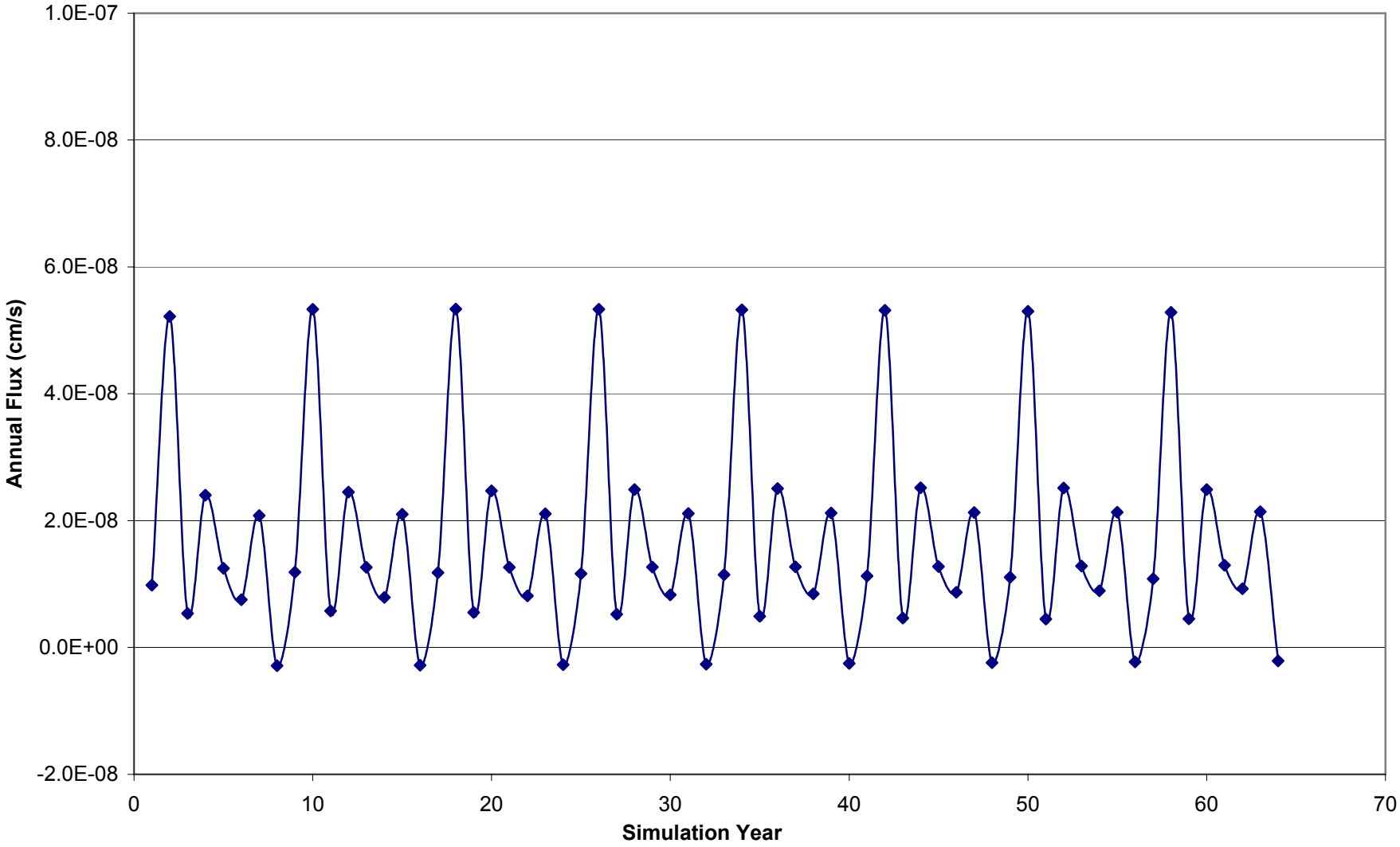

Figure 5-34 Annual Flux Through a 2-Ft Cover Predicted by UNSAT-H Using Maximum Precipitation Data

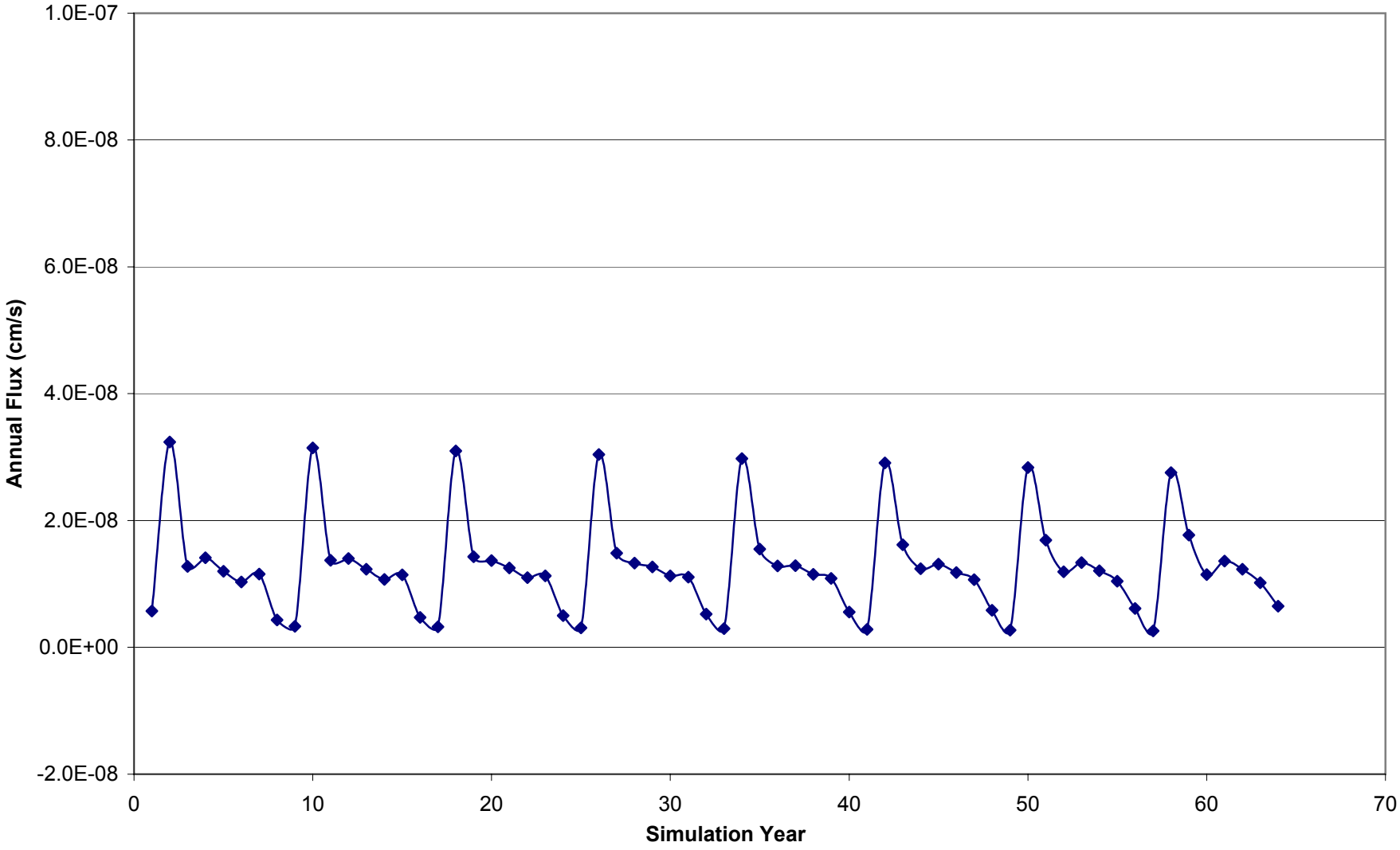

Figure 5-35 Annual Flux Through a 3-Ft Cover Predicted by UNSAT-H Using Maximum Precipitation Data

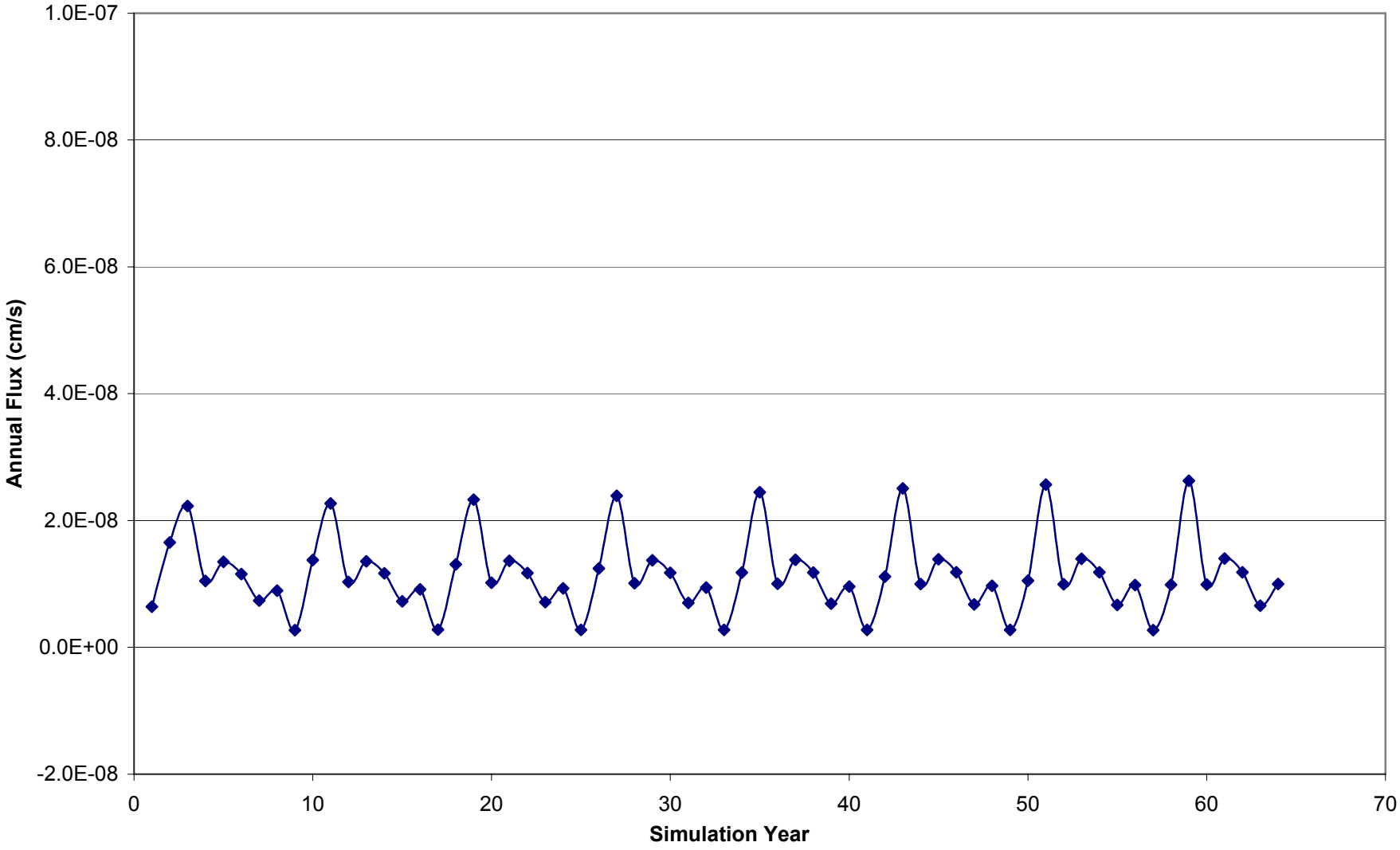

Figure 5-36 Annual Flux Through a 4-Ft Cover Predicted by UNSAT-H Using Maximum Precipitation Data

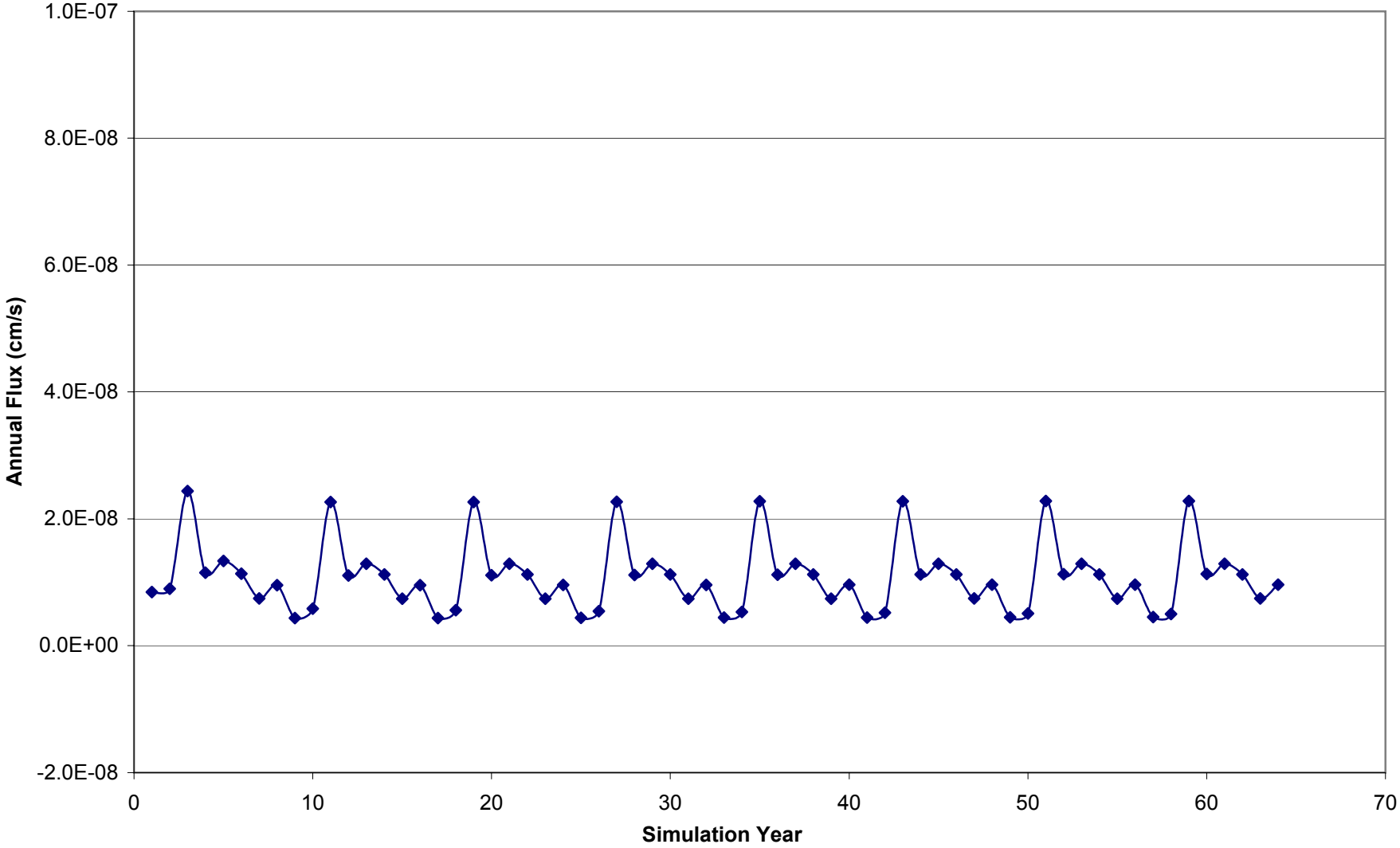

Figure 5-37 Annual Flux Through a 5-Ft Cover Predicted by UNSAT-H Using Maximum Precipitation Data

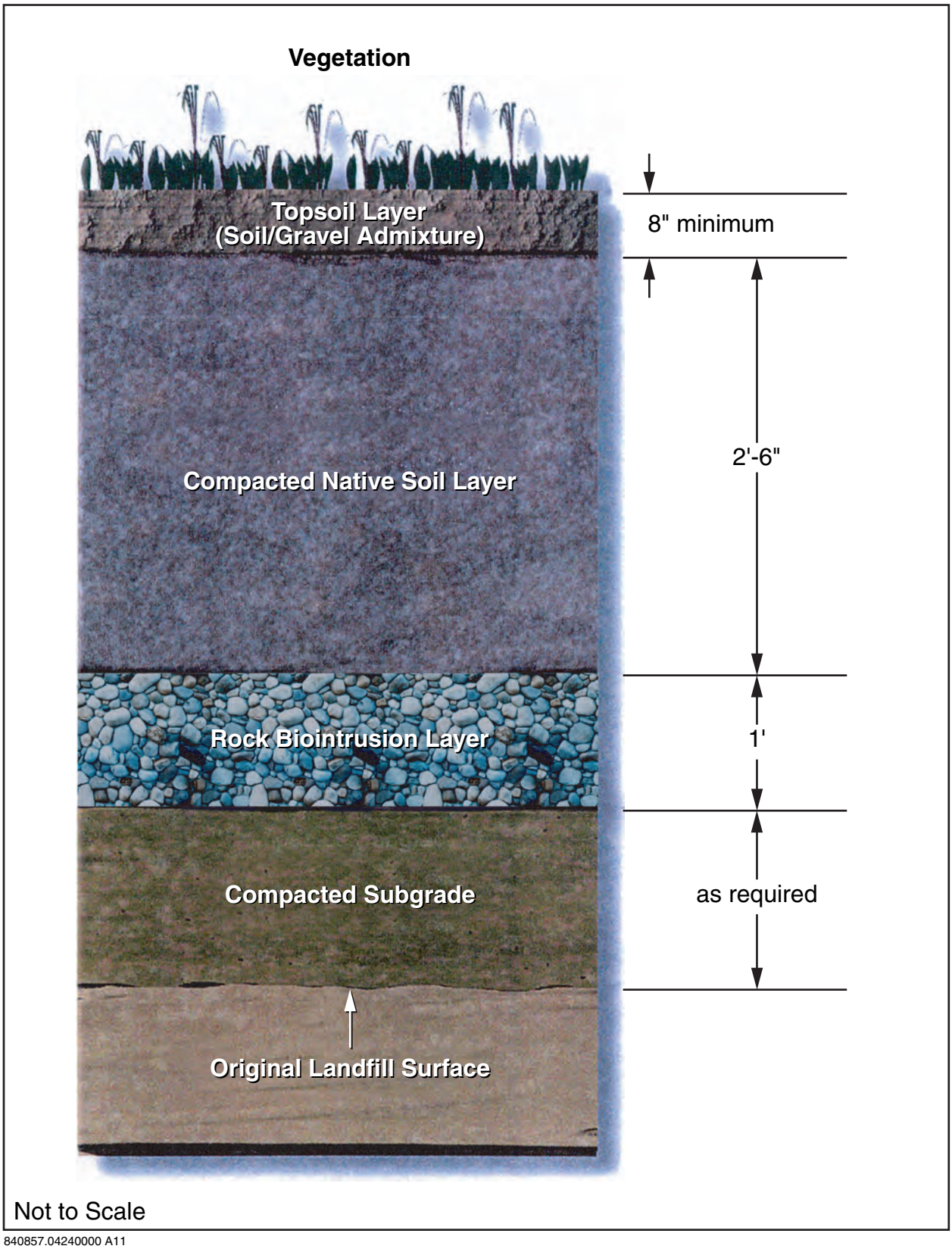

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Figure 6-1 Schematic of Mixed Waste Landfill Alternative Cover

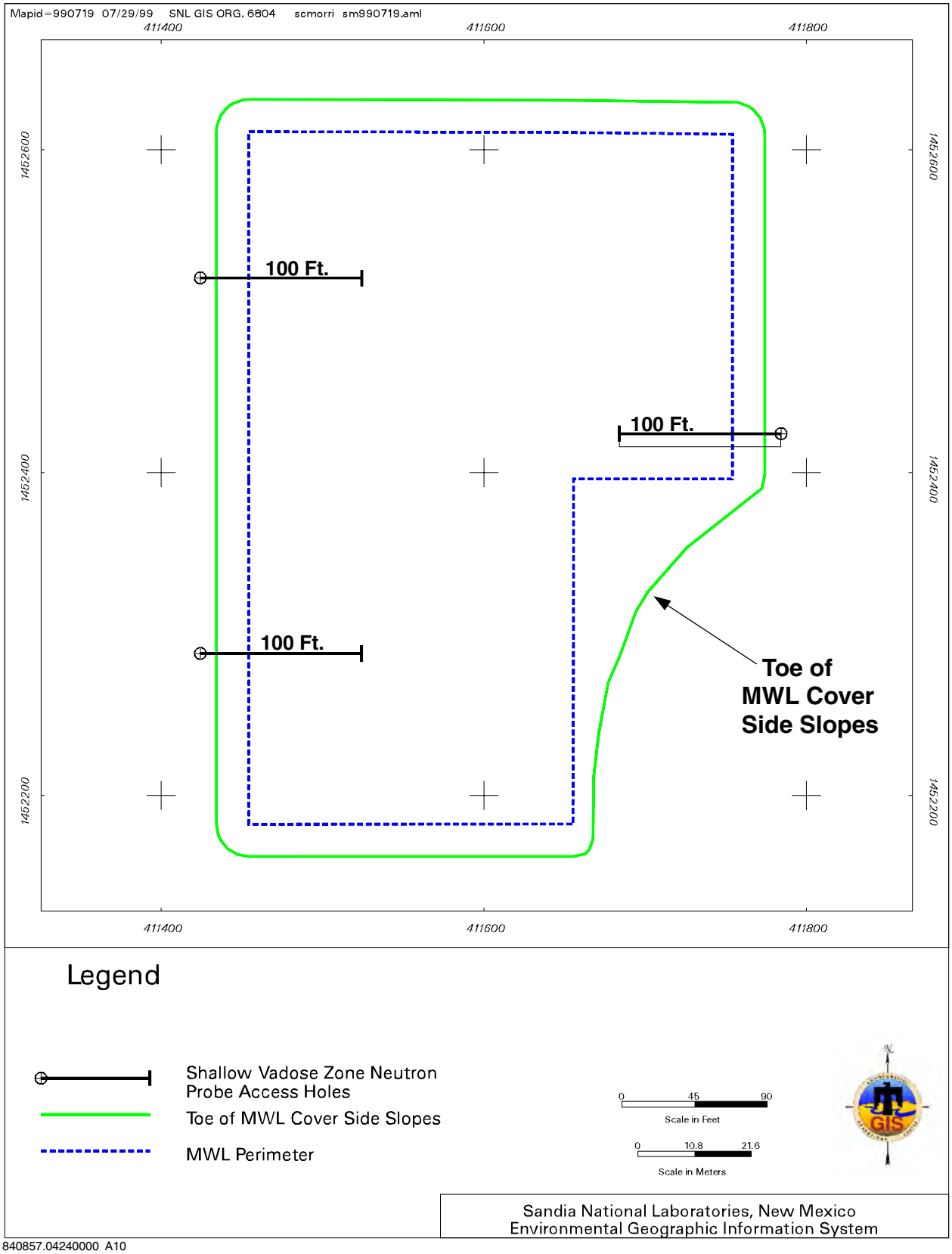

Figure 7-1 Location of Shallow Vadose Zone Neutron Probe Access Holes

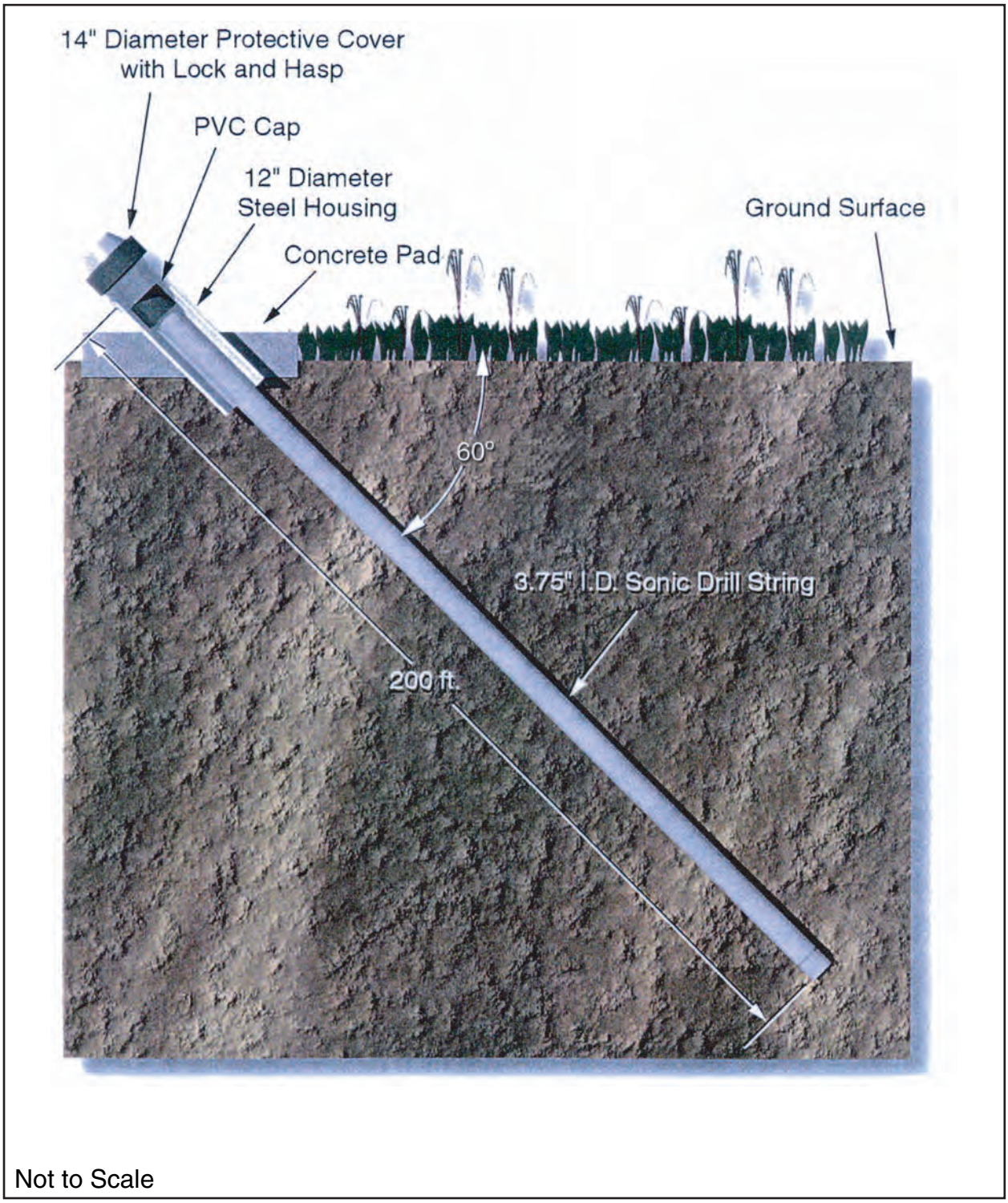

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Figure 7-2 Schematic of Vadose Zone Neutron Probe Access Holes and Casings

TABLES

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Table 5-1
Hydraulic Conductivity Data for Subsurface Soil at the Mixed Waste Landfill

Sample Location	Sample/Borehole	Average Depth (ft)	Saturated Hydraulic Conductivity (cm/s)	Laboratory
Field Measurements				
60 feet north of IP Test Site	Artificial Rainfall Test	2	5.3E-04	In Situ Field Measurement
MWL IP Test Site	IP Test	3	4.0E-04	In Situ Field Measurement
Geometric Mean of Field Measurements			**4.6E-04**	**NA**
Laboratory Measurements				
MWL Perimeter	MWL-BH-01	10	3.8E-05	SNL Hydrology Laboratory
MWL Perimeter	MWL-BH-01	26	1.1E-05	SNL Hydrology Laboratory
MWL Perimeter	MWL-BH-01	52	9.3E-05	SNL Hydrology Laboratory
MWL Perimeter	MWL-BH-01	78	3.0E-04	SNL Hydrology Laboratory
MWL Perimeter	MWL-BH-03	26	8.3E-05	SNL Hydrology Laboratory
MWL Perimeter	MWL-BH-03	52	5.0E-04	SNL Hydrology Laboratory
MWL Perimeter	MWL-BH-03	78	4.4E-06	SNL Hydrology Laboratory
MWL Perimeter	MWL-BH-04	98	2.6E-04	SNL Hydrology Laboratory
MWL Perimeter	MWL-BH-07	26	1.1E-03	SNL Hydrology Laboratory
MWL Perimeter	MWL-BH-07	52	1.7E-05	SNL Hydrology Laboratory
MWL Perimeter	MWL-BH-07	78	7.5E-05	SNL Hydrology Laboratory
MWL Perimeter	MWL-BH-07	104	9.2E-06	SNL Hydrology Laboratory
MWL Perimeter	MWL-BH-09	30	2.1E-04	SNL Hydrology Laboratory
MWL Perimeter	MWL-BH-09	52	8.4E-04	SNL Hydrology Laboratory
MWL Perimeter	MWL-BH-11	26	6.8E-04	SNL Hydrology Laboratory
MWL Perimeter	MWL-BH-11	56	1.0E-05	SNL Hydrology Laboratory
MWL Perimeter	MWL-BH-13	15	4.8E-05	SNL Hydrology Laboratory
MWL Perimeter	MWL-BH-13	36	1.6E-04	SNL Hydrology Laboratory
MWL IP Test Site	015-045	1	2.3E-05	SNL Hydrology Laboratory
MWL IP Test Site	045-075	2	2.0E-04	SNL Hydrology Laboratory
MWL IP Test Site	075-105	3	1.0E-04	SNL Hydrology Laboratory
MWL IP Test Site	105-135	4	2.0E-03	SNL Hydrology Laboratory
MWL IP Test Site	135-165	5	1.0E-04	SNL Hydrology Laboratory
MWL IP Test Site	165-195	6	9.0E-04	SNL Hydrology Laboratory
MWL Test Pit Area 2	Knight Piesold 1a	0.33	3.1E-04	Knight Piesold Laboratory
MWL Test Pit Area 2	Knight Piesold 1b	1.50	2.1E-04	Knight Piesold Laboratory
Geometric Mean of Laboratory Measurements:			**1.1E-04**	**NA**

BH = Borehole.
cm/s = Centimeter(s) per second.
ft = Foot (feet).
IP = Instantaneous profile.
MWL = Mixed Waste Landfill.
NA = Not applicable.
SNL = Sandia National Laboratories.

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Table 5-2
Hydraulic Conductivity Data for Mixed Waste Landfill Cover Soil at 90 Percent Compaction

Sample Location	Sample	Depth Range (ft)	Average Depth (ft)	Saturated Hydraulic Conductivity (cm/s)	Percent Compaction	Laboratory
MWL Test Pit Area 2	Composite 2A	0–2	1	1.0E-05	90	AGRA Earth & Environmental, Inc.
MWL Test Pit Area 1	Composite 1A	0–2	1	1.1E-04	90	AGRA Earth & Environmental, Inc.
MWL Test Pit Area 1	Composite 1B	> 2	3	4.3E-05	90	AGRA Earth & Environmental, Inc.
Geometric Mean of Proposed Cover Soils from MWL Borrow Areas:				**3.6E-05**	**NA**	**NA**
CAMU Soil Piles	Native Soil 1 of 3	Upper 2	1	1.5E-05	90	AGRA Earth & Environmental, Inc.
CAMU Soil Piles	Native Soil 2 of 3	Upper 2	1	1.7E-05	90	AGRA Earth & Environmental, Inc.
CAMU Soil Piles	Native Soil 3 of 3	Upper 2	1	3.2E-05	90	AGRA Earth & Environmental, Inc.
CAMU Soil Piles	Subgrade Soil 1 of 3	Surface to 5	3	1.0E-05	90	AGRA Earth & Environmental, Inc.
CAMU Soil Piles	Subgrade Soil 2 of 3	Surface to 5	3	2.0E-05	90	AGRA Earth & Environmental, Inc.
CAMU Soil Piles	Subgrade Soil 3 of 3	Surface to 5	3	1.0E-05	90	AGRA Earth & Environmental, Inc.
Geometric Mean of Proposed Cover Soils from CAMU Stockpiles:				**1.6E-05**	**NA**	**NA**
Geometric Mean of Proposed Cover Soils from MWL Borrow Areas & CAMU Stockpiles:				**2.1E-05**	**NA**	**NA**

CAMU = Corrective Action Management Unit.
cm/s = Centimeter(s) per second.
ft = Foot (feet).
MWL = Mixed Waste Landfill.
NA = Not applicable.

Table 5-3
Summary of Input Parameters Used for HELP-3, UNSAT-H,
and VS2DT Predictive Modeling

Parameter	HELP-3[a]	UNSAT-H	VS2DT
Porosity, cm^3/cm^3	0.453	0.4	0.4
Field Capacity cm^3/cm^3	0.19	NA	NA
Residual Water Content cm^3/cm^3	NA	0.08	0.08
Wilting Point cm^3/cm^3	0.085	NA	NA
Head at Wilting or Pressure Head in Roots	NA	345 ft (10508 cm)	330 ft (10,058 cm)
Air Entry Parameter Alpha	NA	0.641 ft^{-1} (0.021 cm^{-1})	0.641 ft^{-1} (α' = -1.56 ft)
Van Genuchten "n"	NA	2.00	2.00
Initial Water Content	0.085	0.0862	0.0862
Initial Head, ft	NA	80 ft (2438 cm)	80 ft (2438 cm)
Saturated Hydraulic Conductivity	2.04 ft/day	0.85 ft/day (1.08 cm/hr)	0.85 ft/day
Slope	0.02 ft/ft	0 (1-dimensional)	0 (1-dimensional)
Drainage Length	200 ft	NA	NA
Maximum Root Depth	NA	3.25 ft	3.28 ft
Evaporative Zone Depth	42 inches	NA	NA
Atmospheric Pressure Potential	NA	750 ft (22860 cm)	500 ft to 1,000 ft
Head where Transpiration Starts to Decrease	NA	165 ft (5029 cm)	NA
Temperature	Air temp varies	293°K	NA
Membrane Defects	No membrane	NA	NA

[a]HELP-3 runs used HELP-3's default Type 6 soil because the model was very sensitive and inconsistent in its response to soil parameters.

cm = Centimeter(s).
cm^3 = Cubic centimeter(s).
HELP-3 = Hydrologic Evaluation of Landfill Performance Model, Version 3.
°K = Degree(s) Kelvin.
ft = Foot (feet).
hr = Hour.
NA = Not applicable.
UNSAT-H = Unsaturated Soil Water and Heat Flow Model.
VS2DT = Variably-Saturated 2-D Flow and Solute Transport Model.

Table 5-4
Summary of Mixed Waste Landfill Cover Modeling Results Using Historical Precipitation Data

Model	Parameter	1-ft Cover	2-ft Cover	3-ft Cover	4-ft Cover	5-ft Cover
HELP-3	Cumulative Infiltration (cm)	28.0	0.09	0.15	0.00	0.00
UNSAT-H	Cumulative Infiltration (cm)	41.5	15.00	8.44	5.79	4.15
VS2DT	Cumulative Infiltration (cm)	37.5	5.49	0.43	0.07	0.09
HELP-3	Average Flux (cm/s)	1.4E-08	4.3E-11	7.1E-11	0.0E+00	0.0E+00
UNSAT-H	Average Flux (cm/s)	2.0E-08	7.3E-09	4.1E-09	2.8E-09	2.0E-09
VS2DT	Average Flux (cm/s)	1.8E-08	2.7E-09	2.1E-10	3.6E-11	4.5E-11
HELP-3	Average Infiltration Rate (cm/yr)	0.4314	0.0014	0.0023	0.0000	0.0000
UNSAT-H	Average Infiltration Rate (cm/yr)	0.6396	0.2307	0.1299	0.0891	0.0638
VS2DT	Average Infiltration Rate (cm/yr)	0.5768	0.0844	0.0066	0.0011	0.0014
HELP-3	Maximum Volumetric Moisture Content	0.28	0.18	0.17	0.16	0.16
UNSAT-H	Maximum Volumetric Moisture Content	0.21	0.15	0.13	0.12	0.11
VS2DT	Maximum Volumetric Moisture Content	0.20	0.13	0.10	0.09	0.09

cm = Centimeter(s).
ft = Foot (feet).
HELP-3 = Hydrologic Evaluation of Landfill Performance Model, Version 3.
s = Second.
UNSAT-H = Unsaturated Soil Water and Heat Flow Model.
VS2DT = Variably-Saturated 2-D Flow and Solute Transport Model.
yr = Year.

Table 5-5
Summary of Mixed Waste Landfill Cover Modeling Results Using Maximum Precipitation Data

Model	Parameter	1-ft Cover	2-ft Cover	3-ft Cover	4-ft Cover	5-ft Cover
HELP-3	Cumulative Infiltration (cm)	35.4	0.20	0.47	0.58	0.86
UNSAT-H	Cumulative Infiltration (cm)	70.1	33.8	25.8	23.2	21.8
VS2DT	Cumulative Infiltration (cm)	77.7	19.4	3.38	0.78	0.66
HELP-3	Average Flux (cm/s)	1.8E-08	1.0E-10	2.3E-10	2.9E-10	4.3E-10
UNSAT-H	Average Flux (cm/s)	3.5E-08	1.7E-08	1.3E-08	1.1E-08	1.1E-08
VS2DT	Average Flux (cm/s)	3.8E-08	9.6E-09	1.7E-09	3.9E-10	3.3E-10
HELP-3	Average Infiltration Rate (cm/yr)	0.5539	0.0032	0.0073	0.0091	0.0135
UNSAT-H	Average Infiltration Rate (cm/yr)	1.0959	0.5277	0.4024	0.3624	0.3400
VS2DT	Average Infiltration Rate (cm/yr)	1.2144	0.3024	0.0529	0.0122	0.0104
HELP-3	Maximum Volumetric Moisture Content	0.30	0.20	0.18	0.17	0.17
UNSAT-H	Maximum Volumetric Moisture Content	0.24	0.17	0.14	0.14	0.13
VS2DT	Maximum Volumetric Moisture Content	0.22	0.15	0.12	0.10	0.10

cm = Centimeter(s).
ft = Foot (feet).
HELP-3 = Hydrologic Evaluation of Landfill Performance Model, Version 3.
s = Second.
UNSAT-H = Unsaturated Soil Water and Heat Flow Model.
VS2DT = Variably-Saturated 2-D Flow and Solute Transport Model.
yr = Year.

APPENDIX A
Construction Specifications

MIXED WASTE LANDFILL ALTERNATIVE COVER
CONSTRUCTION SPECIFICATIONS
REVISION 2
July 29, 2005

SPECIFICATION NUMBER	TITLE
01001	Definitions
01563	Temporary Diversion and Control of Water during Construction
02110	Clearing and Grubbing
02115	Biointrusion Barrier
02200	Earthwork
02210	Grades, Lines, and Levels
02221	Trenching, Backfilling, and Compaction
02445	Administrative Control Fences and Gates
02670	Monitoring Well MW-4 Extension
02930	Reclamation Seeding and Mulching

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SECTION 01001

DEFINITIONS

General Conditions	General terms and conditions for construction projects at Sandia National Laboratories, New Mexico.
Operator	Sandia National Laboratories, New Mexico
Construction Team or Contractor	Hereinafter referred to as the "Contractor." Operates separately from the Operator and the Construction Quality Assurance (CQA) Engineer. Responsible for constructing the Mixed Waste Landfill (MWL) alternative cover in strict accordance with the design criteria, specifications, design drawings, and CQA Plan using the necessary construction procedures and techniques.
Construction Quality Assurance Engineer	Hereinafter referred to as the CQA Engineer. Operates separately from the Operator and the Contractor. Responsible for activities specified in the CQA Plan (e.g., inspection, verification testing, and documentation).

END OF SECTION

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SECTION 01563

TEMPORARY DIVERSION AND CONTROL OF WATER DURING CONSTRUCTION

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Work Included

The Contractor shall furnish all materials, labor, tools and equipment for controlling surface water and dewatering work areas prior to and throughout construction operations. Control measures implemented may include berms, swales, ditches, temporary pipes/hoses, portable pumps, silt fences, sediment traps, or any other measure approved by the Operator in accordance with this specification.

1.1.2 Related Work Specified Elsewhere

1) Clearing and Grubbing shall be in accordance with Section 02110 of these specifications.

2. The Biointrusion Barrier shall be placed in accordance with Section 02115 of these specifications.

3) Earthwork shall be in accordance with Section 02200 of these specifications.

4) Reclamation Seeding and Mulching shall be in accordance with Section 02930 of these specifications.

1.1.3 Work to be performed by the Operator and/or the CQA Engineer:

1) Review and approve data submittals as required by this specification.

2) Inspect work for compliance with requirements of these specifications, in addition to inspection by the Contractor and with the design drawings.

3) Review pre-placement conditions, placement of controls, and other job conditions during performance of the work.

4) Perform final inspection and acceptance of water diversion and control work.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIAL REQUIREMENTS

2.1.1 Equipment

1) All equipment and tools shall conform to the safety requirements of the MWL Health and Safety Plan.

2) All equipment and tools used by the Contractor to perform the work shall be subject to inspection by the Operator before the work is started and maintained in satisfactory working condition at all times.

3) The Contractor's equipment shall be adequate and capable of controlling water prior to and throughout construction as required by this specification.

2.1.2 Materials

1) All materials shall be furnished by the Contractor and shall be subject to approval by the Operator.

2) Maintenance, repairs, and replacement of materials damaged by the Contractor or his subcontractors shall be the responsibility of the Contractor.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Standing water outside the construction boundary may be allowed to infiltrate.

3.1.2 The Contractor shall manage storm water such that all construction areas shall be free of standing water. Suitable water control measures shall be constructed at all locations where construction work may be affected by surface water at the time of the work.

3.1.3 The Contractor shall divert surface water around the periphery of the construction area by constructing temporary ditches, berms, or other means of control.

3.1.4 The Contractor shall be solely responsible for the protection of work against damage, delay, or environmental impacts from water flow.

3.1.5 The Contractor shall direct and control surface water in a manner that protects adjacent structures and facilities.

3.2 WORK IN EXTREME WEATHER

3.2.1 In the event of extreme storm activity, the Contractor shall provide protective measures to prevent damage to the construction area and maintain control of runoff and run-on. During such extreme storm events, the Contractor shall protect slopes by methods approved by the Operator. The Contractor shall inspect erosion protection structures within 24 hours after extreme storm events to verify that erosion protection structures are in place and functional. To maintain the integrity of erosion prevention structures, the Contractor shall clean out, as necessary, all temporary control structures of debris and sediment buildup, and repair or replace any damaged areas either in the temporary control structures or in permanent work areas as identified by the Operator.

3.3 INSPECTIONS AND REPAIRS

3.3.1 The Contractor shall inspect temporary water control structures and materials on a regular basis and shall record inspection findings in the Daily Field Report. The inspection records shall be submitted weekly to the Operator.

3.3.2 The Contractor shall remove debris and sediment build-up from the temporary control structures as required to maintain the intended flow path.

3.3.3 Should an overflow or breach condition be encountered or any other damage observed at the temporary water control structures, repair and/or replacement of the damaged area shall be completed by the Contractor.

3.3.4 Acceptance criteria for repaired and/or replaced temporary water control structures shall be in accordance with the requirements of this section.

3.4 REMOVAL OF TEMPORARY CONTROL MEASURES

Temporary storm water control measures shall be removed once the work has been completed and as approved by the Operator. The materials removed shall be properly disposed of by the Contractor, at locations designated by the Operator. All areas where temporary control structures are removed shall be regraded and revegetated in accordance with Sections 02200 and 02930 of these specifications.

3.5 ACCEPTANCE

The Contractor shall submit a description of any repair or replacement work required to the Operator prior to implementation. Acceptance criteria for repaired or replaced water control measures shall be in accordance with the requirements of this specification.

END OF SECTION

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SECTION 02110

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Work Included

The Contractor shall furnish all materials, labor, tools, and equipment, and shall perform clearing and grubbing during construction activities in accordance with this specification and as shown on the design drawings.

1.1.2 Related Work Specified Elsewhere

1) Temporary Diversion and Control of Water during Construction shall be in accordance with Section 01563 of these specifications.

2) Trenching, Backfilling, and Compaction shall be in accordance with Section 02221 of these specifications.

3) Reclamation Seeding and Mulching shall be in accordance with Section 02930 of these specifications.

1.1.3 Work to be performed by the Operator and/or the CQA Engineer:

1) Review and approve submittals as required for this specification.

2) Designate items that require salvage, storage, reuse, and/or relocation.

3) Perform final inspection and confirm acceptance of clearing and grubbing.

4) In addition to inspection by the Contractor, the Operator and/or the CQA Engineer may inspect work for compliance with the requirements of this specification.

1.2 SUBMITTALS

1.2.1 Procedures, Certifications, and Records

The Contractor shall submit test results in accordance with the requirements of this specification and the MWL CQA Plan to the Operator and/or the CQA Engineer as soon as this information is available so that the Operator and/or the CQA Engineer can

review work for compliance with the requirements of this specification and make CQA decisions in real-time.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIAL REQUIREMENTS

2.1.1 All equipment and tools used by the Contractor to perform the work shall be subject to inspection by the Operator before the work is started and shall be maintained in satisfactory working condition by the Contractor at all times.

2.1.2 The Contractor's equipment shall have the capability to perform the indicated clearing and grubbing specified herein.

2.1.3 The Contractor shall ensure that all equipment used for clearing and grubbing work is fitted with appropriate safety devices that comply with all applicable Federal laws and the MWL Health and Safety Plan, and that will adequately protect equipment operators and minimize exposure of site workers and others.

2.2 ITEMS SALVAGED FOR REUSE, STORAGE, OR RELOCATION

The Operator will designate items that require reuse, storage, or relocation.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Site Inspection

The Contractor shall inspect the site to determine the nature, location, size, and extent of vegetative material, debris, and obstructions to be removed or preserved, as specified herein.

3.1.2 Traffic

The Contractor shall conduct clearing and grubbing operations to ensure minimum interference with roads, walks, and adjacent facilities. The Contractor shall not close or obstruct roads, walks, or adjacent operational facilities without written permission from the Operator.

3.1.3 Protection of Existing Structures and Facilities

The Contractor shall provide protection necessary to prevent damage to the existing structures and facilities which are to remain in place. The Contractor shall restore or replace damaged property to original condition, or to the satisfaction of the Operator.

Items damaged in removal shall be repaired and refinished, or replaced by the Contractor with new matching items as required by the Operator.

3.1.4 Salvageable Items

Items damaged in removal shall be repaired, refinished, or replaced by the Contractor with new matching items as required by the Operator. The Contractor shall save and protect from construction damage all vegetative materials (shrubs, grass, and other vegetation) beyond the limits of the required clearing and grubbing. The Contractor shall restore or replace damaged vegetative materials to the conditions as required by the Operator, in accordance with Section 02930 of these specifications.

3.1.5 Protection of Monuments and Other Permanent Surface Features

The Contractor shall locate and mark existing monuments, monitoring wells, stanchions, and markers before construction operations commence and shall protect such items during construction. The Contractor shall restore or replace damaged items to original condition as required by the Operator.

3.2 CLEARING AND GRUBBING

3.2.1 Clearing and Grubbing

The Contractor shall clear the site of shrubs, vegetation, rocks and debris as required within the limits of the landfill cover, laydown and stockpile areas south of the MWL. Roots exceeding 1 inch in dimension, as well as rocks and other debris exceeding 2 inches in dimension in the top 6 inches of the existing site grade shall be removed by hand or mechanical means. Removal methods shall minimize the disturbance of soils below 6 inches in depth. Clearing and grubbing shall conform to the Radiological Work Permit (RWP).

3.2.2 Reclamation Seeding and Mulching

The Contractor shall seed and mulch disturbed areas in accordance with Section 02930 of these specifications.

3.3 DISPOSAL OF WASTE AND DEBRIS MATERIALS

3.3.1 Organic Material

Organic materials, including grass, shrubs, stumps, roots, and other organic debris removed due to clearing activities, shall be transported by the Contractor to a stockpile/disposal site designated by the Operator. The stockpile/disposal site shall be located within ¼ mile of the project area. Organic material shall be stockpiled or disposed of as directed by the Operator.

3.3.2 Disposal

The Contractor shall remove all materials not designated for relocation, reuse, or salvage. These materials shall be disposed of or stockpiled as directed by the Operator.

3.4 DAMAGED AREAS

The Contractor shall confine clearing and grubbing operations to within those areas required for cover construction or as directed by the Operator. Any areas outside the designated areas that are damaged or disturbed by the Contractor's operations shall be reclaimed by the Contractor. Reclamation shall be in accordance with Section 02930 of these specifications.

3.5 ACCEPTANCE

Clearing and grubbing not in accordance with the requirements of this specification shall be repaired and/or replaced by the Contractor at the Contractor's expense. The Contractor shall submit a description of the repair and/or replacement methods to the Operator for approval before use. Acceptance criteria for repaired and/or replaced clearing and grubbing shall be in accordance with the requirements of this specification.

END OF SECTION

SECTION 02115

BIOINTRUSION BARRIER

PART 1 GENERAL

1.1 TOPOGRAPHIC SURVEY

A topographic survey shall be performed immediately prior to and after placement of the biointrusion barrier in order to document as-built conditions and elevations. Ground elevations shall be determined to the nearest 0.1 ft using conventional ground surveying techniques.

1.2 DESCRIPTION OF WORK

This section describes the requirements for placement of crushed rock directly on the subgrade layer for use as a biointrusion barrier to discourage small and large burrowing mammals from penetrating the cover. Crushed rock for use as a biointrusion barrier will be provided by the Operator in stockpiles located south of the MWL.

PART 2 BIOINTRUSION BARRIER MATERIAL

The biointrusion barrier material shall consist of crushed rock of stone size so that 50 percent of the fragments, by weight, shall be larger than the D_{50} = 4-inch size. The graded material shall be a mixture composed primarily of larger stone sizes but with a sufficient mixture of other sizes to fill the smaller voids between the larger rock fragments. The diameter of the largest rock fragment in such a mixture shall be 6 inches (1.5 times the D_{50} = 4-inch size).

PART 3 EXECUTION

3.1 PLACEMENT

The biointrusion barrier shall be placed in a single lift directly on the subgrade layer. The completed biointrusion barrier layer shall be a minimum of 1 ft in thickness and not exceed 1.25 ft in thickness.

3.2 COMPACTION

The biointrusion barrier material shall be compacted using heavy equipment approved by the Operator prior to use. Compaction shall consist of repeated passes over all areas where biointrusion barrier material has been placed until the crushed rock fragments are firmly locked in place. The compaction equipment shall be operated at a speed that prevents displacement of the biointrusion barrier material.

END OF SECTION

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SECTION 02200

EARTHWORK

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Work Included

The Contractor shall furnish all materials, labor, tools, and equipment for all types of earthwork to be performed during the construction activities in accordance with this specification and as shown in the design drawings. Earthwork includes grading and placement of all earthen cover materials, disposal of unsuitable materials, and reclamation of areas designated by the Operator.

1.1.2 Related Work Specified Elsewhere

1) Temporary Diversion and Control of Water during Construction shall be in accordance with Section 01563 of these specifications.

2) Clearing and Grubbing shall be in accordance with Section 02110 of these specifications.

3. The Biointrusion Barrier shall be placed in accordance with Section 02115 of these specifications.

4) Grades, Lines, and Levels shall be in accordance with Section 02210 of these specifications.

5) Trenching, Backfilling, and Compaction shall be in accordance with Section 02221 of these specifications.

6) Reclamation Seeding and Mulching shall be in accordance with Section 02930 of these specifications.

1.1.3 Work to be performed by the Operator and/or the CQA Engineer:

1) Review and approve submittals as required by this specification,

2) Review and approve results of quality assurance tests and surveying performed for compliance with this specification,

3) Document and monitor corrective actions,

4) Identify the acceptable borrow areas and soil stockpiles,

5) Have the option to approve all compaction equipment prior to use,

6) Have the option to inspect and approve surface conditions prior to placement of fill and crushed rock,

7) Have the option to inspect and approve all fill and crushed rock prior to placement, and

8) Have the option to perform final inspection and confirm acceptance of earthwork.

1.2 SUBMITTALS

1.2.1 Procedures, Certifications, and Records

The Contractor shall submit test results in accordance with the requirements of this specification and the MWL CQA Plan to the Operator and/or the CQA Engineer as soon as this information is available so that the Operator and/or the CQA Engineer can review work for compliance with the requirements of this specification and make CQA decisions in real-time.

1.3 QUALITY ASSURANCE

The Contractor shall prepare, maintain, and use a written QA/QC Manual for the work performed. The QA/QC Manual shall include requirements to ensure the application of the latest design documents and the incorporation of approved changes. As a minimum, the Contractor shall record and maintain appropriate data that verify the quality of materials, the application of approved procedures, and performance of tests and inspections. The Contractor shall maintain appropriate written approval signatures for acceptance of work performed.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIALS

2.1.1 Equipment

1) All equipment and tools shall comply with the safety requirements of the MWL Health and Safety Plan.

2) All equipment and tools used by the Contractor to perform the work shall be subject to inspection by the Operator before the work is started and shall be maintained in satisfactory working condition at all times. All compaction

equipment shall be inspected for acceptance by the Operator prior to the start of construction.

3) The Contractor's equipment shall be adequate for and have the capability to produce the requirements specified herein. Compaction equipment shall be appropriate to compact the fill as specified by the manufacturer.

2.1.2 Fill

Fill shall be from an Operator-designated soil stockpile or borrow area and shall be free of plants, rubble, litter, insect infestation, and other deleterious matter and be free of rocks larger than 2-inches in dimension.

1) Subgrade fill shall be obtained from the TA-3 borrow pits soil stockpile approximately 1.5 miles south of the MWL and be classified by the Unified Soil Classification System (USCS) as SM, SC as determined in accordance with ASTM D4318 and ASTM D2487. The Contractor shall screen Subgrade fill to conform to the following gradation:

Sieve Designation	Percent Passing
#10	80 - 100
#40	70 - 100
#200	20 - 40

2) Crushed rock for the biointrusion barrier shall be obtained from the stockpile south of the MWL. The material shall have a minimum dimension of 1 inch and be free of all fine material. The crushed rock will be free of organic material, soft and friable fragments, and other objectionable materials as determined by the Operator. The maximum fragment size of the biointrusion barrier shall be 6 inches with D_{50} = 6 inches, and each fragment shall have 100 percent fracture face.

3) Native Soil Layer fill shall be obtained from the TA-3 borrow pits soil stockpile approximately 1.5 miles south of the MWL and be classified by the Unified Soil Classification System (USCS) as SM, SC as determined in accordance with ASTM D4318 and ASTM D2487. The Contractor shall screen Native Soil Layer fill to conform to the following gradation:

Sieve Designation	Percent Passing
#10	80 – 100
#40	70 – 100
#200	20 – 40

4) Topsoil Layer soil shall be obtained from the TA-3 borrow pits soil stockpile approximately 1.5 miles south of the MWL and be classified by the Unified Soil Classification System (USCS) as SM, SC in accordance with ASTM D4318 and ASTM D2487. The Contractor shall screen Topsoil Layer fill to conform to the following gradation:

Sieve Designation	Percent Passing
#10	90 - 100
#40	85 - 100
#200	20 - 45

The Topsoil Layer fill shall be admixed with 3/8-inch, crushed gravel 25 percent by volume, before placing and grading. The gravel is to be clean with no more than 5 percent passing the #4 sieve.

5) Pre-acceptance QC testing of fill soils shall be in accordance with Section 3.4 of this specification. Acceptance of materials with variations from this classification will be evaluated by the CQA Engineer and the Operator.

PART 3 EXECUTION

3.1 PROTECTION AND SAFETY

The Contractor shall keep all operational areas adjacent to or part of this project usable at all times. The Contractor shall provide all necessary measures for the protection of the workers and the public, as per the standards established by the Operator or the Occupational Safety and Health Administration (OSHA).

3.1.1 The Contractor shall provide protection necessary to prevent damage to existing structures indicated in the design drawings or indicated by the Operator to remain in place. The Contractor shall restore damaged property to original condition, and obtain written approval of repairs from the Operator.

3.1.2 The Contractor shall clearly mark all laydown areas.

3.1.3 The Contractor shall mark or otherwise indicate the location of existing monuments and markers, and protect these structures before construction operations commence. The Contractor shall be responsible for the marking and/or protection of all necessary objects.

3.1.4 During earthwork operations, a representative of the Contractor shall be present at all times to observe work and notify the CQA Engineer and Operator immediately upon the discovery of any deviations from this specification.

3.2 EXISTING UTILITIES

3.2.1 There may be existing utilities within the limits of the construction or borrow areas. Known utilities shall be identified by the Operator and the utilities protected by the Contractor. The Operator shall be immediately notified of utilities not shown on the design drawings.

3.3 INSTALLATION OF COVER MATERIALS

3.3.1 General Requirements

1) The Contractor shall ensure that the stockpiling and handling of fill and crushed rock is confined within the limits of the designated work area. Stockpiling of clean imported material shall be confined to the Contractor's laydown and storage area as approved by the Operator. Stockpiled materials shall have stable slopes and be evenly graded and self-draining. Materials shall be stockpiled in such a way that any storm water can be controlled to prevent escape of excessive fill from the stockpile area.

2) The Contractor shall place all materials to the lines, grades, and elevations as shown in the design drawings and as specified in Section 02210 of these specifications.

3) The Contractor shall not begin placement of fill or crushed rock until after acceptance by the CQA Engineer and the Operator of the existing landfill surface or layer and placement conditions for all underlying layers.

4) The Contractor shall not place fill or crushed rock on frozen surfaces, in standing water, or when fill contains snow or ice.

5) The Contractor shall operate compaction equipment so that structures or underlying instrumentation are not damaged or overstressed during placement operations. The Contractor shall use hand-operated mechanical tampers for compaction of fill and crushed rock adjacent to wells or instrumentation wherever rolling compaction equipment is impractical for use.

6) The Contractor shall use placement methods which ensure the integrity of the underlying fill and crushed rock.

7) The Contractor shall slope temporary grades to direct water away from the construction area to reduce the potential for ponding of water. The Contractor shall provide erosion protection as specified in Section 01563 of these specifications.

8) Previously approved compacted subgrade, lifts, or layers disturbed by subsequent construction operations by the Contractor or adverse weather shall

be reworked to the required placement conditions specified herein or to the satisfaction of the CQA Engineer and Operator.

9) Application of water for dust suppression activities shall comply with Section 01563 of these specifications. Standing water will be minimized during dust suppression operations.

10) The Contractor shall ensure that unsuitable materials shall not enter the construction area.

3.3.2 Fill

1) The Contractor shall perform field-testing of the compacted materials in accordance with Section 3.4 of this specification. The Contractor shall submit results of the testing to the CQA Engineer and Operator for approval prior to placement of subsequent lifts.

2) The Contractor shall take care to avoid disturbance of the underlying lifts, layers, and instrumentation.

3) The Contractor shall reclaim borrow areas in accordance with Section 02930 of these specifications. Borrow areas shall be regraded to minimize erosion and sustain vegetation.

3.3.3 Existing Landfill Surface

1) The existing grade shall be prepared as required in Sections 02110 of these specifications.

2) The existing grade shall be scarified to a depth not to exceed 6 inches.

3) The contractor shall remove all rock and debris greater than 2 inches in dimension in preparation for compaction.

4) The Contractor shall moisten the soil to approximate optimum moisture (-2 to +2 percentage points) and compact/proof-roll the surface utilizing 10 passes of a roller. Depressions that are formed with the proof-rolling shall be filled with moistened, clean fill, and the filled area recompacted with 10 passes of the roller. The roller shall have a minimum total ballasted weight of 25 tons and a minimum pneumatic tire pressure of 90 psi. No proof rolling shall be allowed within a ~~2-ft~~ 3-ft radius of any groundwater monitoring well, measuring device, or other placed surface as designated by the Operator and/or CQA Engineer.

3.3.4 Subgrade

1) The TA-3 borrow pits , located approximately 1.5 miles south of the MWL, shall be used to obtain fill.

2) Subgrade fill may be stockpiled at an Operator-approved location at the MWL.

3) The Contractor shall remove all rock and debris greater than 2 inches in dimension from the fill.

4) The Contractor shall place the fill in maximum 8-inch loose lifts to attain maximum 6-inch compacted lift thickness.

5) The Contractor shall compact fill to not less than 90 percent of maximum dry density at -2 to + 2 percentage points of optimum moisture content, as determined by ASTM D698 (Standard Proctor testing).

6) The Contractor shall perform field-testing of the compacted fill in accordance with Section 3.4 of this specification. The Contractor shall submit test results to the CQA Engineer and Operator for approval prior to placement of subsequent lifts.

7) The Contractor shall take care to minimize disturbance to underlying lifts.

8) Lifts not compacted to the density and moisture content specifications or not meeting the requirements of this specification shall be reworked to the full depth of the lift and recompacted until the specifications are attained or the Operator accepts the placement conditions.

3.3.5 Biointrusion Barrier

1) The biointrusion barrier stockpile, located south of the MWL, shall be used to obtain crushed rock for the biointrusion barrier.

2) The biointrusion barrier shall be constructed using a graded, crushed rock. Crushed rock shall be of stone size so that 50 percent of the fragments, by weight, shall be larger than the D_{50} = 4-inch size. The graded material shall be a mixture composed primarily of larger stone sizes but with a sufficient mixture of other sizes to fill the smaller voids between the larger rock fragments. The diameter of the largest rock fragment in such a mixture shall be 6 inches (1.5 times the D_{50} = 4-inch size).

3) The Contractor shall place the crushed rock at a minimum of 1 ft in thickness and not exceed 1.25 ft in thickness.

4) The Contractor shall compact the crushed rock layer until the crushed rock fragments are firmly locked in place. Compaction equipment shall be operated at a speed that prevents displacement of the biointrusion barrier material.

3.3.6 Native Soil Layer

1) The TA-3 borrow pits , located approximately 1.5 miles south of the MWL, shall be used to obtain Native Soil Layer fill.

2) Native Soil Layer fill may be stockpiled at an Operator-approved location at the MWL.

3) The contractor shall remove all rock and debris greater than 2 inches in dimension from the fill.

4) The Contractor shall place the fill in maximum 8-inch loose lifts to attain maximum 6-inch compacted lift thickness.

5) The Contractor shall compact fill to not less than 90 percent of maximum dry density at -2 to + 2 percentage points of optimum moisture content, as determined by ASTM D698 (Standard Proctor testing).

6) The Contractor shall perform hydraulic conductivity testing on samples obtained from each lift as it is constructed. Samples shall be obtained by means of a thin-walled sample tube or equivalent sampling device in a manner that minimizes disturbance to the lift and in the direction perpendicular to the plane of compaction. Samples shall be sealed and carefully stored to prevent drying during storage and transport. Hydraulic conductivity testing shall be performed in the laboratory according to ASTM specifications for rigid wall testing.

7) The hydraulic conductivity of the samples from each lift shall have a target maximum value of 4.6×10^{-4} cm/s, the estimated hydraulic conductivity of the underlying natural soils. It is expected that approximately 5 percent of the hydraulic conductivity tests will fail to meet the target value of 4.6×10^{-4} cm/s. The failing samples shall have a hydraulic conductivity no greater than one-half order of magnitude above the target value.

8) The Contractor shall perform field-testing of the compacted fill in accordance with Section 3.4 of this specification. The Contractor shall submit test results to the CQA Engineer and Operator for approval prior to initiation of placement of subsequent lifts.

9) Lifts not compacted to the density and moisture content specifications or not meeting the requirements of this specification shall be reworked to the full

depth of the lift and recompacted until the specifications are attained or the Operator accepts the placement conditions.

3.3.7 Topsoil Layer

1) The TA-3 borrow pits , located approximately 1.5 miles south of the MWL, shall be used to obtain topsoil.

2) Topsoil may be stockpiled at an Operator-approved location at the MWL.

3) The topsoil shall be admixed with 25 percent, by volume, 3/8-inch crushed gravel.

4) The Contractor shall place topsoil in a minimum 8-inch loose lift.

5) Topsoil shall be minimally compacted to facilitate root development.

6) The Contractor shall take care to minimize disturbance to the underlying layer.

3.4 TESTING

3.4.1 General

The Contractor shall be responsible for the performance of all pre-acceptance and quality control testing. The Contractor shall submit test results in accordance with the requirements of this specification and the MWL CQA Plan to the Operator and/or the CQA Engineer as soon as this information is available so that the Operator and/or the CQA Engineer can review work for compliance with the requirements of this specification and make CQA decisions in real-time. Test results shall be provided from an approved independent soils testing laboratory.

3.4.2 Fill and Borrow Area Testing

The Contractor shall submit results for the following tests conducted during construction:

1) Subgrade Layer: Standard Proctor (ASTM D698), Gradation (ASTM C136), Classification (ASTM D2487 and D4318)

2) Native Soil Layer: Standard Proctor (ASTM D698), Gradation (ASTM C136), Classification (ASTM D2487 and D4318), Saturated Hydraulic Conductivity (ASTM rigid wall testing)

3) Topsoil Layer: Gradation (ASTM C136), Classification (ASTM D2487 and D4318)

The CQA Engineer and Operator shall review and accept submittals pertaining to testing prior to the transportation and placement of fill.

3.4.3 Field Placement Testing

The Contractor shall be responsible for the performance of all field testing and for confirmation of placement conditions. The Contractor shall submit all field test data for review and approval by the CQA Engineer and Operator. Table 3.1 outlines the material type, test methods, and test frequency for field placement activities.

3.5 INSPECTION

3.5.1 The Contractor shall be responsible for pre-operation, operation, and post-operation inspection during the performance of all work.

3.5.2 The Operator reserves the right to inspect all work for compliance with this specification.

3.6 ACCEPTANCE

The Contractor shall be responsible for documenting all test results and the number of compaction passes completed per lift. Placed materials not in accordance with the requirements of this specification shall be repaired and/or replaced by the Contractor. The Contractor shall submit a description of repair and/or replacement methods to the Operator for written approval before use. Acceptance criteria for repaired and/or replaced materials shall be in accordance with the requirements of this specification.

Areas that do not conform to the compaction specifications will be first investigated by the Contractor for the extent of the non-conformance. Areas that are of a different material type or that have failed the specifications after efforts to recompact the fill shall undergo additional testing regardless of the testing frequency guidelines. The Operator will determine when additional testing is required. Additional testing may include Standard Proctor and Gradation tests. Results of additional testing shall be submitted to the Operator for review. Following review of the testing results, the Operator shall determine whether a new moisture-density relationship curve shall be developed or if the Contractor shall continue to rework the non-conforming areas to meet specifications. If a new moisture-density relationship curve is produced for a change in soil type, all tests outlined in Table 3.1 shall be conducted for the new material type.

Final acceptance shall be explicitly detailed by survey location, layer description, material type, and lift number. A final report shall be submitted by the Contractor within 30 calendar days after final acceptance of the cover, detailing all field survey and quality control information performed during construction operations.

TABLE 3.1
Testing Methods and Frequencies for Borrow and Fill Areas

Item	Test Method	Frequency
Existing landfill surface	No Field Testing	Not applicable
Borrow Area Testing:		
Subgrade	Gradation (ASTM C136)	1/500 cubic yards
	Classification (ASTM D2487)	1/500 cubic yards
	Standard Proctor (ASTM D698)	1/500 cubic yards
Fill Area Testing:		
Subgrade	Field Density and Moisture Testing (ASTM D2922 and ASTM D3017)	5/acre/lift
Borrow Area Testing:		
Native Soil Layer	Gradation (ASTM C136)	1/500 cubic yards
	Classification (ASTM D2487 and D4318)	1/500 cubic yards
	Standard Proctor (ASTM D698)	1/500 cubic yards
Fill Area Testing:		
Native Soil Layer	K_{sat} (saturated hydraulic conductivity)	1/acre/lift
	Field Density and Moisture Testing (ASTM D2922 and ASTM D3017)	5/acre/lift
Borrow Area Testing:		
Topsoil Layer	Gradation (ASTM C136)	1/500 cubic yards
	Classification (ASTM D2487 and D4318)	1/500 cubic yards
Fill Area Testing:		
Topsoil Layer	No Field Testing	

END OF SECTION

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SECTION 02210

GRADES, LINES, AND LEVELS

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Work Included

The Contractor shall furnish all materials, labor, tools and equipment to perform surveying. The Contractor shall perform surveying to ensure that the proper grades, lines, and levels are established as set forth in these specifications and as shown in the design drawings. The Operator may procure an independent survey, provided by an independent firm registered in the State of New Mexico, to verify construction surveys. Construction surveys may be completed by the Contractor or an independent firm provided the work is completed under the supervision of a Registered Land Surveyor in the State of New Mexico.

1.1.2 Related Work Specified Elsewhere

1) Clearing and Grubbing shall be performed in accordance with Section 02110 of these specifications.

2) Earthwork shall be performed in accordance with Section 02200 of these specifications.

3) The Biointrusion Barrier shall be placed in accordance with Section 02115 of these specifications.

4) Trenching, Backfilling, and Compaction shall be performed in accordance with Section 02221 of these specifications.

5) Monitoring Well MW-4 Extension shall be performed in accordance with Section 02670 of these specifications.

1.1.3 Work to be performed by the Operator and/or CQA Engineer:

1) Review and approve submittals as required for this specification,

2) Provide Contractor with SNL/NM survey grid information,

3) Provide two benchmarks near the landfill, as shown in the design drawings,

4) Inspect work for compliance with the requirements of this specification in addition to inspection by the Contractor,

5) Verification of "as constructed" survey of the final cover closure surface,

6) Perform final inspection and confirm acceptance of surveying work.

1.2 REFERENCE DOCUMENTS

SNL/NM topographic grid and MWL design drawings.

1.3 SUBMITTALS

1.3.1 Procedures

1) The Contractor shall submit a plan for the work, including descriptions of survey equipment, procedures used to establish temporary or permanent benchmarks or measurements, field notes, calculations, reductions, closures, and documentation for any benchmarks or monuments to the Operator for approval.

2) Data shall be reduced and plotted by the Contractor in a form acceptable to the Operator. Legible notes, drawings, and reproducible documentation shall be submitted to the Operator for approval. The Contractor shall supply the following survey data to the Operator for approval:

   A) Topography map of final grade of each of the intermediate layers of the cover (Subgrade, Biointrusion Barrier, Native Soil Layer) with a contour interval of 0.5 feet and the location, as appropriate, of groundwater monitoring wells and instrumentation.

   B) Topography map of the final grade of the cover with a contour interval of 0.5 feet and the location, as appropriate, of groundwater monitoring wells and instrumentation.

3) All topography plats and all project benchmarks shall be based upon the SNL/NM grid. In addition to the above noted submittals, all plats shall also be submitted in electronic microstation or autocad format.

4) The Contractor shall not proceed with placement of an overlying layer or with subsequent work phases until the surveyor has completed the survey of the existing layer measurements and the data have been reviewed and accepted by the Operator.

1.3.2 Certifications

The Contractor shall submit a letter to the Operator after completion of the work specified herein, verifying conformance to the requirements identified in this specification. The letter shall be prepared and executed by a Professional Land Surveyor registered in the State of New Mexico.

1.3.3 Records

The Contractor shall submit to the Operator for information, all field notes from surveying and layout activities.

1.4 QUALITY ASSURANCE

The Contractor shall be responsible for protecting and maintaining all horizontal and vertical control points during construction.

1.4.1 Accuracy

Optical survey, tape measurement, and electronic measurement shall have a minimum accuracy of ± 0.1 feet in horizontal locations and ± 0.01 feet in elevations, or as superseded by criteria set forth in other sections of these specifications.

1.4.2 Tolerances

The Contractor shall survey all finished layers within the tolerances specified below:

Description	**Tolerances**
Subgrade:	-0.00 to +0.25 feet
Biointrusion Barrier	-0.00 to +0.25 feet
Native Soil Layer	-0.00 to +0.25 feet
Topsoil Layer	-0.00 to +0.25 feet

The Contractor shall ensure that no low points capable of retaining water are present in the final cover surface. If any low points are identified, the Contractor shall repair such locations.

PART 2 PRODUCTS

None.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 All surveying shall be recorded in the New Mexico State plane central zone NAD 27.

3.1.2 The Contractor shall check and verify that as-built thickness and elevations match those shown in the design drawings based on site benchmarks, and prepare as-built drawings of the cover.

3.1.3 The Contractor shall be responsible for controlling lift thickness and individual layer thickness such that overall cover thickness conforms to the specified tolerances. The Contractor shall be responsible for establishing, recording, protecting, and maintaining all permanent and temporary horizontal and vertical control benchmarks.

3.2 SURVEY MEASUREMENTS

3.2.1 Prior to commencement of construction work, the Contractor shall establish survey control at the construction area.

3.2.2 Survey control points shall be established so that any point within the construction area can be accurately re-established and elevations can be obtained to the required tolerances at any time during the course of construction. The Contractor shall verify all baselines, and horizontal and vertical control benchmarks stipulated in the information provided by the Operator.

3.3 ACCEPTANCE

3.3.1 Surveying work not in accordance with the requirements of this specification shall be repaired and/or replaced by the Contractor. The Contractor shall submit a description of the corrective action methods to the Operator for approval before use. Acceptance criteria for corrected actions shall be in accordance with the requirements of this specification.

3.3.2 In the event of a survey discrepancy, the area in question shall be re-surveyed and verified at no cost to the Operator.

END OF SECTION

SECTION 02221

TRENCHING, BACKFILLING, AND COMPACTING

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Work Included

The Contractor shall furnish all materials, labor, tools, and equipment to complete trenching, backfilling, and compacting necessary during construction activities for installing drainage swales.

1.1.2 Related Work Specified Elsewhere

1) Temporary Diversion and Control of Water during Construction shall be in accordance with Section 01563 of these specifications.

2) Clearing and Grubbing shall be in accordance with Section 02110 of these specifications.

3. The Biointrusion Barrier shall be placed in accordance with Section 02115 of these specifications.

4) Earthwork shall be in accordance with Section 02200 of these specifications.

5) Grades, Lines, and Levels shall be in accordance with Section 02210 of these specifications.

6) Reclamation Seeding and Mulching shall be in accordance with Section 02930 of these specifications.

1.1.3 Work to be performed by the Operator and/or CQA Engineer:

1) Review and approve data submittals required by this specification,

2) Have the option to perform final inspection and acceptance of trenching, backfilling, and compacting.

PART 2 GENERAL REQUIREMENTS

2.1 The Contractor shall be responsible for trenching, backfilling, and compacting.

2.2 The Contractor shall contain trenching, backfilling, and compacting operations within the designated areas, layers, and lifts as indicated in the design drawings. If conditions encountered warrant modification to the designated limits, the Operator shall be notified prior to proceeding.

2.3 The Contractor shall perform trenching, backfilling, and compacting operations in a manner that maintains drainage and control of water at all times, in accordance with Section 01563, Temporary Diversion and Control of Water during Construction.

PART 3 DRAINAGE SWALE EXCAVATION

3.1 The Contractor shall excavate the drainage swale to the required cross-section and grade shown in the design drawings.

3.2 The Contractor shall take care to avoid excavating the drainage swale below the grade indicated except where unsuitable materials are encountered as defined by the Operator. Areas where existing grade is less than that required in the design drawings shall be backfilled to grade.

3.3 The Contractor shall ensure positive drainage of the drainage swale.

3.4 The drainage swale shall be revegetated in accordance with Section 02930.

3.5 The drainage swale shall be maintained by the Contractor until final acceptance of the work.

PART 4 INSPECTION

4.1 The Contractor shall be responsible for in-process inspection during performance of all work.

4.2 In addition to inspection by the Contractor, the CQA Engineer and/or Operator shall inspect all work for compliance with the requirements of this specification.

PART 5 ACCEPTANCE

Trenching, backfilling, and compacting not in accordance with the requirements of this specification shall be repaired or replaced by the Contractor. The Contractor shall submit a description of the repair and/or replacement methods for work not in compliance with this specification to the Operator for written approval before use. Acceptance criteria for repaired and/or replaced trenching, backfilling, and compacting shall be in accordance with the requirements of this specification.

END OF SECTION

SECTION 02445

ADMINISTRATIVE CONTROL FENCES AND GATES

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Work Included

The Contractor shall furnish all materials, labor, tools, and equipment to construct administrative control fences and gates in accordance with this specification and as shown in the design drawings. Fence material shall be produced and installed by methods recognized as good commercial practices.

1.1.2 Work to be performed by the Operator and/or CQA Engineer:

1) Review and approve data submittals required by this specification;

2) Have the option to inspect work for compliance with the requirements of this specification, in addition to inspection by the Contractor;

3) Have the option to review pre-installation conditions, installation, and other job conditions during performance of the work, and;

4) Have the option to perform final inspection and confirm acceptance of administrative control fences and gates.

1.2 REFERENCE DOCUMENTS

None.

1.3 SUBMITTALS

1.3.1 Data

The Contractor shall submit the proposed administrative control fence, gate, and sign materials to the Operator for written approval prior to procurement.

1.3.2 Test Reports

None.

1.3.3 Procedures

The Contractor shall submit a description of methods for repair and/or replacement of administrative control fences and gates that are not in accordance with the requirements of this specification to the Operator for written approval before use.

1.3.4 Certifications

The Contractor shall submit a letter to the Operator verifying conformance to the requirements identified in this specification and as shown in the design drawings.

1.3.5 Records

1) The Contractor shall submit records of inspection to the Operator after completion of the inspection. Inspection records shall include on-site inspection records of the administrative control fences and gates.

2) The Contractor shall submit to the Operator for information all field notes from surveying and layout activities after completion of these activities.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIAL REQUIREMENTS

2.1.1 General

1) Administrative control fences shall be strand barbed wire with tee posts driven into the ground and steel corner posts set in concrete.

2) All fence materials shall be galvanized in accordance with ASTM A123, A384, and A385.

3) All fence items shall be the product of an established fence manufacturer.

2.2.2 Barbed Wire

1) Barbed wire shall conform to ASTM A121 with a Class 1 coating.

2) Fence shall consist of 3 horizontal runs of barbed wire spaced as shown in the design drawings.

3) Barbed wire shall be No. 12-1/2 gauge, 2-strand, copper-bearing, hot-galvanized steel wire with large, four-point-pattern, hard-tempered, round barbs spaced 5 inches apart.

4) Tie wires for fastening barbed wire to steel posts shall be No. 12 gauge copper-bearing steel wire. Tie wires shall be heavily galvanized by the hot-dip process.

5) Stays shall be No. 9 gauge copper-bearing steel wire conforming to the requirements of ASTM A116. Stays shall be 42 inches long.

2.2.3 Posts

1) End and corner posts shall be nominal 2-1/2-inch diameter standard galvanized pipe per ASTM A53, Type S, Grade B, or Operator approved equivalent.

2) Tee posts shall be fabricated from rail, billet, or commercial grade steel which conforms to the requirements of ASTM A702.

2.2.4 Gates

1) All gates, hardware, and accessories for installation of the gates shall be furnished and installed by the Contractor.

2) Hinges shall be pivot-type, galvanized and industry standard size to suit gate size as shown in the design drawings. Hinges shall be non-lift-off type and offset to permit 180-degree gate opening. Each gate leaf shall be provided with 2 hinges.

3) Gates shall be galvanized high carbon-welded, 2-inch diameter, tubular steel 40 inches high, or Operator approved equal, with internal bracing. Gate fabric shall be No. 14 gauge copper-bearing open-hearth steel wire, woven in a 2-inch by 4-inch mesh, and heavily galvanized by the hot-dip process after weaving.

4) Gate posts shall be nominal 2-1/2-inch diameter standard galvanized steel pipe.

2.2.5 Bracing

All end and corner posts shall be braced by means of diagonal trusses. Trusses shall be hot-galvanized 3/8-inch steel rod complete with turnbuckles.

PART 3 EXECUTION

3.1 FOOTINGS

3.1.1 General

1) All corner and end posts shall be set and centered in a concrete encasement to the diameters and depths shown in the design drawings.

2) Concrete footings shall be neatly domed off at the finish grade line to shed water from the posts.

3) Concrete shall have a minimum 28-day strength of 3000 psi.

3.2 ERECTION OF FENCING

3.2.1 General

1) The Contractor shall assemble and erect fences and gates as specified herein and in the design drawings, and in accordance with detailed instructions furnished by the fence manufacturer.

2) Where necessary, the Contractor shall adjust the grade of the fence to fit the contour of the ground. The Operator shall be notified prior to any grading of surface soils.

3.3 ACCEPTANCE

Installation of fences and gates not in accordance with the materials and method requirements of this specification shall be repaired and/or replaced by the Contractor. The Contractor shall submit the repair and/or replacement methods to the Operator for written approval before use. Acceptance criteria for repaired fences and gates shall be in accordance with the requirements of this specification.

END OF SECTION

SECTION 02670

MONITORING WELL MW-4 EXTENSION

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Work Included

The Contractor shall furnish all labor, tools, and equipment necessary to extend groundwater monitoring well MW-4 in accordance with this specification and as shown in the design drawings. The Operator shall provide the Contractor with the materials necessary for extension of monitoring well MW-4.

1.1.2 Related Work Specified Elsewhere

Trenching, Backfilling, and Compaction shall be performed in accordance with Section 02221 of these specifications.

1.1.3 Work to be performed by the Operator and/or CQA Engineer:

1) Review and approve submittals as required by this specification,

2) Inspect and approve existing conditions prior to extension of monitoring well MW-4.

3) Perform final inspection and confirm acceptance of monitoring well MW-4 extension.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIAL REQUIREMENTS

2.1.1 General

The components, materials, and configuration required for monitoring well extension are shown in the design drawings.

PART 3 EXECUTION

3.1 Monitoring Well MW-4 Extension

1) The Contractor shall remove the existing MW-4 concrete pad, stanchions, protective casing, and locking top cap prior to initiation of construction activities.

2) The Contractor shall complete the well extension utilizing acceptable PVC construction techniques before or during cover construction, whichever is most convenient and practical.

3) Existing MW-4 Schedule 80 PVC well casing shall be extended such that the top of the PVC well casing is located a minimum of 2' - 6" above the final grade of the constructed cover.

4) Only hand-operated compaction equipment shall be used to compact soils around the extended well casing as each lift is placed during cover construction.

5) The concrete pad, protective casing, and locking top cap shall be refitted to its original configuration, consisting of steel cover, locking top cap, and concrete pad.

6) The final location and elevation of the top of the new PVC well casing and four corners of the concrete pad shall be surveyed. The results of the survey shall be retained for future use to prepare as-built drawings.

3.2 INSPECTION

3.2.1 The CQA Engineer and Operator shall be responsible for in-process inspection during performance of all work.

3.2.2 Monitoring well extension not in accordance with the requirements of this specification shall be repaired or replaced by the Contractor. The Contractor shall submit a description of the repair and/or replacement methods for work not in compliance with this specification to the Operator for written approval before use. Acceptance criteria for repaired and/or replaced monitoring well extension shall be in accordance with the requirements of this specification.

END OF SECTION

SECTION 02930

RECLAMATION SEEDING AND MULCHING

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Work Included

The Contractor shall furnish all labor, materials, tools and equipment, and shall place seed and mulch in accordance with this specification and as indicated in the design drawings. This section describes the Contractor's requirements to provide a final vegetated surface in those areas designated herein. These designated areas shall be seeded and mulched as set forth in this section.

1.1.2 Work to be performed by the Operator and/or CQA Engineer:

1) Review and approve submittals as required by this specification,

2) Have the option to inspect equipment, work, and materials for compliance with the requirements of this specification, in addition to inspection by the Contractor,

3) Have the option to review pre-seeding conditions and other related job conditions during performance of the work, and,

4) Have the option to perform inspection and acceptance of the final vegetated surfaces.

1.2 REFERENCE DOCUMENTS

City of Albuquerque, Specification 1012, Native Grass Seeding

Biological Assessment for the Sandia National Laboratories Coyote Canyon Test Complex, Kirtland Air Force Base, Albuquerque, New Mexico, July 1992

Vegetation Study in Support of the Design and Optimization of Vegetative Soil Covers, Sandia National Laboratories, Albuquerque, New Mexico, SAND2004-6144.

1.3 SUBMITTALS

1.3.1 Procedures

The Contractor shall submit a Seeding and Mulching Plan to the Operator for written approval after notice to proceed. The plan shall describe the methods of placement and the equipment to be used during operations.

1.3.2 Certification

1) The Contractor shall submit the seed vendor's certified statement for the seed mixture required, stating scientific and common names, percentages by weight, and percentages by purity and germination.

2) The Contractor shall submit a letter to the Operator verifying conformance to the requirements identified in this specification after completion of the work specified herein.

1.3.3 Records

The Contractor shall submit records of inspection to the Operator after completion of the inspection.

PART 2 PRODUCTS

2.1 GENERAL

Seed, fertilizer, mulch, and equipment shall be inspected upon arrival at the job site by the Operator and/or CQA Engineer for the conformity to type and quality in accordance with these requirements. Unacceptable materials shall be removed from the job site by the Contractor.

2.2 EQUIPMENT AND MATERIAL REQUIREMENTS

2.2.1 Seed Mix for Cover and Reclaimed Areas

Seed shall be labeled in accordance with USDA rules and regulations under the Federal Seed Act. Seed shall be furnished in sealed bags or containers clearly labeled to show the name and address of the supplier, the seed name, the lot number, net weight, origin, the percentage of weed seed content, the guaranteed percentage of purity and germination, pounds of live seed of each seed species, the total pounds of pure live seed in the container, and the date of the last germination test which shall be within a period of 6 months prior to commencement of planting operations. Seed shall be from a current or previous year's crop.

The following seed mixture shall be used:

Species	**(lb/acre pure live seed)**
Galleta grass	8.0
Black grama	6.0
Spike dropseed	3.0
Ring muhly	3.0
Total rate:	20 lb/acre

2.2.2 Fertilizer

A starter fertilizer containing nitrogen, phosphorous, potassium, and sulfur shall be used. A 20-20-0-22 shall be acceptable.

2.2.3 Mulch

The Contractor shall furnish all labor, materials, tools and equipment to place a grain straw (wheat, oats, or barley) mulch on the reclaimed areas. The straw mulch shall be applied at the rate of 2 tons/acre. The straw mulch shall be clean, free of seed, and free of noxious weeds.

2.2.4 Equipment

The Contractor shall provide appropriate types of equipment for the performance of drill seeding and mulch spreading. Seeding of the grass species shall be performed with a rangeland grass drill equipped with multiple seed bins, depth bands, and press wheels. Drills shall have agitators to prevent the seed from segregating and lodging in the seed box. The depth bands should be suitable for placing the seed at a depth that does not exceed 1/2 inch.

Mulch crimping equipment shall properly crimp the straw without cutting the straw. Discing equipment shall not be used.

2.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

2.3.1 Delivery

The Contractor shall deliver seed to the site in the original, unopened containers bearing the container labels or tags stating the producer's guaranteed statement of analysis.

2.3.2 Storage

Materials shall be stored in areas designated by the Operator. Seed shall be stored in cool, dry locations away from contaminants and in accordance with manufacturer's recommendations. Storage times shall not exceed manufacturer's recommendations.

2.3.3 Handling

Except for bulk deliveries, the Contractor shall not drop or dump materials from vehicles.

PART 3 EXECUTION

3.1 APPLICATION PROCEDURES

3.1.1 Topsoil Preparation

Prior to seeding, the Contractor shall till the top 3 inches of the surface into an even and loose seed bed, free of clods in excess of 4 inches in dimension, and bring the tilled surface to the desired line and grade. The area to be seeded shall be free of erosion rills and gullies.

3.1.2 Seeding

1) ~~The Contractor shall seed the constructed cover, laydown and stockpile areas, drainage swale, and other locations impacted by construction activities. The TA-3 borrow pits shall not be seeded.~~ Once the MWL cover has been constructed and the TA-3 borrow pits are no longer required for environmental restoration activities, they may be transferred over to Sandia Facilities for continued use at Sandia. However, if the TA-3 borrow pits are not needed by Facilities, they will be seeded and reclaimed.

2) The Contractor shall apply the seed mix uniformly to the prepared surface by means of drill seeding at not less than the minimum rate specified in Part 2.2.1 of this specification.

3) Seed shall be uniformly drilled to a maximum depth of 1/2 inch using equipment specified in Part 2.2.4 of this specification.

4) The Contractor shall seed in a pattern perpendicular to the slope, working from the top of the slope down and using row markers to indicate seeded areas.

5) The Contractor shall seed the grass mixture in either the spring or fall. Spring seeding shall be performed after the chances of freezing temperatures have passed. Fall seeding shall be performed before the ground is frozen and covered with snow and after the time temperatures would cause germination.

6) The stand of grass resulting from the seeding shall not be considered satisfactory until accepted by the Operator. The Contractor shall provide a one-year warranty to assure the stand of grass from the seeding. If areas are

determined to be unacceptable, the unacceptable areas shall be reseeded in accordance with these specifications.

3.1.3 Fertilizer

Fertilizer shall be placed at a spreading volume of 10 lb/acre unless otherwise specified by the Operator.

3.1.4 Mulch

Mulch shall be straw spread uniformly at a rate of 2 tons/acre immediately following seeding. Mulch shall be anchored into the soil to a depth of at least 2 inches with no more than one pass of the crimping equipment. The crimping operation shall proceed perpendicular to the slope so as not to encourage the formation of rivulets down slope. Mulching shall not be performed when wind interferes with placement.

3.2 MAINTENANCE

3.2.1 General

1) Maintenance of the constructed cover, laydown and borrow areas, drainage swale, and other locations impacted by construction activities during seeding shall be provided by the Contractor.

2) Areas damaged by the Contractor during seeding shall be repaired and reseeded by the Contractor at the Contractor's expense.

3.3 ACCEPTANCE

Seeding and mulching not in accordance with the requirements of this specification shall be repaired and/or replaced by the Contractor. The Contractor shall submit a description of the repair and/or replacement methods to the Operator for written approval before use. Acceptance criteria for repaired and/or replaced seeding or mulching shall be in accordance with the requirements of this specification.

END OF SECTION

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APPENDIX B
Construction Quality Assurance Plan

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ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
CQA	construction quality assurance
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
QC	quality control
Sandia	Sandia Corporation
SCA	Soils Contamination Area
SCR	Sandia Construction Representative
SNL	Sandia National Laboratories/New Mexico

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1.0 INTRODUCTION

A construction quality assurance (CQA) Plan is essential for determining, with a reasonable degree of certainty, whether a completed final cover meets or exceeds all design criteria, plans, and specifications. This document presents the various controls established by the CQA Plan for construction of the Mixed Waste Landfill (MWL) alternative cover at Sandia National Laboratories/New Mexico (SNL). It should be recognized that the management of construction quality involves using scientific and engineering principles and practices to verify that the alternative cover to be constructed meets or exceeds design criteria, plans, and specifications. This management activity begins prior to construction, continues throughout construction, and ends when the alternative cover is accepted by the New Mexico Environment Department (NMED).

1.1 Concept and Objectives of the CQA Plan

The governing purpose for the CQA Plan is to verify that the MWL alternative cover is constructed as specified in the design. To verify proper construction, the following objectives must be met:

- Guidelines and requirements in design drawings and construction specifications are followed
- Inspection and verification testing throughout construction to verify that design features are implemented as intended
- Evaluation of variances to the design and their effects upon system performance
- Complete documentation demonstrating that the design has been implemented and that performance requirements have been met.

In meeting these objectives, the following are defined as part of the CQA Plan:

- Quality-related qualifications, responsibilities, and authorities of personnel
- Controls for the procurement of services and materials
- Direction for necessary inspections and verification testing during construction so that execution of the design documents can be confirmed. Acceptance criteria for the inspections and testing are also included
- Provision for team communication throughout construction so that the work progresses as an organized, planned sequence of events which allows revision and change
- Direction for the preparation and maintenance of records so that it can be demonstrated that the construction was performed in accordance with design requirements.

An audit system will be established to provide evaluation of the implementation of the design drawings and construction specifications, the CQA program, and work areas and activities including materials and workmanship.

1.2 Basis of the CQA Plan

The following sources have been used as guidance in the preparation of the CQA Plan:

- U.S. Environmental Protection Agency (EPA), Technical Guidance Document, "Quality Assurance and Quality Control for Waste Containment Facilities," Report No. EPA/600/R-93/182, September 1993
- EPA, Design and Construction of RCRA/CERCLA Final Covers, EPA/625/4-91/025, May 1991
- New Mexico Administrative Code Title 20, Chapter 4, Part 1, Subpart V
- SNL, Mixed Waste Landfill Voluntary Corrective Measures Plan, July 2005

1.3 Presentation of the CQA Plan

The CQA Plan contains general direction for the control of construction activities, such as the definition of organizational responsibilities and authorities, CQA personnel qualifications, and specific technical information, such as execution guidance and verification tests to be performed throughout construction.

Inspection checklists have been developed for use by CQA personnel to document the inspection and verification requirements in the CQA Plan. These checklists will be completed and signed by CQA Inspectors and will be reviewed by the CQA Engineer. The checklists will become part of the final construction report, documenting the CQA process throughout construction. Examples of these checklists are included in Attachment B1 of this Plan.

Whenever possible, nationally recognized test methods such as those published by the American Society for Testing and Materials (ASTM) will be utilized. In general, recognized standards will be cited only by reference and not included verbatim. If a test method is not a nationally recognized standard, the test method will be defined, including criteria for acceptability.

2.0 RESPONSIBILITY AND AUTHORITY

The principal organizations involved in construction of the SNL MWL alternative cover include:

- NMED (Lead Regulatory Agency)
- U.S. Department of Energy (DOE) (Owner/Operator)
- Sandia Corporation (Sandia) (Designer and Operator)

- CQA Contractor
- Construction Team or Contractor
- Testing Laboratory

The areas of responsibility and lines of authority are delineated in the following sections such that the lines of communication are established to effectively implement the CQA Plan. An organizational chart for the project during cover construction is shown in Figure B-1.

2.1 Review/Permitting Agency

The NMED, the lead regulatory agency, has the authority to review the MWL alternative cover design and approve construction of the cover. It is the responsibility of the NMED to review the Operator's site-specific CQA Plan for compliance with the agency's regulatory requirements, and to review all CQA documentation during and/or after construction of the cover to confirm that the CQA Plan was followed and that the cover was constructed as specified.

2.2 DOE (Owner/Operator)

The DOE and Sandia have responsibility for compliance with the regulatory requirements of the NMED in order to obtain approval of the MWL alternative cover design and assure the NMED, by the submission of CQA documentation, that the cover was constructed as specified in the approved design. The DOE also has the authority to accept or reject design drawings and construction specifications, the CQA Plan, reports and recommendations of the CQA Engineer, and the materials and workmanship of the Construction Contractor (see Table 3.1 of Construction Specification 02200).

2.3 Sandia (Designer and Operator)

Sandia's primary responsibility is to design and specify an alternative cover that fulfills the closure needs of the Owner and the regulatory requirements of the NMED. Design activities may not end until the cover is completed. Revisions to the design may be required if unexpected site conditions are encountered or changes in construction methodology occur that could adversely affect cover performance. The CQA program provides assurance that these unexpected changes or conditions will be detected, documented, and addressed during construction.

Sandia has the authority to select and dismiss the organizations responsible for the CQA and construction activities. Responsibilities and authority of Sandia include formulating and implementing the CQA Plan, periodic review of CQA documentation, modifying construction site activity, and specifying corrective measures in cases where deviation from the approved design or failure to meet design criteria, plans, and specifications is identified by CQA personnel. Sandia will have a Construction Representative (Sandia Construction Representative [SCR]) on site to coordinate and oversee all construction-related activities.

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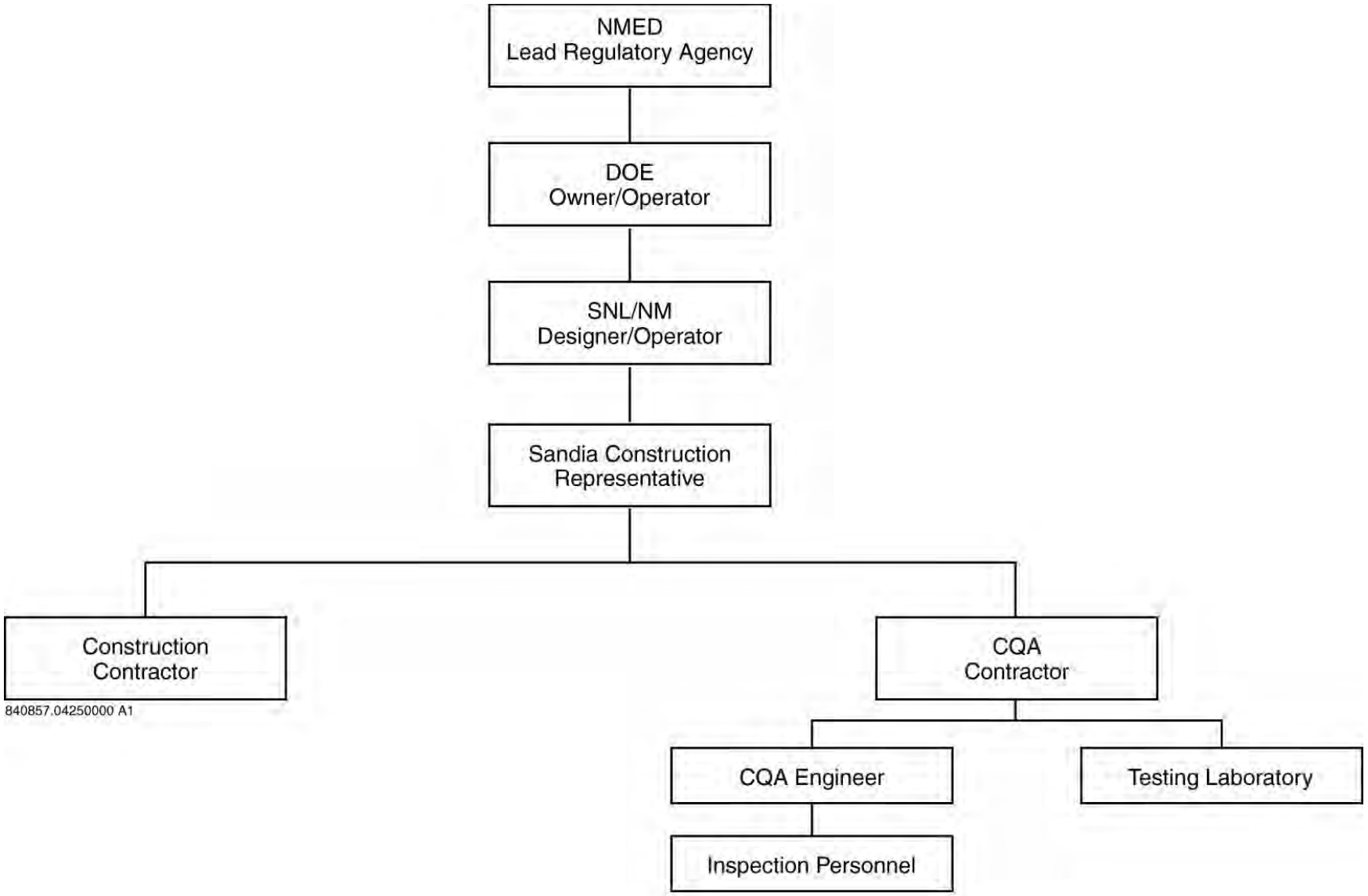

Figure B-1 Organizational Chart, SNL Mixed Waste Landfill Alternative Cover Construction

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2.4 Sandia Construction Representative (Owner's Representative)

The Sandia Construction Representative (SCR) will report directly to Sandia and has the following responsibilities:

- Overall coordination of construction activities
- Oversee implementation of the CQA Plan
- Notify the CQA Contractor, and the Construction Contractor of any nonconformances observed
- Approve changes and notify other personnel, as appropriate, of the changes
- Ensure that inspections and verification tests performed by the CQA Contractor are conducted at required intervals and in accordance with the CQA Plan
- Review as-built drawings, results of inspections, and field and laboratory data from verification testing
- Stop work if conditions adverse to quality are persistent, and ensure that conditions are corrected before proceeding
- Maintain construction documents and records after transfer from the CQA Contractor.

2.5 Construction Team or Contractor

It is the responsibility of the Construction Team or Contractor, hereinafter referred to as the "Contractor," to construct the MWL alternative cover in strict accordance with the design criteria and drawings, construction specifications, and CQA Plan using the necessary construction procedures and techniques.

2.6 CQA Contractor

The overall responsibility of the CQA Contractor is to perform those activities specified in the CQA Plan (e.g., inspection, sampling, and documentation). At a minimum, the CQA Contractor will include a CQA Engineer and the necessary supporting CQA inspection personnel. Specific responsibilities and authority of the CQA Contractor's personnel are defined clearly below and in the associated contractual agreements with the Owner.

2.6.1 CQA Engineer

Specific responsibilities of the CQA Engineer include, but are not limited to, the following:

- Review of design criteria and drawings, and construction specifications for clarity and completeness so that the CQA Plan can be implemented

- Educate CQA inspection personnel on CQA requirements and procedures
- Schedule and coordinate CQA inspection activities
- Direct and support the CQA Inspectors in performing observations and tests by:
  - Confirming that regular calibration of testing equipment is properly conducted and recorded
  - Confirming that the testing equipment (e.g., nuclear density gauge), personnel, and procedures do not change over time or making sure that changes do not adversely impact the inspection process
  - Confirming that the test data are accurately recorded and maintained (this may involve selecting reported results and backtracking them to the original observation and test data sheets)
  - Verifying that the raw data are properly recorded, validated, reduced, summarized, and interpreted
  - Ensuring that construction CQA testing is conducted at the proper frequency.
- Maintain CQA-related documents, including but not limited to the CQA Plan, field notes, meeting notes, test results, and miscellaneous reports
- Provide the SCR with recommendations and reports on the inspection results including:
  - Review and interpretation of data sheets, as-built drawings, and reports
  - Identification of work that will be accepted, rejected, or uncovered for observation, or that may require special testing, inspection, or approval
  - Verification that corrective measures are implemented.
- Report nonconformances to the SCR
- Report to the SCR activities that are adverse to overall quality
- Document nonconformances
- Work with the SCR and the Construction Contractor to resolve problems prior to and during cover construction phases.

2.6.2 CQA Inspection Personnel

The CQA Inspectors will provide day-to-day inspections and field verification tests. Their role is critical to successful demonstration of construction procedures and required documentation. Their major responsibilities include:

- Performing independent on-site inspection of the work in progress to assess compliance with cover design criteria and drawings, and construction specifications
- Inspect delivery tickets and manufacturers quality control (QC) reports to verify that materials meet construction specifications
- Verifying that the equipment used in testing meets the test requirements and that the tests are conducted in accordance with standardized procedures defined by the CQA Plan
- Collecting samples in the field for subsequent verification testing by off-site laboratories. CQA testing will be conducted at a frequency of at least 5% of that done by the Construction Contractor
- Reporting to the CQA Engineer results of all inspections including work that is not of acceptable quality or that fails to meet the specified design criteria
- Reporting of nonconformances, as appropriate, to the construction foremen, superintendents, or manager if correction can be made during the normal course of work
- Reporting of nonconformances to the CQA Engineer if correction cannot be readily achieved to the satisfaction of the CQA Inspector, so that resolution can be accomplished by the CQA Engineer
- Reporting to the CQA Engineer any activities which are adverse to overall quality and any nonconformances which are recurring
- Documenting nonconformances
- Reporting to the CQA Engineer any changes in the design drawings and/or construction specifications
- Documenting inspection and verification testing activities through the completion of specified forms and daily logs.

2.6.3 CQA Certifying Engineer

The CQA Certifying Engineer is responsible for certifying to the Owner and the NMED that, in his or her opinion, the cover has been constructed in accordance with all plans and specifications, and certifying the CQA document has been approved by the NMED. The certification statement is normally accompanied by a final CQA report that contains all the appropriate documentation, including daily observation reports, sampling locations, test results,

drawings of record or sketches, and other relevant data. The CQA Certifying Engineer may be the CQA Engineer or someone else in the CQA Engineer's organization that is a registered professional engineer with experience and competency in certifying like installations.

2.7 Testing Laboratory

The testing laboratory will have its own internal QC plan to verify that the laboratory procedures conform to the appropriate ASTM standards or other applicable testing standards. The testing laboratory is responsible for ensuring that tests are performed in accordance with applicable methods and standards, internal QC procedures are followed, sample chain-of-custody records are maintained, and data are effectively and accurately reported. The testing laboratory must be willing to allow the Operator, CQA Engineer, or the NMED to observe the sample preparation, testing procedures, or record-keeping procedures, if they so desire. The Operator, CQA Engineer, or the NMED may request that they be allowed to observe some or all tests on a particular job at any time, either announced or unannounced. The testing laboratory personnel must be willing to accommodate such a request, but the observer will not interfere with the testing or slow the testing process.

3.0 PERSONNEL QUALIFICATIONS

The key individuals involved in CQA and their minimum recommended qualifications are listed in Table B-1.

Table B-1
Recommended Personnel Qualifications

Individual	Minimum Recommended Qualifications
Sandia Construction Representative	The specific individual designated by the Owner with knowledge of the project, its plans, specifications, and Quality Assurance/Quality Control documents.
CQA Engineer	Employed by an organization that operates separately from the Construction Contractor and Owner/Operator; registered Professional Engineer.
CQA Inspectors	Employed by an organization that operates separately from the Construction Contractor and the Owner/Operator; experienced in performing the appropriate field tests and making observations during construction activities.
CQA Certifying Engineer	Employed by an organization that operates separately from the Construction Contractor and Owner/Operator; registered Professional Engineer in the State of New Mexico.

4.0 PROJECT COMMUNICATIONS

Communication between CQA program participants is crucial. Required reporting to program participants is necessary so that activities can be reviewed and work can proceed. Communications in the form of construction documents, inspection reports, audit reports, verification test results, and daily logs must be timely so that reviews and evaluations can take place.

Throughout this Plan, required report preparation and the individuals responsible for distribution, review, and approval are cited.

4.1 Meetings

Meetings will be held throughout the course of construction. Following are discussions of three specific meeting formats.

4.1.1 Preconstruction Meeting

Prior to the start of construction of the MWL alternative cover, a Preconstruction Meeting will be held to review and acquaint personnel with the requirements of the CQA Program, design drawings, and construction specifications. The Preconstruction Meeting will include a tour of the MWL, borrow areas, and access routes. The meeting will be led by the SCR and the CQA Engineer. Attendance at the meeting is required of all key personnel involved in the project. Meeting notes will be prepared by the CQA personnel and will be maintained in the on-site records system. If any subcontractors arrive on site after construction begins and the preconstruction meeting has been held, the SCR and CQA Engineer will meet with those subcontractors to review appropriate activities of their work. These meetings will be documented as well.

The preconstruction meeting should present the following:

- Organization
- Schedule
- Review requirements of the design drawings and construction specifications
- MWL Health & Safety Plan
- Review requirements of the CQA Program including:
  - Responsibilities and authority of specific personnel such as the CQA Inspectors and the SCR
  - Inspection and verification testing methods, frequencies, and acceptance criteria

— A review of required documentation and operation of the on-site records system

— A discussion of potential nonconformances, the resolution of any such nonconformances, and the responsibility of all personnel to bring nonconformances to the CQA Engineer

— A discussion of the procedure for changes to design drawings and construction specifications and the means for review and approval.

4.1.2 Progress Meetings

Progress meetings will be held at the request of the SCR and should include, as appropriate, members of the Construction Contractor personnel, and the CQA personnel. Progress meetings will be documented in the form of meeting notes prepared by the CQA personnel. These notes will be maintained in the on-site construction and/or CQA records system.

The purpose of the progress meeting is to:

- Review activities and accomplishments
- Review the work location and activities
- Identify the Construction Contractor's personnel and equipment assignments
- Discuss any potential construction problems.

4.1.3 Quality Resolution Meetings

Special meetings may be called by Owner, the Operator, the SCR, or the CQA Engineer to discuss activities adverse to construction quality and to define resolution. It is intended that these meetings be called to discuss quality problems that cannot be readily resolved, or those that continue to be ongoing or recurring.

The purpose of this meeting is to:

- Define and discuss the quality-related problems
- Review appropriate solutions
- Implement a plan to resolve any quality-related problems that have been defined.

Resolution of quality-related problems will be approved by the Operator and/or the SCR, as appropriate. A member of the CQA personnel will prepare meeting notes.

5.0 ALTERNATIVE COVER—OBSERVATIONS, INSPECTION ACTIVITIES, AND TESTS

The alternative cover design for the MWL includes up to 40 inches of compacted subgrade; a 1.0-foot biointrusion barrier; 2.5 feet of compacted native soil fill; and a maximum 8-inch, minimally compacted topsoil layer containing 25% by volume 3/8-inch crushed gravel. The final cover will be seeded with native grasses, mulched and crimped. The layers of the cover in descending order are as follows:

- A maximum 8-inch, minimally compacted topsoil layer containing 25% by volume 3/8-inch crushed gravel
- 2.5 feet of compacted native soil
- A 1.0-foot, compacted biointrusion barrier containing 1.0-in. to 6.0-in. crushed rock
- Up to 40 inches of compacted subgrade.

5.1 Earthwork

This section specifies the observations, inspections and tests necessary to control, verify, and document that the earthwork for the MWL alternative cover conforms to the design drawings and construction specifications.

Earthwork activities include:

- Clearing, grubbing, and compaction of existing MWL surface and perimeter
- Placement and compaction of subgrade fill
- Placement and compaction of biointrusion barrier
- Placement and compaction of native soil layer fill
- Placement and minimal compaction of topsoil layer.

In order to verify proper CQA, inspection checklists have been developed for use by CQA personnel. The checklists will be completed and signed by CQA Inspectors and will be reviewed by the CQA Engineer to ensure that construction of the cover was according to design drawings and construction specifications. The checklists will become part of the final construction report, documenting the CQA process throughout construction. Examples of the inspection checklists for each phase of cover construction are included in Attachment B1 of this Plan. Attachment B1 inspection sheets may be modified as needed to enhance CQA.

5.1.1 Existing Landfill Surface

The alternative cover will extend beyond the MWL fenced perimeter as shown in the design drawing plates. Appropriately, the existing surface and perimeter of the MWL will be cleared, grubbed, and compacted to provide a stable surface for the final cover and side slopes.

5.1.1.1 Observations and Inspections

CQA personnel will perform the following observations and inspections during the preparation of the MWL surface and perimeter:

- Ensure that the MWL surface and perimeter has been cleared of all vegetation, organic matter, rubble, trash, and deleterious material. Rocks larger than 2 inches in dimension will be removed
- Ensure that any loose or soft zones have been appropriately compacted.
- Observe coverage and number of passes by compaction equipment.

5.1.1.2 Laboratory Tests

The Operator will provide archived laboratory data for use in preparation of the existing MWL surface and perimeter. The MWL is designated as a Soils Contamination Area (SCA). Soil samples from the existing landfill surface shall not be taken off-site.

5.1.1.3 Field Tests

In addition to performing the required observations and inspections, CQA personnel will perform the following field tests as required by the earthwork specifications:

- Determination of the soil in-place density and moisture content by nuclear methods performed in accordance with ASTM D2922 and ASTM D3017. Testing shall be performed at a minimum frequency of 5% of that done by the Construction Contractor (see Table 3.1 of Construction Specification 02200). Plot and check all field density test locations and elevations. All holes resulting from nuclear gauge testing will be backfilled with like material and hand-tamped.

5.1.2 Subgrade Fill

Subgrade fill will be obtained from the TA-3 borrow pits. Subgrade fill will bring the entire landfill surface to a central crown and a uniform 2% grade. Subgrade fill will be placed in maximum 8-inch loose lifts to attain maximum 6-inch compacted lift thickness. Fill will be compacted to not less than 90% of maximum dry density at -2 to + 2 percentage points of optimum moisture content, as determined by ASTM D698 (Standard Proctor testing). The subgrade will tie to the existing landscape to achieve a stable and functional slope.

5.1.2.1 Observations and Inspections

CQA personnel will continuously perform the following observations and inspections during construction of the subgrade:

- Inspect the fill to be used for construction of the subgrade. Fill will be obtained from the TA-3 borrow pits. Visual inspections of fill will be made by CQA personnel to detect the presence of organic matter, rubble, trash, and deleterious material. Any such material will be removed prior to use for construction. In addition, irreducible material in excess of 2 inches in dimension will be removed from subgrade fill

- Observe coverage and number of passes made by compaction equipment

- Verify that only hand-operated compaction equipment is used around monitoring wells

- Inspect individual and final lift thickness

- Verify lines and grades of the completed subgrade.

5.1.2.2 Laboratory Tests

Laboratory tests of subgrade fill will be performed to document the engineering properties and to verify the acceptability of the fill for use in construction.

The laboratory tests will include the following:

- Standard Proctor moisture-density relation as determined by ASTM D698 for each 500 cubic yards of fill, or more often if there is a change of material

- Gradation as determined by ASTM C136 performed on each sample subjected to the Standard Proctor Test (one per 500 cubic yards), or when CQA personnel notice a change in material

- Classification as determined by ASTM D2487 and D4318 performed on each sample subjected to the Standard Proctor Test (one per 500 cubic yards), or when CQA personnel notice a change in material.

5.1.2.3 Field Tests

To determine whether construction performance meets project requirements, field testing of in-situ portions of the subgrade fill will be performed. Fill placed at densities and/or moisture contents not conforming to the construction specifications will be removed and replaced or reworked to conform to those specifications.

The field tests include the following:

- Determination of the soil in-place density and moisture content by nuclear methods performed in accordance with ASTM D2922 and ASTM D3017. Testing shall be performed at a minimum frequency of 5% of that done by the Construction Contractor. Plot and check all field density test locations and elevations. All holes resulting from nuclear gauge testing will be backfilled with like material and hand-tamped.

5.1.3 Biointrusion Barrier

A biointrusion barrier composed of 1.0-in. to 6.0-in. and D_{50} = 4 in. crushed rock will be placed between the subgrade fill and the native soil layer. The crushed rock will be placed in a 1-ft minimum, 1.25-ft maximum thickness layer. The crushed rock shall be compacted using heavy equipment. Compaction shall consist of repeated passes over all areas where crushed rock has been placed until the crushed rock fragments are firmly locked in place.

5.1.3.1 Observations and Inspections

CQA personnel will continuously perform the following observations and inspections during construction:

- Inspect the crushed rock to be used for construction of the biointrusion barrier. Crushed rock will be obtained from the stockpile south of the MWL. Visual inspections of crushed rock will be made by CQA personnel to verify that the material conforms to the construction specification and to detect the presence of organic matter, rubble, trash, and deleterious material. Any such material will be removed prior to use for construction.

- Verify that only hand-operated compaction equipment is used around monitoring wells

- Inspect final lift thickness

- Verify lines and grades of the completed biointrusion barrier.

5.1.3.2 Laboratory Tests

No laboratory tests of the biointrusion barrier will be performed.

5.1.3.3 Field Tests

No field tests of the biointrusion barrier will be performed.

5.1.4 Native Soil Layer

A 30-inch layer of native fill will be placed and compacted between the biointrusion barrier and the topsoil layer. Native fill will be placed in successive 8-inch loose lifts to attain maximum 6-inch compacted lift thickness. Fill will be compacted to not less than 90% of the maximum dry density at -2 to + 2 percentage points of optimum moisture content, as determined by ASTM D698 (Standard Proctor testing).

5.1.4.1 Observations and Inspections

CQA personnel will continuously perform the following observations and inspections during construction:

- Inspect the fill to be used for construction of the native soil layer. Fill will be obtained from TA-3 borrow pits. Visual inspections of fill will be made by CQA personnel to detect the presence of organic matter, rubble, trash, and deleterious material. Any such material will be removed prior to use for construction. In addition, irreducible material in excess of 2 inches in dimension shall be removed from native soil layer fill
- Observe coverage and number of passes made by compaction equipment
- Verify that only hand-operated compaction equipment is used around monitoring wells
- Inspect individual and final lift thickness
- Verify lines and grades of the completed native soil layer.

5.1.4.2 Laboratory Tests

Laboratory tests of the compacted native soil fill will be performed to document the engineering properties and to verify the acceptability of the fill for use in construction.

The laboratory tests will include the following:

- Standard Proctor moisture-density relation as determined by ASTM D698 for each 500 cubic yards of fill, or more often if there is a change of material
- Gradation as determined by ASTM C136 performed on each sample subjected to the Standard Proctor Test (one per 500 cubic yards), or when CQA personnel notice a change in material
- Classification as determined by ASTM D2487 and D4318 performed on each sample subjected to the Standard Proctor Test (one per 500 cubic yards), or when CQA personnel notice a change in material.

- Hydraulic conductivity testing on each sample as determined by ASTM rigid wall methods (one per acre per lift), or when CQA personnel notice a change in material.

5.1.4.3 Field Tests

To determine whether construction performance meets project requirements, field testing of in-situ portions of the compacted native soil fill will be performed. Fill placed at densities and/or moisture contents not conforming to the constructions specifications will be removed and replaced or reworked to conform to those specifications.

The field tests include the following:

- Determination of the soil in-place density and moisture content by nuclear methods performed in accordance with ASTM D2922 and ASTM D3017. Testing shall be performed at a minimum frequency of 5% of that done by the Construction Contractor. Plot and check all field density test locations and elevations. All holes resulting from nuclear gauge testing will be backfilled with like material and hand-tamped.

5.1.5 Topsoil Layer

A minimum 8-inch topsoil layer containing 25% by volume 3/8-inch crushed gravel will be placed on top of the native soil layer. Topsoil will be minimally compacted to provide a uniform, prepared surface for seeding and to facilitate root development.

5.1.5.1 Observations and Inspections

CQA personnel will continuously perform the following observations and inspections during construction:

- Inspect the topsoil to be used for construction of the topsoil layer. Topsoil will be obtained from the TA-3 borrow pits. Visual inspections of topsoil will be made by CQA personnel to detect the presence of rubble, trash, and deleterious material. Any such material will be removed prior to use for construction. Organic matter is desirable in the topsoil and, therefore, only gross organic matter, such as Russian thistle will be removed.

- Verify that only hand-operated compaction equipment is used around monitoring wells

- Verify topsoil is free of rocks greater than 2 inches in dimension

- Inspect final thickness

- Verify lines and grades of the completed topsoil layer.

- Verify gravel size and volume admixture with topsoil

5.1.5.2 Laboratory Tests

Laboratory tests of the topsoil layer will be performed to document the engineering properties and to verify the acceptability of the topsoil for use in construction.

The laboratory tests will include the following:

- Gradation as determined by ASTM C136 (one per 500 cubic yards), or when CQA personnel notice a change in material
- Classification as determined by ASTM D2487 and D4318 (one per 500 cubic yards), or when CQA personnel notice a change in material.

5.1.5.3 Field Tests

No field tests of the topsoil layer will be performed.

5.1.6 Reclamation Seeding and Mulching

The topsoil layer will be seeded with native grasses in accordance with the construction specifications.

5.1.6.1 Acceptance of Seed

Following the delivery of the seed mix, the CQA Engineer will inspect the delivery ticket to verify that the quantity and type of seed supplied by the manufacturer is consistent with construction specifications.

5.1.6.2 Storage and Handling

CQA personnel will verify that the seed will be stored in a cool area, free of moisture and standing water.

5.1.6.3 Observations and Inspections

CQA personnel will perform the following observations and inspections during seeding of the topsoil layer:

- Inspect the seed to ensure that it has been stored appropriately and has not rotted
- Verify that seeding takes place during favorable weather conditions (i.e., low winds)

- Verify that the appropriate application method is used
- Observe and verify that the application rate of soil additives and seed are in accordance with the construction specifications
- Survey lines and grades of the final cover
- Verify mulching and crimping.

6.0 MONITORING WELL MW-4 EXTENSION

Groundwater monitoring well MW-4 will be extended such that the top of the PVC casing is located a minimum of 30 inches above the final grade of the completed cover. MW-4 will be refitted to its original configuration, consisting of steel protective cover, locking top cap, and concrete pad. Protective stanchions will not be required.

6.1 Observations and Inspections

CQA personnel will continuously perform the following observations and inspections during construction:

- Ensure that the existing concrete pad, protective steel stanchions, protective steel well casing cover and locking top cap are removed prior to cover construction
- Observe extension of the existing MW-4 PVC well casing. The well casing will be extended before or during cover construction
- Ensure that only hand-operated compaction equipment is used to recompact fill around the extended well casing as each lift is placed during cover construction
- Observe completion of the new concrete pad, protective steel well casing cover and locking top cap to ensure that construction is performed in accordance with construction specifications
- Observe that the final location and elevation of the top of the new PVC well casing and four corners of the concrete pad are surveyed. The results of the survey will be retained for future use to prepare as-built drawings.

6.2 Laboratory Tests

No laboratory tests will be performed during the extension and reconstruction of monitoring well MW-4.

6.3 Field Tests

No field tests will be performed during the extension and reconstruction of monitoring well MW-4.

7.0 NONCONFORMANCE

7.1 Laboratory and Field Nonconformances

Nonconforming items and activities are those that do not meet the design drawings, construction specifications, procurement document criteria, approved work procedures, or the CQA program.

Nonconformances may be detected and identified by any site workers including:

- CQA personnel—during construction operations by observation, field inspections, and/or verification testing
- Laboratory personnel—during the preparation for and performance of laboratory testing and/or during calibration of equipment
- SCR—during the performance of audits, surveillances, and/or other CQA-related activities
- Construction Contractor—during construction operations by field inspections.

Each nonconformance affecting quality will be documented by the personnel identifying or originating nonconformance. For this purpose, the results of calibration and laboratory analysis quality control tests, audit reports, inspection reports, or an internal memorandum or letter can be used as appropriate. This documentation will be compiled by the CQA Engineer and documented in a Nonconformance and Corrective Action Report and submitted to the SCR.

This report will, when necessary, include:

- Description of nonconformance
- Identification of individual(s) identifying or originating the nonconformance
- Method(s) for completing corrective action and corrective action taken
- Schedule for completing corrective action and corrective action taken
- Responsible individuals for correcting the nonconformance and verifying satisfactory resolution.

Documentation will be available to the Owner, SCR, Construction Contractor, CQA Contractor, and/or subcontractor(s), as necessary. It is the responsibility of everyone working at the project

site to inform CQA personnel of potential nonconformances. The CQA personnel will discuss the potential nonconformance and, if necessary, stop work to address the potential nonconformance. In addition, the SCR will be notified by the CQA Engineer as soon as possible of all nonconformances that could impact the results of the work. Corrective action, if warranted, will be determined and implemented.

CQA personnel, as part of future activities, should verify completion of corrective actions for nonconformances.

Any recurring nonconformance should be evaluated by the SCR, CQA Contractor, and/or testing laboratory to determine its cause and the appropriate changes instituted to prevent future recurrence. When such an evaluation is performed, the results will be documented.

8.0 DOCUMENTATION

Compliance with the requirements of the construction specifications for the MWL alternative cover will be documented throughout all phases of construction. Documentation will consist of records prepared by CQA personnel, the independent testing laboratory, the Construction Contractor, and any subcontractors.

8.1 Daily Summary Report

Whenever there is any construction activity, a Daily Summary Report will be prepared. Other records required will depend on the specific work being performed that day.

The Daily Summary Report will be prepared by the CQA Inspector and reviewed by the CQA Engineer. It will contain the following:

- The date
- A summary of the weather conditions
- A summary of locations where construction is occurring
- A list of personnel on the project
- A summary of any meetings held and attendees
- A description of all materials used and references or results of testing and documentation
- The certificates for calibration and recalibration of test equipment
- The inspection checklists.

8.2 Inspection Checklists

Inspection checklists (Attachment B1) will be reviewed by the CQA Engineer, and submitted to the SCR. The purpose of the checklists is to document all inspections performed by CQA personnel during construction activities.

At a minimum, each inspection checklist will contain the following information:

- The date and time of inspection
- The location
- Weather conditions
- The type of inspection
- The procedure used (e.g., ASTM method)
- Test data
- The results of the activity
- Personnel involved in the inspection and sampling activities
- The signature of the inspector.

8.3 Nonconformance and Corrective Action Reports

Whenever any material or workmanship does not meet the requirements of the construction specifications or has an obvious defect, the appropriate personnel will be notified and a Nonconformance and Corrective Action Report will be completed by the CQA Engineer. Additional information on nonconformance, corrective action, and the documentation thereof is presented in Section 8.0 of this Plan.

8.4 Field and Laboratory Test Reporting

Reports of all field and laboratory tests will be submitted to the CQA Engineer and SCR.

8.4.1 Field Test Data

The soil testing technicians will submit reports of all field tests and retests to the CQA Engineer and SCR as soon as possible upon completion of the required tests.

The reports may include, but are not limited to, the following:

- Date of the test and date submitted

- Location of test
- Weather
- Test method (ASTM or approved)
- Wet weight, moisture content, and dry weight of field sample (if required)
- Description of soil
- Ratio of field dry density to maximum lab dry density expressed as a percent (if required)
- Comments concerning the field density passing or failing the specified compaction
- Comments about results.

CQA Inspectors will record field test data on the appropriate inspection checklists or approved forms.

8.4.2 Laboratory Test Data

The independent testing laboratory will submit data reports of all laboratory tests to the CQA Engineer as soon as possible upon completion of the tests. The reports will include, but not be limited to, the following:

- Date of the test and date submitted
- Identification and description of sample tested
- Test method (ASTM or approved)
- Results of test.

8.5 Photographic Reporting

Any photographs used to document the progress and acceptability of cover construction may be incorporated into the daily summary report and the acceptance report.

Each photo will be identified individually as well as in a photograph log that contains the following information:

- The date, time, location, and direction of the photograph
- The name of the photographer
- Brief description of the activity photographed.

8.6 As-Built Drawings

Final as-built drawings will be prepared by the CQA Contractor and will be retained by the Owner as a permanent record of the final configuration and dimensions of the cover features (e.g., subgrade, biointrusion barrier, and final cover). As-built drawings must be reviewed and approved by the CQA Engineer and the SCR.

8.7 Final Documentation

When construction of the MWL alternative cover has been completed and the final inspection/punch list shows that all items have been resolved, a final report will be prepared for submittal to the Operator.

The Construction Quality Assurance Report will include all quality control data generated by the construction contractor as well as quality assurance data generated by the CQA contractor. The Construction Quality Assurance Report will be submitted to the NMED as part of the CMI Report.

The final report will be certified as correct by the CQA Engineer and will contain the following:

- Daily summary reports
- Inspection checklists
- Nonconformance and corrective action reports
- Field test results
- Laboratory test results
- Photographs and photograph logbook
- As-built drawings
- Internal CQA memoranda or reports with data interpretation or analyses
- Design changes.

8.8 Document Control and Storage of Records

During construction of the MWL alternative cover, the CQA Engineer will be responsible for storage of all CQA documents. All records prepared by the CQA Contractor will remain on-site during the project to provide documentation of the cover construction. The CQA documents will include:

- Design drawings
- Construction specifications
- CQA Plan
- Inspection checklists
- Field test data reports
- Laboratory test data reports
- Nonconformance and corrective action reports

- Meeting notes
- Daily summary reports.

Duplicate copies will be kept at another location as a safeguard in case the originals are damaged or lost. Once construction is complete, the originals will be transferred to the SCR.

ATTACHMENT B1
Inspection Checklists

The inspection checklists contained in this attachment are provided for use by CQA personnel during construction of the MWL alternative cover. The format of the inspection checklists may be modified by the CQA Engineer; however, the revised inspection checklist must include all checks and information contained in the original form and meet the approval of the Operator. The inspection checklists will be completed and signed by CQA Inspectors and reviewed by the CQA Engineer. These checklists will become part of the final cover construction report documenting the CQA process throughout construction.

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LIST OF FORMS

Title **Form No.**

Receiving Inspection

Seed/Fertilizer/Mulch RI-01

Testing Inspection

Existing Landfill Surface and Perimeter Field Test Form TI-01
Subgrade Fill Field Test Form TI-02
Native Soil Layer Fill Field Test Form TI-03
Subgrade Fill Laboratory Test Verification Form TI-04
Native Soil Layer Laboratory Test Verification Form TI-05
Topsoil Layer Laboratory Test Verification Form TI-06
Moisture/Density Field Test Results Form TI-07

Construction Inspection

Existing Landfill Surface and Perimeter Clear and Grub Field Form CI-01
Subgrade Fill Field Form CI-02
Native Soil Layer Fill Field Form CI-03
Topsoil Layer Field Form CI-04
Reclamation Seeding and Mulching Field Form CI-05

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RI-01
RECEIVING INSPECTION FORM
SEED/FERTILIZER/MULCH

Project Name _____ Date _____ Time_____
Received by _____
Inspected by _____
Material Name _____ Delivery Shipment No. _____
Transporter/Supplier _____ Storage Location _____
Number of Bags/Bales _____

	SPECIFICATION	MATERIAL RECEIVED	NOTE NO.
Supplier	_____	_____	_____
Supplier designation	_____	_____	_____
Material	_____	_____	_____

(Provide explanatory notes if the answers to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Checks before unloading:		
Have delivery tickets and QC certificates been provided for seed/fertilizer/mulch received?	_____	_____
Does the material description match the construction specifications?	_____	_____
Is the material free of damage?	_____	_____
Is the material acceptable for use?	_____	_____
Checks after unloading:		
Is the material free of damage?	_____	_____
Is the material properly stored?	_____	_____
Is the storage area free of water and/or moisture?	_____	_____

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TI-01
TESTING INSPECTION FORM
EXISTING LANDFILL SURFACE AND PERIMETER FIELD TEST FORM

Project Name _____ Date _____ Time_____

Inspected by _____ Weather _____

Compaction Equipment _____

Surface area and location covered during shift _____
_____
_____

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has soil been moistened to approximate optimum moisture content?	_____	_____
Has surface been compacted/proof-rolled utilizing 10 passes of a roller?	_____	_____
Have depressions been filled with moistened, clean fill, and recompacted with 10 passes of a roller?	_____	_____
Did roller have a minimum ballasted weight of 25 tons?	_____	_____
Did roller have a minimum pneumatic tire pressure of 90 psi?	_____	_____
Was any proof rolling conducted within a 2-ft radius of any groundwater monitoring well?	_____	_____

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TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name _____ Date _____ Time_____

Lift Number _____ Inspected by _____

Borrow Area _____ Weather _____

Compaction Equipment _____

Soil Description _____
_____
_____

Volume and location of soil placed during shift _____
_____
_____

Surface area and location covered during shift _____
_____
_____

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	_____	_____
Have field density test locations and elevations been plotted and checked?	_____	_____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	_____	_____
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	_____	_____

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TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FILL FIELD TEST FORM

Project Name _____ Date _____ Time_____

Lift Number _____Inspected by _____

Borrow Area _____ Weather _____

Compaction Equipment _____

Soil Description _____
_____
_____

Volume and location of soil placed during shift _____
_____
_____

Surface area and location covered during shift _____
_____
_____

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	_____	_____
Have field density test locations and elevations been plotted and checked?	_____	_____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	_____	_____
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	_____	_____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	_____	_____

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TI-04
TESTING INSPECTION FORM
SUBGRADE FILL LABORATORY TEST VERIFICATION FORM

Project Name _____ Date _____ Time_____

Inspected by _____

Weather _____

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor test in accordance with ASTM D698?	_____	_____
Has gradation been performed in accordance with ASTM C136?	_____	_____
Has classification been performed in accordance with ASTM D2487 and D4318?	_____	_____
Do laboratory tests meet the construction specification?	_____	_____

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TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name _____ Date _____ Time_____

Inspected by _____

Weather _____

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor test in accordance with ASTM D698?	_____	_____
Has gradation been performed in accordance with ASTM C136?	_____	_____
Has classification been performed in accordance with ASTM D2487 and D4318?	_____	_____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedures?	_____	_____
Do laboratory tests meet the construction specification?	_____	_____

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TI-06
TESTING INSPECTION FORM
TOPSOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name _____ Date _____ Time_____

Inspected by _____

Weather _____

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has gradation been performed in accordance with ASTM C136?	_____	_____
Has classification been performed in accordance with ASTM D2487 and D4318?	_____	_____
Do laboratory tests meet the construction specification?	_____	_____

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TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

Project Name:
Stockpile Area:
Borrow Area:
Type of Construction:
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf):
Optimum Moisture:
Date:
Time:
Weather:

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					

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CI-01
CONSTRUCTION INSPECTION FORM
EXISTING LANDFILL SURFACE AND PERIMETER CLEAR AND GRUB FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name _____ Date _____ Time_____

Weather _____ Inspected by _____

Compaction Equipment _____

Surface area and location covered during shift _____
_____
_____

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have all shrubs, grass, roots, and other vegetation been completely cleared and grubbed from the landfill surface and perimeter?	_____	_____
Has the landfill surface and perimeter been inspected to ensure that all loose or soft zones have been properly compacted?	_____	_____
Has the landfill surface and perimeter been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	_____	_____
Has the number of passes and the coverage of the compaction equipment been documented?	_____	_____

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CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name _____ Date _____ Time_____
Inspected by _____
Borrow Area _____ Max Dry Density (pcf) _____
Weather _____ Optimum Moisture (%) _____

Compaction Equipment _____

Fill Description
_____
_____
_____

Volume and location of soil placed during shift _____
_____
_____

Surface area and location covered during shift _____
_____
_____

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	_____	_____
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	_____	_____
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	_____	_____
Has approved fill been used during subgrade construction?	_____	_____
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	_____	_____
Has the number of passes and the coverage of the compaction equipment been documented?	_____	_____

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CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name _____ Date _____ Time_____
Lift Number _____ Inspected by _____
Borrow Area _____ Max Dry Density (pcf) _____
Weather _____ Optimum Moisture (%) _____

Compaction Equipment _____

Fill Description
_____
_____
_____

Volume and location of soil placed during shift _____
_____
_____

Surface area and location covered during shift _____
_____
_____

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has the previous lift been surveyed for final grades to verify that it conforms to the construction specifications?	_____	_____
Have TA-3 borrow soils been determined to be suitable for native soil lifts?	_____	_____
Has approved fill been used during lift construction?	_____	_____
Has the lift been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	_____	_____
Has the number of passes and the coverage of the compaction equipment been documented?	_____	_____

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CI-04
CONSTRUCTION INSPECTION FORM
TOPSOIL LAYER FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name _____ Date _____ Time_____
Inspected by _____

Borrow Area _____
Weather _____

Topsoil Description
_____
_____
_____

Volume and location of topsoil placed during shift _____
_____
_____

Surface area and location covered during shift _____
_____
_____

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has the previous lift been surveyed for final grade to verify that it conforms to the construction specifications?	_____	_____
Has the topsoil been admixed with 25% by volume 3/8-inch crushed gravel?	_____	_____
Has approved topsoil been used for topsoil layer?	_____	_____
Has the topsoil layer been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	_____	_____

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CI-05
CONSTRUCTION INSPECTION FORM
RECLAMATION SEEDING AND MULCHING FIELD FORM
(Complete One Form Per Shift When This Work Is Being Done)

Project Name _____ Date _____ Time_____

Weather _____ Inspected by _____

Surface area and location covered during shift _____
_____
_____

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has the cover surface been surveyed for final grade prior to placement of seed?	_____	_____
Has approved seed been used for seeding?	_____	_____
Has the cover surface been mulched and crimped after seeding?	_____	_____
Did seeding take place during favorable weather conditions?	_____	_____
Did application rate of seed mix meet the construction specifications?	_____	_____

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APPENDIX C
Qualifications of Persons Implementing the CMI Plan

Mary Creech

Qualifications

Ms. Creech has seven years experience, six of which have been in the environmental field. She is the assistant task leader for Sandia National Laboratories/New Mexico (SNL/NM) Environmental Restoration Chemical Waste Landfill (CWL), Solid Waste Management Unit (SWMU) 91 (Lead Firing Site), and SWMU 68 (Old Burn Site) projects. She provides regulatory reporting, strategic planning, and waste management coordination services.

At the CWL, Ms. Creech is responsible for managing and documenting the effort to close the associated site operational boundary. She is also responsible for regulatory compliance and documenting removal of waste from the CWL, including writing the final waste management report and detailing the removed waste its final disposition. She heads efforts to prepare the final Toxic Substance Control Act report required by the U.S. Environmental Protection Agency. She has also provided project management for waste management, site closure activities, and personnel as well as client interface for scheduling site closure, budgetary issues, project reporting, and support for contract closure. She has completed disposal packages for project-generated, chemical and bulk wastes generated from the remediation of the CWL and managed the disposition of over 200 waste parcels, including the quality control and assurance for all data.

Ms. Creech has provided strategic planning for the lead-contaminated soil removal and radiological investigation at SWMU 68. She leads in negotiating the waste management and radiological protection aspects of the project with both SNL/NM waste management facilities. She is the primary author for the radiological sampling, analysis, and waste management plan for SWMU 68 (required to comply with both the Nevada Test Site and Envirocare of Utah's waste acceptance criteria) as well as the final report and request for closure.

Ms. Creech is one of the ATLs working on the closure of SWMU 91. She is currently providing waste management coordination and peer review services for the project, which has involved the removal of 18.6 tons elemental lead from an inactive firing range. She provided waste management planning and oversight services as well as strategic planning support for the field implementation aspect of the project.

Training/Education

B.S., Biology, New Mexico Institute of Mining & Technology

Joseph E. Fritts, P.G.

Qualifications

Mr. Fritts is a senior geologist with 19 years of technical and management experience in the environmental field. His experience in hydrogeology and waste management includes investigations of soil and groundwater contamination, site characterization, site remediation, waste management, groundwater protection, and Resource Conservation and Recovery Act (RCRA) Remedial Investigation/Feasibility Studies. Mr. Fritts has Environmental Restoration (ER) experience at Sandia National Laboratories/New Mexico (SNL/NM), Los Alamos National Laboratory, and the U.S. Department of Energy (DOE) Mound Plant. Has worked on hydrogeological investigations at the Naval Air Weapons Station in China Lake, California, and at Project Shoal near Fallon, Nevada.

He has participated in all aspects of a classified landfill remediation project including managing all waste characterization, waste disposal, and waste minimization activities. He has worked to remediate environmental sites including the excavation of contaminated soil and materials, and has worked on earthen covers installed over closed landfill sites. Mr. Fritts has performed extensive fieldwork involving hydrogeologic site investigations at twenty-two mine tailings sites located throughout the western United States.

Mr. Fritts has extensive regulatory compliance experience including RCRA, National Environmental Policy Act, and Uranium Mill Tailings Remedial Action regulations. He has worked with regulators in the New Mexico Environment Department, the DOE, and the U.S. Environmental Protection Agency in order to resolve environmental issues. He has extensive experience supervising drilling programs supervising rotosonic, air rotary, mud rotary, air rotary casing hammer, ODEX, Stratex, and auger drilling methods. He also has experience drilling and installing soil vapor monitoring systems.

He currently provides technical support for various sites that are part of the ER Project at SNL/NM. He is working on a project to install an earthen cover over recently excavated and remediated chemical waste landfill. He oversaw writing and implementation of the quality assurance plan, scheduling, and daily oversees cover installation operations.

Training/Education

B.S., Geology, University of New Mexico

A.A., Humanities, Orange County Community College

Timothy J. Goering

Qualifications

Mr. Goering has more than 22 years of technical experience in the environmental field, including 18 years experience as a groundwater hydrologist working on various U.S. Department of Energy (DOE) projects, including Remedial Action and Environmental Restoration Programs. His expertise includes groundwater hydrology, vadose zone characterization, aquifer characterization, corrective measures studies, Resource Conservation and Recovery Act (RCRA) facility investigations (RFI), and Superfund investigations as well as waste management and compliance with state and federal regulations including RCRA, Comprehensive Environmental Response, Compensation, and Liability Act, National Environmental Policy Act, Uranium Mill Tailing Remedial Action, Toxic Substances Control Act, and DOE orders pertaining to radioactive, mixed, and hazardous wastes. He works with regulators in the New Mexico Environment Department (NMED), the Nuclear Regulatory Commission (NRC), and the U.S. Environmental Protection Agency to resolve issues on environmental problems and provides expert testimony for public hearings and private litigation.

Mr. Goering supports Sandia National Laboratories/New Mexico (SNL/NM) Environmental Restoration Project on a variety of groundwater-related issues. His responsibilities at the Mixed Waste Landfill (MWL) include overseeing groundwater characterization and monitoring activities, including vadose zone characterization activities, and preparation of RCRA documents such the recently completed MWL Corrective Measures Study (CMS) and the Corrective Measures Implementation Plan. The CMS included evaluating technologies and potential remedial alternatives for the MWL, and developing their cost estimates. In addition, he provided expert testimony on the CMS in support of the DOE and SNL/NM in a public hearing held by the NMED in December 2004.

For the MWL, Mr. Goering assisted with development of an alternative cover, a thick layer of soil and native vegetation that uses evapotranspiration to minimize infiltration. He helped to develop and conduct the Phase 2 RFI Work Plan for the MWL, which included performing surface geophysics to delineate waste trench boundaries at the site, sampling volatile organic compounds in soil vapor and tritium in soils, designing and installing groundwater monitoring wells, conducting aquifer pump-and-recovery tests, overseeing groundwater sampling activities, and drilling angled boreholes beneath pits and trenches to assess subsurface contamination.

Training/Education

M.S., Hydrology and Water Resources, University of Arizona

B.A., Environmental Science, University of Virginia

J. Ben Martinez

Qualifications

Mr. Martinez serves as environmental scientist, engineer, and project manager specializing in construction/remediation, removal/installation of above- and underground storage tanks (ASTs and USTs) and field service activities. He has ten years of experience in project supervision/management on numerous Sandia National Laboratories/New Mexico (SNL/NM) and U.S. Department of Defense environmental construction projects. He prepares budgets and implements workplans, technical reports, final assessment reports, environmental impact statements, environmental assessments, quality assurance project plans, and health and safety plans. He is also an experienced heavy equipment operator.

Mr. Martinez has participated in numerous field operations at SNL/NM since 1997. His duties include project/site management, health and safety oversight, operation of heavy machinery, and soil, water, and radiological sampling and screening. He is currently the project/site manager of four Environmental Restoration Project sites, the TA-II Classified/Radiological Landfill Backfill Projects, the TA-III Chemical Waste Landfill Backfill Project, Solid Waste Management Unit (SWMU) 91 (Lead Firing Site), and SWMU 68 (Old Burn Site).

Mr. Martinez was contractor-oversight manager for the U.S. Postal Service (USPS) UST Removal, Replacement, and Upgrade Project, in New Mexico and Colorado. He was involved in the decommissioning and retrofitting and modifications (upgrading) of the UST systems to comply with 1998 USPS U.S. Environmental Protection Agency regulations.

Mr. Martinez investigated several SWMUs at Kirtland Air Force Base (KAFB) to characterize the nature and extent of hazardous and radioactive material releases from each unit. All sites were part of a Resource Conservation and Recovery Act facility investigation and involved sampling with direct push technology for the collection of subsurface soil samples.

As assistant project manager/field operations manager for the U.S. Army Corps of Engineers (USACE) Program at KAFB, Mr. Martinez was responsible for implementation of the work plan by subcontracted personnel performing UST removal/replacement construction activities in adherence with USACE military specifications. The scope of work required removal of 102 USTs, some of which were compromised and leaking. He sampled for contaminants in excavations, logged, and coordinated with laboratories in compliance with applicable regulatory protocols. Other technical tasks included coordination with basewide network personnel including water, sewer, gas, communication, and other associated utilities. He ensured that all Occupational Safety and Health Administration and Brown & Root safety procedures were followed. To replace some tanks that were removed, 20 ASTs and 10 vaulted below storage tanks were constructed.

Training/Education

B.S., Environmental Science, New Mexico Highlands University

Anthony R. Martinez

Qualifications

Mr. Martinez has worked in the environmental field for more than five years as a site safety officer, field technician, heavy equipment operator, and waste management specialist. He has been part of the Chemical Waste Landfill (CWL) and Corrective Action Management Unit project teams at Sandia National Laboratories/New Mexico (SNL/NM) since 2000. His experience includes the operation of heavy equipment, environmental sampling/ characterization, hazardous/mixed/solid waste management, and the development, writing, and field implementation of Health and Safety (H&S) plans and task-specific hazard analyses. He was the site safety officer for three major SNL/NM Environmental Restoration remediation/construction projects.

Mr. Martinez's responsibilities include conducting and documenting daily safety meetings, coordinating with adjacent facility safety personnel, interacting with other SNL/NM safety professionals, and tracking H&S training records. He has also been a key member of the management team for CWL Solid Waste Management Unit (SWMU) 91 (Lead Firing Site) and SWMU 68 (Old Burn Site) and is actively involved with problem solving and process improvement. He is currently the site safety officer for the CWL cover installation field project and is responsible for implementing the Integrated Safety Management System approach, which involves ensuring that all related project hazards are identified and addressed on a continual basis. The combination of his field and H&S experience has resulted in an excellent project safety record while maintaining operational efficiency.

Mr. Martinez has provided site H&S oversight on three major projects since 2004, including the CWL backfilling and final cover installation and SWMU 68 and SWMU 91 Voluntary Corrective Actions (VCAs). He was the site safety officer responsible for these VCAs, which included significant excavation of lead-contaminated soil and various debris. Because simultaneous activities were needed, careful advance planning, communication, organization, coordination, and oversight were necessary. The SWMU 91 VCA involved the excavation of approximately 18,000 cubic yards of soil and debris, from which approximately 18 tons of lead were removed for recycling using a three-stage mechanical screen plant as part of a waste/debris segregation process. Approximately 500 cubic yards of soil and solid waste were disposed of off site. SWMU 68 also involved the excavation and disposal of over 500 cubic yards of soil and solid waste, as well as the disassembly of a burn pan test structure and surrounding earthen berm. He led the effort to remove the pan structure and berm, which included scanning the soil for radiological contamination. Using an approach to minimize waste, under his direction the team safely decommissioned the burn pan and earthen berm, generating less than a cubic yard of depleted uranium and thorium soil waste.

Training/Education

Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response Supervisor Certification

Site Safety Officer Training, IT Corporation

Michael M. Mitchell

Qualifications

Mr. Mitchell has more than 16 years of technical and management experience in environmental consulting, covering all phases of project work driven by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA). His experience includes preparing major reports under RCRA, including Final Voluntary Corrective Measure, Corrective Measures Study (CMS), Final Closure, and Post-Closure Care Plans and Reports as well as a Permit Application for an interim status landfill closing under both 40CFR264 and 40CFR265 requirements.

Mr. Mitchell prepares hydrogeological investigations for RCRA and CERCLA sites, including definition of vadose zone and aquifer characteristics, groundwater flow patterns, geologic and exposure pathways, and the nature and extent of contamination in soil and groundwater. He develops health and safety plans, work plans, waste management plans, and environmental sampling procedures. He designs and implements remediation plans at U.S. Department of Defense and U.S. Department of Energy sites contaminated with hazardous and radioactive materials and manages remediation projects involving heavy equipment and excavation, waste screening and segregation, and waste management. He coordinates and supervises drilling, sampling, analytical laboratory services, heavy equipment operation, and waste management and disposal.

Mr. Mitchell is assistant task leader for the Chemical Waste Landfill (CWL) and Solid Waste Management Unit 91 (Lead Firing Site) for Sandia National Laboratories/New Mexico Environmental Restoration Project. He negotiates final resolution of CMS Report and Post-Closure Care Permitting issues with the New Mexico Environmental Department, coordinates and documents technical aspects of the CWL vegetative soil cover construction project, and oversees final closure reporting to meet RCRA and Toxic Substance Control Act requirements. He is the primary author of regulatory deliverables that set the foundation for final CWL closure.

Mr. Mitchell ensures compliance with state and federal RCRA, National Environmental Policy Act, and Occupational Safety and Health Administration requirements associated with characterization and remediation projects as well as providing public and regulatory presentations support.

Training/Education

M.S., Geology, University of Tennessee

B.A., Geology, Trinity University

Jerry L. Peace

Qualifications

Mr. Peace is a geologist, geophysicist, and civil engineer for Sandia National Laboratories/New Mexico (SNL/NM). His diverse background includes environmental, geoscience, civil engineering, applied geophysics, drilling engineering, soil physics and mechanics, geology, vadose zone hydrology, predictive modeling, groundwater monitoring, remote sensing, environmental sensors, public relations, and environmental regulations experience. He heads all activities at the Mixed Waste Landfill.

Mr. Peace is the project manager and technical leader of a multidisciplinary team of experienced, hands-on professionals who investigate the geologic, hydrologic, and engineering properties of SNL/NM cold-war-legacy waste sites. His team develops documentation, implements noninvasive and invasive technologies, reduces and interprets data, reports findings, and implements the best available remedial measures.

He is also the project manager and technical leader of environmental restoration project geophysics at SNL/NM, which includes airborne and ground magnetic and electromagnetic surveys to delineate subsurface legacy waste burials and the Rio Grande basement structure to determine regional geology, structure, and groundwater transport mechanisms.

He is also the project manager and technical leader of environmental restoration project drilling engineering at SNL/NM, which includes air/rotary casing hammer, resonant sonic, Stratex, reverse circulation drilling technologies to delineate subsurface structure, lithology, geohydrology to determine vadose zone and groundwater transport mechanisms.

Training/Education

Ph.D., Geophysical Engineering, New Mexico State University

M.S., Civil Engineering, New Mexico State University

M.S., Geophysics, University of Alaska

B.S., Geology, New Mexico State University

Donald P. Schofield

Qualifications

Mr. Schofield has worked at Sandia National Laboratories/New Mexico (SNL/NM) for more than 20 years, the last 11 of which have been with the Environmental Restoration (ER) Project. He has overseen the successful deployment of both large and small cleanup operations. He has served as field technician, assistant task leader, and task leader. He managed the ER Field Office that provided personnel and equipment to support Solid Waste Management Unit (SWMU) characterization and remediation. He has extensive experience in contract placement and oversight, as well as project management (schedule, scope, and cost). He has played key roles in the selection, procurement, and implementation of remediation technologies in the field.

From 1998 through 2002, Mr. Schofield was the Assistant Task Leader for the Chemical Waste Landfill, Landfill Excavation Voluntary Corrective Measure, which involved the complete excavation and removal of the original landfill contents. His focus on this four-year, multimillion dollar remediation project (the largest ER Project at SNL/NM) was on contract management and field problem solving. The contents of the former CWL, approximately 52,000 cubic yards of contaminated soil and waste, were removed, segregated, and characterized for final disposal. He established a multidisciplinary team of environmental professionals that backfilled the CWL in two distinct phases from 2002 to 2004. The CWL excavation met all risk-based cleanup goals. The final report was approved by the New Mexico Environment Department in December 2004.

Mr. Schofield is the Task Leader for the CWL cover installation project completed in July 2005. He also serves as the Task Leader of the SWMU 68 (Old Burn Site) and SWMU 91 (Lead Firing Site) Voluntary Corrective Action (VCA) projects that were completed in 2004 and 2005 (final reporting pending). He is responsible for project management, including field construction activities. The SWMU 91 VCA included the excavation of soil and debris, from which lead and metal were removed for recycling. Confirmatory sampling and geophysical surveys were used to demonstrate that corrective action objectives had been met. SWMU 68 was also remediated to maximize operational efficiencies using the same field personnel. The remediation at SWMU 68 included the removal of soil and solid waste for disposal, man-made structures, and radiological soil contamination. Confirmatory sampling demonstrated project goals had been met, as well as site grading, re-vegetation, and related reporting tasks. Projects were safely completed on time and within budget

He was also the assistant task leader for the treatment and disposal of soil at SNL/NM's Corrective Action Management Unit from 2002 to 2003, providing technical input and oversight for the construction of the aboveground, mounded cover. During 2003 he managed the backfilling operations for two excavated landfills at TA-II.

Training/Education

B.S., University of Minnesota, College of Forest Engineering

APPENDIX D
Health and Safety Plan

Site or Activity Name: Mixed Waste Landfill Vegetative Cover Installation

Job Site Location: Technical Area 3

Technical Task Leader: Jerry Peace, SNL/NM, 6116 **Alternate:** Don Schofield, SNL/NM, 6134

Site Safety Officer: To Be Determined **Alternate:** Various personnel

Amendment No.: NA

( ) Amendment to Existing Approved HASP **( ) Date Existing Approved HASP**

HASP prepared by:

Tim Goering, SNL/NM 6147 — Date 7/7/05
Assistant Task Leader

HASP approved by:

Jerry Peace, SNL/NM 6116 — Date 7/7/05
Task Leader - MWL

Michael Oborny, SNL/NM 6328 — Date 7/27/05
Industrial Hygienist

Dick Fate, SNL/NM 6147 — Date 7/29/05
Department Manager

1.0 INTRODUCTION

1.1 Objective

This Health and Safety Plan (HASP) for the Mixed Waste Landfill addresses installation of the vegetative cover and bio-intrusion barrier at Sandia National Laboratories' Mixed Waste Landfill (MWL). The vegetative cover design and additional details for cover installation are presented in the MWL Voluntary Corrective Measures Work Plan. A detailed history of the MWL and additional background information are presented in the Mixed Waste Landfill Phase 2 RFI Report (Peace et al. September 2002).

The Mixed Waste Landfill (MWL) is located approximately 5 miles southeast of Albuquerque International Sunport and 4 miles south of Sandia National Laboratories/New Mexico (SNL/NM) Technical Area (TA)-1. The landfill occupies 2.6 acres in the north-central portion of TA-3. The MWL accepted containerized and uncontainerized low-level radioactive waste and minor amounts of mixed waste from SNL/NM research facilities and off-site generators from March 1959 to December 1988. Approximately 100,000 cubic feet of low-level radioactive waste (excluding packaging, containers, demolition and construction debris, and contaminated soil) containing 6300 curies (Ci) of activity (at the time of disposal) were disposed of at the MWL.

1.2 Project Organization

The MWL project is managed by SNL/NM Environmental Restoration (ER) Project Task Leaders (TLs). Jerry Peace is the TL responsible for the MWL Project. Don Schofield will be the primary Sandia interface with other SNL/NM Departments, such as Compliance and Generator Interface, Hazardous Waste Management, Radioactive and Mixed Waste Management, Security, and Radiation Protection Operations. Daily coordination of activities involving other SNL/NM Departments will be routinely performed by Assistant Task Leaders (ATLs) and/or task-specific SSOs, as appropriate. Mike Mitchell will be Project Manager, and Tim Goering and Joseph Fritts will be responsible for QA/QC and hydrologic testing of the cover.

1.3 Health and Safety Goals and Objectives

The goal of the Health and Safety program is to deploy the MWL vegetative cover with zero occupational injuries or illnesses for site workers. This HASP integrates the information and experience gained from 15 years of characterization, sampling activities, and waste management conducted at the MWL to anticipate and recognize potential hazards associated with the remaining MWL activities, evaluate those hazards in a systematic fashion, and describe the engineering and administrative methods that will be used to control the hazards. This approach, along with the commitment of MWL ER staff and management to continuous process improvement, is consistent with the principles of the Integrated Safety Management System (ISMS). If new information about site hazards is obtained, this HASP will be amended and the changes communicated to all affected parties as appropriate based upon the identified hazards.

2.0 Project Health and Safety Roles and Responsibilities

Section 1.3 presents the general project-level organization. The following sections provide additional information relative to the task-specific implementation of this HASP and related task work. According to SNL/NM policy, any site worker has the authority to stop work if unsafe conditions exist at the site.

2.1 ER Task Leaders (TLs)

The ER TLs have the primary responsibility for project completion and are the focal point of communication and direction between SNL/NM support organizations and contractor personnel. The TLs are responsible for all task work at the MWL, including administering contracted project activities and contractor personnel technical work. The TLs report directly to the SNL/NM ER Department 6147 Manager and work with the SNL/NM Contract Representative to administer contracts. The TLs will coordinate all interactions and activities with SNL/NM, DOE, the public, and other organizations, except those interactions or responsibilities they specifically delegate.

2.2 Assistant Task Leaders (ATLs)

The ER ATLs will assist the TLs and will interact with other contractor personnel and SNL/NM support organizations to ensure safe task completion. ATLs will typically coordinate day-to-day work the task-specific contractors are performing, under the direction of the TL(s). ATLs will be responsible for maintaining appropriate training and serve as the focal point of communication between support organizations and task-specific contractor personnel. ATLs will also coordinate with the Hazardous Waste Management Office (HWM), the Radioactive and Mixed Waste Management Facility (RMMF), and the Radiation Protection Office (RPO).

2.3 Task-Specific Contractor Personnel

The TLs will staff specific task work with appropriate, qualified contractor personnel. Task-specific contractors will be responsible for maintaining appropriate training and performing site work safely, as specified in their contracts.

2.4 Site Safety Officer (SSO)

The SSO may vary based upon the task work being performed. For each task, at least one SSO will be designated by the TL. The SSO role may be filled by a TL, ATL, or task-specific contractor. The SSO will be responsible for the following specific activities:

- Conduct and document daily tailgate safety briefings for all task-specific personnel and identify who will be responsible for carrying the two-way radio or cell phone and/or pager;
- Verify appropriate training documentation is maintained on site for each task-specific site worker;
- Review Task Hazard Analysis (THA) information with site workers, including PPE requirements;
- Coordinate health and safety issues and emergency response actions with site personnel and others, as appropriate.

- Monitor weather conditions;
- Maintain site safety field logs that include the following information: weather conditions, employees on-site, safety issues and any corrective actions implemented;
- Coordinate with SNL/NM industrial hygiene, safety, and radiation protection personnel as necessary and appropriate; and
- Enforce compliance with all requirements of this HASP and stop work if an unsafe condition is identified.

2.5 Site Visitors

All visitors most obtain permission prior to visiting the site from the SNL/ER Department Manager or the ER TL on site. Site visitors will be required to receive a task-specific site safety briefing and comply with health and safety requirements as specified by the SSO if they are present in an area of the site where work is being performed. The TL or ATL on site can then appropriately respond to the visitor and notify available on-site personnel of the visitor's purpose and request appropriate support.

3.0 Identified Work Tasks and Task Hazard Analyses

Identified work tasks and the Task Hazard Analysis (THA) process are described in this section. The THA process is the tool that will be used to evaluate and control hazards associated with identified work tasks. If new tasks are added to the MWL work scope, THAs will be prepared and reviewed with all involved site workers prior to starting the new task.

Identified work tasks at the MWL are summarized below.

Task Scope	Comments
Cover Installation ▪ Remove perimeter fences, and install temporary area boundary using T-posts and rope. ▪ Clear and grub existing landfill surface. Grubbing is not to exceed 6 in. in depth. ▪ Compact landfill surface to prepare for subgrade fill. ▪ Place and compact subgrade fill (from TA-3 soil stockpiles). ▪ Place rock bio-intrusion barrier. ▪ Place and compact native soil layer fill (from TA-3 soil stockpiles). ▪ Place and minimally-compact topsoil layer.	Grubbed material will be stockpiled and used as mulch or rip-rap as needed in the design specifications. The MWL is a Soil Contamination Area (SCA). Site workers will be required to read and sign the RWP prior to performing work in the SCA, and will follow the RWP during cover construction activities. However, once the subgrade fill has been applied, the only applicable radiological control to be applied will be no intrusive work.

▪ Seed the cover, lay-down area, borrow areas, and other disturbed areas with a native seed mix, as needed. Additional tasks to be conducted include: ▪ Soil screening ▪ Surveying ▪ Equipment decontamination, if needed (see Section 7.0). ▪ Clearing, grubbing, shallow excavation (at the TA-3 borrow area), minor cut and fill, contouring, scarifying, and harrow work. ▪ Road maintenance and dust control ▪ QA/QC sampling ▪ Nuclear gauge moisture and density verification measurements	Mechanical screening, grading, shallow excavation for surface water drainage features, and other closure activities are covered under this THA. Shallow excavation to generate additional clean fill from a borrow pit area is also covered under this THA. Soil screening will be conducted on clean soils near the TA-3 borrow area west of the CAMU. During screening, personnel at the nearby RWMMF will be notified regarding heavy equipment traffic. A dust permit and digging permit will be required.
Task Scope	**Comments**
<u>Waste Management Activities</u> ▪ Miscellaneous waste management tasks, including waste characterization, packaging, labeling, inspections, and movement.	No wastes are anticipated other than PPE, miscellaneous operational wastes, and decon water. The MWL is a Soil Contamination Area (SCA). Site workers will be required to read and sign the RWP prior to performing work in the SCA. However, once the subgrade has been applied, the only applicable radiological control to be applied will be no intrusive work.
<u>Mobilization, Demobilization and Site Closure</u> ▪ Fence removal and installation ▪ Addition or removal of temporary structures including site trailers ▪ Miscellaneous site clean-up activities ▪ Loading, unloading, and moving equipment and supplies. ▪ Geophysical surveys and other surveys	Much of this work will be performed between other task work as the schedule and personnel availability permit.

3.1 Task Hazard Analyses

The Task Hazard Analysis (THA) tool is the approach used to identify hazards and establish hazard controls prior to the execution of work. This approach is an integral part of implementing SNL/NM's Integrated Safety Management System initiative at the MWL.

Preliminary THA summaries have been prepared for each identified task and are provided in Attachment D1. Each task is described, the required equipment listed, and the anticipated level of PPE specified. Hazards are sorted into four categories: chemical, physical, radiological, and biological, and then rated based upon the probability of occurrence and the severity of the consequences. Anticipated control measures are then described. The hierarchy of controls is elimination, substitution, engineering, administration, and PPE. Potential offsite impacts are considered and control measures described, although for most of the remaining task work there is very low probability of any off-site impacts. These THAs will be modified and/or new ones generated as new information becomes available and/or new tasks are added to the work scope. THAs for non-routine tasks will be performed and reviewed with site workers prior to conducting the specific task. The results of these THAs will be incorporated in the daily, task-specific tailgate safety briefings. The TL will maintain the most current version of THAs, distribute them to personnel as appropriate, and attach them to the site HASP.

3.2 Underground Utilities

All soil disturbance, regardless of depth, will require a dig permit so the location of buried utilities can be identified prior to the start of field work. A comprehensive excavation permit has been submitted to cover all activities described in this HASP, and to comply with the SNL/NM Excavation and Penetration Activities Procedure AP-004 Revision 8. In the past, if the activity did not penetrate below 1 foot, an excavation permit was not required and the hazard of encountering underground utilities was not, as a rule, considered. Now all surface-disturbing activities will follow the procedures below. Surface disturbing activities include:

Digging	Sampling
Scraping	Fence construction
Grading	Posting & signage installation

- Before any excavation is performed, submit a request for an Excavation Permit to Facilities.
- Have any underground utilities identified, spotted and marked by Facilities before start of the activity.
- When submitting a request for an excavation permit describe the work area and note the exact location on a drawing of the site.
- Designate a sufficient size work area to allow the opportunity to locate work away from marked utilities.
- Pre-inspect the area after spotting has been completed to see if there are buried utility issues that need to be resolved.
- Do not mechanically dig closer than 5 feet to any marked or mapped buried utilities.
- If hand digging within the 5-foot exclusion area is not possible, call the Excavation Permit organization in Facilities Management for other options.

- No intrusive digging activities are planned at the Mixed Waste Landfill. However, clean soils will be excavated to a depth of up to 3 ft from the TA-3 borrow area, located approximately ¾ mile south of the MWL.
- Alert authorities if any underground utilities are encountered. Call 311, the non-emergency hotline (24/7) for guidance. For emergencies call 911. Notify your line management.
- Report even known utilities that are uncovered so that Facilities can determine their exact location with GPS equipment and correct their drawings, if needed.
- Report any site-installed utilities to Facilities so they may add them to the drawings of the area.

3.4 Hot Work

Various activities at the MWL may require welding, cutting metal with a cutting torch, or other forms of hot work. The SNL/NM Hot Work Administrative Procedure AP-032 Revision 1 will be followed for all applicable hot work at the MWL, including obtaining a hot work permit prior to conducting the related work. The permit process identifies hazards associated with hot work and identifies appropriate controls for those hazards. The hot work permit will be maintained on site. Any hot work being conducted by outside contractors will be performed under the MWL hot work permit, and Sandia will provide oversight and fire watch support during the hot work. The SSO will also ensure that any person performing hot work will be provided with and will wear proper protection specific to the particular task.

3.5 Weather

Weather-related hazards include heat stress, sunburn, cold stress, rain, wind, hail, snow, and lightning. The task-specific SSO is responsible for briefing workers on weather-related hazards, warning signs, and appropriate hazard control measures. All site personnel are responsible for monitoring weather conditions while performing activities outside, and stopping work if weather conditions create an unsafe work environment. If lightning occurs within 1 mile of the work area (5 to 7 second count between the lightning flash and the sound of thunder), work will be stopped until the lightning moves further away or the storm dissipates.

3.6 Borrow Area Excavation

The TA-3 borrow area is located west of the CAMU in the southern part of TA-3. The excavation at the borrow area will extend no deeper than 3 ft bgs, and therefore, does not constitute a significant hazard.

4.0 Personal Protective Equipment

Due to the nature of the hazards at the MWL, this work will be performed in Level D PPE, as described below.

Level D Protection

- Cotton coveralls
- Climate appropriate underclothes
- Hard Hat*
- Safety shoes/boots
- Safety glasses w/sideshields or goggles
- Work Gloves (leather or cotton)*

*Task-specific PPE requirements will be determined by the SSO and communicated to workers at the tailgate safety briefing.

The SSO is responsible for evaluating the PPE requirements and can make appropriate changes based upon actual site conditions and/or information obtained during task work. The SSO for each task will determine if hard hats are necessary based upon whether or not an overhead hazard exists. Equipment operators working in closed cabs for all tasks do not need to wear safety glasses or hardhats. No buried MWL wastes are likely to be encountered during cover construction activities, as wastes are buried several feet or more below ground surface. For this reason, Tyvek or other disposable coveralls are not required, and Level D PPE will be adequate for all activities on site.

Tritium is present in surface soils at the MWL. Most of the tritium occurs in soils primarily in the northern half of the MWL, with the greatest concentration occurring in the Classified Area. Figure D-1 shows the distribution of tritium in surface soil at the MWL, based on sampling activities conducted in the early 1990's. Tritium activities in surface soil are relatively low and do not pose a threat to human health or the environment (Peace et al, 2002).

Plutonium-238 has been detected at concentrations of up to 0.103 pCi/g in localized surface soils in the unclassified area of the MWL (Figure D-2). Risk assessment shows the plutonium (at the concentrations detected) does not pose a threat to human health or the environment (SNL/NM 2002).

Standard dust suppression techniques will be used to minimize the generation of windblown dust. These techniques include the limited spraying of soils with water or the use of soil fixatives to minimize dust generation. Fixatives used for dust control shall be reviewed prior to application for potential effects on landfill leachate and landfill surface runoff. Over-application of water resulting in free liquids will not be allowed because of waste minimization controls.

If required and specified, fixatives may be used to mitigate dust. Dust control will be in accordance with the New Mexico Environment Department's Ambient Air Quality Standards (NMAC Title 20 Chapter 2 Part 3) and all applicable DOE and SNL standards. Work will be restricted or suspended if unacceptable amounts of dust are being generated as determined by the SSO and/or radiological control technician. Work areas that have the potential for generating dust will require dust suppression techniques.

PPE requirements by task are summarized below and in the task-specific THAs provided in Attachment D1.

Task Activities	PPE Requirements and Comments
Cover Installation ▪ Remove perimeter fences, and install temporary area boundary using T-posts and rope. ▪ Clear and grub existing landfill surface. Grubbing is not to exceed 6 in. in depth. ▪ Compact landfill surface to prepare for subgrade fill. ▪ Place and compact subgrade fill (from TA-3 soil stockpiles). ▪ Place gravel/cobble bio-intrusion barrier. ▪ Place and compact native soil layer fill (from TA-3 soil stockpiles). ▪ Place and minimally-compact topsoil layer. ▪ Seed the cover, lay-down area, borrow areas, and other disturbed areas with a native seed mix, as needed. Additional tasks to be conducted include: ▪ Soil screening ▪ Surveying ▪ Equipment decontamination, if needed ▪ Clearing, grubbing, shallow excavation (at the TA-3 soil borrow area), minor cut and fill, contouring, scarifying, and harrow work ▪ Road maintenance and dust control ▪ QA/QC sampling ▪ Nuclear gauge moisture and density verification measurements	All activities can be performed in Level D PPE (Section 4.0). Task-specific PPE requirements will be determined and communicated to site workers by the SSO, or by the Rad Technician in accordance with the RWP # 2562 .

Waste Management Activities ▪ Miscellaneous waste management tasks, including waste characterization, packaging, labeling, inspections, and movement.	All waste management tasks are adequately covered by Level D PPE (Section 4.0). Task-specific PPE requirements will be determined and communicated to site workers by the SSO.
Mobilization, Demobilization and Site Closure ▪ Fence removal and installation ▪ Addition or removal of temporary structures including site trailers ▪ Miscellaneous site clean-up activities ▪ Loading, unloading, and moving equipment and supplies ▪ Geophysical surveys and other surveys	All activities can be performed in Level D PPE (Section 4.0). Task-specific PPE requirements will be determined and communicated to site workers by the SSO.

5.0 Personnel Training and Medical Monitoring Requirements

All on-site workers must sign the HASP compliance agreement in Section 10.0 and attend the daily, task-specific tailgate safety meetings. All site visitors entering active work areas, regardless of employer, must receive a site-specific safety briefing delivered by the SSO or designee for that work area.

The task-specific SSOs are responsible for verifying training compliance for site workers involved in the specific tasks they are assigned to. The TLs, with support from the task-specific SSOs, ATLs and administrative staff are responsible for tracking and notifying personnel when training updates are needed. Copies of training records will be maintained at the MWL site. Unless otherwise noted, all training must be documented by a certificate of completion, by signing a training log, or an SNL/NM TEDS printout. Site workers are responsible for providing the SSO or designee with training documentation prior to starting work, and attending scheduled training. All site workers must comply with medical surveillance requirements outlined in 29 CFR 1910.120(f).

Site Safety Officers will be required to have RAD Worker II training. Because construction activities will be noninvasive, heavy equipment operators in closed cabs are required to have Rad Worker 1 training. For any work requiring use of a respirator, site workers must have medical approval, respiratory protection training, and a respiratory fit test. At least one person on site must have CPR, First Aid, and Fire Extinguisher training. Site workers that operate a forklift must have the appropriate SNL/NM training (FKL153G) or equivalent training from another source.

Training requirements for site personnel are summarized in the Table below.

Responsibility	Required Training*
Task-Specific Site Safety Officers (SSOs)	40-hour OSHA HAZWOPER, 8 Hr. Annual Refresher, 8 Hr. HAZWOPER Supervisor Training, 24-Hr. Supervised OJT, ESH100, Rad Worker II
Task Leaders and Assistant Task Leaders	40-hour OSHA HAZWOPER, 8 Hr. Annual Refresher, 8 Hr. HAZWOPER Supervisor Training, 24-Hr. Supervised OJT, ESH100, Rad Worker II
Site Workers (including Task Specific Contractors)	40-hour OSHA HAZWOPER, 8 Hr. Annual Refresher, 24-Hr. Supervised OJT, ESH100, Rad Worker 1
Heavy Equipment Operators	40-hour OSHA HAZWOPER, 8 Hr. Annual Refresher, 24-Hr. Supervised OJT, ESH100, Rad Worker 1, Drivers License [CDL not required, as operators will not be on public roads]

*SNL/NM security training requirements applicable to the level of clearance for each worker will be completed and documented.

6.0 Monitoring

Dust monitoring may be required during the initial phase of the construction project. If it is requested by a task-specific SSO, dust monitoring will be coordinated with the MWL TL(s).

Because the MWL is an SCA, work in radiologically-controlled areas is addressed under RWP # 2562 and subsequent revisions. Screening and sampling for radiological contamination will be conducted as per the RWP and project waste characterization criteria. Radiation monitoring may be required by the RWP. The radiation monitoring instruments will be calibrated and maintained by SNL/NM Radiation Protection. The criteria for stopping work and notifying the SNL/NM Radiological Control Technician are specified in the RWP.

7.0 Work Zones and Decontamination

Chemical decontamination for personnel and equipment will not be required, as no wastes will be excavated from the site. Radiological decontamination of equipment may be required during the subgrade preparation phase of the project, when heavy equipment may encounter contaminated soils. Radiological decontamination is addressed in RWP # 2562 and subsequent revisions. Once clean subgrade have been placed over the contaminated soils, radiological decontamination will no longer be necessary

7.1 Work Zones

An exclusion zone (EZ) will be established to protect personnel during heavy equipment operations on the cover. A contamination reduction zone (CRZ) will not be necessary, as no excavation into contaminated materials is anticipated, and personnel decontamination should not be required. The SSO will be responsible for setting up appropriate task-specific EZs within the MWL site operational boundary. The necessity for a radiological buffer and decontamination area will addressed in RWP # 2562 and subsequent revisions.

7.2 Personnel Decontamination

Personnel decontamination should not be necessary during the MWL cover construction project, as contamination levels in MWL soils are relatively low. Once soils are covered by the subgrade layer, there will be no potential for contamination of personnel during the remaining cover construction activities. RWP # 2562 and associated revisions discuss radiological requirements for decontamination when exiting a radiologically-controlled area.

7.3 Equipment Decontamination

Equipment that comes into contact with contaminated MWL soil during the initial phase of the project may require decontamination, in accordance with the MWL RWP # 2562. The approved MWL decontamination procedure involves either a dry decon or washing equipment with a high-pressure spray or a low-pressure wash/brush, using a surfactant such as Alconox mixed with water.

If necessary (and if required by the RWP), a decontamination pad may be set up alongside the landfill and used for heavy equipment decontamination. Smaller equipment may also be decontaminated in this location or in leak-proof containers. All decontamination fluids will be collected and sampled for disposal following established waste management procedures.

After the subgrade material has been placed, heavy equipment will no longer require decontamination for the remainder of site work, and radiological control procedures will be eliminated because there will be no further potential for contamination. The only radiological control remaining in place will be the requirement for no intrusive activities at the site.

8.0 Emergency Response Plan

This section provides information regarding the action(s) to be taken by site personnel in the event of an emergency situation. Based on the current activities at the MWL, the potential for a project emergency, such as encountering buried unexploded ordnance, is extremely unlikely. The potential for other TA 3 operations to affect work at the MWL is possible, but also limited. This section provides important emergency information, including lines of communication, to ensure site personnel are prepared to deal with an on-site emergency or off-site evacuation.

8.1 Communication and Muster Points

Direct voice communication and/or two-way radios will be the primary means for communication on-site. Because more than one crew may be working on site at the same time, each crew will carry a site radio or cell phone if crews are not working in the same general area. A designated member of the work crew (typically the SSO, site supervisor, or designee) will carry and monitor the radio or cell phone. More than one work crew may be covered by one radio or cell phone if they are all working in the same general area and have coordinated ahead of time to notify each other in case of an emergency situation. This will be documented through the tailgate safety briefing in the morning before the field work begins.

Site emergencies will be communicated either directly (person to person) or through the site radios or cell phones. An off-site emergency within TA 3/5 that requires the notification and/or evacuation of MWL site personnel will be communicated via two-way radios from the SNL/NM Incident Command (two-way IC radios) and/or Sandia alpha-numeric pagers. Because MWL personnel may not be in the site trailers at all times during the day, the two-way IC radio or cell phone/Sandia pager will provide a back-up means to ensure MWL personnel are notified of a TA 3/5 emergency situation (off-site emergency). At least one, on-site, MWL representative will carry and monitor the two-way IC radio or wear the Sandia pager and carry a cell phone. The person(s) carrying the two-way IC radio or cell phone/Sandia pager will be identified in the daily tailgate safety briefings and be responsible for notifying the other MWL site personnel in the event of an off-site emergency.

In the event of an off-site or on-site emergency situation, the MWL TL(s) will be notified immediately. The MWL TLs, if available, or designee, will be responsible for communicating with other SNL/NM organizations/personnel. In the event of an emergency that requires the evacuation of the immediate area, personnel will muster at the MWL muster points (Figure D-3).

If an evacuation of TA 3 is required, all MWL site personnel will proceed directly to the Kirtland Air Force Base Golf Course parking lot and wait there until further information is available, or as directed by the SSO, TL(s), or designee.

Specific roles and responsibilities to be carried out by site personnel will depend on the nature of the incident. Site workers will carry out the various initial response actions, including notifying everyone in the immediate vicinity of the emergency situation and associated hazards.

Communications during site emergencies will occur in the following sequence:

1. On-site personnel will be notified first via direct voice communication, supplemented if necessary by two-way radio or cell phone communication, to ensure all on-site MWL personnel are aware of the situation. If more practical given the circumstances, two blasts on a vehicle or hand-held horn will be repeated to sound the initial warning. If someone is injured, site workers will check scene for hazards and notify the closest, properly-trained First Aid/CPR responder. If imminent danger exists, proceed directly to step 4 and then proceed with the following steps.

2. If possible based upon the situation, notify the MWL TL(s) immediately, who in turn will notify the 6147 Department Manager. The TL(s) and/or SSO(s) will determine appropriate initial responses, including selecting a muster point if appropriate (Figure D-3). As per Section 3.2, if a buried utility is encountered, notify the non-emergency hotline immediately and stop intrusive work in the area.
3. Activate the SNL/NM Incident Command by phone, two-way IC radio, or cellular phone.
4. Use tailgate safety briefing forms or site entry logs and the buddy system at the muster point to account for all site workers.

MEDICAL EMERGENCY

In case of a medical emergency/injury, the SSO (or nearest site worker) will survey the scene and ensure that it is safe to enter and render assistance. If emergency medical attention is needed the SSO will immediately activate or have someone else activate the SNL/NM Emergency Response by calling 911 on a land line or 844-0911 by cell phone, or by using the two-way IC radio. The SSO or the nearest trained site worker will then provide CPR and/or emergency first aid as necessary. If the situation is not a medical emergency, the injured individual(s) should be transported to the Sandia Medical Clinic or Lovelace Medical Center for non-business hours, as appropriate. Lovelace Medical Center will typically be used by contractors for minor injuries and non-emergency medical conditions. The evacuation routes to Sandia Medical Clinic and the Lovelace Medical Center are shown in Figure D-4.

Medical Clinic Information	
SNL Medical Clinic Address: Building 831, corner of F & 7th Streets, KAFB, NM Route to SNL Medical Clinic: Exit east from TA-3 to Pennsylvania (Lovelace Rd.), then left (northwest) to Wyoming, then right (north) to F Street, east on F Street to 7th Street *[Used during normal business hours of 0700-1700]*	**SNL Medical Clinic: 845-8692 (reception)** **845-8159 (Dr. McCarthy)**
Lovelace Hospital Address: 5400 Gibson Blvd. SE. Route to Lovelace Hospital: Exit east from TA 3 to Pennsylvania Ave, go left (northwest) to Wyoming, go right (north) to Gibson, go left (west) to Emergency Entrance, 5400 Gibson Blvd. See Figure D-4 for map to Lovelace. *[Used only during non-regular business hours]*	**Lovelace Phone: 262-7000 (main switchboard)** **262-7222 Emergency Room**

8.2 Emergency Contact Information

Emergency contact information provided below for the MWL Project.

EMERGENCY CONTACTS	NAME/ORGANIZATION NUMBER	PHONE
24-Hour Emergency Line	Incident Command System/3137	911 (base) / 844-0911 (cell)
Non-Emergency Hotline	Incident Command System/3137	311 (base) / 844-6515 (cell or base)
Sandia Medical Clinic	Staff	911 (base) / 844-0911 or 844-0081 (cell or base)
Lovelace Medical (Gibson)	Staff	Emergency Room: 262-7222 (cell) or 7-262-7222 (base)
Department Manager	Dick Fate / 6147	284-2568 (office)
Project Task Leaders	Jerry Peace / 6116 Don Schofield / 6141	284-2472 (office) 844-4088 (office) / 259-7098 (cell)
Assistant Task Leaders	Mike Mitchell / 6141 Tim Goering / 6147 Joe Fritts / 6146	284-6757 (office) 250-7224 (cell) 284-2563 (office) 845-8703 (office) / 681-8016 (cell)
Fire Department	KAFB	911 (base) / 844-0911 (cell)
KAFB EOD	Staff	846-2229
Radiation Protection Operations	To Be Determined	To Be Determined
Industrial Hygiene	Michael Oborny / 6328	845-8040
Safety Engineering	Michael Oborny / 6328	845-8040
6100 ES&H Coordinator	Johnny Ethridge / 6140	845-9295

9.0 References for Key MWL Project Documents

The following project documents contain information that is relevant to the task work described and covered by this HASP.

Peace, J.L. and T.J. Goering, January 2005. "Calculation Set for Design and Optimization of Vegetative Soil Covers, Sandia National Laboratories, Albuquerque, New Mexico", Sandia National Laboratories Report SAND2005-0480.

Peace, J.L. and T.J. Goering, March 2004. "Mixed Waste Landfill Corrective Measures Study Final Report, Sandia National Laboratories, Albuquerque, New Mexico", Sandia National Laboratories Report SAND2004-0627.

Peace, J.L, T.J. Goering, M.D. McVey, and D.J. Borns, May 2003. "Deployment of an Alternative Cover and Final Closure of the Mixed Waste Landfill, Sandia National Laboratories, Albuquerque, New Mexico," SAND Report SAND2003-0836.

Peace, J.L., Goering, T.J. and M.D. McVey, September 2002. "Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation, Sandia National Laboratories, Albuquerque, New Mexico", Sandia National Laboratories Report SAND2002-2997.

Sandia National Laboratories/New Mexico (SNL/NM), July 2005. "Mixed Waste Landfill Voluntary Corrective Measures Work Plan, Sandia National Laboratories/New Mexico", prepared at Sandia National Laboratories by J. Peace and T. Goering for the US Department of Energy, Albuquerque, New Mexico.

10.0 Compliance Agreement

All site workers will be required to review and comply with the information contained in this HASP. This will be documented by the site workers signing the compliance agreement form on the following pages. The signed agreement will be maintained on site.

HEALTH AND SAFETY PLAN ACKNOWLEDGMENT:
I have read, understand, and agree to abide by the provisions detailed in this Site Health and Safety Plan. Failure to comply with these provisions may lead to disciplinary action and my dismissal from the site.

Printed Name	Signature	Organization/Company	Date

HEALTH AND SAFETY PLAN ACKNOWLEDGMENT (continued):

I have read, understand, and agree to abide by the provisions detailed in this Site Health and Safety Plan. Failure to comply with these provisions may lead to disciplinary action and my dismissal from the site.

Printed Name	Signature	Organization/Company	Date

HEALTH AND SAFETY PLAN ACKNOWLEDGMENT (continued):

I have read, understand, and agree to abide by the provisions detailed in this Site Health and Safety Plan. Failure to comply with these provisions may lead to disciplinary action and my dismissal from the site.

Printed Name	Signature	Organization/Company	Date

Attachment D1

Task Hazard Analyses
For:
Vegetative Cover Installation Activities
Waste Management Activities
Mobilization, Demobilization and Site Closure Activities

TASK HAZARD ANALYSIS
Task — MWL Vegetative Cover Installation

Description —
A vegetative cover with a rock bio-intrusion barrier will be installed on the Mixed Waste Landfill (MWL). The cover will be placed over the original 2.6-acre landfill surface and will consist of three feet of compacted native soil, overlying a rock bio-intrusion layer. A vegetated topsoil layer admixed with 25 percent 3/8-in. crushed gravel will be applied to maintain water balance and mitigate water and wind erosion.

Tasks associated with MWL Vegetative Cover Installation activities include:

- Remove perimeter fences and install temporary operational boundary using T-posts and rope.
- Clear and grub existing landfill surface. Grubbing is not to exceed 6 in. in depth. Grubbed materials will be stockpiled onsite and used as mulch or rip-rap where needed.
- Compact landfill surface to prepare for subgrade fill.
- Place and compact subgrade fill (from TA-3 soil stockpiles).
- Place rock bio-intrusion barrier.
- Place and compact native soil layer fill (from TA-3 soil stockpiles).
- Place and minimally-compact topsoil layer.
- Seed the cover, lay-down area, borrow areas, and other disturbed areas with a native seed mix. The surface will be drill-seeded, mulched and crimped.

Additional tasks to be conducted include:

- Mechanical screening of fill material
- Surveying
- Equipment decontamination (if required by the RWP) and cleaning
- Clearing, grubbing, minor cut and fill, contouring, scarifying, and harrow work. Shallow excavation (≤3 feet) will be conducted at the TA-3 borrow area west of the CAMU.
- Road maintenance and dust control

- QA/QC sampling
- Moisture and density verification measurements using a CPN MC-3 Portaprobe

Equipment Required:

- Heavy Equipment- excavator, four yard loader, dozer (D-6 or equivalent), dozer (JD 650 or equivalent) grader, soil compactor, 60-ft boom lift, high reach fork lift
- Mechanical screen (ScreenAll)
- Vehicles-14-yard dump truck, water truck (2000 and 4000 gallon), water wagon, pick-ups
- Hand Tools-shovels, picks, etc.
- GPS and survey equipment
- CPN MC-3 Portaprobe
- Safety Equipment

Level of Protection: Level D PPE will be appropriate for all cover installation activities (see Section 4.0 for discussion of PPE). The task-specific SSO is responsible for evaluating the PPE requirements and can make appropriate changes based upon actual site conditions and/or information obtained during task work. The SSO for the cover installation tasks will determine if hard hats are necessary based upon whether or not an overhead hazard exists. Equipment operators working in closed cabs do not need to wear safety glasses or hardhats.

MWL Vegetative Cover Installation - Potential Hazards and Controls

Potential Hazard	Hazard Rating	Control
General Approach to Work Hazards	Not Applicable	Maintain worker awareness and coordinate task-specific work regime through tailgate safety briefings. Use buddy system and team approach to keep workers watching out for each other.
Chemical • Direct contact with chemically-contaminated soil and debris	Not Applicable	Chemical contamination of MWL surface soils is not significant, and will not be an issue. Only clean soil and rock will be used for MWL cover construction.
Physical • Cover construction • Heavy Equipment • Excavation Activities-Utilities • Mechanical screening • Tools • Worker fatigue • Heat and Cold stress • Slip, Trip and Fall • Heavy Lifting	Medium	The construction area will be controlled, and these controls will be maintained until cover installation are completed. Only qualified operators will operate heavy equipment, which will be equipped with backup alarms. Heavy equipment will be inspected daily when used. The number of workers in the work area will be minimized when heavy equipment is operating. Any excavation activities will follow OSHA requirements for sloping, as appropriate. An SNL/NM excavation permit will be required for the TA-3 borrow area. The permit requirements and reporting protocol will be reviewed with workers. The mechanical screen will be located downwind of personnel and water will be used for dust control. If dust control measures are not adequate, screening will be stopped. All tools will be inspected prior to use. A work/rest plan will be implemented as appropriate by the SSO. Workers will dress appropriately for the weather conditions and heat/cold stress warning signs and hazards will be reviewed. Shaded rest areas and sheltered, heated rest areas will be provided. Frequent water/hydration breaks will be implemented. Workers will watch for and eliminate (where possible) slip, trip and fall hazards. Safe lifting procedures will be reviewed with workers and mechanical aids used whenever feasible.

Potential Hazard	Hazard Rating	Control
Radiological • Ingestion or inhalation of radiologically-contaminated soil and dust	Low	The MWL is a Soil Contamination Area (SCA). Site workers will be required to read and sign the RWP prior to performing work in the SCA. Dust suppression techniques will be used to minimize the generation of dust during construction. These include limited spraying of soils with water or the use of soil fixatives. Work areas that have the potential for generating dust will require dust suppression.
Explosive	Not Applicable	No explosive hazards anticipated.
Biological • Snakes, Rodents, Insects	Low	Work areas will be kept clean and places of refuge for biological hazards eliminated where possible. Worker awareness will be maintained through tailgate safety briefings.

TASK HAZARD ANALYSIS
Task — MWL Vegetative Cover Installation (Concluded)

Potential Off-Site Impacts:

1. Increased traffic – Considerable vehicle and heavy equipment traffic related to cover construction will occur within the site operational boundary. However, subgrade and native soil layer fill from the TA-3 soil stockpiles will be trucked to the MWL from the soil stockpiles and borrow area, located approximately 1 mile south of the MWL. Increased localized traffic in TA-3 is anticipated during the four month construction period for the cover. Suggested truck routes from the soil stockpiles to the MWL are shown in Figure D-5. Additional traffic will also be generated during the trucking of rock from an offsite source to the MWL for the bio-intrusion layer. Traffic impacts on KAFB as a whole are expected to be minimal, however. If necessary, local traffic near the MWL will be re-directed.
2. Increased noise – no significant off-site impact anticipated.
3. Utility outages - no off-site impact anticipated.
4. Dust - suppress dust with limited water as necessary, or with soil fixatives, if appropriate. Use magnesium chloride/water mixture as appropriate to maintain soil stockpiles and local road surfaces. The decision to apply magnesium chloride will be made by the site

manager or the SSO. Mechanical screening will be terminated at the request of the SSO if dust suppression techniques are not adequate to prevent offsite dust releases due to wind that adversely impacts on-site or off-site personnel.

5. Fire - Task Leader, SSO, or designee will communicate with local facility Points of Contact and initiate emergency response plan if necessary.

TASK HAZARD ANALYSIS
Task — Waste Management

Description —
Minimal waste will be generated by the MWL cover construction project. Waste generated will likely be limited to small quantities of miscellaneous operational wastes. Although the MWL is an SCA, the generation of radiological waste should be minimal. Organic debris removed during clearing and grubbing the landfill surface will be utilized onsite as mulch during the seeding operation. Similarly, rocks removed during clearing and grubbing and concrete waste generated during fence removal will be utilized onsite in the rock bio-intrusion barrier, or as rip rap for the cover.

Waste management tasks include

- Waste characterization sampling
- Waste packaging, labeling, inspections, and other miscellaneous waste management tasks

Heavy equipment and light vehicles may be used when necessary to move waste containers and waste materials. Radiological release surveys may be required for items, equipment, containers, etc. before leaving the SCA. RWP # 2562 and subsequent revisions will be followed for all work in the SCA. The task-specific SSO for any waste management activities conducted in the SCA will be responsible for reviewing the RWP with site workers and coordinating with Radiation Protection, as appropriate, to ensure compliance with the RWP and this HASP.

Equipment Required:
- Heavy Equipment-backhoe, forklift, front loader
- Vehicles- pick-ups.

- Hand Tools-shovels, picks, hammers, screwdrivers, etc...
- Power Tools-drill, saws, air-tools, etc...
- Rigging-slings, chokers, barrel lifters, chains, shackles, hooks
- Safety Equipment- radiation monitors as per RWP
- Polyethylene sheeting

Level of Protection: Level D is required for waste management tasks. See Section 4.0 for discussion of PPE.

Waste Management - Potential Hazards and Controls

Potential Hazard	Hazard Rating	Control
General Approach to Work Hazards	Not Applicable	Maintain worker awareness and coordinate task-specific work regime through tailgate safety briefings. Use buddy system and team approach to keep workers watching out for each other.
Chemical • No hazards anticipated	Not Applicable	No contact with chemical contamination is anticipated during MWL cover construction.

Potential Hazard	Hazard Rating	Control
Physical • Heavy Equipment • Motor vehicle use for transport • Tools • Worker fatigue • Heavy lifting • Heat and Cold Stress • Slip, Trip and Fall	Medium	Only qualified operators will operate heavy equipment, which will be equipped with backup alarms. Heavy equipment will be inspected daily when used. The number of workers in the work area will be minimized when heavy equipment is operating. Site workers using motor vehicles will have a current driver's licenses and obey all traffic laws. All tools will be inspected prior to use. A work/rest plan will be implemented as appropriate by the task-specific SSO. Safe lifting procedures will be reviewed with workers and mechanical aids used whenever feasible for heavy lifting. Workers will dress appropriately for the weather conditions and heat and cold stress warning signs and hazards will be reviewed. Shaded rest areas and sheltered, heated rest areas will be provided. Frequent water/hydration breaks will be implemented. Workers will watch for and eliminate (where possible) slip, trip and fall hazards.
Radiological • Handling potentially contaminated soil/debris	Low	The MWL is a soil contamination area (SCA). MWL soils are contaminated with tritium and plutonium. SCA controls will be maintained within the MWL perimeter until the subgrade layer has been placed. Waste management tasks have a low potential radiological hazard rating, and will be conducted in accordance with the RWP.
Explosive	Not applicable	No explosive hazards anticipated.
Biological • Snakes, Rodents, Insects	Low	Areas will be kept clean and places of refuge for biological hazards eliminated where possible. Worker awareness will be maintained through tailgate safety briefings.

Potential Off-Site Impacts:
No offsite impacts anticipated.

TASK HAZARD ANALYSIS
Task — Mobilization, Demobilization, and Site Closure Activities

Description — This task covers numerous activities that are related to mobilization, demobilization, and site closure activities. Site closure activities include permanently closing down site restoration operations at the MWL and the associated temporary infrastructure. The following list summarizes the main types of activities covered under this task.

- Fence removal and installation
- Removal of temporary structures, including site trailers
- Removal of temporary utilities (if applicable)
- Redistribution of SNL/NM owned equipment and material
- Miscellaneous site clean up activities
- Loading and unloading, movement of equipment, supplies, and waste materials
- Preparing equipment and supplies for transport off-site
- Surveys

These activities will be conducted in a phased manner, as personnel and resources allow. Also covered under this task will be any welding or hot work required as part of remaining MWL task work (see Section 3.4). A final survey is planned after completion of cover installation. After completion of the site closure activities the site will be in its end-state condition.

Equipment Required:

- Heavy Equipment – forklift, front-end loader, track-hoe, backhoe, small front-end loader
- Hand Tools – hammers, shovels, sledge hammer, etc.
- Power Tools – electric drill, circular saw, etc.
- Rigging-slings, chokers, barrel lifters, chains, shackles, hooks
- Welding/hot work equipment (Section 3.4)
- Vehicles – pick-up trucks, dump truck, semi-trucks
- Safety Equipment

Level of Protection: Level D PPE should cover all demobilization activities (see Section 4.0 for discussion of PPE). The task-specific SSO and the assigned rad technician are responsible for evaluating the PPE requirements and can make appropriate changes based on the specific demobilization task work being performed. Hot work may require additional PPE, which will be determined by the task-specific SSO and consistent with the SNL/NM Hot Work Permit (Section 3.4).

Mobilization, Demobilization, and Site Closure Activities - Potential Hazards and Controls

Potential Hazard	Hazard Rating	Control
General Approach to Work Hazards	Not Applicable	Maintain worker awareness and coordinate task-specific work regime through tailgate safety briefings. Use buddy system and team approach to keep workers watching out for each other.
Chemical	Not Applicable	No intrusive work in contaminated areas.
Physical • Heavy equipment • Motor vehicle use for transport • Electrical • Tools • Hot work • Heat and cold stress • Slips, trips, and falls • Heavy lifting	Medium	Heavy equipment will be inspected daily when used. Only qualified operators will operate heavy equipment, which will be equipped with backup alarms. The number of workers in the work area will be minimized when heavy equipment is operating. If a crane is needed it will be obtained, along with a SNL/NM qualified operator, through SNL/NM Facilities. Site workers using motor vehicles will have a current drivers license and obey all traffic laws. Qualified electricians perform electrical work. Lock out tag out procedures will be followed where applicable. An SNL/NM excavation permit covering the entire MWL area has been obtained. The permit requirements and reporting protocol will be reviewed with workers who are involved with any type of intrusive activities. All tools will be inspected prior to use. A hot work permit will be obtained from SNL/NM Facilities prior to conducting hot work. Proper precautions, including fire prevention, will be followed as per the permit. Workers will dress appropriately for the weather conditions and heat/cold stress warning signs and hazards will be reviewed. Shaded rest areas and sheltered, heated rest areas will be provided. Frequent water/hydration breaks will be implemented. Workers will watch for and eliminate (where possible)

Potential Hazard	Hazard Rating	Control
		slip, trip and fall hazards, as part of a "good house-keeping" approach. Safe lifting procedures will be reviewed with workers and mechanical aids used whenever feasible for heavy lifting.
Radiological	Low	The MWL is an SCA. Soils are contaminated with tritium and localized plutonium. SCA controls will be maintained within the MWL perimeter until the subgrade layer has been placed. Mobilization, demobilization, and site closure tasks have a low potential radiological hazard rating, and will be conducted in accordance with the RWP.
Explosive	Not Applicable	No explosive hazards anticipated.
Biological • Snakes, Rodents, and Insects	Low	Areas will be kept clean and places of refuge for biological hazards eliminated where possible. Worker awareness will be maintained through tailgate safety briefings.

Potential Off-Site Impacts:
No off-site impacts anticipated.

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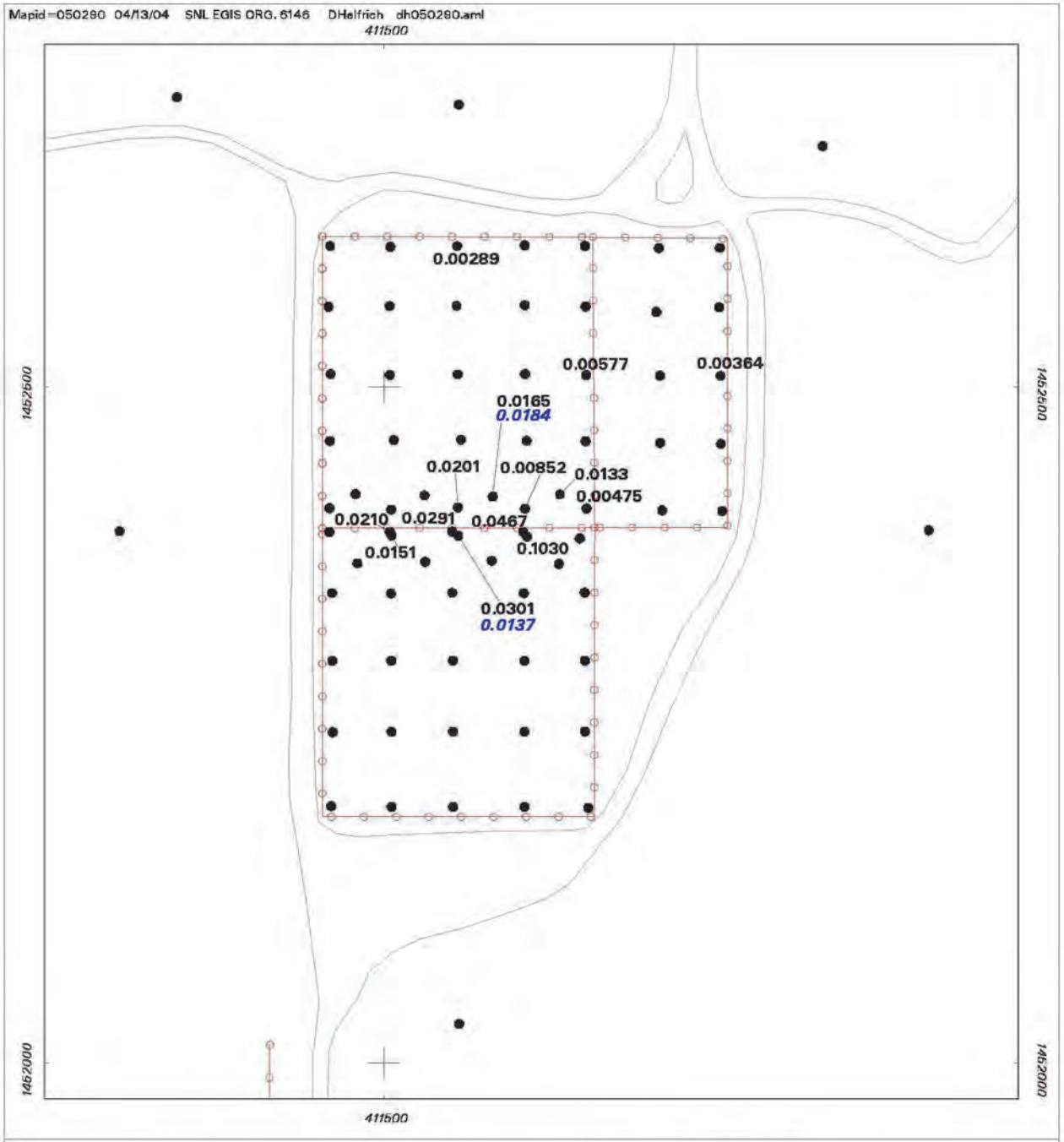
Figures

Figure D-1
1993 Tritium Surface Soil Sampling Results

840857.04240000 A13



Legend

PU-238 Surface Soil Sample
units measured in pCi/g
(no value = 0.0 pCi/g)
(*0.0137* = duplicate sample)

Unpaved Road

Fence / MWL Boundary

Figure D-2
Plutonium-238 Concentrations Detected in Surface Soil at the Mixed Waste Landfill

0 60 120
Scale in Feet

0 14.4 28.8
Scale in Meters

N

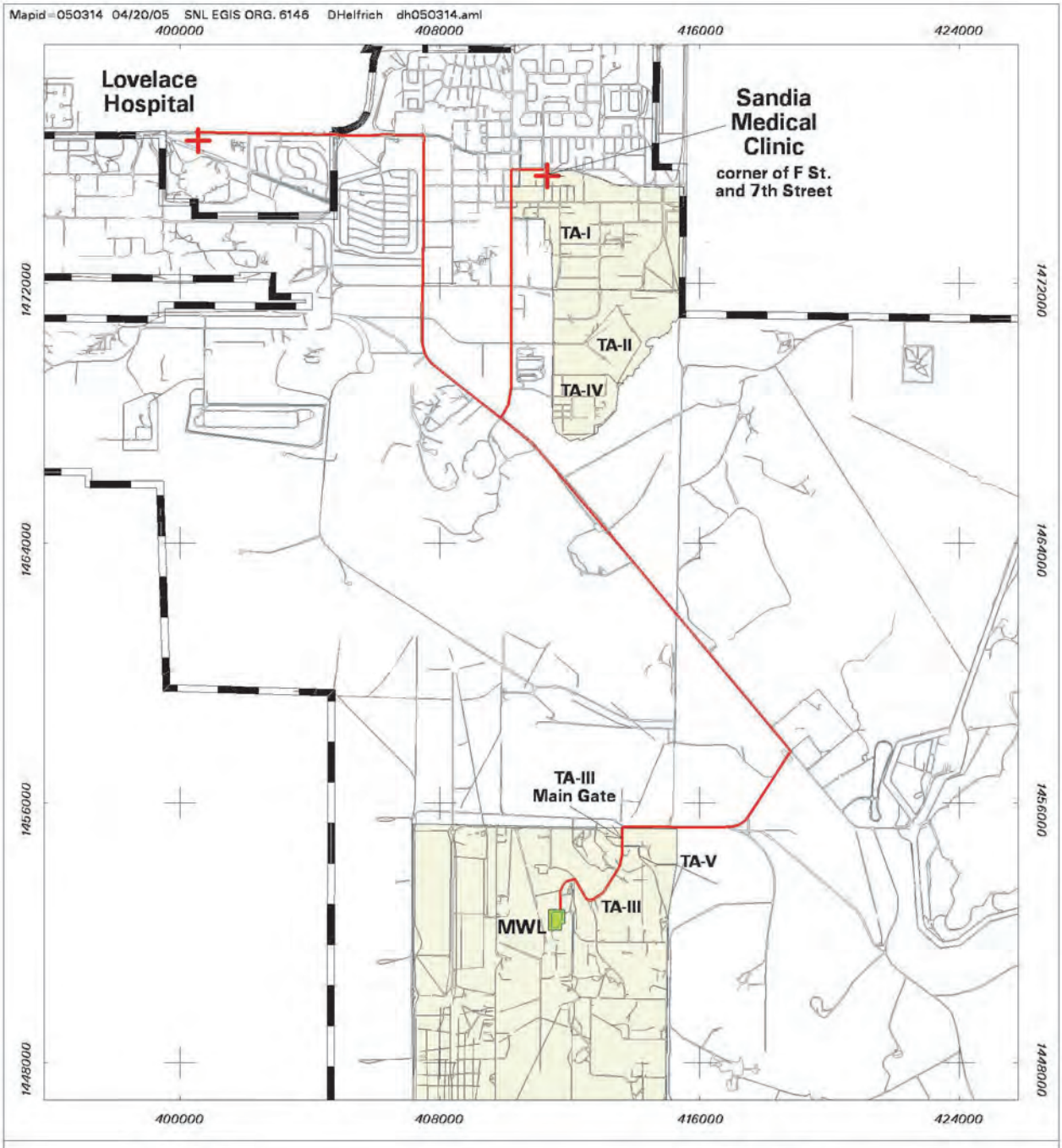
Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04240000 A14

Figure D-3
Mixed Waste Landfill Muster Points

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04240000 A15



Legend

- Medical Facility
- Emergency Route
- Road
- KAFB Boundary
- SNL Technical Area
- Mixed Waste Landfill

Figure D-4
Mixed Waste Landfill
Evacuation Route to
Sandia Medical & Lovelace

0 2500 5000
Scale in Feet

0 600 1200
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04240000 A16

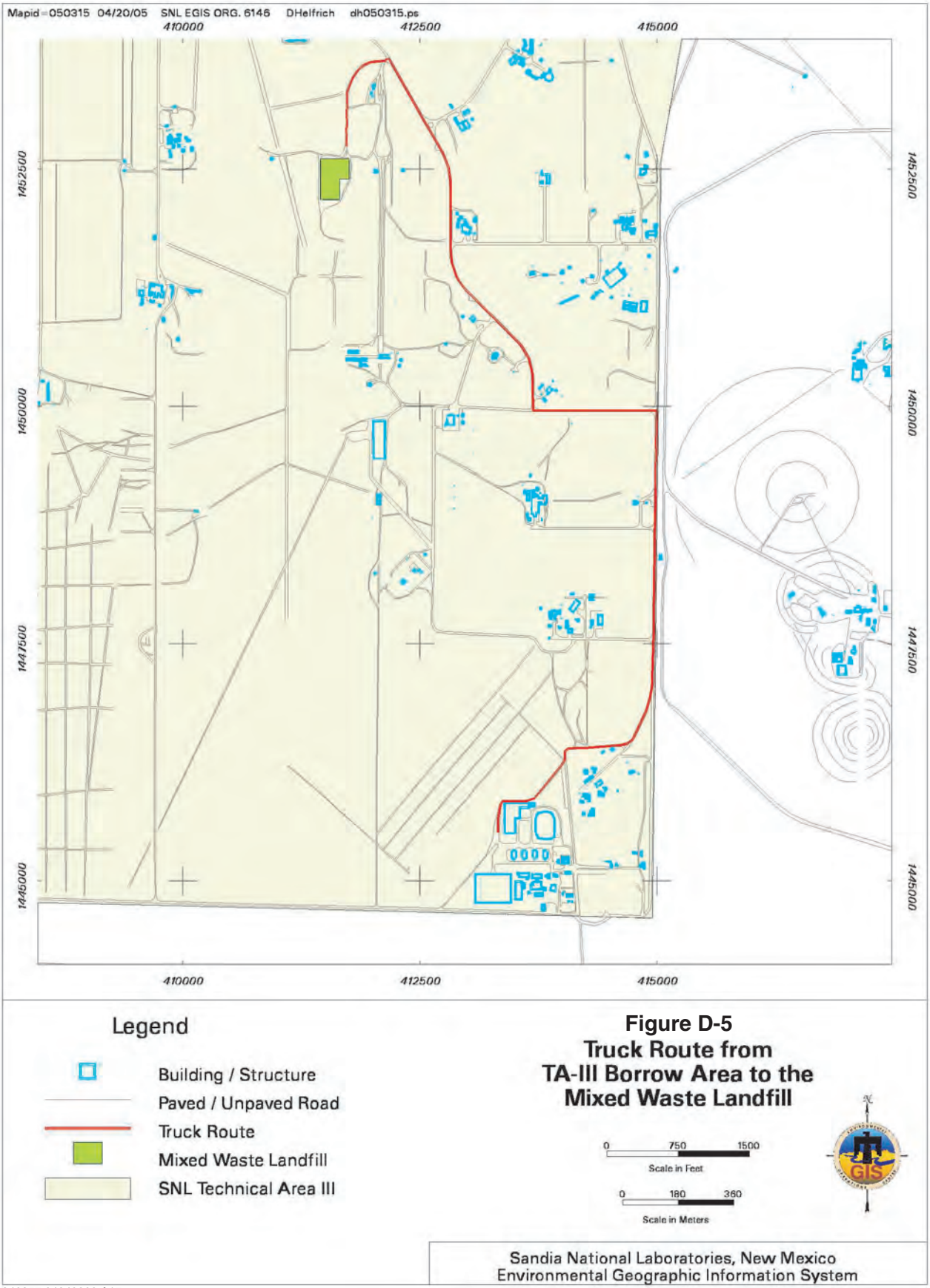


Figure D-5
Truck Route from
TA-III Borrow Area to the
Mixed Waste Landfill

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04240000 A17

APPENDIX E
Probabilistic Performance-Assessment Modeling of the Mixed Waste Landfill at Sandia National Laboratories

SANDIA REPORT

SAND2007-0170
Unclassified-Unlimited Release
Printed January 2007

Probabilistic Performance-Assessment Modeling of the Mixed Waste Landfill at Sandia National Laboratories (2nd Edition)

Clifford K. Ho, Timothy J. Goering, Jerry L. Peace, and Mark L. Miller

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550

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Probabilistic Performance-Assessment Modeling of the Mixed Waste Landfill at Sandia National Laboratories

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Abstract

A probabilistic performance assessment has been conducted to evaluate the fate and transport of radionuclides (amercium-241, cesium-137, cobalt-60, plutonium-238, plutonium-239, radium-226, radon-222, strontium-90, thorium-232, tritium, uranium-238), heavy metals (lead and cadmium), and volatile organic compounds (VOCs) at the Mixed Waste Landfill (MWL). Probabilistic analyses were performed to quantify uncertainties inherent in the system and models for a 1,000-year period, and sensitivity analyses were performed to identify parameters and processes that were most important to the simulated performance metrics. Comparisons between simulated results and measured values at the MWL were made to gain confidence in the models and perform calibrations when data were available. In addition, long-term monitoring requirements and triggers were recommended based on the results of the quantified uncertainty and sensitivity analyses.

At least one-hundred realizations were simulated for each scenario defined in the performance assessment. Conservative values and assumptions were used to define values and distributions of uncertain input parameters when site data were not available. Results showed that exposure to tritium via the air pathway exceeded the regulatory metric of 10 mrem/year in about 2% of the

simulated realizations when the receptor was located at the MWL (continuously exposed to the air directly above the MWL). Simulations showed that peak radon gas fluxes exceeded the design standard of 20 $pCi/m^2/s$ in about 3% of the realizations if up to 1% of the containers of sealed radium-226 sources were assumed to completely degrade in the future. If up to 100% of the containers of radium-226 sources were assumed to completely degrade, 30% of the realizations yielded radon surface fluxes that exceeded the design standard. For the groundwater pathway, simulations showed that none of the radionuclides or heavy metals (lead and cadmium) reached the groundwater during the 1,000-year evaluation period. Tetrachloroethylene (PCE) was used as a proxy for other VOCs because of its mobility and potential to exceed maximum contaminant levels in the groundwater relative to other VOCs. Simulations showed that PCE reached the groundwater, but only 1% of the realizations yielded aquifer concentrations that exceeded the regulatory metric of 5 μg/L.

Based on these results, monitoring triggers have been proposed for the air, surface soil, vadose zone, and groundwater at the MWL. Specific triggers include numerical thresholds for radon concentrations in the air, radionuclide and heavy-metal concentrations in surface soil, soil-gas concentrations of VOCs in the vadose zone, moisture content in the vadose zone, and uranium and VOC concentrations in groundwater. The proposed triggers are based on U.S. Environmental Protection Agency and Department of Energy regulatory standards. If a trigger is exceeded, then a trigger evaluation process will be initiated which will allow sufficient data to be collected to assess trends and recommend corrective actions, if necessary.

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Preface to the 2nd Edition

This 2nd Edition includes revisions to address comments made by the New Mexico Environment Department (NMED, November 2006).

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1. Introduction

1.1 Background and Objectives

The Corrective Measures Implementation (CMI) Plan for the Mixed Waste Landfill (MWL) at Sandia National Laboratories, Albuquerque, NM, is being submitted to the New Mexico Environment Department (NMED). As part of the final order selecting a remedy for the MWL (NMED May 2005), NMED required that the CMI Plan include a comprehensive fate and transport model to determine if contaminants will move from the MWL down through the vadose zone to groundwater. In addition, the NMED required that the CMI Plan include triggers for future action that identify and detail specific monitoring results that will require additional testing or implementation of an additional or different remedy.

This report presents the probabilistic fate and transport models that were used to assess the performance of the MWL. Relevant contaminants of concern at the site were included, and site-specific models and parameters were used in a probabilistic analysis. Results of the analysis were compared to regulatory performance metrics, and sensitivity analyses were performed to determine the most important parameters and processes that impacted the variability of the simulated performance metrics. Based on these simulations and results, appropriate triggers were identified and defined to address long-term monitoring requirements at the site.

A period of 1,000 years was selected for the probabilistic analysis to be consistent with DOE Order 435.1. DOE Order 435.1 requires that performance assessments be conducted for low-level radioactive waste disposed after September 26, 1988, and that performance objectives be evaluated for a 1,000-year period to determine potential risk impacts to the public and environment. Although most of the MWL wastes were disposed of prior to September 26, 1988, a 1,000 year period was nonetheless determined to be appropriate for assessment of regulatory performance metrics.

1.2 Overview of the Mixed Waste Landfill

The Mixed Waste Landfill (MWL) is located approximately five miles southeast of Albuquerque International Sunport and four miles south of Sandia National Laboratories' (SNL) central facilities (Figure 1). The landfill is a fenced, 2.6-acre area in the north-central portion of Technical Area 3 (TA-3). The mean elevation at the MWL is 5381 feet.

The MWL was established in 1959 as a disposal area for low-level radioactive and mixed waste that was generated at SNL research facilities. Originally, the landfill was opened as the "Area 3 Low-level Radioactive Dump," when the low-level radioactive disposal area in Technical Area 2 was closed in March 1959. The MWL accepted low-level radioactive waste and minor amounts of mixed waste from March 1959 through December 1988. Approximately 100,000 cubic ft of low-level radioactive waste containing approximately 6,300 curies of activity was disposed of at the landfill.

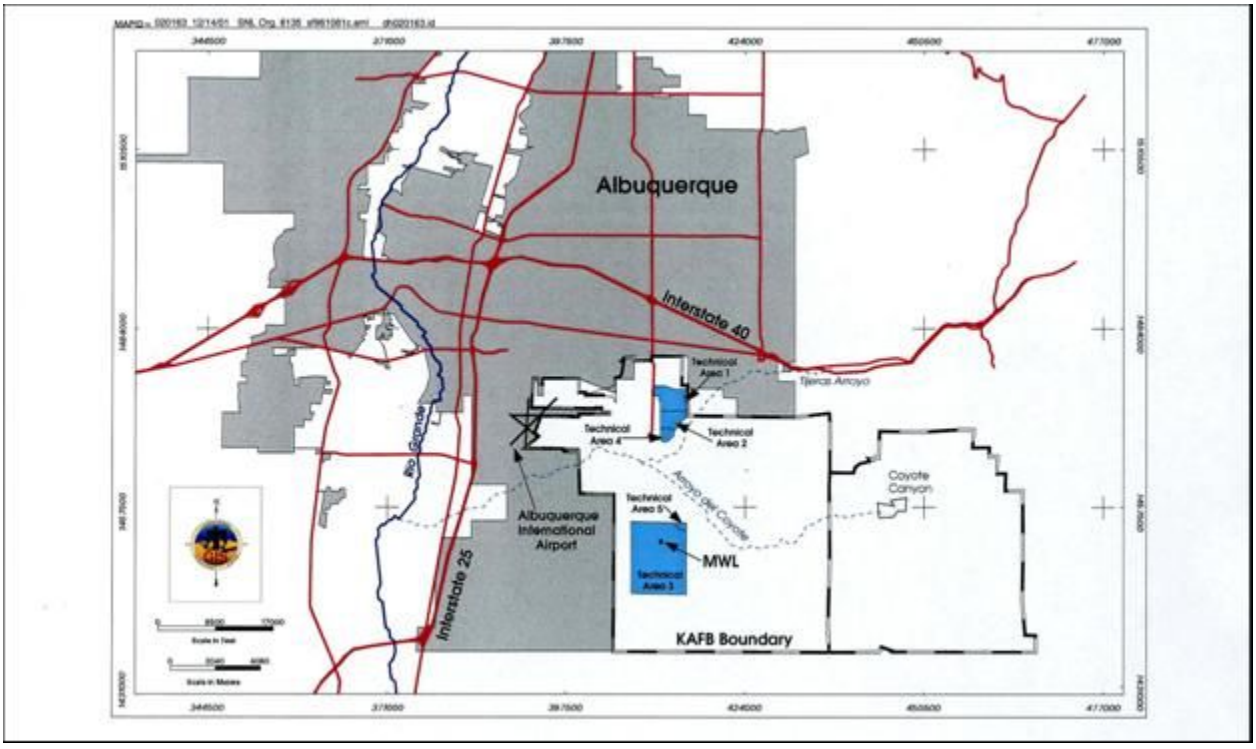

Figure 1. Location of the Mixed Waste Landfill relative to Albuquerque, NM, and Kirtland Air Force Base.

1.2.1 Site Description

The MWL consists of two distinct disposal areas: the classified area, occupying 0.6 acres, and the unclassified area, occupying 2.0 acres (Figure 2). Low-level radioactive and mixed waste has been disposed of in each area. Wastes in the classified area were buried in unlined, vertical pits. Wastes in the unclassified area were buried in unlined, shallow trenches.

A Phase 1 RCRA facility investigation was conducted in 1989 and 1990 to determine if a release of RCRA contaminants had occurred at the MWL and to begin characterizing the nature and extent of any such release. The Phase 1 facility investigation indicated that tritium was the primary contaminant of concern. No organic contaminants were identified. A Phase 2 RCRA facility investigation was initiated in 1992 to determine contaminant source, define the nature and extent of contamination, identify potential contaminant transport pathways, evaluate potential risks posed by the levels of contamination identified, and recommend remedial action, if warranted, for the landfill.

The Phase 2 RCRA facility investigation incorporated the streamlining approach, combining data quality objectives and the observational approach. Nonintrusive field activities were conducted first to facilitate the efficiency and cost-effectiveness of intrusive field activities. Data collected during the Phase 2 RCRA facility investigation were evaluated using U.S. Environmental Protection Agency-approved methods. Initially, a constituent population was statistically compared to natural background. Any constituent failing the statistical comparison was further

analyzed for spatial distribution. Constituents that failed the statistical comparison to background and showed a strong spatial correlation were identified as potential contaminants of concern.

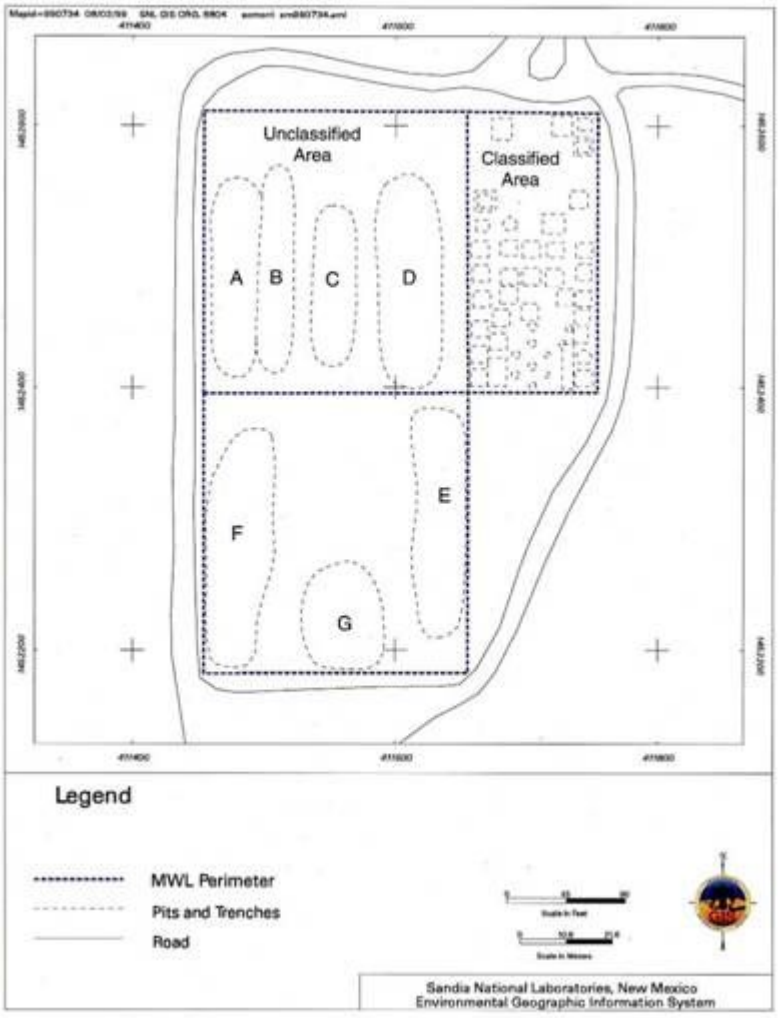

Figure 2. Map of the Mixed Waste Landfill.

The Phase 2 RCRA facility investigation was completed in 1995. This investigation included surface radiological surveys; ambient air sampling; soil sampling for background metals and radionuclides; soil sampling for volatile organic compounds (VOCs), semivolatile organic compounds, target analyte list metals, and radionuclides; nonintrusive geophysical surveys; passive and active soil gas sampling; borehole drilling; installation of groundwater monitoring wells; groundwater sampling; vadose zone tests; aquifer tests; and risk assessment. The Phase 2 RCRA facility investigation confirmed the findings of the Phase 1 RCRA facility investigation.

1.2.2 Contaminants of Concern

Based on the results of the Phase 1 and Phase 2 RCRA Facility Investigations, tritium was found to be the primary contaminant of concern that has been released from the MWL. An estimated 2400 curies of tritium were disposed of in the MWL. Tritium is extremely mobile when incorporated in water in liquid and vapor form, moving easily through the vadose zone and into the atmosphere.

Tritium levels range from 1100 picocuries/gram in surface soils to 206 picocuries/gram in subsurface soils in the classified area of the landfill. The highest tritium levels are found within 30 feet of the surface in soils adjacent to and directly below classified area disposal pits. At depths greater than 30 feet below ground surface, tritium levels fall off rapidly to a few picocuries/gram of soil.

Tritium also occurs as a diffuse air emission from the landfill. Tritium emissions from the MWL are diminishing with time due to its half-life of 12.3 years. Total tritium emissions to the atmosphere were measured at 0.294 curies/year in 1993 and at 0.090 curies/year in 2003 (Peace et al., 2002; Anderson, 2004).

An estimated 27,900 kg (9.3 curies) of uranium-238 (depleted uranium) are present in the MWL inventory. Based on the results from the Phase 1 and Phase 2 RFIs, there is no indication that uranium has been released from the MWL. However, because of the large quantity of depleted uranium disposed of in the MWL, the fate and transport of uranium was modeled in this study.

Other radionuclides present in the MWL inventory include cobalt-60, strontium-90, cesium-137, plutonium-238 and -239, americium-241, radium-226, and thorium-232. The fate and transport of these radionuclides was modeled, although there is no evidence that these radionuclides have been released from the MWL.

There is an estimated 128,000 kg of lead disposed of within various pits and trenches in the landfill. Most of the lead is in the form of shielding (i.e. lead bricks, casks, pigs, and shipping canisters). Smaller lead items include containers commonly used to dispose of radioactive sources. The lead containers were typically placed in concrete-filled A/N cans or 55-gallon drums. Larger lead items include five massive stainless steel and lead casks disposed of in Trench F, each weighing up to 40 tons. The fate and transport of lead was modeled, although there is no evidence that lead has been released from the MWL.

Cadmium is not specifically listed in the MWL inventory. However, slightly-elevated cadmium has been detected in five boreholes along the west side of the MWL to depths of up to at least 104 ft bgs. The cadmium concentrations in MWL soils range from non-detect to 1.97 mg/kg, approximately two times the NMED maximum background value of 0.9 mg/kg. The source of cadmium in MWL soils is unknown.

Cadmium has occasionally been detected in MWL groundwater at concentrations above the EPA MCL, although these detections are sporadic and unpredictable. Because the cadmium detections above the MCL are inconsistent, it is believed that these detections do not indicate contamination from the MWL. Nevertheless, cadmium is considered a contaminant of concern, and the fate and transport of cadmium was modeled.

During the Phase 2 RCRA Facility Investigations, low levels of VOCs were detected in soil gas samples obtained from the landfill. The primary VOCs detected in soil gas at the MWL include tetrachloroethene (PCE), trichloroethene (TCE), dichloro-difluoromethane, 1,1,1-trichloroethane (1,1,1-TCA), trichlorofluoromethane, and 1,1,2-trichloro,1,2,2-trifluoroethane. Of these VOCs, PCE was determined to have the highest potential to reach groundwater at concentrations near its maximum contaminant level (Klavetter, 1995a). Other VOCs were either not as mobile or did not have sufficiently high initial soil gas concentrations. For this reason, PCE is a contaminant of concern, and the fate and transport of PCE was modeled. However, because the remaining VOCs still have some potential to contaminate groundwater, PCE was modeled in this study as a proxy for all of the VOCs.

Radon gas generation from the landfill is based on the estimated 6 curies of radium-226 in the MWL inventory. Most of the radium-226 in the MWL is in the form of sealed sources. Emission of radon gas from the MWL was investigated in 1997. No significant difference between the MWL and the background measurements in terms of median, mean, and standard deviation was observed (Haaker, 1998). However, at the request of the NMED, radon was included in the MWL fate and transport model.

In summary, the following list of actual and potential contaminants was included in the MWL fate and transport model: tritium, americium-241, cesium-137, cobalt-60, plutonium-238 plutonium-239, radium-226, radon-222, strontium-90, thorium-232, uranium-238, lead, cadmium, and PCE.

2. Modeling Approach

2.1 Previous Modeling Studies

This section summarizes previous modeling studies conducted for the MWL. These studies include fate and transport modeling studies conducted by Argonne National Laboratory, Sandia, and WERC (Consortium for Environmental Education & Technology Development). Cover performance modeling studies were conducted by Sandia in support of the MWL cover design, and are summarized in this section as well.

2.1.1 Fate and Transport Modeling Studies

Previous fate and transport modeling studies conducted for the MWL include a study by Argonne National Laboratory in 1995 as part of a preliminary human health risk assessment for the MWL; a subsequent study conducted by Sandia in 1995 regarding the potential migration of radionuclides and organic compounds from the MWL; a 1997 study to model the infiltration of reactor coolant water discharged into an MWL trench in 1967; and a study conducted in 2001 by WERC of tritium migration through the vadose zone beneath the MWL.

Argonne National Laboratory Modeling Study

One of the earlier modeling studies on the MWL was conducted by Johnson et al. (1995) at Argonne National Laboratory (ANL). The ANL study used a "worst case" scenario approach in which they took conservative values of parameters at different levels of model complexity to ascertain the probable fate and transport of, as well as risk from, the contaminants. The study used a tiered approach for modeling the fate and transport of contaminants, with increasing model complexity and more justifiable simplifying assumptions.

The first-tier screen was a geometric approach in which tritium from the MWL was distributed evenly throughout the vadose zone. This first-tier screening suggested that tritiated water from the MWL could potentially reach groundwater, although the likelihood was considered small.

The second-tier analysis utilized a one-dimensional analytical solution for flow and transport in the vadose zone, but did not include lateral dispersion, which would reduce concentrations of tritium and the distance traveled by tritium from the landfill. This analysis showed that tritium concentrations could exceed the EPA drinking water guideline of 20,000 pCi/L after 57 years if the underlying soils were fully saturated. However, because of the uncertainty of the input parameters (particularly velocity, which was considered too high), the analysis over-predicted tritium concentrations in subsurface soils.

The final tier utilized a three-dimensional numerical code, TRACR3D, which still is extensively used for flow and transport calculations. This code is relatively complex, utilizing finite-element solutions for both the saturated and unsaturated zones. Tritium was the primary contaminant modeled because of its assumed higher mobility compared to other radionuclides and organic contaminants. Conservative assumptions were used in the model, boundary conditions, and hydrologic parameters to bound the probable extent and concentration of tritium. The model predicted that 27 years after disposal, the maximum tritium contamination reaches 184 ft below ground surface (bgs) with a maximum concentration of 2.8×10^6 pCi/L, significantly higher than measured field values. After an additional 100 years, the tritium was predicted to have traveled to a depth of 230 ft bgs, with a maximum tritium concentration of 5,400 pCi/L. The ANL study concluded that no detectable tritium concentrations would be likely to reach groundwater at the MWL.

The study also included screening calculations for aqueous-phase transport of PCE and TCE, and predicted that these VOCs could reach the water table approximately 250 years from time of disposal. No calculations were conducted for vapor-phase transport, which has proven to be the most significant transport mechanism for organic compounds in the vadose zone at nearby ER sites, including the Chemical Waste Landfill.

Sandia Modeling of Radionuclide and Organic Compound Transport

A subsequent study was conducted by Sandia in August 1995 to simulate potential contaminant flow and transport from the MWL. The study was conducted using the code Borehole Optimization Support System (BOSS), originally developed to determine the optimum number and location of boreholes and monitoring wells necessary to define the nature and extent of contamination. Monte Carlo uncertainty analysis of flow and transport was used to simulate the

migration of radionuclides and organic compounds from the MWL. (Klavetter, 1995a; Klavetter, 1995b).

BOSS was first used to simulate the migration of radionuclides, including tritium, cesium-137, and strontium-90 from the MWL, using more representative hydrologic property values than were applied in the ANL study. The modeling study predicted that no detectable tritium would reach groundwater at the MWL, and that detectable tritium would not migrate below a depth of 40 m (131 ft). These results are consistent with the actual tritium distribution data for subsurface soils collected during the Phase 2 RFI. The model also predicted that no detectable activity of cesium-137 and strontium-90 would migrate even 10 m below the MWL pits and trenches.

The code BOSS was also used to simulate the vapor-phase and aqueous-phase transport of the six VOCs detected in MWL soil gas (Section 1.2.2). The modeling results demonstrated that aqueous-phase transport of organic contaminants from the MWL was not a significant transport mechanism. The modeling results also demonstrated that vapor-phase transport of five of the six organic compounds was not significant, due to the low concentrations of these contaminants detected in the soil gas.

Concentrations of PCE detected in soil gas near the MWL surface were calculated to be high enough to result in concentrations of sub-ppb to a few ppb in groundwater within 50 years. The model predicted that the lateral extent of PCE in the groundwater would be limited, with PCE at concentrations greater than 1 ppb extending less than 130 m (426 feet) downgradient of the MWL. The study recommended that further evaluation of the fate and transport of PCE be considered, including a review of PCE concentrations in borehole soil samples collected during the Phase 2 RFI. PCE was detected at low concentrations in soil samples from 2 of the 16 boreholes drilled during the Phase 2 RFI. PCE was detected in BH-3 at a maximum concentration of 2.45 *J* µg/kg, and in MW-4 at a maximum concentration of 5.4 µg/kg (Peace et. al., 2002).

Modeling Study of Reactor Coolant Water Infiltration

In 1997, a modeling study was conducted to simulate the infiltration of 271,500 gallons of reactor coolant water from a trench at the MWL (Wolford1997). The objective of the study was to evaluate the potential migration of coolant water discharged into Trench D of the MWL in May and June, 1967. The water originated from the Sandia Engineering Reactor Facility in Technical Area 5, and contained approximately 1 Ci of total radioactivity, primarily short-lived fission products. Trench D was an active disposal trench at the time, and was believed to be the most likely source for contaminant release and migration from the MWL.

The modeling study used the code VS2DT (Healy, 1990), a finite difference unsaturated flow and transport model developed by the U.S. Geological Survey. The modeling results indicated that the reactor coolant water, and any tritium mobilized by the water, would not have migrated beyond a depth of approximately 120 ft, based on a 30-year simulation. The modeling results were consistent with Phase 2 RFI field measurements of tritium activities in subsurface soils, which showed tritium detected to a maximum depth of 120 ft bgs.

The study also simulated the fate and transport of the coolant water and tritium for a period of 90 years into the future. The study predicted that the coolant water and any tritium in the water would not migrate more than 5 to 10 ft below its current predicted depth of 120 ft. Due to radioactive decay, tritium concentrations in the water were predicted to decrease at a faster rate than the downward movement of the wetting front.

WERC Modeling of Tritium Migration through the Vadose Zone

In January 2001, WERC was requested by the U.S. Congress to perform an independent peer review of the performance of the MWL. The results of the study are presented in WERC (2001).

As part of this study, members of the WERC review team developed a fate and transport model of tritium migration in the vadose zone beneath the MWL. The code GoldSim, a generalized object-oriented probabilistic spreadsheet, was used to model tritium contaminant concentrations and fluxes at various depths beneath the MWL over time. The model incorporated mass transport from a source (inventory), various release mechanisms, transport processes, migration pathways, and radionuclide decay.

The WERC team concluded that based on their model results, the spatial and temporal distribution of tritium activities measured in the vadose zone appear to be consistent with those expected, given the inventory, regional meteorology, subsurface soil conditions, and hydrologic parameters. Their modeling results showed good agreement with the Phase 2 RFI data regarding tritium distributions in subsurface soils beneath the MWL. The WERC team also concluded that future concentrations of tritium in subsurface soils at the MWL should decrease over the next 10 years, based on diffusion and natural decay of tritium.

2.1.2 Cover Performance Modeling

In addition to the fate and transport models discussed above, Sandia has conducted extensive cover performance modeling to predict infiltration through various thicknesses of alternative covers. The results from these studies were used to develop the MWL alternative cover design.

Early Cover Performance Modeling

Sandia's early cover performance modeling studies utilized multiple codes to assess infiltration through various thicknesses of alternative covers. The codes used included the water balance model, HELP-3 (Schroeder et al. 1994), and two unsaturated flow models, UNSAT-H (Fayer and Jones 1990) and VS2DT (Healy 1990).

The earlier modeling studies are documented in Wolford (1998); SNL (April 1999); and culminate with the modeling results presented in the original MWL design document, "Deployment of an Alternative Cover and Final Closure of the Mixed Waste Landfill, Sandia National Laboratories, New Mexico" (SNL September 1999). This report was submitted to the NMED in September 1999 for technical review and comment, and was later published as a SAND report by Peace et al. in 2003. The cover performance modeling results from the report are also presented in Section 5.3 of the main text of the MWL Corrective Measures Implementation Plan.

In order to demonstrate that the MWL alternative cover design complies with regulatory guidance, the hydrologic performance of the cover was modeled using HELP-3, UNSAT-H and VS2DT. These codes were used to predict infiltration through soil covers ranging in thickness from 1 to 5 ft. All three models demonstrated that deployment of a vegetated soil cover for final closure of the MWL would reduce infiltration into the landfill to a small percentage of the total precipitation. The models also demonstrated that a 3-ft-thick vegetated soil cover meets the intent of RCRA Subtitle C regulations. Additional cover thicknesses did not lead to significantly better performance. Additional details on the cover performance modeling using HELP-3, UNSAT-H and VS2DT are presented in Section 5.3 of the MWL CMI Plan.

Recent Cover Performance Modeling

The most recent cover performance modeling was conducted in 2003 and 2004 using site-specific climate, hydrologic, and vegetation input parameters. The modeling simulated infiltration of water through the MWL soil cover using the one-dimensional, numerical code UNSAT-H. UNSAT-H is a Richards' equation-based model that simulates infiltration, unsaturated flow, redistribution, evaporation, plant transpiration, and deep infiltration of water. The modeling results corroborated the results from earlier modeling studies. The recent modeling results are published in the SAND report entitled, "Calculation Set for Design and Optimization of Vegetative Soil Covers" (Peace and Goering, 2005). The modeling results were used to determine infiltration input parameters for the MWL probabilistic performance-assessment model.

One of the objectives of the modeling was to assess whether a 3-ft soil cover would meet the EPA-prescribed technical equivalency criteria. The EPA performance-based, technical equivalency criteria used are 31.5 millimeter (mm)/year (yr), or less, for net annual infiltration and 1×10^{-7} centimeter (cm)/second (s) average infiltration rate, based on a hydraulic conductivity of 1×10^{-7} cm/s and the assumption of unit-gradient conditions. The modeling results verified that the 3-ft MWL cover will meet the EPA-prescribed technical equivalency criteria for RCRA landfills under both present and future conditions.

Present conditions were simulated by modeling infiltration through various thicknesses of an engineered cover, while future conditions were simulated by modeling infiltration through various thicknesses of soil under natural conditions (i.e. the "natural analog"). The recent cover modeling results are discussed further in Section 3.4 below. Complete modeling input parameters, boundary conditions, and results are presented in Peace and Goering (2005).

2.2 Probabilistic Performance-Assessment Modeling Approach

This section summarizes the approach used in this study to provide a comprehensive performance assessment of the MWL. Previous studies have looked at individual components of the landfill performance, and nearly all of the studies relied on deterministic evaluations. This study describes a probabilistic performance-assessment approach that captures the inherent uncertainties in the system while honoring site-specific features, processes, and parameters. Sensitivity analyses are also introduced that utilize the probabilistic results to identify the parameters and processes that are most important to the simulated performance metrics.

A performance assessment is defined in DOE M 435.1-1 as "an analysis of a radioactive waste disposal facility conducted to demonstrate there is a reasonable expectation that performance objectives established for the long-term protection of the public and the environment will not be exceeded following closure of the facility." In addition, DOE M 435.1-1 states that the method used for the performance assessment must include uncertainty analyses. A method that addresses these requirements has been used for the Waste Isolation Pilot Plant (DOE, 1996), the Yucca Mountain Project (DOE, 1998), and the intermediate-depth Greater Confinement Disposal Boreholes (Cochran et al., 2001) to assess the long-term performance of nuclear waste repositories. Probabilistic performance assessments have also been used for sites with uranium mill tailings (Ho et al., 2004). A similar systematic approach has been used here to conduct a performance assessment of the MWL. The approach is outlined as follows:

1. Develop and screen scenarios based on regulatory requirements (performance objectives) and relevant features, events, and processes

2. Develop models of relevant features, events, and processes

3. Develop values and/or uncertainty distributions for input parameters

4. Perform calculations and sensitivity/uncertainty analyses

5. Compare results to performance objectives, identify important parameters and processes, and provide feedback to improve calculations, as needed

In Step 1, a scenario is identified as a well-defined sequence of features, events and processes that describes possible future conditions at the disposal site. An example of a scenario is the release of radionuclides from a landfill via the vadose zone to the aquifer, where water is pumped from a well and ingested by an individual. The decision to evaluate various scenarios depends, in part, on relevant performance objectives set forth by regulatory requirements. In addition, scenarios should be chosen that represent features, events, and processes that are relevant to the specific site being evaluated.

Step 2 develops the models that are necessary to simulate the chosen scenarios in the performance assessment. The models that are used vary in complexity, and a hierarchy of models can exist. A conceptual model of each scenario is developed to guide the development of more detailed mechanistic models of individual features, events, and processes that comprise the scenario. These detailed models are then integrated into a total-system model of the entire scenario. The integration of the more detailed models may include the models themselves or a simplified abstraction of the model results.

In Step 3, values are assigned to the parameters to populate the models. If the parameter is well-characterized, a single deterministic value may be assigned. However, uncertainty and/or variability in the parameter may require the use of distributions (e.g., log-normal, uniform) to define the values. Experimental data, literature sources, and professional judgment are often used to determine these distributions. The development of uncertainty distributions for parameters used in this study is described in Section 3.3.

In Step 4, calculations are performed using the integrated models. Because stochastic parameters are used, a Monte Carlo approach is taken to create an ensemble of simulations that use different combinations of the input parameters. For each run (realization), a value for each input parameter is sampled from the uncertainty distribution, and the simulation is performed. The results of each realization are equally probable, and the collection of simulation results yields an uncertainty distribution that can be compared to performance objectives to assess the risk of exceeding those performance objectives or metrics. Sensitivity analyses can also be performed to determine which parameters the performance metrics are most sensitive to (see Section 2.2.1).

The last step (Step 5) is to analyze and compare the results with relevant performance objectives. The findings are typically documented as cumulative distribution functions that present the probability of exceeding a performance objective. Important parameters and processes are also identified through sensitivity analyses. Together, these results may be used to assess the overall performance, prioritize site characterization, evaluate alternative designs, or identify triggers for future actions to address long-term monitoring requirements for regulatory compliance. In this study, the primary purpose of the performance assessment is to determine which contaminants and performance objectives are at risk based on the simulated performance of the MWL. This information will then provide a basis for the triggers that are identified and recommended for the site.

2.2.1 Sensitivity Analyses

A probabilistic performance assessment provides not only a quantification of uncertainties in the simulated performance metrics, it also allows for a quantified sensitivity analysis to be performed. A sensitivity analysis of the probabilistic assessment results can provide valuable information regarding the processes and parameters that are most important to the simulated performance metric(s). This information provides understanding about the relationship between uncertainty in individual input parameters and the uncertainty in the performance of the system. In addition, knowledge of the parameters having the greatest influence on future performance can be used to help prioritize site characterization activities, to help optimize landfill cover design, and to assist in the design of monitoring systems and triggers. Using a sensitivity analysis provides the quantitative information necessary to ensure that resources are directed to those aspects of the cover system that "drive" performance and not on those aspects of cover design that have little significance.

The sensitivity of the performance-assessment model can be determined from the Monte Carlo probabilistic realizations using regression analysis. Multiple regression analysis involves construction of a linear regression model of the simulated output (the dependent variable) and the stochastic input variables (independent variables) using a least-squares procedure. Stepwise linear regression is a modified version of multiple regression that selectively adds input parameters to the regression model in successive steps (Helton and Davis, 2000). In this method, a sequence of regression models is constructed that successively adds the most important input parameters to the regression to improve the overall correlation. In the end, the sensitivity analysis identifies those parameters that are significantly correlated to the performance metric, and omits those parameters that are not. This study uses a stepwise linear rank regression to perform sensitivity analyses on simulated performance metrics that are at risk of being exceeded.

3. Performance-Assessment Modeling of the Mixed Waste Landfill

3.1 Scenarios and Performance Objectives

In this study, relevant contaminants of concern were grouped into the following categories: (1) radionuclides, (2) heavy metals, and (3) VOCs. Table 1 summarizes the specific contaminants, scenarios, and performance objectives that were considered in this study. In general, the two pathways of concern include transport of volatile or gas-phase contaminants from the MWL to the atmosphere, and migration of aqueous-phase or vapor-phase contaminants through the vadose zone to the groundwater. For each of these primary pathways, relevant performance objectives and metrics were identified for each of the contaminants of concern. The chosen scenarios represent the most likely releases of contaminants from the MWL based on estimated inventories, contaminant properties, and previous studies.

Table 1. Summary of scenarios and performance objectives used in the performance assessment of the MWL.

Scenario	Description	Performance Objectives[a]
1	Water percolates through the cover to the waste	• Infiltration through the cover shall be less than 10^{-7} cm/s (a unit-gradient flow is assumed to equate infiltration to hydraulic conductivity) (U.S. EPA 40 CFR 264.301)
2	Tritium diffuses to the atmosphere and migrates via gas and aqueous phases through the vadose zone to the groundwater	• Dose to the public via the air pathway shall be less than 10 mrem/yr (excludes radon) (U.S. EPA 40 CFR 61.92) • Dose from beta particles and photon emitters shall be less than 4 mrem/yr (U.S. EPA 40 CFR 141.66; U.S. EPA, 2003) • Tritium concentrations in groundwater shall not exceed 20,000 pCi/L (40 CFR 141.66 Table A; tied to 4 mrem/yr)
3	Radon steadily diffuses to the atmosphere and migrates via gas and aqueous phases through the vadose zone to the groundwater	• The average flux of radon-222 gas shall be less than 20 pCi/m^2/s at the surface of the landfill (U.S. EPA 40 CFR 192) • Radon concentrations in groundwater shall not exceed 300 pCi/L (proposed EPA rules, Federal Register: November 2, 1999 (Volume 64, Number 211) Pages 59345-59378)
4	One or more radionuclides migrate via the aqueous phase through the vadose zone to the groundwater	• Maximum concentrations in groundwater of gross alpha particle activity (including radium-226 but excluding radon and uranium) is 15 pCi/L (U.S. EPA 40 CFR 141.66; U.S. EPA, 2003) • Uranium concentrations in groundwater shall not exceed EPA MCL of 30 μg/L (U.S. EPA 40 CFR 141.66; U.S. EPA, 2003) • Dose from beta particles and photon emitters shall be less than 4 mrem/yr (U.S. EPA 40 CFR 141.66, U.S. EPA, 2003)
5	Lead and cadmium migrate via the aqueous phase through the vadose zone to the groundwater	• Lead concentrations in groundwater shall not exceed the EPA action level of 15 μg/L (U.S. EPA, 2003) • Cadmium concentrations in groundwater shall not exceed the EPA MCL of 5 μg/L (U.S. EPA, 2003)
6	PCE migrates through the vadose zone to the groundwater	• PCE concentrations in groundwater shall not exceed the EPA MCL of 5 μg/L (U.S. EPA 40 CFR 141.61; U.S. EPA, 2003

MCL = Maximum Contaminant Level

[a]The point of compliance is taken at the boundary of the waste site. The period of performance was specified as 1,000 years in the regulations for some of the performance metrics, but for many of the performance metrics, the period of performance was not specified. In this study, a 1,000 -year period was simulated.

3.2 Performance-Assessment Models

The following sections describe the models that were developed and used to simulate the fate and transport of the different contaminants in the various scenarios summarized in Table 1.

3.2.1 FRAMES/MEPAS

The aqueous transport of heavy metals (lead and cadmium) and the radionuclides were simulated using the probabilistic simulation tools FRAMES[1] (Framework for Risk Analysis in Multimedia Environmental Systems; Whelan et al., 1997) and MEPAS[2] (Multimedia Environmental Pollutant Assessment System; Whelan et al., 1992), developed by Pacific Northwest National Laboratory. The FRAMES system, which integrates the fate and transport models comprising MEPAS, allows for a holistic approach to modeling in which models of different type (i.e., source, fate and transport, exposure, health impact), resolution (i.e., analytical, semi-analytical, and numerical), and operating platforms can be combined as part of the overall assessment of contaminant fate and transport in the environment. The FRAMES system employs a graphical user interface for integrating computer models, an extensive contaminant database, a probabilistic sensitivity/uncertainty module, and textual and graphical viewers for presenting modeling outputs.

Existing models in FRAMES include those derived from MEPAS (Whelan et al., 1992). MEPAS is a physics-based environmental analysis code that integrates source-term, transport, and exposure models for endpoints such as concentration, dose, or risk. MEPAS is capable of computing contaminant fluxes for multiple routes, which include leaching to groundwater, overland runoff, volatilization, suspension, radioactive decay, constituent degradation, and source/sink terms. In this study, only the source-term and vadose-zone models were implemented. The source-term model conservatively simulates leaching from the waste zone (assuming no containment) based on either the solubility or the inventory-limited concentration (Streile et al., 1996). Decay of constituents can also occur within the source-term model. The transport of the contaminant through the vadose-zone is then simulated assuming liquid-phase advection, dispersion, adsorption, and decay of the contaminant (Whelan et al., 1996). It should be noted that gas-phase transport is not assessed in FRAMES/MEPAS. Separate models were used to evaluate the gas-phase transport of tritium, radon, and VOCs.

In this study, the aquifer concentration and subsequent dose, if applicable, were conservatively estimated based on the simulated concentration of the constituent in the groundwater at the interface of the vadose-zone and the water table (e.g., dilution caused by transport in the saturated zone was ignored). Section 3.3 presents the input parameters that were used in the radionuclide-transport models.

Uncertainty analyses are performed in FRAMES using the sensitivity module. The sensitivity module can be attached to any model that has been integrated into FRAMES and allows the user to stochastically vary any input parameter that is identified in the process models. Input parameters can be stochastically varied by a distribution, correlation coefficient, an equation, or

[1] http://mepas.pnl.gov/FRAMESV1 (FRAMES v. 1.5)
[2] http://mepas.pnl.gov/earth/mepasmain.html (MEPAS v. 4.1.1)

any combination of these three options. Four distributions are currently available: (1) uniform, (2) log uniform, (3) normal, and (4) log normal. The sensitivity module utilizes the Latin Hypercube Sampling (Wyss and Jorgensen, 1998) technique to minimize the number of modeling runs that must be performed to accurately represent distributions selected by the user. In this study, 100 realizations were simulated for each scenario (a sensitivity analysis was performed using 100 vs. 200 realizations in Section 3.5.2.2, and results showed that 100 realizations were sufficient to adequately represent the distribution of the simulated output).

3.2.2 Transient Gas- and Liquid-Phase Transport

A separate model was used to model the transient transport of tritium in both the gas and liquid phases at the MWL. As stated in the previous section, FRAMES/MEPAS was used to simulate the transport of radionuclides such as tritium, but only in the liquid phase. Tritium, in the form of tritiated water, is volatile and can be transported via both the gas and liquid phases. Regulatory metrics exist for dose caused by exposure to tritium (a beta particle emitter) in both the air and groundwater pathways (see Table 1). Also, because the half-life of tritium is relatively short (12.3 years), a transient analysis was required. Therefore, the transport of tritium was modeled using a transient model that accounts for advective liquid-phase transport, diffusive gas-phase transport, decay, and adsorption (if applicable) in the vadose zone (Jury et al., 1983; Jury et al., 1990). This same model was also used to model the transport of PCE. In this model, a contaminated zone is assumed to initially exist with a defined thickness and concentration. Over time, the contaminant migrates and decays (if applicable) assuming a flux boundary condition at the surface, defined by an atmospheric boundary layer thickness (see Jury et al., 1983) and a zero concentration boundary beneath the waste zone at a location infinitely far away from the source. Superposition is used to account for a clean overburden (cover) above the waste zone (Jury et al., 1990). The analytical solution to this model was implemented in Mathcad,® and a Monte Carlo analysis was implemented with the uncertain variables using 100 realizations. Section 3.3 presents the input parameters and distributions that were used in the tritium- and PCE-transport models.

3.2.3 Steady-State Gas- and Liquid-Phase Transport

Radon-222 is generated from the decay of radium-226, which is a decay product of uranium-238. Because these parent constituents have long half lives, the source of radon-222 production is assumed to last indefinitely. Therefore, the transient model described in the previous section that accounts for a finite source of contaminant is not appropriate. Instead, a steady-state model of radon transport was developed to account for steady generation of radon-222, advective liquid-phase transport, diffusive gas-phase transport, and decay (see Appendix A in Section 7). Mathcad® was used to provide a Monte Carlo analysis of the analytical solution using 100 realizations. Section 3.3 presents the input parameters and distributions that were used in the radon-transport model.

3.3 Input Parameters and Distributions

The constituents that were included in the performance assessment of the MWL are summarized in Table 2. The parameter values and distributions that were used are also summarized in the table. The adsorption coefficient (K_d) was assumed to be an uncertain parameter, so a range of values was obtained from the literature for the constituent and soil type (sandy loam) at the MWL. A log-uniform distribution was used to emphasize the lower values in the distribution. The inventory of each constituent was also assumed to be an uncertain variable. The estimated inventory from previous reports and studies was used as the lower bound in a uniform distribution for each constituent. The lower bound was multiplied by two to obtain the upper bound for the assumed uniform distribution. The maximum solubility obtained from the literature for each constituent was used. All other parameters were obtained from site-specific reports, scientific literature, or EPA recommendations.

Table 3 summarizes the parameters and distributions used to define the contaminated waste zone (source term) in the models. The waste-zone length, width, and thickness is based on the size of the pits, trenches, and dimensions of the MWL. The maximum thickness of the cover is based on the design specifications given in Peace et al. (2005). The minimum thickness of the cover is set equal to zero as a bounding value to account for the possibility that complete erosion of the cover may occur in the future. This is a conservative bounding assumption since the intent is to maintain the integrity of the cover at the MWL.

Table 4 summarizes the parameters and distributions used to describe the vadose-zone in the models. Uncertainty was included for a number of variables including thickness of the vadose zone, infiltration rate, hydraulic conductivity, and site-specific transport parameters. The distributions used for the various vadose-zone parameters were derived from site-specific data or literature pertaining to the constituents and scenarios evaluated in this study. The liquid- and gas-phase tortuosity coefficients are used to calculate effective diffusion coefficients in porous media. The tortuosity coefficient accounts for the increased tortuosity and reduced area available for diffusion in porous media. The minimum value is based on formulation by Millington (1959), and the maximum value is assumed to be equal to one (the upper bound), which yields the maximum diffusion. Studies of enhanced vapor diffusion have shown that large values of the tortuosity coefficient (yielding diffusion rates equivalent to those in free space) are possible in unsaturated porous media because of evaporation and condensation mechanisms across liquid islands in pores (Ho and Webb, 1998).

Finally, Table 5 summarizes the parameters and distributions used to estimate dose due to exposure via the atmospheric (e.g., inhalation) or groundwater pathway. Dose via inhalation and dermal adsorption of gas-phase tritium was calculated based on the surface flux ($pCi/m^2/s$) of tritium determined in the models.[3] The length and width of the waste zone was used to determine the flux rate of tritium at the surface (pCi/s), and the average wind speed and vertical mixing height was used to determine the average concentration above the landfill. The inhalation rate was then used to estimate the human intake of gas-phase tritium, and the dose-

[3] Inhalation and dermal adsorption of gas-phase radon and PCE were not used as performance metrics in this analysis because the enforceable regulatory metrics pertaining to radon and PCE do not use dose (surface flux of radon and groundwater concentration of PCE was used). Table 1 summarizes the performance metrics that were used for these constituents.

conversion factor (Table 2) was used to determine the dose. For groundwater exposure, a conservative estimate for water ingestion (10 L/day) was used together with the simulated groundwater concentrations to determine intake. The assumed water ingestion rate of 10 L/day is five times greater than the EPA drinking-water standard of 2 L/day and is intended to account for indirect sources of water ingestion and absorption such as consumption of vegetables and fruits irrigated by contaminated water. The dose-conversion factor was then used to estimate dose via the groundwater pathway.

Table 2. Summary of input parameters and distributions for constituents used in the models.

Constituent and Molecular Weight	Inventory[a]	Half-Life[b]	Specific Activity (Ci/g)[c]	Adsorption Coefficient, K_d (mL/g)[d]	Max Solubility (mg/L)[e]	Liquid-Phase Diffusion Coefficient (m^2/s)[f]	Gas-Phase Diffusion Coefficient (m^2/s)[f]	Henry's Constant (C_g/C_l)[g]	Dose Conversion Factor (rem/pCi)[h]
Americium-241$^{\alpha}$	Uniform: 0.04 - 0.08 Ci	433 yrs	3.43	Log-Uniform: 1900 – 9600	2.4×10^{4}	6×10^{-10}	N/A	N/A	3.64×10^{-6}
Cesium-137$^{\beta}$	Uniform: 410 – 820 Ci	30.2 yrs	86.4	Log-Uniform: 30 – 4600	137,000	6×10^{-10}	N/A	N/A	5.0×10^{-8}
Cobalt-60$^{\beta}$	Uniform: 3500 – 7000 Ci	5.27 yrs	1130	Log-Uniform: 60 – 1300	600	6×10^{-10}	N/A	N/A	2.69×10^{-8}
Plutonium-238$^{\alpha}$	Uniform: 0.0012 - 0.0024 Ci	87.7 yrs	17.1	Log-Uniform: 80 – 520	0.24	6×10^{-10}	N/A	N/A	3.2×10^{-6}
Plutonium-239$^{\alpha}$	Uniform: 0.0012 - 0.0024 Ci	2.41×10^{4} yrs	0.0621	Log-Uniform: 80 – 470	0.24	6×10^{-10}	N/A	N/A	3.54×10^{-6}
Radium-226$^{\alpha}$	Uniform: 6-12 Ci	1,600 yrs	0.989	Log-Uniform: 500 – 36,000	0.45	6×10^{-10}	N/A	N/A	1.32×10^{-6}
Radon-222$^{\alpha}$	Constant generation from Radium-226	3.82 days	1.54×10^{5}	0	N/A	$0.07\exp[-4(S - S\phi^2 + S^5)]$ where S=liquid saturation, ϕ=porosity		0.26^{-1}	1.44×10^{-8} (inhalation)
Strontium-90$^{\beta}$	Uniform: 410 -820 Ci	29.1 yrs	137	Log-Uniform: 15 – 20	90,000	6×10^{-10}	N/A	N/A	1.42×10^{-7}
Thorium-232$^{\alpha}$	Uniform: 1 – 2 Ci	1.4×10^{10} yrs	1.10×10^{-7}	Log-Uniform: 20 – 2000	23	6×10^{-10}	N/A	N/A	2.73×10^{-6}
Tritium$^{\beta}$ H-3	Uniform: 2400 – 4800 Ci	12.3 yrs	9690	0	N/A	2.3×10^{-9}	2.6×10^{-5}	1.7×10^{-5}	6.4×10^{-11} (inhalation; x1.5 to include dermal absorption)

Constituent and Molecular Weight	Inventory[a]	Half-Life[b]	Specific Activity (Ci/g)[c]	Adsorption Coefficient, K_d (mL/g)[d]	Max Solubility (mg/L)[e]	Liquid-Phase Diffusion Coefficient (m^2/s)[f]	Gas-Phase Diffusion Coefficient (m^2/s)[f]	Henry's Constant (C_g/C_l)[g]	Dose Conversion Factor (rem/pCi)[h]
Uranium-238$^{\alpha}$	Uniform: 9.3 – 18.6 Ci	4.47×10^9 yrs	3.35×10^{-7}	Log-Uniform: 0.4 – 15	24	6×10^{-10}	N/A	N/A	2.55×10^{-7}
Cadmium 112.41	Uniform: 1350 – 2700 kg	stable	N/A	Log-Uniform: 8 – 80	1.4×10^6	6×10^{-10}	N/A	N/A	N/A
Lead 207.2	Uniform: 128,000 – 256,000 kg	stable	N/A	Log-Uniform: 270 – 4360	4.43×10^5	6×10^{-10}	N/A	N/A	N/A
PCE 165.83	Uniform: 5 – 70 kg	Log-Uniform: 9 mos – 10^{10} yrs	N/A	Log-Uniform: 0.038 - 2	N/A	9.2×10^{-10}	9.5×10^{-6}	0.42	N/A

N/A–Not Applicable or not used in the model; for solubility, this indicates that the value is not limiting

$^{\alpha}$Alpha particle; $^{\beta}$Beta particle

[a]Minimum inventory of all constituents except cadmium and PCE was estimated from values in SNL (1993); maximum value was assumed to be twice the minimum value. Cadmium inventory was estimated from measured soil concentrations (Peace et al., 2002) and maximum simulated penetration depth (120 feet) of coolant water potentially carrying the cadmium (Wolford, 1997). PCE inventory is estimated from measured soil-gas concentrations (Peace et al., 2002); the maximum measured gas concentration (5,900 ppb) was used as a minimum value in a uniform distribution increasing to ten times this value (calibrated to available data). The maximum areal extent of the MWL was used (430 feet x 300 feet) along with an uncertain thickness ranging from 10-27 feet (see Table 3 for waste-zone description).

[b]Lide (2005); half-life of PCE is assumed to range from 9 months (EPA fact sheet: www.epa.gov/OGWDW/dwh/t-voc/tetrachl.html) to 10^{10} yrs (no degradation)

[c]Specific activity is calculated as 3.575×10^5/(half-life (yrs) x molecular weight)

[d]U.S. EPA (1999), Sheppard and Thibault (1990), Looney et al. (1997), EPA fact sheet: www.epa.gov/OGWDW/dwh/t-voc/tetrachl.html

[e]Looney et al. (1997), Chen et al. (2002), Ohe et al. (2002), Elless and Lee (1998), BSC (2005), and EPA Online Fact Sheets (www.epa.gov/safewater/dwh/t-ioc/cadmium.html; www.epa.gov/safewater/dwh/t-ioc/lead.html). Based on the maximum inventory and minimum waste volume possible, the solubility may potentially limit the maximum aqueous source concentration for radium-226, thorium-232, uranium-238, and lead; all other constituents are not limited by the solubility.

[f]Whelan et al. (1996), Smiles et al. (1995), Rogers et al. (1994), U.S. NRC (1989), Reid et al. (1987)

[g]Rogers et al. (1984), U.S. NRC (1989), Smiles et al. (1995), steam tables, and EPA's online Henry's Constant calculator (www.epa.gov/athens/learn2model/part-two/onsite/esthenry.htm)

[h]U.S. EPA (1988)

Table 3. Summary of input parameters and distributions for the waste zone.

Input Parameter	Value or Distribution	Basis and Comments
Waste-Zone Length [m]	Uniform 3.05 – 131	Minimum value determined by size of individual pit (10'). Maximum value determined by extent of Mixed Waste Landfill.
Waste-Zone Width [m]	Uniform 3.05 – 91.4	Minimum value determined by size of individual pit (10'). Maximum value determined by extent of Mixed Waste Landfill.
Waste-Zone Thickness [m]	Uniform 3.05 – 8.23	The thickness of the waste zone for all constituents except for cadmium is based on the depth of the trenches and pits, which range from 3 – 8 m (10 – 27 feet). The thickness of the cadmium contamination zone is assumed to be equal to 36.6 m (120 feet), which is the maximum simulated penetration depth of the coolant water that may have carried the cadmium (Wolford, 1997).
Thickness of Cover and Clean Overburden [m]	Uniform 0 – 4.88	Minimum value is assumed to be zero due to erosion.[a] Maximum value is based on maximum thickness of the cover at various locations (Peace et al., 2005).

[a]The intent is to maintain the integrity of the cover at the MWL. Complete erosion of the cover is a conservative bounding assumption for modeling purposes.

Table 4. Summary of input parameters and distributions for the vadose zone.

Input Parameter	Value or Distribution	Basis and Comments
Thickness of Vadose Zone[a] [m]	Uniform 133 - 148	Thickness of the vadose zone for all constituents except for cadmium is based on measured depths to the water table. The depth to the water table from the surface ranges from 141 – 151 m (461 - 495 feet) (Goering et al., 2002). The range of vadose-zone thicknesses accounts for the waste-zone thickness. For cadmium, the thickness is assumed to be 104 m (461 – 120 = 341 feet).
Infiltration Rate [m/s]	Uniform 1.18×10^{-11} – 6.12×10^{-11}	Minimum value based on infiltration through 2 ft of engineered cover under current climate (Peace and Goering, 2005); maximum value based on two times the current maximum precipitation in a natural analog vegetative cover to account for future climates (Waugh, 1997; Menking et al., 2004).
Saturated Hydraulic Conductivity [cm/day]	Log-Normal Mean log: 1.039 S.D. log: 0.705 Upper bound: 173 Lower bound: 0.38	Peace et al. (2003)
Porosity [-]	Uniform 0.302 – 0.445	Peace and Goering (2005)
Volumetric Moisture Content [-]	Uniform 0.053 – 0.225	Peace and Goering (2005)
Longitudinal dispersivity [m]	0.1 times the travel distance (vadose-zone thickness)	Based on field data reported in Gelhar et al. (1992). This is used in the FRAMES/MEPAS models for liquid transport to the groundwater.
Liquid-Phase Tortuosity Factor [-]	Uniform 0.001 – 1	Lower bound based on formulation of Millington (1959); upper bound is physical limit. This is used in the tritium and PCE models.
Gas-Phase Tortuosity Factor [-]	Uniform 0.1 – 1	Lower bound based on formulation of Millington (1959); upper bound is physical limit. This is used in the tritium and PCE models.

[a]Used only in FRAMES/MEPAS. For all other models, the depth to the water table (141-151 m) is used.

Table 5. Summary of input parameters and distributions for the biosphere.

Input Parameter	Value or Distribution	Basis and Comments
Atmospheric Boundary Layer Thickness [m]	Uniform 0.001 – 1	Minimum is based on values reported by Jury et al. (1983). Maximum is a conservative upper value.
Vertical Atmospheric Mixing Length [m]	2	Conservative value to encompass volume occupied by a human (Yu et al., 1993).
Average Wind Speed [m/s]	3.63	Average value based on seven years of site data (SNL Site Environmental Monitoring Reports 1990-1996).
Inhalation Rate [m^3/day]	20	U.S. EPA (1991)
Water Intake [L/day]	10	Conservative estimate to account for drinking water and indirect ingestion or absorption via plants, animals, showering, etc. Recommended value for drinking water is 2 L/day (U.S. EPA, 2000).
Distance to Receptor [m]	0	The point of compliance for groundwater concentrations is assumed to be at the boundary of the landfill. Receptor is assumed to be located adjacent to landfill for inhalation, and water used for drinking, irrigation, etc. is assumed to be drawn from the aquifer directly beneath the MWL.

Key Assumptions:

The key assumptions regarding the models and input parameters used in the performance assessment of the MWL are summarized below:

- Receptor located adjacent to MWL
    - Tritium dose caused by continuous inhalation and exposure of tritium flux directly above MWL.
    - Groundwater dose calculated based on concentrations in aquifer directly beneath MWL. Water intake assumed to be 10 L/day (five times EPA standard of 2 L/day for drinking water).
- Maximum waste inventory set equal to twice estimated values based on historical records.
- Sealed sources of radium-226 allowed to degrade in 1,000 years (emanation factor for radon-222 allowed to increase).
- Cover allowed to completely erode in 1,000 years.
- 1-D model: yields maximum transport to surface and groundwater.
- Bounding tortuosity coefficients: yields maximum diffusion rates.

3.4 Water Infiltration through the Cover

Infiltration of water through a proposed soil cover for the MWL was modeled using the one-dimensional, numerical code UNSAT-H (Peace and Goering 2005). UNSAT-H is a Richards' equation-based model that simulates infiltration, unsaturated flow, redistribution, evaporation, plant transpiration, and deep infiltration of water. The modeling was conducted in 2003 and 2004 using site-specific climate, hydrologic, and vegetation input parameters. The modeling results corroborated the results from earlier modeling studies presented in Section 5.3 of the MWL Corrective Measures Implementation Plan. Complete modeling input parameters, boundary conditions, and results are discussed in Peace and Goering (2005).

One of the objectives of the modeling was to assess whether the proposed 3-ft cover will meet the EPA-prescribed technical equivalency criteria. The EPA performance-based, technical equivalency criteria used in this study are 31.5 millimeter (mm)/year (yr), or less, for net annual infiltration and 1 x 10^{-7} centimeter (cm)/second (s) average infiltration rate, based on a hydraulic conductivity of 1 x 10^{-7} cm/s and the assumption of constant unit gradient conditions. The modeling results demonstrate that the proposed 3-ft MWL cover will meet the EPA-prescribed technical equivalency criteria for RCRA landfills under both present and future conditions.

3.4.1 Model Description

The modeling study was formulated in one dimension, vertically, and was discretized by placing computational nodes at predetermined vertical spacing in a conceptual soil profile to evaluate the performance of a cover 3 ft in thickness. Figure 3 shows a cross-section of the conceptual soil profile and its numerical discretization. A total of 30 nodes were used to discretize a conceptual soil profile 6 ft in thickness. A thickness of 6 ft is used so that the overlying nodes of interest are not adversely impacted by the lowermost boundary conditions.

The conceptual soil profile was simulated as a lithologic monolayer. A soil profile with uniform soil and hydrologic properties translates into a significant conservative estimate of liquid water flow. If multiple layers are simulated, the water potential in the underlying layer must equal the water potential in the overlying layer before flow into the lower layer occurs. Multiple layering in performance modeling as well as multiple layers in nature attenuate the downward flow of liquid water (e.g., multiple capillary barriers). UNSAT-H input parameters for the cover are summarized in Table 6-1 in Peace and Goering (2005). All parameters are site-specific and were carefully measured to obtain the most accurate estimate of infiltration possible.

Climatic data represent the site-specific conditions to the maximum extent possible. The historical rainfall record from Albuquerque International Sunport, dating from 1919 to 1996, was used to input precipitation and simulate infiltration through the cover. Two discrete sets of precipitation data were compiled from the historical record. The first data set, the "historical precipitation data," included 65 years of daily rainfall recorded from 1932 to 1996. The second data set, the "maximum precipitation data," included the 8 heaviest years' rainfall recorded between 1919 and 1996, repeated 8 times for a total of 64 years. The heaviest rainfall years were 1919, 1929, 1940, 1941, 1982, 1986, 1988, and 1992. These maximum precipitation data represent a climate change of 50% more precipitation overall (1.5 times the current level).

Precipitation during these years ranged from 12 in. to over 15 in. The current average annual precipitation for the Albuquerque area is 8.65 in./yr.

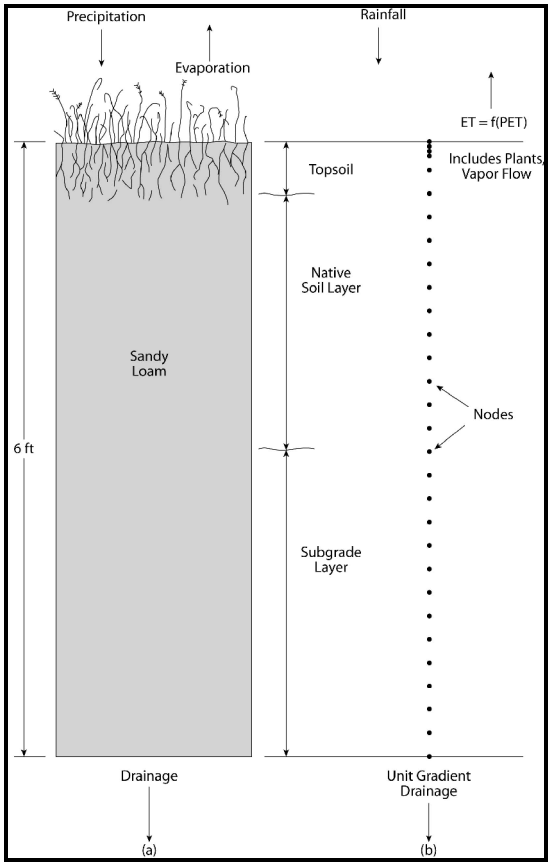

Figure 3. (a) Conceptual model for infiltration model. (b) Nodal discretization in UNSAT-H.

Literature evidence suggests that wetter conditions probably occurred during the last glacial episodes in the Southwest. Studies of paleoclimate during the Last Glacial Maximum suggest that precipitation in the Estancia basin, located west of the Manzano Mountains, nearly doubled relative to modern levels during brief, decade- to century-long episodes of colder and wetter climate (Menking et al. 2004). Farther west, studies of floral assemblages in late Pleistocene packrat middens near Yucca Mountain, Nevada, indicate that precipitation was an estimated 2.4 times modern levels during the Last Glacial Maximum (Menking et al. 2004).

Because precipitation in the southwest may have been significantly higher in the past, a precipitation multiplier of 2X was used to estimate maximum infiltration levels in the future through the MWL cover. A polynomial extrapolation of infiltration was developed using the results from modeling the "historical precipitation data" and the "maximum precipitation data", and assuming that hydrologic properties of the cover are at equilibrium with the natural system.

Plant transpiration is the primary mechanism in removing water from a cover. Without plants, covers would only depend on evaporation to remove water from the soil profile. Vegetative input for the UNSAT-H code included root depth, root length density, leaf area index, growing season, and percent bare area. Root depth, root length density, leaf area index, growing season, and percent bare area for a climax community were measured in the field (Peace and Goering, 2005).

3.4.2 Model Results

The UNSAT-H code simulated infiltration through a soil cover with a climax community of native vegetation. The range of average infiltration rates for the MWL was predicted under current and future climate conditions. For both the current and future scenarios, the estimated infiltration rates through a 2-ft cover rather than a 3-ft cover were used to be conservative, as the model predicted infiltration through a 3 ft cover to be slightly negative, i.e. a net upward flux (Peace and Goering 2005).

Under present climate conditions, the model predicted the average infiltration rate through the proposed MWL cover to be 1.18×10^{-9} cm/s for the historical precipitation scenario and 5.34×10^{-9} cm/s for the maximum precipitation scenario.

Under future climate conditions, the properties of the MWL cover soils will gradually revert towards those of the natural soils around the landfill, as the bulk density and porosity of the soil equilibrate with natural conditions. Under these conditions, the model predicted the average infiltration rates to be 2.44×10^{-10} cm/s for the historical precipitation scenario and 1.04×10^{-9} cm/s for the maximum precipitation scenario.

Since the maximum precipitation scenario represents a 50% increase in precipitation over the historical precipitation scenario, a polynomial regression for infiltration as a function of precipitation can be determined (assuming that zero infiltration occurs with zero precipitation). We assign a normalized precipitation value of one to the historical precipitation scenario and a value of 1.5 to the maximum precipitation scenario. The quadratic regression then allows extrapolation to future climates where the precipitation is expected to be twice as high as present values. If the future precipitation is twice as high as current precipitation, the precipitation multipliers will increase to 2X for the historical scenario and 3X for the maximum scenario. Applying these multipliers to the quadratic regression yields estimated future infiltration rates of 2.29×10^{-9} cm/s for the historical precipitation scenario and 6.12×10^{-9} cm/s for the maximum precipitation scenario (Figure 4). We use 6.12×10^{-9} cm/s as an upper bound for the infiltration distribution to represent maximum precipitation conditions in the future, and we use 1.18×10^{-9} cm/s as a lower bound for the infiltration distribution to represent current precipitation conditions with the engineered cover design.

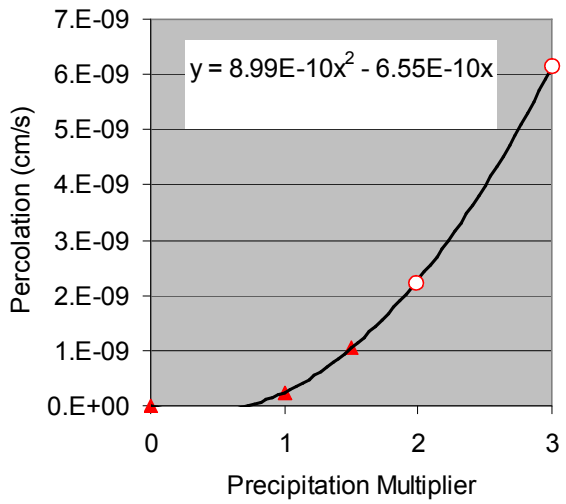

Figure 4. Polynomial regression used to estimate future infiltration values as a function of precipitation multipliers. Triangles denote simulated values; circles denote extrapolated values.

In summary, the modeling results demonstrate that the proposed 3-ft soil cover will meet the EPA-prescribed technical equivalency criteria for both present and future climate conditions, even if precipitation is significantly higher. The EPA performance-based, technical equivalency criteria are 31.5 mm/yr or less for net annual infiltration and 1 x 10^{-7} cm/s average infiltration rate, based on a hydraulic conductivity of 1 x 10^{-7} cm/s and the assumption of constant unit gradient conditions. Predicted average infiltration rates through the MWL cover are expected to range from 1.18 X 10^{-9} cm/s for present conditions to 6.12 X 10^{-9} cm/s for future conditions, under the assumption of significantly higher precipitation. These infiltration rates are considerably lower than the EPA performance-based, technical equivalency criterion of 1 x 10^{-7} cm/s.

3.4.3 Summary of Key Results and Assumptions

- Simulations of infiltration through the engineered cover at the MWL show that the net annual infiltration will be less than the regulatory metric of 10^{-7} cm/s.
- Predicted average infiltration rates through the MWL cover are expected to range from 1.18 X 10^{-9} cm/s for present conditions to 6.12 X 10^{-9} cm/s for future conditions.
- Key Assumption:
    - Predicted range of infiltration rates was based on simulated infiltration averaged over 64 years of data (as opposed to selected annual or daily averages).

3.5 Fate and Transport of Tritium

3.5.1 Model Description

As described in Section 3.2.2, the fate and transport of tritium was simulated using a model that accounts for transient liquid advection, gas diffusion, and decay (Jury et al., 1983; Jury et al., 1990). The upper boundary condition at the surface allowed for gas-phase transport of tritium to the atmosphere across a prescribed (uncertain) boundary-layer thickness. The concentration at the bottom of the model was specified as zero infinitely far away from the source.

The initial inventory of tritium was estimated from past records (SNL, 1993), and the extent of the contaminated waste zone was allowed to vary from the size of an individual pit to the entire size of the MWL. The inventory was allowed to vary between the estimated value (as a lower bound) and an upper bound equal to twice the estimated value. The simulations were run until tritium concentrations decreased to negligible values in the system. One hundred realizations were used in the simulations.

3.5.2 Model Results

3.5.2.1 Comparison to Field Data

In 1990 and 1993, measurements of tritium at the surface and at locations in the subsurface were measured at the MWL (Johnson et al., 1995). These measurements were used as a reference to check the simulated results of the model. Figure 5 shows the simulated tritium surface flux as a function of time for 100 realizations. The minimum and maximum measured tritium surface flux values taken in 1993 are also shown in the figure. The measured values are shown spanning 5 to 33 years because the actual time elapsed since the tritium was emplaced is uncertain. Emplacement of waste at the MWL began in 1960 and ended in 1988; therefore, the measured values sampled in 1993 could have occurred between 5 and 33 years after emplacement. Results show that the simulated results during this span of time are either within or above the measured bounding values. Figure 6, Figure 7, and Figure 8 show similar plots and results for different locations in the subsurface. In most cases, the simulated fluxes and concentrations are higher than the measured values. These results and comparisons provide evidence that the models can provide realistic values for the simulated outputs. In addition, the comparisons confirm that the model is producing conservatively high results for surface fluxes and subsurface concentration because of the conservative values and distributions used for the model parameters.

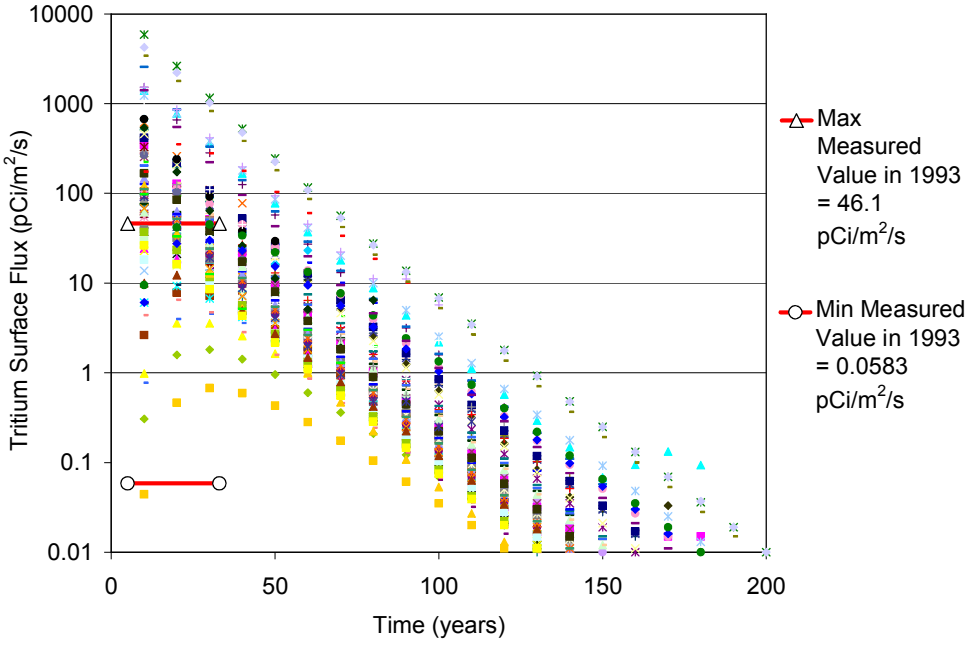

Figure 5. Comparison of simulated tritium surface flux as a function of time for 100 realizations with range of measured values in 1993.

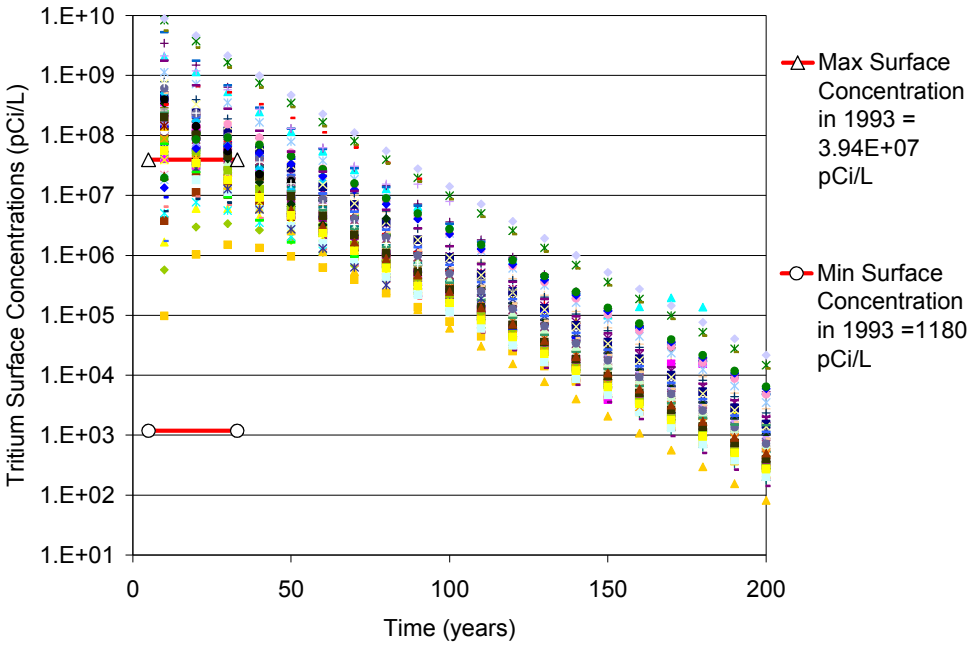

Figure 6. Comparison of simulated tritium surface concentration as a function of time for 100 realizations with range of measured values in 1993.

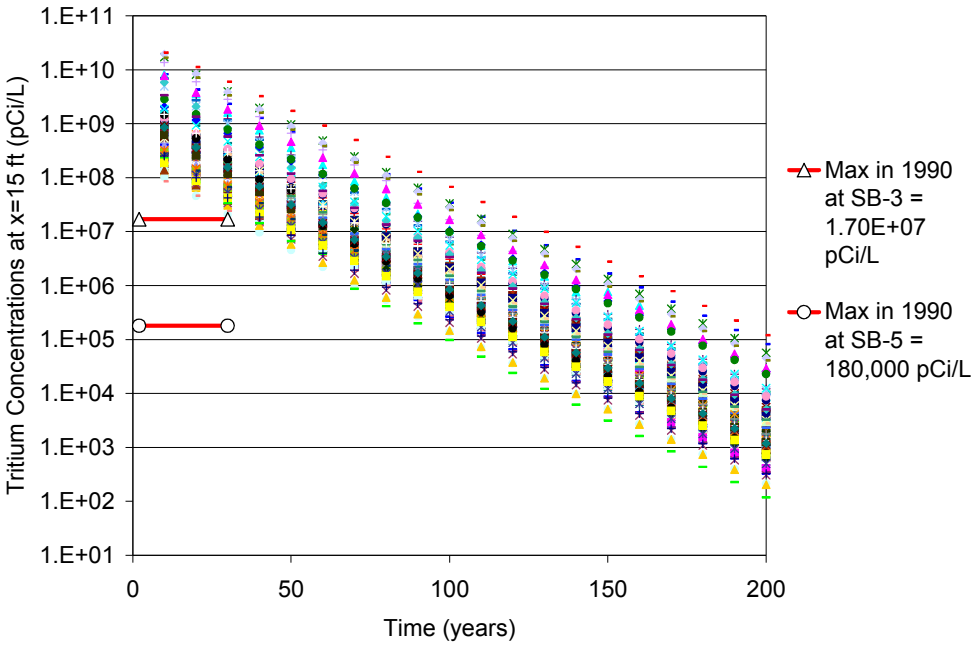

Figure 7. Comparison of simulated tritium concentration at a depth of 15 feet as a function of time for 100 realizations with measured maximum values in 1990.

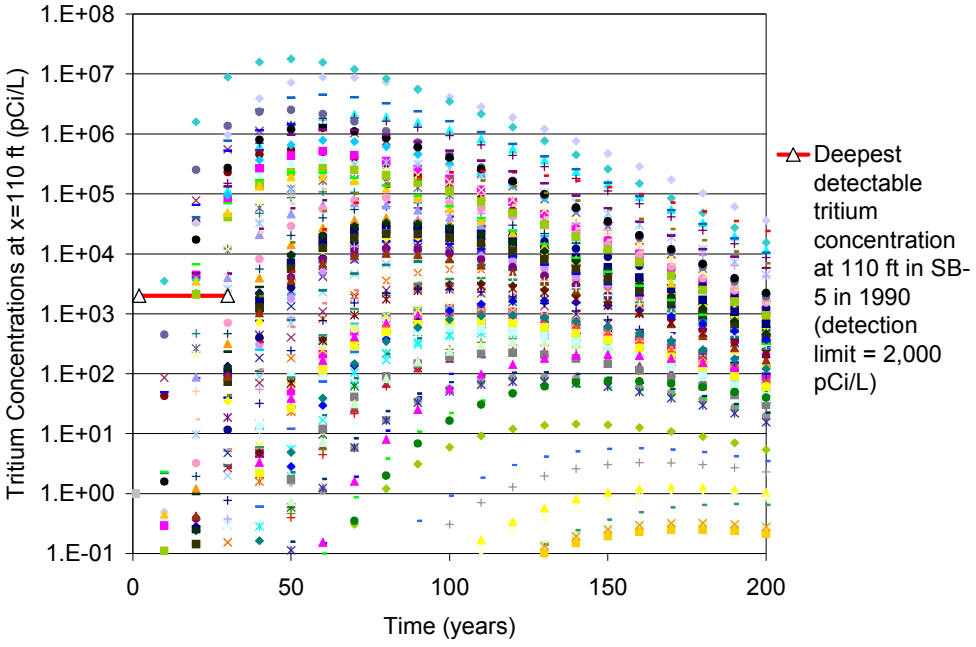

Figure 8. Comparison of simulated tritium concentration at a depth of 110 feet as a function of time for 100 realizations with measured value in 1990.

3.5.2.2 Comparison to Performance Objectives

The simulated tritium concentrations reaching the groundwater are shown in Figure 9 for all 100 realizations as a function of time. The peak tritium groundwater concentrations are all small, and Figure 10 shows the cumulative probability of the peak concentrations for 100 realizations and 200 realizations. The results show that the simulated tritium groundwater concentrations are all well below 20,000 pCi/L. In addition, the distribution resulting from 100 realizations is nearly the same as the distribution resulting from 200 realizations (therefore, all subsequent analyses only use 100 realizations).

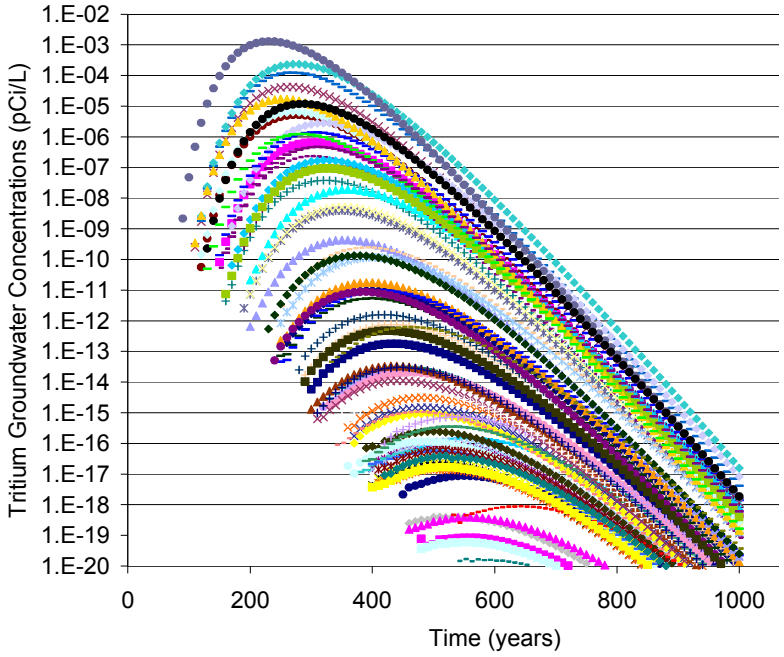

Figure 9. Simulated tritium concentrations in the aquifer as a function of time for 100 realizations.

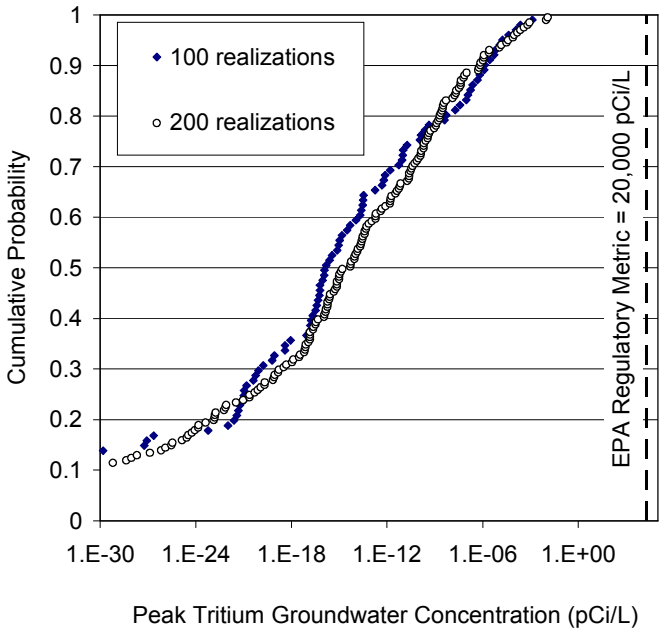

Figure 10. Cumulative probability for simulated peak tritium groundwater concentrations using 100 and 200 realizations.

Figure 11 shows the cumulative probability for the simulated peak tritium dose via groundwater, which is calculated based on the simulated aquifer concentrations and a conservative water intake of 10 L/day (accounts for drinking water, indirect ingestion via plants and animals, absorption and inhalation via showering, etc.). The results shows that all realizations are well below the EPA metric of 4 mrem/year.

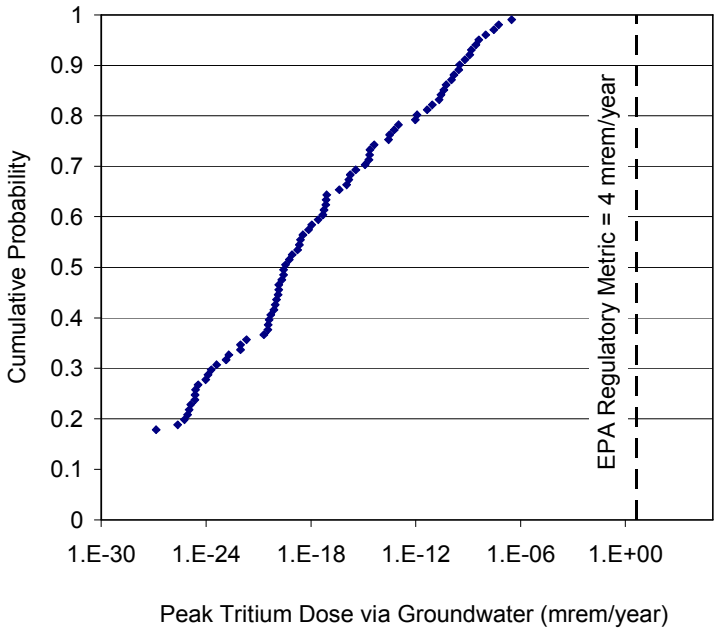

Figure 11. Cumulative probability for simulated peak tritium dose via the groundwater pathway using 100 realizations.

Figure 12 shows the cumulative probability for the simulated peak tritium dose via the air pathway for 100 realizations. The simulated dose due to inhalation (and skin absorption) is based on the concentration of gas-phase tritium immediately above the MWL. The average wind velocity, vertical mixing length, and surface flux of tritium are used to calculate the air concentration above the MWL, and the inhalation rate is used to calculate the intake (Table 5). The dose conversion factor (Table 1) is then used to calculate the dose rate. Because the simulated surface flux of tritium for several realizations was quite high (Figure 5), a small percentage (~2%) of the realizations yield a dose via the air pathway that exceeds the EPA metric of 10 mrem/year.

It should be noted, however, that Figure 5 shows the peak tritium surface fluxes occurring before 50 years due to the natural decay of tritium. The simulated maximum surface concentrations of tritium that yielded the peak fluxes are on the order of 10^{10} pCi/L. If measured values of tritium vapor concentrations at the surface over the next few decades are not shown to increase from previously measured values, which are several orders of magnitude less than maximum simulated values, the dose due to tritium via the air pathway is not likely to be exceeded.

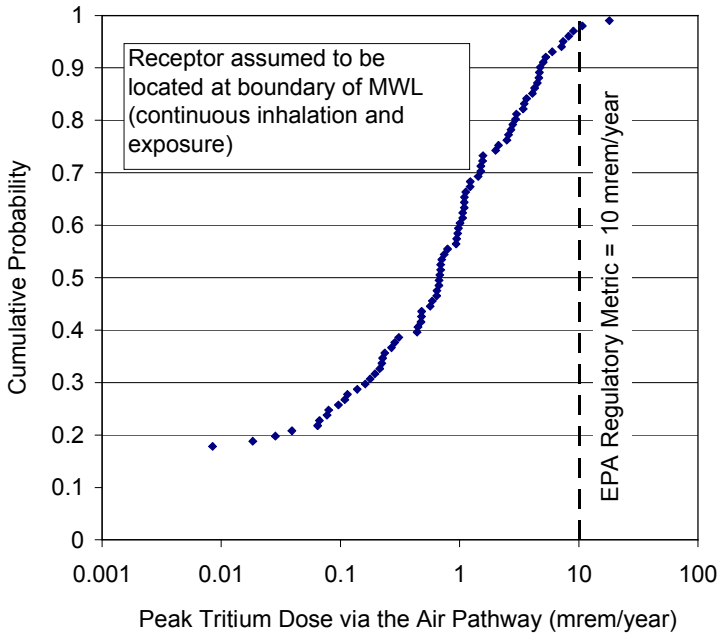

Figure 12. Cumulative probability for simulated peak tritium dose via the air pathway for 100 realizations.

3.5.2.3 Sensitivity Analysis

A sensitivity analysis (as described in Section 2.2.1) was performed to determine the parameters that were most important to the simulated performance metrics of aquifer concentration and inhalation dose. Figure 13 presents a chart that summarizes the results of the stepwise linear rank regression analysis. All of the uncertain input variables summarized in Table 2 through Table 5 relevant to tritium transport were evaluated, but only the most important input variables are shown in Figure 13. The ΔR^2 values in Figure 13 provide a measure of the incremental contributions from each input variable to the variability in the simulated performance metric. For example, the uncertainty in the liquid-phase tortuosity accounts for about 60% of the variability in the simulated tritium aquifer concentration

The sensitivity of the inhalation dose to liquid-phase tortuosity and moisture content indicates that the transport of tritium is dependent on upward diffusion through the liquid phase as well as the gas phase. A conservative upper bound for the liquid- and gas-phase tortuosity coefficients was implemented in this study (Table 4) to account for the possible effects of enhanced vapor diffusion (Ho and Webb, 1998). The dependence on cover thickness and atmospheric boundary-layer thickness indicates that the inhalation dose is also dependent on the upper boundary conditions of the landfill. Therefore, the thickness and integrity of the cover should be monitored and maintained to mitigate tritium migration to the surface. Finally, although not included as an uncertain parameter, the location and disposition of the receptor played an

important role in the simulated inhalation dose. In this study, the receptor was assumed to be located adjacent to the MWL, continuously inhaling air directly above the MWL (24 hours a day, 365 days a year). If the receptor were located further away from the site, or if the exposure were not continuous, the simulated dose via the air pathway would be considerably less.

The variability of the tritium aquifer concentration is shown to be dependent on the liquid-phase mobility parameters, indicating that diffusion of liquid-phase tritium is important. A separate ("one-off") sensitivity analysis of infiltration revealed that the infiltration would have to be increased by several orders of magnitude (close to the saturated hydraulic conductivity of the vadose zone) in order for the tritium to reach substantial concentrations in the groundwater.

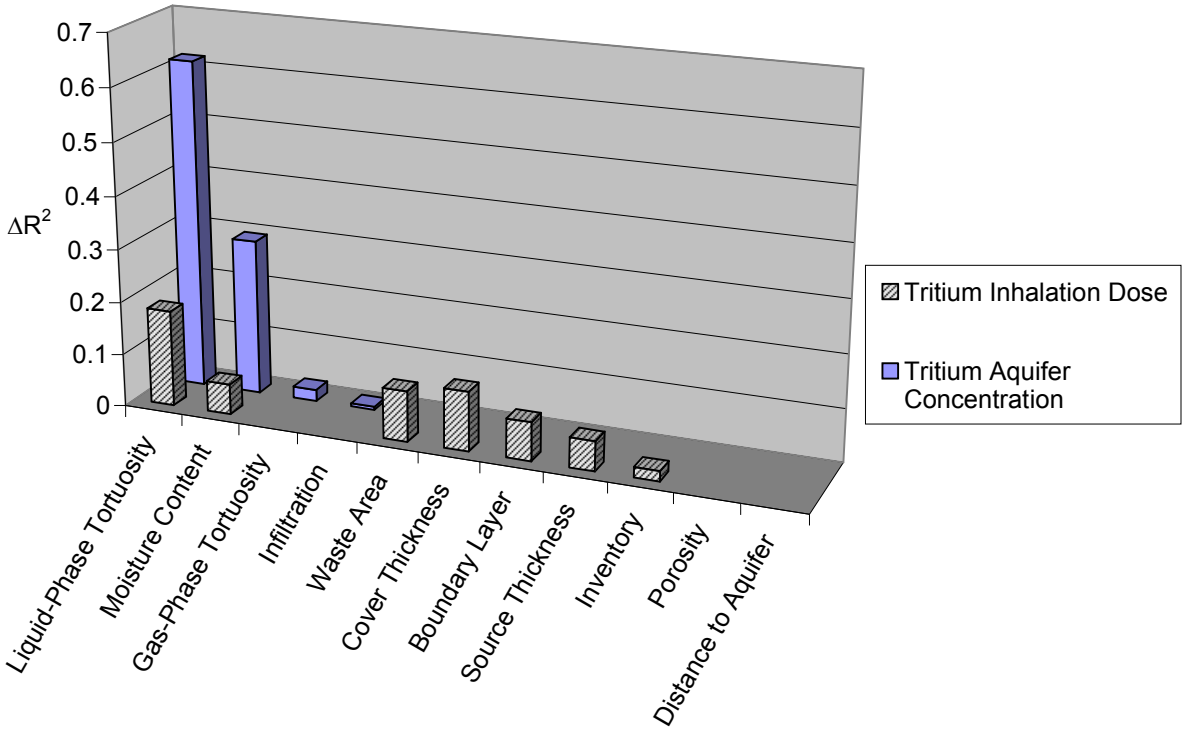

Figure 13. Analysis of sensitivity of simulated tritium inhalation dose and aquifer concentration to uncertain input parameters.

3.5.3 Summary of Key Results and Assumptions

- All simulated realizations of tritium aquifer concentration and dose via the groundwater pathway were well below the regulatory metrics of 20,000 pCi/L and 4 mrem/year, respectively.

- A small percentage (2%) of the simulated dose due to tritium via the air pathway exceeded the regulatory metric of 10 mrem/year.

- Parameters impacting tritium diffusion through both the liquid and gas phases (e.g., tortuosity coefficient, moisture content, cover thickness, atmospheric boundary-layer thickness) were found to be important to the simulated inhalation dose.

- Key Assumptions:

    - Receptor located at MWL; continuous inhalation and exposure of tritium flux from subsurface
    - Cover allowed to erode completely
    - 1-D model: maximum transport to surface
    - Bounding tortuosity coefficients: maximum diffusion rate
    - Maximum waste inventory set equal to twice estimated value of 2,400 Ci

3.6 Fate and Transport of Radon

3.6.1 Model Description

Section 3.2.3 and Appendix A describe the steady-state radon transport model that was developed for this study. Diffusion, advection, and decay of radon is included in the model. A constant generation of radon is assumed to occur in the prescribed waste zone, which can vary in size. A significant difference between the current model and previous models of radon transport in geological media (see, for example, Rogers et al., 1984) is the nature of the radium-226 source. In previous studies, the radium-226 originated from ore deposits containing uranium. At the MWL, pure radium-226 was disposed of in sealed containers. Therefore, the overall concentration of radium-226 can be much higher in the current analysis, but the emanation factor, *E*, which governs how much radon-222 gas can be released from the radium-226, can be significantly lower because of the containment. Generally speaking, the integrity of radioactive sealed sources is very robust. The radium-226 sealed sources disposed of in the MWL were most likely fabricated according to design standards that required tests to evaluate the integrity of the sources subject to extreme temperature, impact, pressure, and vibration (see, for example, 10 CFR 39.41). Radon-222 originating from uranium-238 was not considered in the radon-transport model because the activity of radium-226 (parent of radon-222) resulting from the decay of uranium-238 is negligible (15 microCuries after the first 1,000 years) relative to the radium-226 activity assumed in the model (6-12 Curies). However, radon-222 was included as a decay product of uranium-238 in the FRAMES/MEPAS liquid-phase transport simulations of the radionuclides (see Section 3.7.2.2).

3.6.2 Model Results

3.6.2.1 Comparison to Field Data

Radon surface fluxes at the MWL were measured in 1997 (Haaker, 1998). A total of 89 four-inch-diameter activated charcoal radon canisters were used to evaluate the radon surface fluxes in the vicinity of the MWL, as well as background values. Results showed that the measured radon fluxes above the MWL were not significantly different than the background values. The median flux in the vicinity of the MWL was 0.33 pCi/m^2/s while the median background flux was 0.35 pCi/m^2/s. The maximum measured fluxes for the MWL and background were 1.02 and 0.664 pCi/m^2/s, respectively. This difference in maximum values was used to calibrate the emanation factor in the radon transport model. The emanation factor governs how much radon is released to the immediate surroundings from the radium-226 source. A factor of zero represents no emission (complete containment), and a factor of one represents total emission (no containment).

The potential sources of radon-222 (radium-226) were sealed and contained, and the sealed sources were likely tested for integrity before disposal in the MWL. Therefore, the containment is assumed to be generally intact at present, but defects or breaks may still be present. The minimum emanation factor, which accounts for present-day emissions, was adjusted to yield a radon flux between 0.1 and 1 pCi/m^2/s (equivalent to the difference in maximum measured and background fluxes). The resulting minimum emanation factor used in the probabilistic simulations was 10^{-6}. The maximum emanation factor was estimated based on the possibility that the sealed containers may degrade in the future. The integrity of the containers is expected to last well beyond 1,000 years, but an upper value of the emanation factor was set equal to 0.01 to represent the possibility that 1% of the containers will completely degrade within 1,000 years. An evaluation was also performed assuming that the maximum emanation factor was equal to one, which is equivalent to complete degradation of the containment of all the radon sources within 1,000 years. A log-uniform distribution between 10^{-6} and the maximum value was used for the emanation factor.

3.6.2.2 Comparison to Performance Objectives

Figure 14 shows the cumulative probability for the simulated peak radon-222 surface flux for 100 realizations. For the scenario with a maximum emanation factor of 0.01 (1% of the radon-source containers degrades completely), the results show that 97% of the simulated radon surface fluxes are below the design standard of 20 pCi/m^2/s (3% of the realizations yield radon surface fluxes that exceed the design standard). In the bounding scenario, where we allow all of the containment of the sealed sources to completely degrade, nearly 30% of the realizations exceed the design standard of 20 pCi/m^2/s. As shown in the sensitivity analysis in the next section, the large uncertainty in the emanation factor allowed significant variations in the simulated radon surface flux. It is unlikely that the sealed sources and containers for radium-226 will degrade significantly over the next few hundred years, but because the half-life of radium-226 and uranium-238 is extremely long, radon-222 will continue to be generated from these parent products indefinitely. Therefore, degradation of the containers may eventually cause the emanation factor for radon-222 to increase at some point in the future. For a 1,000-year

evaluation period, however, the probability of exceeding the radon surface-flux design standard is very small if the sealed sources and containers do not degrade significantly and the emanation factor remains below 0.01.

Simulated radon concentrations in groundwater were negligible ($<10^{-20}$ pCi/L). The short half-life of radon (3.8 days) and the large thickness of the vadose zone prohibit radon from migrating significant distances to the water table when the source originates from the landfill. However, in Section 3.7, small amounts of radon are shown to reach the groundwater after 10,000 years when radon is included as progeny of uranium-238, which is fairly mobile (relative to the other non-volatile radionuclides). This effectively mobilizes the source of radon toward the groundwater. However, the decay chain for uranium-238 to radium-226 to radon-222 is an extremely long process (billions of years). Therefore, the amount of radon-222 produced from uranium-238 in 1,000 years is extremely small; no radon-222 is simulated to reach the groundwater in 1,000 years, even when it is included as progeny of uranium-238.

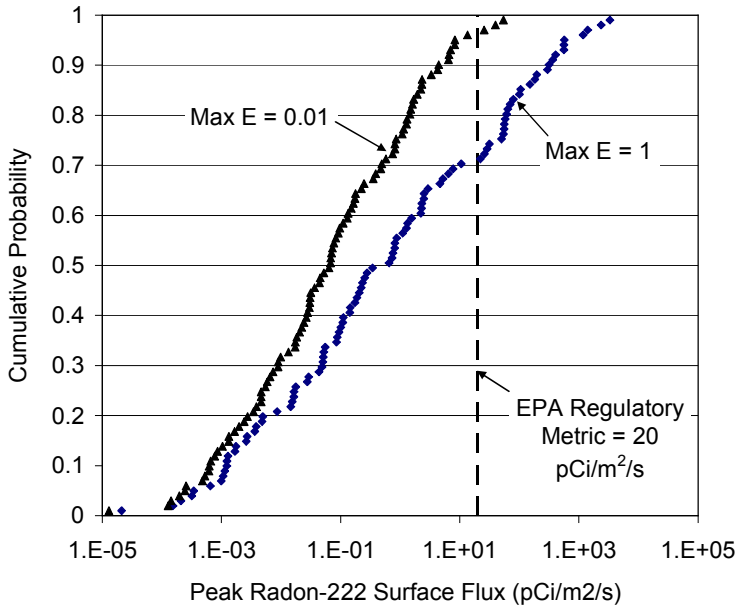

Figure 14. Cumulative probability for simulated peak radon-222 surface flux for 100 realizations using two different maximum values for the emanation factor, E.

3.6.2.3 Sensitivity Analysis

A sensitivity analysis (as described in Section 2.2.1) was performed to determine the stochastic input parameters that were most important to the simulated radon surface flux. Figure 15 presents a chart that summarizes the results of the stepwise linear rank regression analysis. The emanation factor was by far the most significant variable that influenced the variability in the simulated radon surface flux. The waste volume, cover thickness, and effective diffusion coefficient were also shown to be statistically correlated to the simulated radon surface flux, but to a much lower degree.

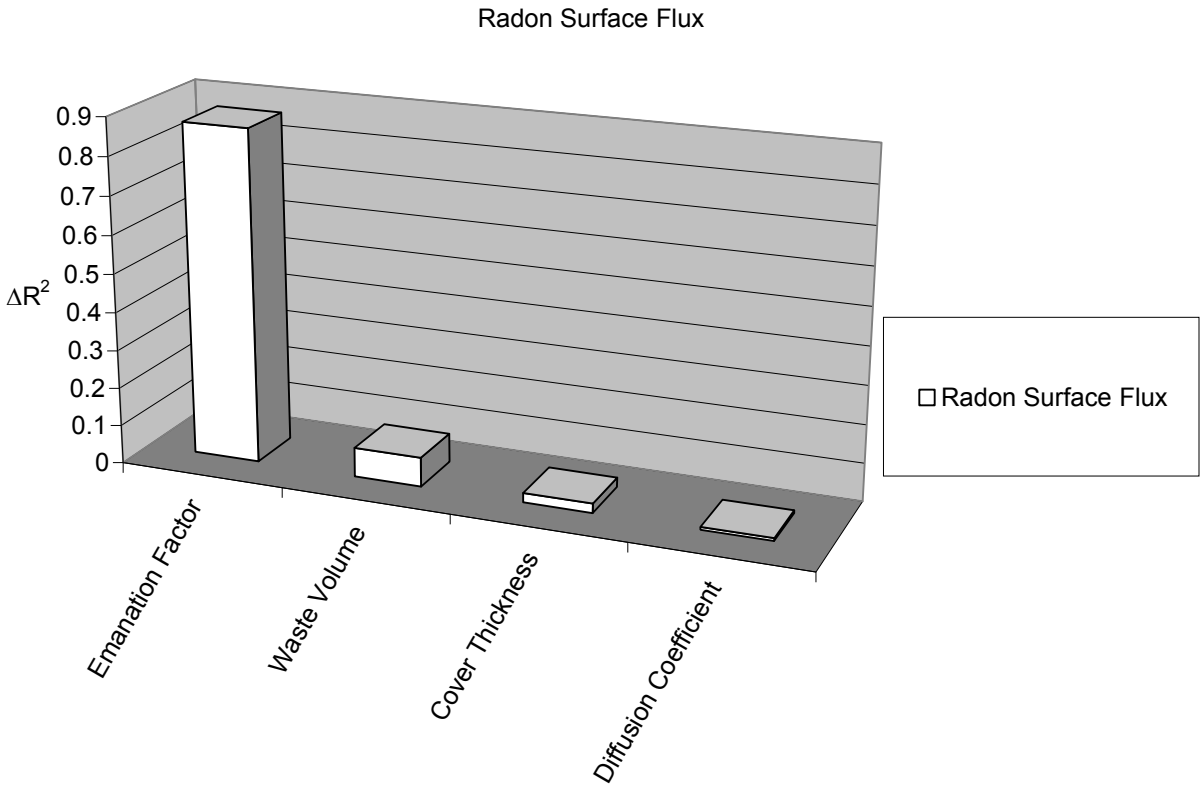

Figure 15. Analysis of sensitivity of simulated radon surface flux to uncertain input parameters.

3.6.3 Summary of Key Results and Assumptions

- Sensitivity studies show that the emanation factor, which depends on the integrity of the radium-226 containment, is important to the performance of the landfill with regard to surface radon fluxes.

- For a maximum radon emanation factor of 0.01 (1% of the radium-226 containers fail), the simulated radon surface fluxes exceed the design standard of 20 $pCi/m^2/s$ in about 3% of the realizations. For a maximum radon emanation factor of 1 (100% of the radium-226 containers fail), the simulated radon surface fluxes exceed the design standard in about 30% of the realizations.

- Simulated radon concentrations in the groundwater were negligible.

- Key Assumptions:

    - Sealed sources of radium-226 allowed to degrade in 1,000 years (emanation factor allowed to increase)
    - Cover allowed to erode completely
    - 1-D model: maximum transport to surface

3.7 Fate and Transport of Other Radionuclides

3.7.1 Model Description

The FRAMES/MEPAS source-term and vadose-zone models (see Section 3.2.1) were used to evaluate the aqueous-phase transport of the following radionuclides to the groundwater: amercium-241, cesium-137, cobalt-60, plutonium-238, plutonium-239, radium-226, strontium-90, thorium-232, tritium, and uranium-238. Although tritium was simulated separately using the model of Jury et al. (1983, 1990), it was also included in the FRAMES/MEPAS model. Decay products of plutonium-238 (e.g., uranium-234), radium-226 (e.g., radon-222), and uranium-238 (e.g., uranium-234, radium-226) are also simulated in the FRAMES/MEPAS model (see Whelan et al., 1996).

3.7.2 Model Results

3.7.2.1 Comparison to Field Data

Other than the detection of tritium and radon in the atmosphere and subsurface as discussed in previous sections, no other radionuclides have been detected at the surface or in the subsurface beyond the extent of the landfill. The inventory for each of the radionuclides shown in Table 2 was estimated based on past records regarding the content of the MWL (SNL, 1993). The upper value for the inventory distribution of each radionuclide was conservatively assumed to be equal to twice the estimated value from past records.

3.7.2.2 Comparison to Performance Objectives

In all realizations, none of the radionuclides were simulated to reach the groundwater in 1,000 years.[4] All of the radionuclides were retarded sufficiently by adsorption to prevent significant migration in 1,000 years, even with the realistically conservative distributions used for model inputs (Table 2). In order to assess potential failure mechanisms, additional scenarios were performed.

Alternative Scenario: Increased Infiltration

First, the infiltration was increased while holding all other input parameters at fixed, conservative values. After 1,000 years, uranium (uranium-238, uranium-234) reached the groundwater when the Darcy infiltration through the vadose-zone was increased by an order of magnitude over its maximum stochastic value (6.12×10^{-11} m/s) to 6.12×10^{-10} m/s, but the groundwater concentrations were still less than the regulatory metric of 30 μg/L. Groundwater concentrations of uranium exceeded the regulatory metric when the simulated Darcy infiltration increased by two orders of magnitude over the maximum stochastic value to 6.12×10^{-9} m/s.

[4] Tritium was simulated to reach the groundwater when vapor-phase transport was included in Section 3.5, but simulated tritium groundwater concentrations and dose were well below the regulatory metrics.

Alternative Scenario: Increased Simulation Period

FRAMES/MEPAS was allowed to run past 1,000 years to assess the potential travel times of the different radionuclides to the groundwater using the original distributions and parameter values (Table 2). Only uranium-238 and its decay products (uranium-234, radon-222) were simulated to reach the groundwater after ~10,000 years. The other radionuclides were retarded by their relatively large adsorption coefficients. The radon-222 that reached the groundwater was a decay product of uranium-238. As shown in previous simulations of radon originating from the waste zone (Section 3.6), radon originating from the MWL was not simulated to reach the water table because of its short half-life (3.8 days). However, since uranium-238 has a small distribution coefficient (K_d) and long half-life, a number of realizations showed that uranium-238 and some of its daughter products (uranium-234 and radon-222) could reach the water table after ~10,000 years. Although the decay of uranium-238 to radon-222 is extremely slow, some small but finite amount of radon-222 is generated from uranium-238 as it moves toward the water table. In MEPAS, the Bateman equation (Bateman, 1910) is used to estimate the relative concentrations of the daughter products as a function of the concentration of the parent, the half lives of the parent and daughter products, and the time elapsed.

Figure 16 shows the cumulative probability for simulated peak radon-222 (progeny from uranium-238) aquifer concentrations for 100 realizations after a simulated period greater than 10,000 years. Although the radon-222 reached the water table as a result of the transport of its parent product, uranium-238, the concentration of radon-222 in the groundwater is still well below the proposed limit of 300 pCi/L.

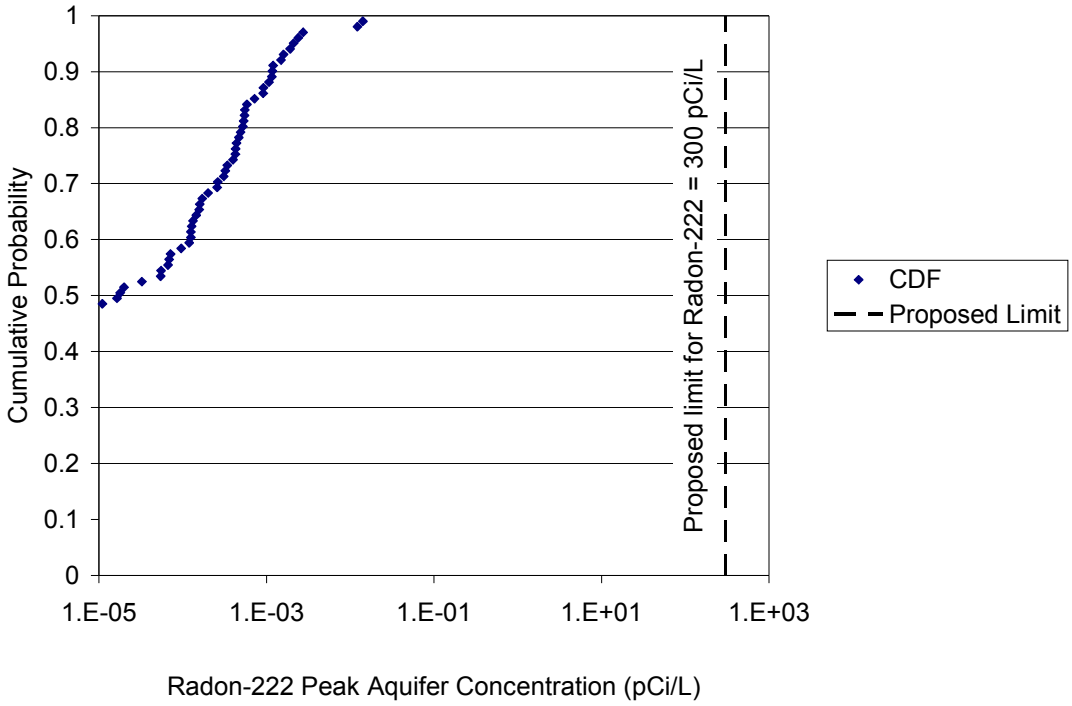

Figure 16. Cumulative probability for simulated peak radon-222 (progeny from U-238) aquifer concentrations for 100 realizations for a time period extending beyond 10,000 years.

Figure 17 shows the cumulative probability for the simulated peak uranium concentration in the groundwater for 100 realizations after a simulated time period greater than 10,000 years. The total uranium concentration is comprised of both uranium-234 (decay product of plutonium-238 and uranium-238) and uranium-238. All realizations yielded peak uranium aquifer concentrations that were less than the EPA regulatory metric of 30 μg/L.

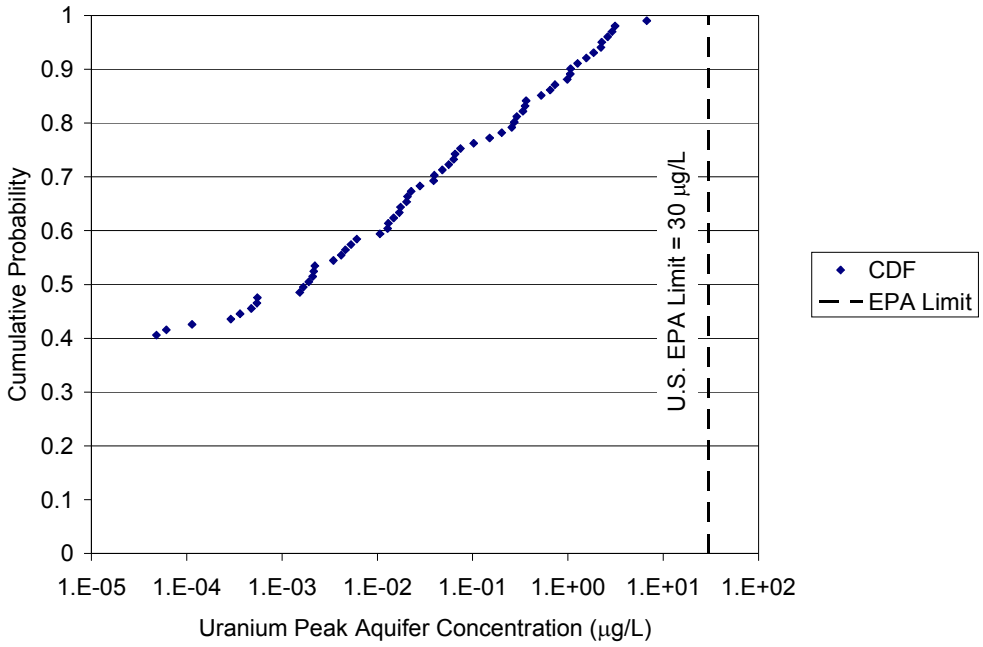

Figure 17. Cumulative probability for simulated peak uranium aquifer concentrations for 100 realizations for a time period extending beyond 10,000 years.

The total groundwater dose for extended periods of time (past 10,000 years) is calculated from the peak aquifer concentrations of uranium (uranium-234 and uranium-238) and radon. The groundwater consumption is assumed to be a conservative 10 L/day to account for drinking water, indirect ingestion through irrigation of vegetables and intake by food-producing animals, and absorption via showering. Figure 18 shows the cumulative probability for the simulated total peak groundwater dose for 100 realizations after a simulated period greater than 10,000 years. The EPA regulatory metric of 4 mrem/year (for beta particles) is shown for reference, but it does not actually apply to the primary constituents contributing to the dose, uranium-234 and uranium-238, which are alpha particles.

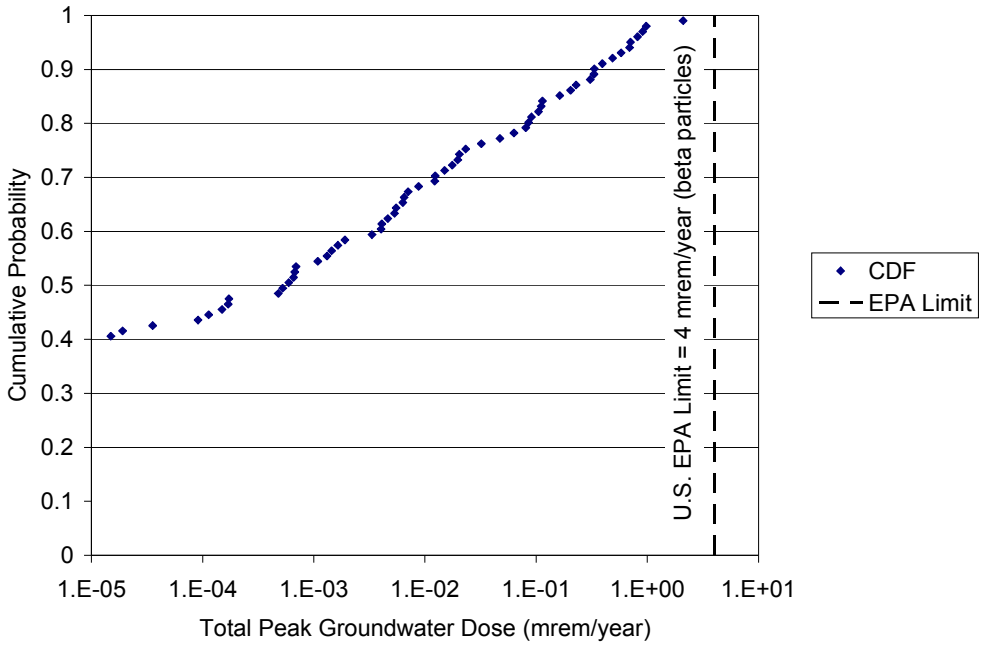

Figure 18. Cumulative probability for simulated peak groundwater dose for all radionuclides for 100 realizations for time periods extending beyond 10,000 years.

3.7.2.3 Sensitivity Analysis

Although no radionuclides were simulated to reach the groundwater within 1,000 years, sensitivity analyses were performed on the extended simulations (>10,000 years) to identify important parameters and processes (Figure 19). Sensitivity analyses show that the infiltration is the primary parameter impacting the variability in the simulated aquifer concentrations for uranium-238, its decay products (uranium-234, radon-222), and the simulated dose via groundwater. A "one-off" sensitivity analysis showed that the infiltration would have to be increased by two orders of magnitude to increase the uranium concentrations above the regulatory metric of 30 μg/L within 1,000 years. Other parameters that were found to be statistically correlated to the variability in the simulated performance metrics were waste length and width, uranium-238 K_d, and the bulk density (which, together with the K_d value, impacts the retardation).

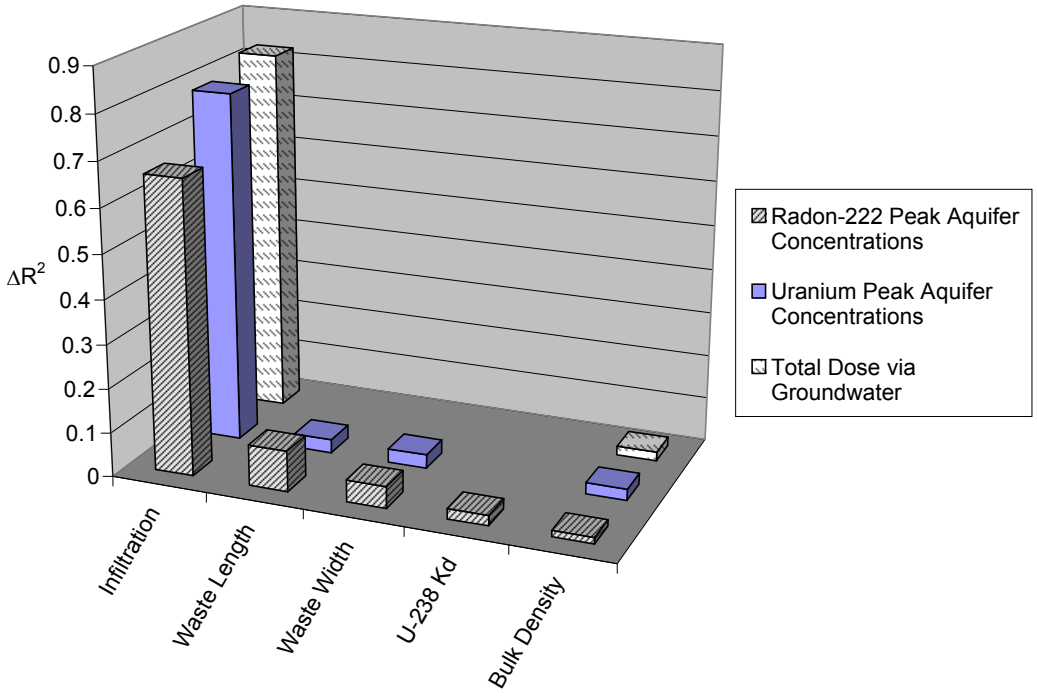

Figure 19. Analysis of sensitivity of simulated peak radon aquifer concentrations, peak uranium aquifer concentrations, and total dose via groundwater to uncertain input parameters for a time period extending beyond 10,000 years.

3.7.3 Summary of Key Results and Assumptions

- None of the radionuclides were simulated to reach the groundwater within 1,000 years for all realizations.

- Only uranium-238 (and some of its decay products) were simulated to reach the water table for extended periods (>10,000 years). All peak aquifer concentrations were still less than the EPA regulatory metric of 30 µg/L.

- Infiltration rate was found to be the most significant parameter impacting the variability in the simulated groundwater concentrations and dose via groundwater. Uranium groundwater concentrations were simulated to exceed the regulatory metric of 30 µg/L if the infiltration increased two orders of magnitude above the maximum stochastic value to 6.12×10^{-9} m/s.

- Key Assumptions:
    - 1-D model: maximum transport to groundwater
    - Receptor assumed to be located at MWL. Water intake assumed to be 10 L/d (5 times greater than EPA standards)

3.8 Fate and Transport of Heavy Metals

3.8.1 Model Description

The fate and transport of two heavy metals, lead and cadmium, were simulated using FRAMES/MEPAS (see Section 3.2.1). The inventory of lead was estimated from previous records (SNL, 1993), and uncertainty in the inventory was captured by using a uniform distribution with the estimated value as a lower bound (see Table 2). There were no records of cadmium being disposed of at the MWL, but soil samples revealed concentrations of cadmium in the subsurface (Peace et al., 2002). The maximum soil concentrations of cadmium were used with the bulk density of the soil and maximum simulated penetration of coolant water (Wolford, 1997) to estimate the mass of cadmium in the MWL. This value was then used as a lower bound in a uniform distribution (see Table 3).

3.8.2 Model Results

Neither lead nor cadmium were simulated to reach the groundwater in all 100 realizations for 1,000 years. Extended simulation periods (>10,000 years) also did not yield any breakthrough of lead or cadmium to the water table. Therefore, comparisons to the regulatory metrics of 15 μg/L and 5 μg/L for lead and cadmium, respectively, are not plotted. Both lead and cadmium have relatively large adsorption coefficients (see Table 2), which retard their transport through the thick vadose zone.

3.8.2.1 Sensitivity Analysis

A "one-off" sensitivity analysis was performed to determine the impact of infiltration on the transport of lead and cadmium while holding all other parameters at constant conservative values. Results showed that cadmium could reach the groundwater in 1,000 years and exceed its regulatory metric if the Darcy infiltration were increased by three orders of magnitude over the maximum expected infiltration, which is based on future climate scenarios (i.e., from $6x10^{-11}$ m/s to $6x10^{-8}$ m/s). Lead was simulated to reach the water table in 1,000 years if the infiltration were increased by four orders of magnitude over the maximum expected infiltration. Although this additional increase in infiltration is not expected to occur based on detailed infiltration simulations (see Section 3.4), the infiltration at the MWL should be monitored in the future. Significant increases (by several orders of magnitude or more) may lead to increased potential for migration of heavy metals and other contaminants to the groundwater.

3.8.3 Summary of Key Results and Assumptions

- Neither lead nor cadmium were simulated to reach the groundwater in 1,000 years (or extended periods past 10,000 years)
- Additional increases in infiltration would (3-4 orders of magnitude over expected maximum infiltration rates) allow cadmium and lead to reach the groundwater in 1,000 years.
- Key Assumptions:
    - 1-D model: maximum transport to groundwater

3.9 Fate and Transport of Volatile Organic Compounds

3.9.1 Model Description

Volatile organic compounds (VOCs) were used as cleaners and solvents for machining and other industrial processes at Sandia National Laboratories. Rags, residual containers, and other wastes contaminated with these contaminants were disposed of at the MWL. Although no quantitative estimates of the volumes of these contaminants disposed of in the MWL exists, soil samples provide an estimate of the extent and concentration of the region contaminated with VOCs at the MWL. Previous studies have shown that VOCs such as trichloroethylene (TCE) and tetrachloroethylene (PCE) can migrate long distances in the vapor phase. Klavetter (1995a) showed that among the VOCs of concern at the MWL, PCE was the only VOC that posed a threat to exceeding regulatory metrics in the groundwater (PCE has a greater Henry's constant and, hence, greater gas-phase transport rate than TCE for the same aqueous source concentration). However, because there is still a potential for other VOCs from the MWL to migrate to groundwater due to their mobility, PCE was modeled in this study as a proxy for other VOCs detected in soil gas and in soils beneath the MWL.

In this study, PCE is simulated using the transient model of Jury et al. (1983, 1990), which accounts for aqueous-phase advection, gas-phase diffusion, adsorption, and decay (see Section 3.2.2). Table 2 summarizes the uncertainty distributions that were used in the model. The inventory was calculated based on the maximum measured soil gas concentration (5,900 ppb) at 30 feet (Peace et al., 2002). We assumed that the PCE vapor was in equilibrium with its aqueous phase (using Henry's constant). The maximum measured gas concentration (5,900 ppb) was used as a minimum value in a uniform distribution increasing to ten times this value to develop a range of equilibrium aqueous concentrations. The maximum value was based on calibrations with measured data (see next section). The total mass of PCE was then calculated using the moisture content, maximum areal extent of the MWL (430 feet x 300 feet), and an uncertain thickness ranging from 10-27 feet. Other values in Table 2 were taken from conservative values and ranges found in the literature for PCE.

3.9.2 Model Results

3.9.2.1 Comparison to Field Data

Samples of PCE soil-gas concentrations were taken at the MWL in 1993 (Johnson et al., 1995). The ranges of measured values at two different depths (10 feet and 30 feet) were compared to simulated soil-gas concentrations using the transient PCE transport model described in the previous section. Figure 20 and Figure 21 show the comparisons for all 100 simulated realizations. As discussed in previous sections, the measured values in 1993 are shown spanning a time period between 5 and 33 years, which accounts for the uncertainty in the time of emplacement. Results show the majority of simulated soil-gas concentrations during this time period at the two depths are between the maximum and minimum values measured in 1993.

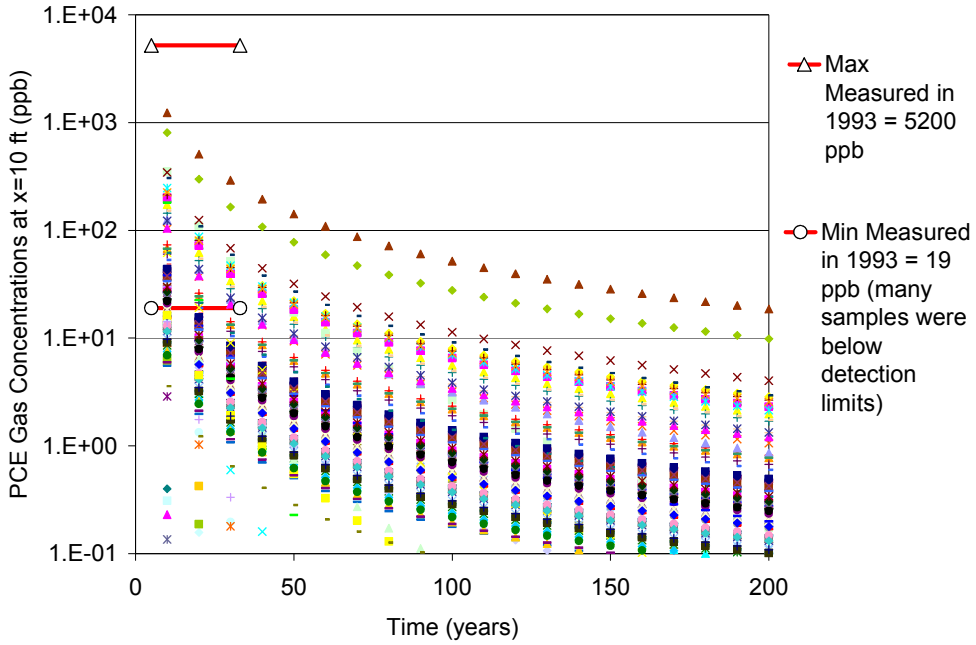

Figure 20. Simulated PCE gas concentration at a depth of 10 feet as a function of time for 100 realizations with a range of measured values in 1993.

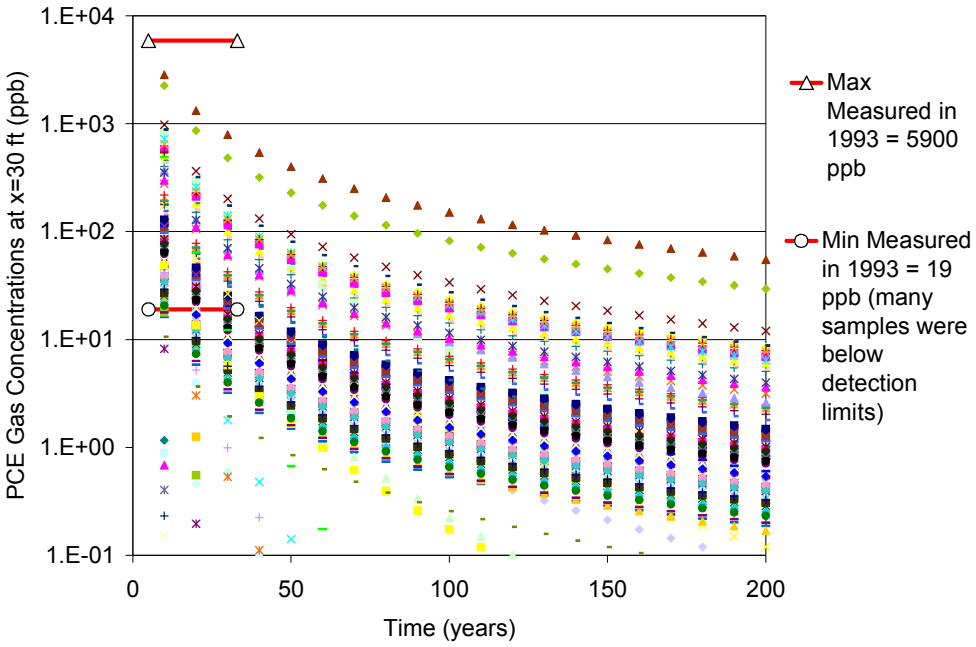

Figure 21. Simulated PCE gas concentration at a depth of 30 feet as a function of time for 100 realizations with a range of measured values in 1993.

3.9.2.2 Comparison to Performance Objectives

Figure 22 shows the simulated PCE concentrations in the groundwater as a function of time for all 100 realizations. The majority of the realizations show the aquifer concentrations peaking before 50 years. Depending on the time of disposal, this corresponds to peak concentrations occurring by 2010 – 2040. So far, no detectable amounts of PCE have been found in the groundwater at the MWL. This is still consistent with the simulations, which show a large amount of variability in the simulated concentrations resulting from uncertainty included in the input parameters (see next section).

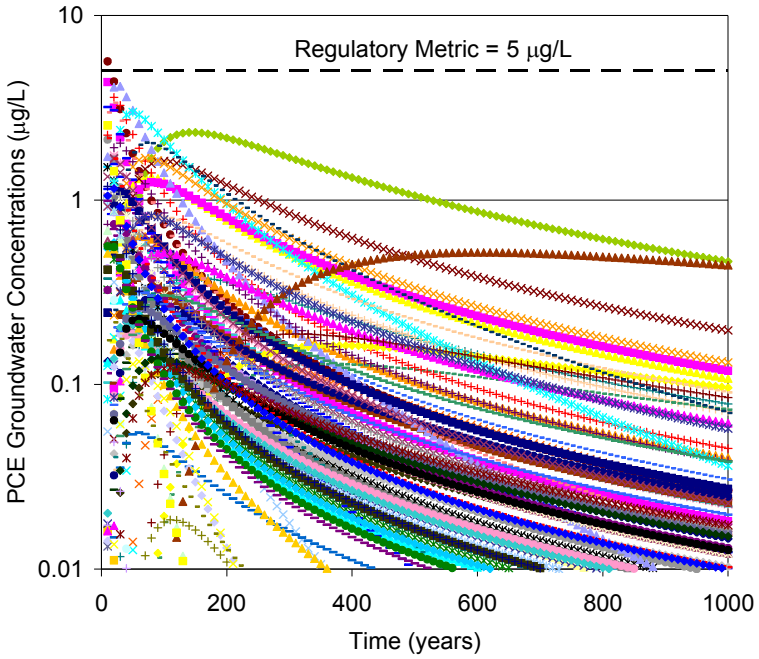

Figure 22. Simulated PCE groundwater concentrations for 100 realizations.

The cumulative probability of the peak PCE groundwater concentration for all 100 realizations is shown in Figure 23. The results show that approximately 99% of the realizations yield groundwater concentrations less than the regulatory metric of 5 µg/L. Only 1% of the realizations yielded groundwater concentrations that exceeded the regulatory metric.

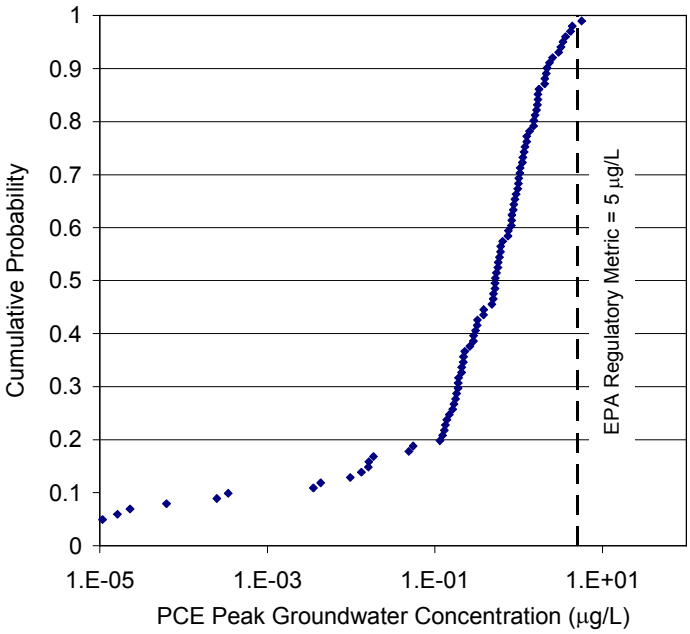

Figure 23. Cumulative probability for simulated PCE peak groundwater concentrations for 100 realizations.

3.9.2.3 Sensitivity Analysis

The uncertainty in the PCE K_d, half-life (degradation), inventory concentration, source thickness, and cover thickness values were found to be the most statistically significant parameters that impacted the variability in the simulated PCE aquifer concentrations. As stated in previous sections, the adsorption coefficient, K_d, plays an important role in the retardation and mobility of the constituent. The half-life and inventory both govern the persistence and availability of the PCE during migration to the groundwater. The source thickness also contributes to the overall inventory of PCE since the inventory concentration is applied to the entire source volume.

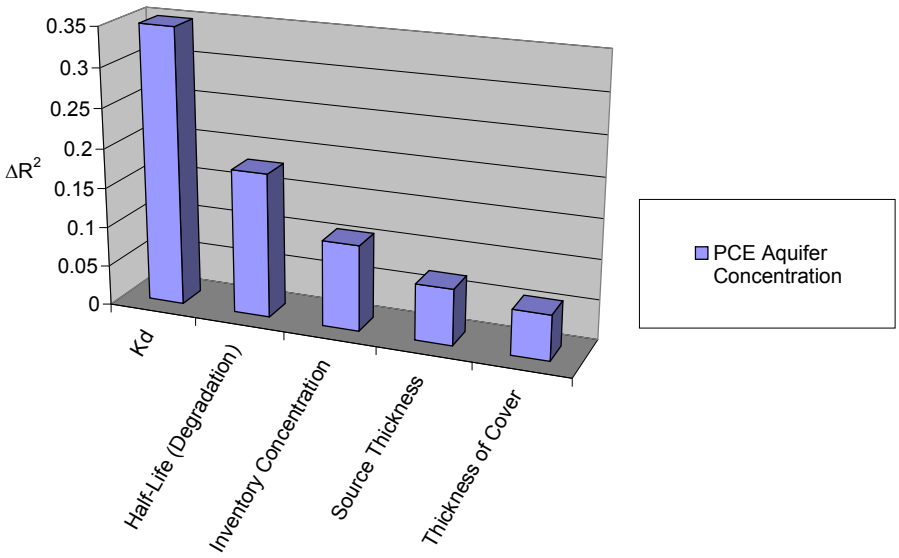

Figure 24. Analysis of sensitivity of simulated PCE peak aquifer concentrations to uncertain input parameters.

3.9.3 Summary of Key Results and Assumptions

- 99% of the realizations yielded peak PCE concentrations in the groundwater that were less than the regulatory metric of 5 µg/L. The majority of the realizations showed that the peak PCE groundwater concentration occurred within 100 years.
- Uncertainty in the PCE adsorption coefficient, half-life, inventory concentration, source thickness, and cover thickness were found to be significantly correlated to the simulated groundwater concentrations.
- Key Assumptions:
    - 1-D model: maximum transport to groundwater

4. Recommended Triggers for Long-Term Monitoring

The NMED's Class 3 permit modification (NMED, May 2005) requires that the MWL CMI Plan include triggers for future action that identify and detail specific monitoring results that will require additional testing or the implementation of an additional or different remedy. Based on the results of the probabilistic performance-assessment modeling for the MWL, the following parameters were identified as important for meeting the performance metrics:

- Surface emissions of tritium and radon
- Infiltration through the MWL cover
- Concentrations of uranium in groundwater
- Concentrations of VOCs in the vadose zone and in groundwater

Monitoring triggers are proposed for these parameters to ensure that the MWL performance metrics and corrective action objectives are met. The proposed triggers are based on EPA and DOE regulatory standards, and are discussed in Section 4.2. To address concerns regarding potential mobilization of contaminants by biota, additional monitoring triggers are proposed for metals and radionuclides in surface soil near animal burrows and ant nests.

A trigger evaluation process is proposed in Section 4.1. This process will be initiated if a trigger is exceeded during long-term monitoring at the MWL. The logic and rationale behind specific triggers are presented in Section 4.2.

Additional details regarding long-term monitoring at the MWL will be presented in the MWL Long Term Monitoring and Maintenance Plan. This plan will be submitted within 180 days after the NMED's approval of the MWL CMI Report. The plan will include all necessary physical and institutional controls to be implemented in the future, and will also include contingency procedures to be implemented if the MWL remedy fails to be protective of human health and the environment.

4.1 Trigger Evaluation Process

A trigger evaluation process is recommended for the MWL during long-term monitoring activities at the site. The process will be a phased approach designed to ensure the protection of human health and the environment, while allowing adequate data collection to evaluate whether corrective action is warranted. This process is based upon the "Conceptual Corrective Measure Evaluation Process' proposed in the Post-Closure Care Plan for the Chemical Waste Landfill (SNL, September 2005).

In the event that a trigger level is exceeded, the process shown in Figure 25 will be used to ensure that adequate data are collected to determine whether additional corrective action is warranted. The increased frequency of data collection proposed in the trigger evaluation process (see Step 3 in Figure 25 and the corresponding explanation on the reverse side of the figure) will ensure that adequate data are collected to eliminate field sampling error, laboratory error, or short-term exceedances that do not reflect long-term trends. Thus, any recommendations for corrective action because of trigger exceedances will be based upon data trends rather than upon single detection values above the trigger level. If data trends in the monitored parameters indicate an established trend above the proposed trigger value, the process requires that a technical letter report be submitted to the NMED recommending whether or not corrective action should be implemented.

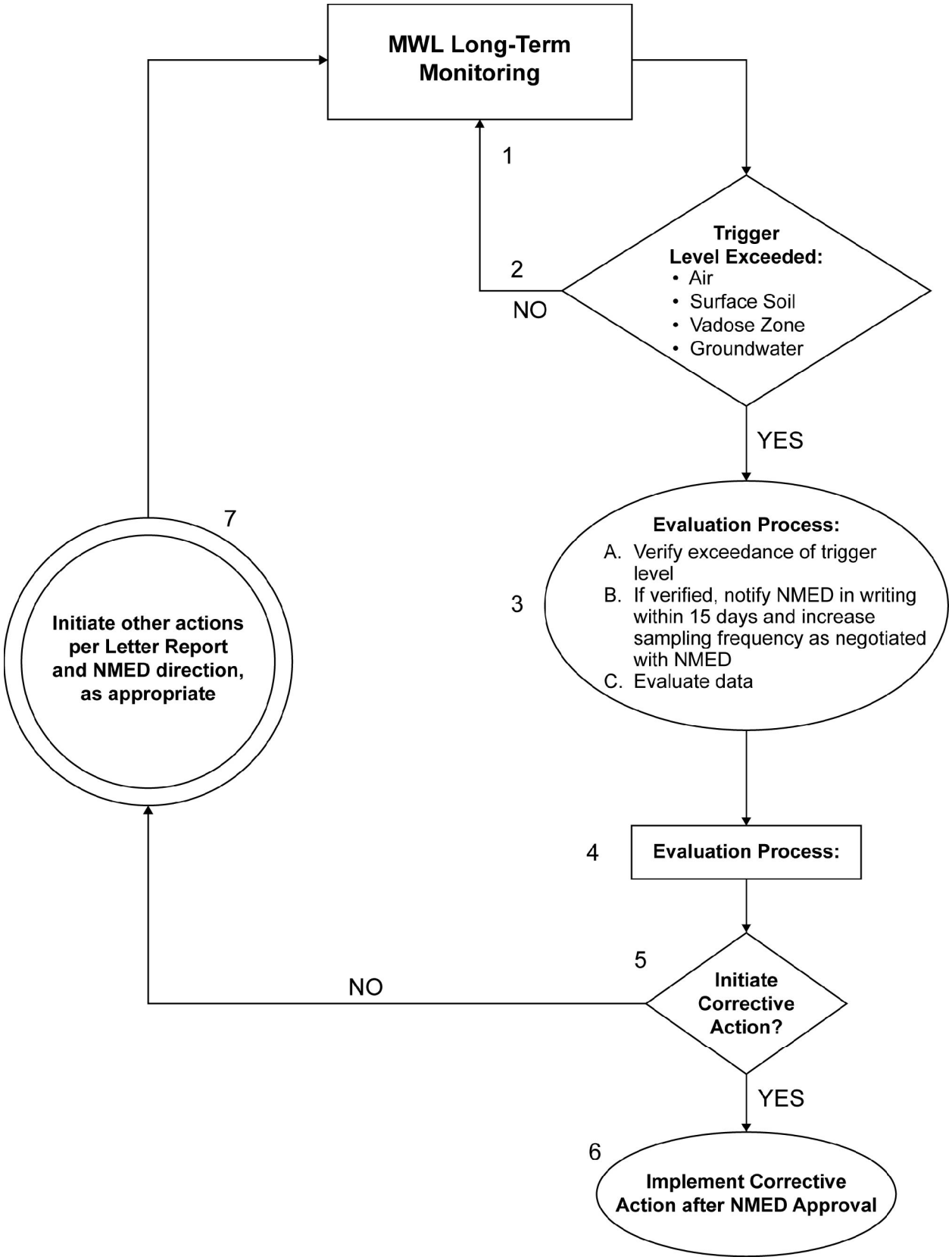

Figure 25. Trigger evaluation process for the Mixed Waste Landfill.

The steps outlined in Figure 25 are explained below:

1. Long-term monitoring of the air, surface soil, vadose zone, and groundwater at the MWL.

2. Exceedance of one or more trigger levels initiates the specific actions described below.

3. Step A of the evaluation process initiates resampling to verify the result(s) that exceeded the trigger level. Step B is based upon the conceptual model for the MWL. Because infiltration through the MWL cover is expected to be very low, and contaminant transport times in the vadose zone and groundwater are anticipated to be relatively slow, a longer period for data collection at an increased sampling frequency is recommended to determine trends. The length of this period and the increased sampling frequency will be negotiated with the NMED. Once the increased sampling data have been collected, the data and any resulting trends will be evaluated to determine the significance of the exceedance (Step C).

4. After the resulting trends have been evaluated, a brief technical letter report will be prepared and submitted to the NMED within three months of receiving the final data set that summarizes the trigger exceedance(s), presents the results of the increased monitoring, and provides recommendations regarding corrective action.

5. NMED Decision Point: after the technical letter report is submitted to the NMED, a meeting will be held to discuss the data evaluation and the recommendations regarding corrective action. If the NMED determines that further investigation of the trigger exceedance is needed, NMED may require corrective action based on a finding that releases of contaminants have occurred, are occurring, or are likely to occur.

6. If the data trend is increasing and higher than the proposed trigger value, corrective action may be necessary. The technical letter report will address appropriate options and form the basis for further discussion with NMED to determine the final corrective action.

7. If the data trend is not clear or is decreasing, corrective action may not be necessary, but other actions may be required as proposed in the technical letter report or requested by the NMED.

4.2 Proposed Triggers

Based on the results of the probabilistic performance-assessment modeling conducted for the MWL, and on subsequent input received from the NMED, monitoring triggers are proposed for the air, surface soil, vadose zone, and groundwater at the MWL These triggers are listed in Table 6, and are discussed below.

Table 6. Proposed Monitoring Triggers for the Mixed Waste Landfill.

Environmental Medium	Monitoring Parameter	Main Potential Receptors	Proposed Trigger Value	Sampling Points	Performance Objective	Applicable Guideline or Regulation
Air	Radon	Humans	4 pCi/L (measured by Track-Etch radon detectors)	MWL Perimeter	Average flux of radon-222 gas shall be less than 20 $pCi/m^2/s$ at the landfill surface (design standard)	EPA Action Threshold for radon in air (U.S. EPA 2005)
Surface Soil	Tritium	Humans and ecological receptors	20,000 pCi/L tritium in soil moisture	MWL Perimeter	Dose to the public via the air pathway shall be less than 10 mrem/yr	DOE Order 5400.5, 10 CFR 61 Subpart H, 40 CFR 141.66
Surface Soil	Cs-137	Humans and ecological receptors	0.664 pCi/g	Animal burrows & ant nests on the cover	Radionuclide concentrations in soil shall not exceed NMED-Approved Maximum Background Concentrations	NMED-Approved Maximum Background Concentrations (Dinwiddie 1997)
Surface Soil	Ra-226	Humans and ecological receptors	2.30 pCi/g	Animal burrows & ant nests on the cover	Radionuclide concentrations in soil shall not exceed NMED-Approved Maximum Background Concentrations	NMED-Approved Maximum Background Concentrations (Dinwiddie 1997)
Surface Soil	Th-232	Humans and ecological receptors	1.01 pCi/g	Animal burrows & ant nests on the cover	Radionuclide concentrations in soil shall not exceed NMED-Approved Maximum Background Concentrations	NMED-Approved Maximum Background Concentrations (Dinwiddie 1997)
Surface Soil	U-235	Humans and ecological receptors	0.16 pCi/g	Animal burrows & ant nests on the cover	Radionuclide concentrations in soil shall not exceed NMED-Approved Maximum Background Concentrations	NMED-Approved Maximum Background Concentrations (Dinwiddie 1997)

Table 6 (continued)

Environmental Medium	Monitoring Parameter	Main Potential Receptors	Proposed Trigger Value	Sampling Points	Performance Objective	Applicable Guideline or Regulation
Surface Soil	U-238	Humans and ecological receptors	1.4 pCi/g	Animal burrows & ant nests on the cover	Radionuclide concentrations in soil shall not exceed NMED-Approved Maximum Background Concentrations	NMED-Approved Maximum Background Concentrations (Dinwiddie 1997)
Surface Soil	Arsenic	Humans and ecological receptors	17.7 mg/kg	Animal burrows & ant nests on the cover	RCRA metal concentrations in soil shall not exceed NMED Industrial/Occupational Soil Screening Levels	NMED Industrial/Occupational Soil Screening Levels (NMED 2006)
Surface Soil	Barium	Humans and ecological receptors	100,000 mg/kg	Animal burrows & ant nests on the cover	RCRA metal concentrations in soil shall not exceed NMED Industrial/Occupational Soil Screening Levels	NMED Industrial/Occupational Soil Screening Levels (NMED 2006)
Surface Soil	Cadmium	Humans and ecological receptors	56.4 mg/kg	Animal burrows & ant nests on the cover	RCRA metal concentrations in soil shall not exceed NMED Industrial/Occupational Soil Screening Levels	NMED Industrial/Occupational Soil Screening Levels (NMED 2006)
Surface Soil	Chromium	Humans and ecological receptors	3400 mg/kg	Animal burrows & ant nests on the cover	RCRA metal concentrations in soil shall not exceed NMED Industrial/Occupational Soil Screening Levels	NMED Industrial/Occupational Soil Screening Levels (NMED 2006)
Surface Soil	Lead	Humans and ecological receptors	800 mg/kg	Animal burrows & ant nests on the cover	RCRA metal concentrations in soil shall not exceed NMED Industrial/Occupational Soil Screening Levels	NMED Industrial/Occupational Soil Screening Levels (NMED 2006)
Surface Soil	Mercury	Humans and ecological receptors	100,000 mg/kg	Animal burrows & ant nests on the cover	RCRA metal concentrations in soil shall not exceed NMED Industrial/Occupational Soil Screening Levels	NMED Industrial/Occupational Soil Screening Levels (NMED 2006)

Table 6 (continued)

Environmental Medium	Monitoring Parameter	Main Potential Receptors	Proposed Trigger Value	Sampling Points	Performance Objective	Applicable Guideline or Regulation
Surface Soil	Selenium	Humans and ecological receptors	5680 mg/kg	Animal burrows & ant nests on the cover	RCRA metal concentrations in soil shall not exceed NMED Industrial/Occupational Soil Screening Levels	NMED Industrial/Occupational Soil Screening Levels (NMED 2006)
Surface Soil	Silver	Humans and ecological receptors	5680 mg/kg	Animal burrows & ant nests on the cover	RCRA metal concentrations in soil shall not exceed NMED Industrial/Occupational Soil Screening Levels	NMED Industrial/Occupational Soil Screening Levels (NMED 2006)
Subsurface Soil	Moisture Content	Humans via groundwater	23 percent by volume	Linear depths of 10 ft to 100 ft along neutron probe access holes beneath the MWL	Infiltration through the cover shall be less than the EPA-prescribed technical equivalence criterion of 31.5 mm/yr [10E-7 cm/s]	RCRA 40 CFR Part 264.301
Subsurface Soil Gas	PCE	Humans via groundwater	20 ppmv	Deepest FLUTe Sampling Port	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Subsurface Soil Gas	TCE	Humans via groundwater	20 ppmv	Deepest FLUTe Sampling Port	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Subsurface Soil Gas	Total Volatile Organic Compounds	Humans via groundwater	25 ppmv	Deepest FLUTe Sampling Port	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Uranium	Humans via groundwater	15 µg/L	Downgradient monitoring well locations	Uranium concentrations in groundwater shall not exceed the EPA MCL of 30 µg/L	EPA Primary Drinking Water Standard
Groundwater	1,1,1-Trichloroethane (1,1,1-TCA)	Humans via groundwater	100 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	1,1,2-Trichloroethane	Humans via groundwater	2.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard

Table 6 (continued)

Environmental Medium	Monitoring Parameter	Main Potential Receptors	Proposed Trigger Value	Sampling Points	Performance Objective	Applicable Guideline or Regulation
Groundwater	1,1-Dichloroethene	Humans via groundwater	3.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	1,2-Dichloroethane	Humans via groundwater	2.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	1,2-Dichloropropane	Humans via groundwater	2.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Benzene	Humans via groundwater	2.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Carbon tetrachloride	Humans via groundwater	2.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Chlorobenzene	Humans via groundwater	50 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Ethyl benzene	Humans via groundwater	350 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Methylene chloride	Humans via groundwater	2.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Styrene	Humans via groundwater	50 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Tetrachloroethene (PCE)	Humans via groundwater	2.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Toluene	Humans via groundwater	500 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard

Table 6 (continued)

Environmental Medium	Monitoring Parameter	Main Potential Receptors	Proposed Trigger Value	Sampling Points	Performance Objective	Applicable Guideline or Regulation
Groundwater	Trichloroethene (TCE)	Humans via groundwater	2.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Vinyl Chloride	Humans via groundwater	1.0 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Xylenes (Total)	Humans via groundwater	5,000 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	cis-1,2-Dichloroethene	Humans via groundwater	35 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Trans-1,2-Dichloroethene	Humans via groundwater	50 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Method 8260 VOCs with no MCLs	Humans via groundwater	EPA Region 6 Human Health Medium-Specific Screening Levels	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA Region 6 Human Health Medium-Specific Screening Levels	EPA Region 6 Human Health Medium-Specific Screening Levels

CFR = Code of Federal Regulations.
cm = Centimeter(s).
DOE = U.S. Department of Energy.
EPA = U.S. Environmental Protection Agency.
ft = Foot (feet).
L = Liter(s).
m = Meter(s).
m^2 = Square meter(s).
µg = Microgram(s).
MCL = Maximum contaminant level.
mm = Millimeter(s).
mrem = Millirem.
MWL = Mixed Waste Landfill.
pCi = Picocurie(s).
RCRA = Resource Conservation and Recovery Act.
s = Second(s).
TCA = Trichloroethane.
VOC = Volatile organic compound.
yr = Year(s).

4.2.1 Surface Soil and Air Monitoring Triggers

Proposed surface soil and air monitoring triggers include a trigger for tritium concentrations in soil collected at select locations along the MWL perimeter, and a trigger for radon emissions from the MWL. Triggers are also proposed for radionuclides and metals in surface soil near animal burrows and ant nests to address concerns regarding potential mobilization of contaminants by biota.

4.2.1.1 Tritium

Tritium is the most mobile radionuclide disposed of at the MWL, and the performance-assessment modeling indicates that there is a possibility that tritium emitted from the MWL may exceed the performance objective of 10 mrem/yr dose to the public via the air pathway. For this reason, a trigger is proposed for tritium emitted from the MWL. Figure 12 shows that the simulated peak tritium dose via air exceeded the performance objective in only 2% of the realizations. Figure 6 reveals that the maximum simulated surface concentration of tritium for the realizations that yielded the peak doses via air are on the order of 10^9-10^{10} pCi/L. Therefore, we propose a conservative trigger value of 20,000 pCi/L in surface soils at the MWL perimeter.

The proposed tritium trigger would apply to surface soil samples currently collected annually at select locations along the MWL perimeter by Sandia's Environmental Monitoring group. Soil samples have been collected from these locations and analyzed for tritium on an annual basis since 1985. Soil moisture is extracted from these samples, and tritium concentrations in the soil moisture are determined using liquid scintillation. Any increase in tritium emissions from the MWL would be indicated by elevated tritium concentrations in these soil samples.

Figure 26 shows a comparison between historical tritium concentrations measured in samples from the four perimeter locations, and the proposed trigger value of 20,000 pCi/L. All exceedances of the trigger value occurred prior to 1998, and exceedances are not anticipated in the future due to radioactive decay and the relatively short (12.3 year) half-life of tritium. If measured concentrations of tritium at the surface exceed 20,000 pCi/L, this would indicate a significant increase relative to present-day values, and the trigger evaluation process (Figure 25) would be followed. Because the proposed trigger value is 4-5 orders of magnitude less than simulated concentrations that yielded exceedances in the dose via air, the proposed trigger value serves as a conservative early-warning indicator for potential exceedances of tritium dose via air.

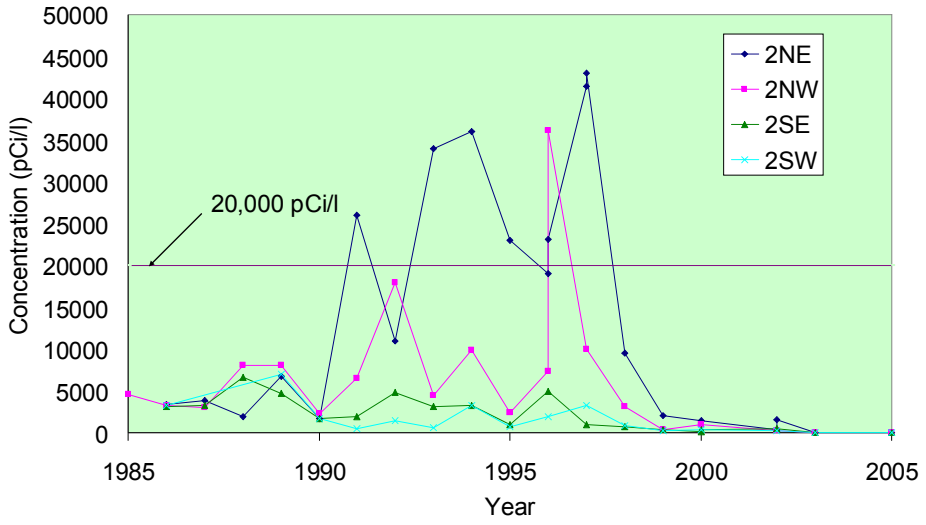

Figure 26. Comparison between historical tritium concentrations measured in samples from the four perimeter locations, and the proposed trigger value of 20,000 pCi/L.

4.2.1.2 Gamma-Emitting Radionuclides and Heavy Metals

NMED has requested that surface soil near animal burrows and ant nests be monitored for radionuclides and heavy metals (NMED, Nov 2006). Triggers proposed for gamma-emitting radionuclides are the NMED-HWB Approved Background Values (Dinwiddie 1997). Triggers proposed for RCRA metals concentrations in surface soil are the NMED Industrial/Occupational Soil Screening Levels (NMED June 2006).

Triggers for gamma-emitting radionuclides and RCRA metals are listed in Table 6. Specific details regarding monitoring frequency and locations will be included in the MWL Long Term Monitoring and Maintenance Plan, to be submitted following completion of the MWL cover.

4.2.1.3 Radon

A trigger for radon is also recommended based on the results of the probabilistic performance-assessment modeling. The modeling indicates that there is a possibility that the radon-222 flux from the MWL to the atmosphere will exceed the design standard of 20 $pCi/m^2/s$ at the landfill surface. Commercially-available Track-Etch radon detectors are recommended to measure the radon concentration in air along the MWL perimeter. These detectors provide an integrated average concentration of radon in air over long exposure periods, on the order of 3 to 6 months. The alternative monitoring detectors, charcoal canisters, are useful only for short exposure periods, on the order of a few days.

The proposed trigger for radon in air is 4 pCi/L, and the proposed point of compliance is the MWL perimeter. The 4 pCi/L value is the EPA "action threshold" for radon in household air (U.S. EPA, 2005). This proposed value is much lower than the simulated radon-gas

concentrations (>10,000 pCi/L) at the surface of the MWL that yielded fluxes that exceeded the design standard of 20 pCi/m^2/s. Should the radon trigger of 4 pCi/L be exceeded in air at the MWL point of compliance, then the trigger evaluation process shown in Figure 25 will be implemented. Additional details regarding long-term monitoring of radon at the MWL will be presented in the MWL Long Term Monitoring and Maintenance Plan.

4.2.2 Vadose Zone Monitoring Triggers

The vadose zone beneath the MWL extends nearly 500 ft from ground surface to groundwater. Because VOCs released from the MWL have the potential to migrate to groundwater, a robust monitoring system is planned for the vadose zone at the MWL to serve as an early warning system for protecting groundwater. This system will provide early evidence of potential threats to groundwater, and it will allow corrective action to be initiated long before groundwater contamination occurs.

Long-term-monitoring of the vadose zone is planned for VOCs and for moisture content to ensure that the MWL remedy remains protective of human health and the environment. Details of the proposed monitoring systems for VOCs, moisture content, and trigger values are discussed below. Additional details regarding the frequency and extent of long-term monitoring activities will be included in the MWL Long-Term Monitoring and Maintenance Plan.

4.2.2.1 Volatile Organic Compounds

Volatile organic compounds (VOCs) are the most mobile of the hazardous constituents detected in soils beneath the MWL. Two passive and three active soil-gas surveys at the MWL have shown the presence of low concentrations of VOCs in soil gas (Peace et al., 2002). In addition, low concentrations of VOCs were detected in a 1993 study of VOC and tritium fluxes to the atmosphere from MWL soils (Radian Corp., 1993). Low concentrations of VOCs were also detected in subsurface soil samples collected from boreholes drilled during the MWL Phase 2 RFI.

VOC concentrations with depth will be monitored using three Flexible Liner Underground Technologies (FLUTe™) sampling wells. The FLUTes™ are proposed to be constructed in vertical boreholes located immediately outside the perimeter of the MWL cover with the locations selected near areas where the highest concentrations of VOCs were detected during earlier studies at the MWL. Actual locations of the FLUTe™ boreholes will be selected in conjunction with NMED. Soil gas sampling ports are proposed to be installed in each FLUTe™ at depths of 50 ft, 100 ft, 200 ft, 300 ft, and 400 ft below ground surface. Soil gas data collected from the FLUTes™ will be used to assess current VOC distributions with depth, and to monitor VOC concentrations over time, allowing early identification of any potential threats to groundwater.

Triggers are proposed for PCE, TCE, and total VOCs in soil gas at the MWL. The proposed triggers are 20 ppmv for PCE and TCE, and 25 ppmv for total VOCs. These triggers, although not based on risk or regulatory limits, are sufficiently low to protect groundwater quality of the

aquifer. All triggers would apply to samples collected from the deepest sampling port in each FLUTe™. Triggers would not apply to samples collected from shallower ports.

4.2.2.2 Moisture Content

Moisture content with depth will be monitored using a neutron moisture meter in three neutron probe access boreholes that were installed to a linear depth of 200 ft at a 30 degree angle directly below the waste disposal cells. The moisture content data will be used to evaluate infiltration through the MWL disposal cell cover. Infiltration is an important parameter for determining whether or not MWL performance objectives are met.

Infiltration through the cover will be indirectly monitored by monitoring the moisture content in the vadose zone beneath the MWL. A significant increase in moisture content beneath the landfill may indicate that the disposal cell cover may not be performing as originally designed, and that infiltration through the cover is greater than originally predicted.

Moisture contents will be measured using neutron logging, and data will be compared to baseline moisture content data collected prior to deployment of the MWL cover. A significant increase in moisture content within the vadose zone may indicate that corrective action is warranted in order to prevent the downward movement of liquid water through the disposal cell. Moisture content data will be evaluated to ensure that the performance objective of infiltration through the MWL cover is less than the EPA-prescribed technical equivalence criteria of 10^{-7} cm/s (31.5 mm/yr), as detailed below.

Infiltration may be estimated indirectly using Darcy's Law. The method is based on soil-physics and the relationship between unsaturated hydraulic conductivity and volumetric moisture content of subsurface soils. The method is described in detail in the MWL Phase 2 RFI SAND Report (Peace et al., 2002). Assumptions required for this method include one-dimensional, steady-state flow, a vertical hydraulic gradient of unity, and the assumption that the downward flux of water beneath the root zone will eventually reach groundwater.

If one applies these assumptions, then the downward flux at a particular depth is equivalent to the unsaturated hydraulic conductivity as a function of the moisture content at that depth. Thus, by monitoring the moisture content of the vadose zone beneath the MWL, one can also indirectly monitor the downward flux through the vadose zone. If infiltration through the cover increases significantly, than the downward flux through the vadose zone would increase as well, resulting in higher moisture content in the vadose zone beneath the landfill. Hence, by monitoring moisture content in the vadose zone, one can indirectly monitor the performance of the MWL cover. A significant increase in moisture content beneath the MWL may indicate that the cover is not performing as designed.

Figure 27 shows the calculated unsaturated hydraulic conductivity curves for 18 subsurface soil samples collected from the IP Test site, located approximately 500 ft west of the MWL. Based on this figure, and assuming a unit gradient in the vadose zone, if infiltration through the MWL cover exceeds the EPA-prescribed technical equivalence criteria of 10^{-7} cm/s (31.5 mm/yr), then volumetric moisture content in the underlying soils will exceed approximately 23 percent.

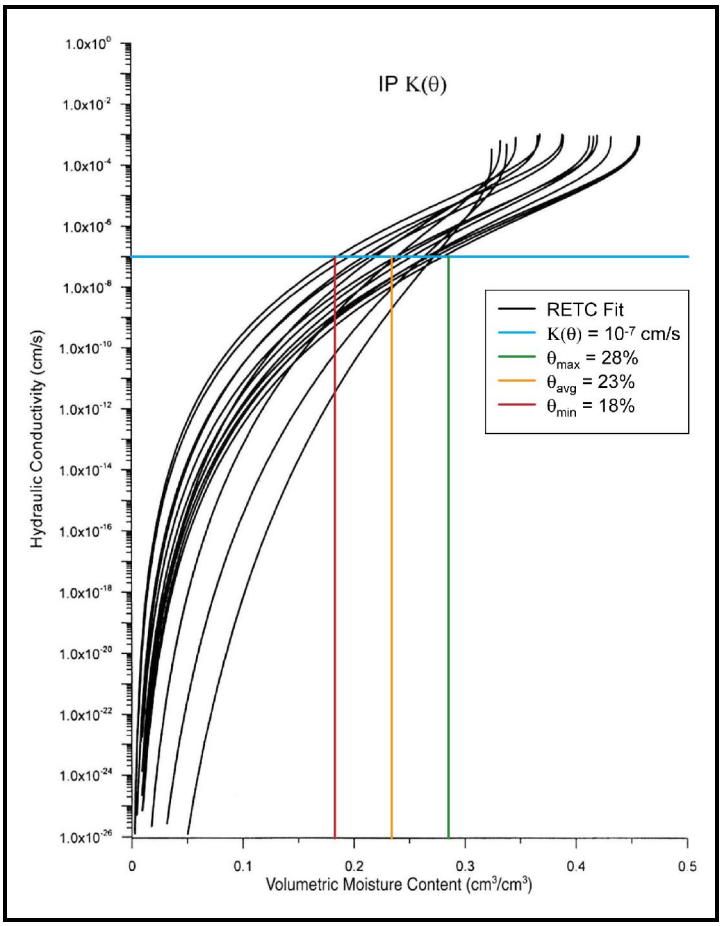

Figure 27. Hydraulic conductivity as a function of volumetric moisture content for different soil samples at the site

The recommended trigger level is the moisture content which corresponds to an unsaturated hydraulic conductivity equal to the EPA-prescribed technical equivalence criteria of 10^{-7} cm/s (31.5 mm/yr). The moisture content at which this occurs is 23 percent by volume, and the proposed trigger level for moisture content in the vadose zone is, therefore, 23 percent by volume. This value is based arbitrarily on the EPA-prescribed technical equivalence criteria, and does not necessarily indicate that hazardous constituents or radionuclides are migrating from the landfill.

The 23-percent trigger is proposed for linear depths of 10 ft and 100 ft (vertical depths of 8.7 ft to 86.6 ft) along the neutron probe access holes in the vadose zone beneath the MWL. This interval is proposed as the "regulated interval" because it lies beneath the root zone, and yet is shallow enough that a response would be detected fairly rapidly if there is a significant increase in infiltration through the cover. Should this 23-percent trigger level be exceeded in the regulated interval, then the process shown in Figure 25 will be implemented. Additional details regarding vadose zone monitoring at the MWL will be presented in the MWL Long Term Monitoring and Maintenance Plan.

4.2.3 Groundwater Monitoring Triggers

Based on the results of the probabilistic performance-assessment modeling, monitoring triggers are proposed for uranium and VOCs in groundwater at the MWL. These proposed triggers are discussed below.

4.2.3.1 Uranium

Uranium occurs naturally in MWL groundwater at concentrations ranging from 1.34 to 9.23 μg/L, and averaging 5.97 μg/L. Total uranium concentrations in groundwater beneath the MWL are well within the total uranium ranges established by the United States Geological Survey (USGS) for the Middle Rio Grande Basin (USGS, 2002). Isotopic analyses of uranium have demonstrated that it is of natural origin (Goering et al., 2002).

The probabilistic performance-assessment modeling for the MWL indicates that there is a possibility that uranium will reach the groundwater (although none of the simulations showed the uranium concentrations exceeding the regulatory metric of 30 μg/L). For this reason, a monitoring trigger of 15 μg/L (1/2 of the EPA MCL) is proposed for uranium in MWL groundwater at the point of compliance. The proposed point of compliance is at the downgradient monitoring wells. Should the uranium trigger value be exceeded in MWL groundwater at the point of compliance, then the trigger evaluation process shown in Figure 25 will be implemented. Additional details regarding long-term monitoring of uranium in groundwater will be presented in the MWL Long Term Monitoring and Maintenance Plan.

4.2.3.2 Volatile Organic Compound Triggers for Groundwater

Groundwater monitoring for VOCs at the MWL has been conducted for sixteen years, since September 1990, and there is no evidence that wastes from the MWL have contaminated groundwater. However, earlier studies as well as the current probabilistic performance-assessment modeling have shown that there is a potential for VOCs to contaminate groundwater at the MWL.

The potential downward vertical transport of six organic compounds to groundwater by both aqueous-phase transport and vapor-phase transport was evaluated in 1995 (Klavetter, 1995). The study showed that PCE could eventually migrate to groundwater through vapor-phase transport. Although the modeling predicted that the most likely PCE concentrations in groundwater would be considerably lower than the detection limit of 0.5 ppb, sensitivity analyses suggested that PCE concentrations could potentially reach 1 to 5 ppb within 50 years (Klavetter, 1995a).

The current probabilistic performance-assessment modeling also simulated the migration of PCE to groundwater and arrived at similar conclusions regarding the potential contamination of groundwater by PCE through vapor-phase transport. Because PCE was modeled in this study as a proxy for other VOCs detected in soil gas and in soils beneath the MWL, there is a potential for other VOCs from the MWL to also migrate to groundwater in the future. For this reason, continued groundwater monitoring for VOCs at the MWL is recommended.

Groundwater trigger levels are proposed for all Target Compound List VOCs for which there are primary EPA MCLs, or for which there are EPA Region 6 Human Health Medium-Specific Screening Levels. The proposed groundwater trigger levels for VOCs with MCLs are equal to ½ of the EPA MCLs; concentrations of VOCs with no corresponding MCLs will be compared to the EPA Region 6 Human Health Medium-Specific Screening Levels.

The proposed point of compliance is the downgradient monitoring wells. Should any VOC trigger values be exceeded in MWL groundwater at the point of compliance, then the trigger evaluation process shown in Figure 25 will be implemented. Additional details regarding long-term monitoring of VOCs in groundwater will be presented in the MWL Long Term Monitoring and Maintenance Plan.

4.3 Summary of Recommended Triggers

Based on the results of the probabilistic performance-assessment modeling conducted for the MWL, monitoring triggers have been proposed for the air, surface soil, vadose zone, and groundwater at the MWL. Specific triggers include numerical thresholds for (1) radon concentrations in the air, (2) tritium, gamma-emitting radionuclides, and heavy metal concentrations in surface soil, (3) VOC concentrations and moisture content in the vadose zone, and (4) uranium and VOC concentrations in groundwater. The proposed triggers are based on EPA, DOE and NMED regulatory standards, as well as on NMED maximum background concentrations for select radionuclides. If a trigger is exceeded, then SNL/DOE will initiate a trigger evaluation process which will allow sufficient data to be collected to assess trends and recommend corrective action, if necessary.

By utilizing these triggers during long-term monitoring at the MWL, SNL/DOE will ensure that the MWL remedy continues to protect human health and the environment, while meeting the performance objectives for the cover and the corrective action objectives established in the MWL Corrective Measures Study.

5. Summary and Conclusions

A probabilistic performance assessment has been conducted to evaluate the fate and transport of contaminants of concern at the Mixed Waste Landfill. The contaminants that were simulated include radionuclides (amercium-241, cesium-137, cobalt-60, plutonium-238, plutonium-239, radium-226, radon-222, strontium-90, thorium-232, tritium, and uranium-238), heavy metals (lead and cadmium), and a volatile organic compound (PCE). The current analysis differs from previous analyses in several ways: (1) probabilistic analyses[5] were performed to quantify uncertainties inherent in the system and models; (2) a comprehensive analysis of the performance of the MWL was evaluated and compared against relevant regulatory metrics; (3) sensitivity analyses were performed to identify parameters and processes that were most important to the simulated performance metrics; and (4) long-term monitoring requirements and

[5] One hundred realizations were used in the probabilistic analyses. A preliminary comparison between the results of 100 vs. 200 realizations revealed that the output distribution was adequately represented by 100 realizations.

triggers were recommended based on the results of the quantified uncertainty and sensitivity analyses. The key results of this study are summarized below:

Infiltration through the Cover:

- Net infiltration through the engineered cover at the MWL was simulated to be less than the regulatory metric of 10^{-7} cm/s for all conditions and scenarios.

- Predicted average infiltration rates through the MWL cover are expected to range from 1.18×10^{-9} cm/s for present conditions to 6.12×10^{-9} cm/s for future conditions. These values were used in a uniform distribution for the performance-assessment simulations.

- To ensure that future infiltration rates will not exceed the regulatory metric of 10^{-7} cm/s, the moisture content of the vadose zone will be monitored. Based on the site-specific two-phase characteristic curves of the soil, a moisture content of 23 percent by volume will be used as a trigger to indicate if the infiltration metric is exceeded.

Release of Radionuclides to the Atmosphere:

- A small percentage (2%) of the simulated dose due to exposure to tritium via the air pathway exceeded the regulatory metric of 10 mrem/year.

- Parameters impacting tritium diffusion through both the liquid and gas phases (e.g., tortuosity coefficient, moisture content, cover thickness, atmospheric boundary-layer thickness) were found to be important to the simulated inhalation dose.

- Sensitivity studies show that the emanation factor, which depends on the integrity of the radium-226 containment, is important to the performance of the landfill with regard to surface radon fluxes.

- For a maximum radon emanation factor of 0.01 (1% of the radium-226 containers fail), the simulated radon surface fluxes exceed the design standard of 20 $pCi/m^2/s$ in about 3% of the realizations. For a maximum radon emanation factor of 1 (100% of the radium-226 containers fail), the simulated radon surface fluxes exceed the design standard in about 30% of the realizations.

- Based on these results, both radon and tritium concentrations are recommended to be monitored at the surface of the MWL in the future. In addition, other radionuclides that may be brought to the surface by burrowing animals or insects are also proposed to be monitored. Specific triggers are identified in Table 6.

Release of Radionuclides to the Groundwater:

- None of the radionuclides were simulated to reach the groundwater within 1,000 years for all realizations.

- Only uranium-238 (and some of its decay products) were simulated to reach the water table for extended periods (>10,000 years). All peak aquifer concentrations were still less than the EPA regulatory metric of 30 μg/L.

- Infiltration rate was found to be the most significant parameter impacting the variability in the simulated groundwater concentrations and dose via groundwater. Uranium groundwater concentrations were simulated to exceed the regulatory metric of 30 μg/L if the infiltration increased two orders of magnitude above the maximum stochastic value to 6.12×10^{-9} m/s.

- Uranium in the groundwater will be monitored in the future and a trigger value of 15 μg/L, equal to ½ of the U.S. EPA maximum contaminant level in drinking water, is proposed.

Release of Heavy Metals to the Groundwater:

- Neither lead nor cadmium were simulated to reach the groundwater in 1,000 years (or extended periods past 10,000 years)

- Additional increases in infiltration (3-4 orders of magnitude over expected maximum infiltration rates) allowed cadmium and lead to reach the groundwater in 1,000 years.

- No triggers are recommended for lead or cadmium in groundwater at this time. However, heavy metals are proposed to be monitored in surface soils to account for transport by burrowing animals or instects (see Table 6).

Release of VOCs to the Groundwater:

- Only 1% of the realizations yielded peak PCE concentrations in the groundwater that exceeded the regulatory metric of 5 μg/L. The majority of the realizations showed that the peak PCE groundwater concentration occurred within 100 years.

- Uncertainty in the PCE adsorption coefficient, half-life (degradation), inventory concentration, source thickness, and cover thickness were found to be significantly correlated to the simulated groundwater concentrations.

- Based on these results, PCE and other volatile organic compounds are recommended to be monitored in the vadose zone and in groundwater at the MWL in the future (see Table 6). Trigger values for the soil gas in the vadose zone will be 20 ppmv for TCE and PCE, and 25 ppmv for total VOCs. Trigger values in groundwater will be based on values equal to ½ of the U.S. EPA maximum contaminant levels in drinking water. Concentrations of VOCs with no corresponding MCLs will be compared to the EPA Region 6 Human Health Medium-Specific Screening Levels.

Key Assumptions:

- Receptor located adjacent to MWL
    - Tritium dose caused by continuous inhalation and exposure of tritium flux directly above MWL.
    - Groundwater dose calculated based on concentrations in aquifer directly beneath MWL. Water intake assumed to be 10 L/day (five times EPA standard of 2 L/day for drinking water).
- Maximum waste inventory set equal to twice estimated values based on historical records.
- Sealed sources of radium-226 allowed to degrade in 1,000 years (emanation factor for radon-222 allowed to increase).
- Cover allowed to completely erode in 1,000 years.
- 1-D model: yields maximum transport to surface and groundwater.
- Bounding tortuosity coefficients: yields maximum diffusion rates.

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7. Appendix A: Derivation of a Steady-State Gas and Liquid-Phase Radon Transport Model

A steady-state radon transport model is derived here to account for advection in the liquid phase, diffusion in both the liquid and gas phases, and decay of radon-222. Because radium-226, which is the source of radon-222, has a half-life of 1,600 years, we assume steady-state conditions (e.g., the source of radon-222 is constant and the resulting long-term radon-222 concentration profile does not change with time). Assuming steady-state conditions is conservative because the radon-222 concentration profile is assumed to develop instantaneously.

We define three regions in the model: (1) a clean overburden (or cover) free of radium-226 that extends to a depth, L_1, beneath the surface; (2) a contaminated source zone of radium-226 that extends to a depth, L_2, from the surface; and (3) a vadose zone free of radium-226 that extends a distance, L_3, to the water table (see Figure 28). The radon-222 generated by the radium-226 is free to diffuse and advect upward to the atmosphere and downward toward the water table. Downward liquid advection also carries aqueous-phase radon toward the water table. Partitioning of radon between the gas and liquid phases is assumed to occur instantaneously and can be described by a liquid/gas partitioning coefficient, k (this is the inverse of Henry's constant, K_H). The steady-state governing equations for the transport of radon-222 in these two regions is as follows:

$$D_{eff}^{(1)} \frac{d^2 C_g^{(1)}}{dx^2} - kq \frac{dC_g^{(1)}}{dx} - \lambda C_g^{(1)} \left(\theta_g^{(1)} + k\theta_w^{(1)} \right) = 0 \tag{1}$$

$$D_{eff}^{(2)} \frac{d^2 C_g^{(2)}}{dx^2} - kq \frac{dC_g^{(2)}}{dx} - \lambda C_g^{(2)} \left(\theta_g^{(2)} + k\theta_w^{(2)} \right) + \dot{Q} = 0 \tag{2}$$

$$D_{eff}^{(3)} \frac{d^2 C_g^{(3)}}{dx^2} - kq \frac{dC_g^{(3)}}{dx} - \lambda C_g^{(3)} \left(\theta_g^{(3)} + k\theta_w^{(3)} \right) = 0 \tag{3}$$

where

$$D_{eff} = \frac{0.07}{10^4} e^{\left[-4\left(S_l - S_l\phi^2 + S_l^5\right)\right]} \tag{4}$$

$$\dot{Q} = \frac{E \; Ci_{226}}{SA_{226} 1000} \frac{\lambda_{226}}{V} \tag{5}$$

where the superscripts (1), (2), and (3) denote the three regions shown in Figure 28, C_g is the radon gas-phase concentration [kg/m^3], x is the distance from the surface [m] (positive downward), D_{eff} is the effective diffusion coefficient [m^2/s] for combined gas and aqueous phases (Rogers et al., 1984), S_l is the liquid saturation [-], k is the water/gas partitioning coefficient (i.e., water concentration/gas concentration) [-], q is the Darcy infiltration rate [m/s], λ is the decay

coefficient for radon-222 and is calculated as ln(2)/half-life [1/s], θ_g and θ_w are the gas and moisture volumetric contents, respectively, $\dot{Q}$ is the volumetric generation rate of radon-222 [kg/m^3/s], E is the emanation factor for radon-222 that accounts for containment of the radium-226 (0 = complete containment; 1 = no containment), Ci_{226} is the concentration of radium-226 in curies, SA_{226} is the specific activity of radium-226 [Ci/g], λ_{226} is the decay coefficient for radium-226 [1/s], and V is the total volume of the contaminated waste zone (region 2). In this derivation, we assume local equilibrium between the gas and aqueous phases; therefore, the equation can be expressed entirely in terms of the gas concentration, C_g, and the partitioning coefficient, k, is used to convert between the gas concentration and aqueous concentration.

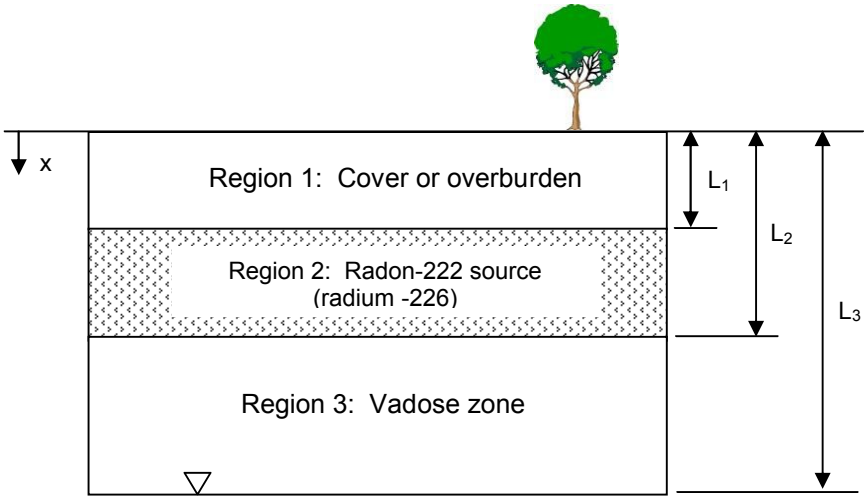

Figure 28. Conceptual model of three-region radon-transport model.

The boundary conditions for this system are as follows: (1) the radon concentration at the surface in region 1 is zero (this is conservative because it creates the largest gradient for radon flux to the atmosphere); (2) the radon concentration in region 1 is equal to the radon concentration in region 2 at the interface of regions 1 and 2; (3) the radon flux in region 1 reaching the interface between regions 1 and 2 must be equal to the radon flux entering region 2; (4) the radon concentration in region 2 is equal to the radon concentration in region 3 at the interface of regions 2 and 3; (5) the radon flux in region 2 reaching the interface between regions 2 and 3 must be equal to the radon flux entering region 3; and (6) the radon concentration infinitely far away from the source (as $x \rightarrow \infty$) goes to zero. These boundary conditions can be expressed as follows:

$$C_g^{(1)}(x=0) = 0 \tag{6}$$

$$\begin{aligned} C_g^{(1)}(x=L_s) &= C_g^{(2)}(x=L_s) \\ C_w^{(1)}(x=L_s) &= C_w^{(2)}(x=L_s) \end{aligned} \tag{7}$$

$$D_{eff}^{(1)} \left. \frac{dC_g^{(1)}}{dx} \right|_{x=L_s} = D_{eff}^{(2)} \left. \frac{dC_g^{(2)}}{dx} \right|_{x=L_s} \tag{8}$$

$$\begin{aligned} C_g^{(2)}(x = L_s) &= C_g^{(3)}(x = L_s) \\ C_w^{(2)}(x = L_s) &= C_w^{(3)}(x = L_s) \end{aligned} \tag{9}$$

$$D_{eff}^{(2)} \left. \frac{dC_g^{(2)}}{dx} \right|_{x=L_s} = D_{eff}^{(3)} \left. \frac{dC_g^{(3)}}{dx} \right|_{x=L_s} \tag{10}$$

$$C_g^{(3)}(x \to \infty) = 0 \tag{11}$$

If we assume that the soil properties and hydrologic conditions are the same in all three regions, the solutions to the ordinary differential equations (1) - (3) for the three regions can be expressed as follows:

$$C_g^{(1)} = c_1 e^{r_1 x} + c_2 e^{r_2 x} \tag{12}$$

$$C_g^{(2)} = c_3 e^{r_1 x} + c_4 e^{r_2 x} + Q_{source} \tag{13}$$

$$C_g^{(3)} = c_5 e^{r_1 x} + c_6 e^{r_2 x} \tag{14}$$

where

$$c_1 = -c_2 \tag{15}$$

$$c_2 = \frac{c_3 e^{r_1 L_1} \left(r_1 - r_2 \right) - r_2 Q_{source}}{e^{r_1 L_1} \left(r_2 - r_1 \right)} \tag{16}$$

$$c_3 = \frac{r_2 Q_{source}}{e^{r_1 L_2} \left(r_1 - r_2 \right)} \tag{17}$$

$$c_4 = \frac{c_2 \left(e^{r_2 L_1} - e^{r_1 L_1} \right) - c_3 e^{r_1 L_1} - Q_{source}}{e^{r_2 L_1}} \tag{18}$$

$$c_5 = 0 \tag{19}$$

$$c_6 = \frac{c_3 e^{r_1 L_2} + c_4 e^{r_2 L_2} Q_{source}}{e^{r_2 L_2}} \tag{20}$$

$$r_1 = \frac{kq + \sqrt{(kq)^2 + 4D_{eff}\lambda_{eff}}}{2D_{eff}} \tag{21}$$

$$r_2 = \frac{kq - \sqrt{(kq)^2 + 4D_{eff}\lambda_{eff}}}{2D_{eff}} \tag{22}$$

$$\lambda_{eff} = \lambda\left(\theta_g + k\theta_w\right) \tag{23}$$

$$Q_{source} = \frac{\dot{Q}}{\lambda_{eff}} \tag{24}$$

Equations (12) - (24) yield the solutions for the gas concentrations in the three regions defined in Figure 28. The aqueous concentration can be obtained by multiplying the gas concentration at any location by the liquid/gas partition coefficient, *k*. The groundwater concentration at the interface of the vadose zone and the water table, $C_w^{(3)}(L_3)$, can be expressed as follows:

$$C_w^{(3)}(L_3) = k\, C_g^{(3)}(L_3) \tag{25}$$

The upward flux of radon-222 gas at the surface, q_s [kg/m^2/s] can be determined by evaluating the gas-phase concentration gradient at the surface (region 1) using Fick's Law:

$$q_s = -\left(-D_{eff} \left. \frac{dC_g^{(1)}}{dx} \right|_{x=0} \right) = D_{eff} c_2 (r_2 - r_1) \tag{26}$$

The negative sign preceding the term in parentheses is to account for the positive downward direction of *x*. Equation (26) is used to estimate the radon gas flux at the surface in the performance assessment, and Equation (25) is used to determine the radon groundwater concentration. The concentration and flux of radon can be converted to pCi/L and pCi/m^2/s using the specific activity of radon (see Table 2) and appropriate unit conversions.

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Volume I

TAB 5

Notice of Public Comment Period for Mixed Waste Landfill

Corrective Measures Implementation Work Plan, November 2005

(Including Fate and Transport Model)

From: NMED/Kieling
To: Interested Citizen

Back of Tab 5

State of New Mexico
ENVIRONMENT DEPARTMENT
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Telephone (505) 428-2500
Fax (505) 428-2567
www.nmenv.state.nm.us

BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

DERRITH WATCHMAN-MOORE
DEPUTY SECRETARY

December 9, 2005

SUBJECT: NOTICE OF PUBLIC COMMENT PERIOD FOR SANDIA NATIONAL LABORATORIES' MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN (INCLUDING FATE AND TRANSPORT MODEL)

Dear Interested Citizen:

Enclosed is a **Public Notice** regarding the U. S. Department of Energy (DOE)/Sandia Corporation's (Permittees) Corrective Measures Implementation (CMI) Work Plan for the Sandia National Laboratories (SNL) Mixed Waste Landfill (MWL). The CMI Work Plan includes the results of a fate and transport model that predicts the future movement of contaminants at the MWL.

The DOE is owner, and with Sandia Corporation, co-operator of SNL. The Permittees are located at the following addresses: SNL, 1515 Eubank SE, Albuquerque, NM, 87123; and NNSA/DOE, Sandia Site Office, KAFB-East, Pennsylvania & H Street, Albuquerque, NM 87116.

The enclosed Public Notice provides locations where the CMI Work Plan and the associated fate and transport model may be reviewed by any member of the public. Comments on the CMI will be received through **5:00 p.m.** on **February 7, 2006**.

Any person seeking additional information may contact:

Mr. William Moats
New Mexico Environment Department
C/O Sandia National Laboratories
P. O. Box 5800/MS 1089
Albuquerque, NM 87185
E-mail: wpmoats@sandia.gov
Telephone: (505) 284-5086
Fax: (505) 284-2616

Mr. John E. Kieling
Program Manager
New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Dr. East, Bldg 1
Santa Fe, NM 87505
E-mail: john.kieling@state.nm.us

Sincerely,

John E. Kieling
Manager
Permits Management Program

State of New Mexico
ENVIRONMENT DEPARTMENT
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
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BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

DERRITH WATCHMAN-MOORE
DEPUTY SECRETARY

PUBLIC NOTICE NO. 05-18

NEW MEXICO ENVIRONMENT DEPARTMENT
HAZARDOUS WASTE BUREAU
SANTA FE, NEW MEXICO
December 9, 2005

NOTICE OF PUBLIC COMMENT PERIOD FOR SANDIA NATIONAL LABORATORIES MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN (INCLUDING FATE AND TRANSPORT MODEL)

The federal Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §§ 6901 to 6992(k), provides for the regulation of hazardous waste. Congress waived the immunity of the United States for actions brought under state hazardous and solid waste laws as well as under RCRA. Pursuant to Section 3006 of RCRA, 42 U.S.C § 6926, the U.S. Environmental Protection Agency (EPA) delegated to the New Mexico Environment Department (NMED), on April 16, 1985 by delegation numbers 8-31 and 8-32, the authority to enforce the Hazardous Waste Act (HWA) and its implementing regulations, the New Mexico Hazardous Waste Management Regulations (HWMR), 20.4.1 NMAC, in lieu of EPA enforcement through RCRA. NMED has maintained its delegation from EPA over hazardous waste management in New Mexico and from time to time has amended its state program to conform to statutory or regulatory changes in RCRA. The HWMR require corrective action at solid waste management units (SWMUs) where releases of hazardous waste or hazardous constituents have or may have occurred.

The U. S. Department of Energy, owner and operator, and Sandia Corporation, co-operator, (hereinafter referred to as the Permitees) have been issued a RCRA Permit for the Sandia National Laboratories (SNL) Facility, located in Bernalillo County, New Mexico, EPA ID# NM5890110518. The Permittees must comply with the HWA, the HWMR, and the SNL RCRA Permit and must conduct corrective action as necessary to protect human health and the environment.

On May 26, 2005, the NMED Secretary approved a final permit and ordered a final remedy for SNL's Mixed Waste Landfill. As part of these actions, the Permittees were required to submit to the NMED a Corrective Measures Implementation (CMI) Work Plan, which is to include a fate and transport model predicting the future movement of contaminants. The CMI Work Plan was submitted to the NMED on November 3, 2005 and includes a fate and transport model. Pursuant to the Secretary's order, the NMED is seeking public comment on the CMI Work Plan prior to making a final decision on whether to approve the plan.

LOCATION OF THE SNL FACILTY AND THE MWL

The Permittees are located at the following addresses: SNL, 1515 Eubank SE, Albuquerque, NM, 87123; and NNSA/DOE, Sandia Site Office, KAFB-East, Pennsylvania & H Street, Albuquerque, NM 87116. The Permittee's primary contact for this action is Mr. John Gould, NNSA/Sandia Site Office, DOE, at P.O. Box 5400, Albuquerque, NM 87185.

SNL is located within the boundaries of Kirtland Air Force Base (KAFB), south of Albuquerque in Bernalillo County, New Mexico. KAFB occupies 52,233 acres. SNL research and administration facilities occupy 2,842 acres and are divided into five Technical Areas (TAs), (designated 1 through 5) and several test areas. TA-1, TA-2, and TA-4 are separate research facilities in the north-central portion of KAFB. TA-3 and TA-5 are contiguous research facilities forming a 4.5-square-mile rectangular area in the southwestern portion of KAFB. TA-3 alone encompasses 2,000 acres.

The Mixed Waste Landfill (MWL) is located approximately 5 miles southeast of the Albuquerque International Sunport and 4 miles south of TA-1. The landfill occupies 2.6 acres in the north-central portion of TA-3.

FACILITY OPERATIONS

SNL, in operation since 1945, is engaged in research and development of conventional and nuclear weapons, alternative energy sources, and a wide variety of national security related research and development. As a result of these activities, SNL has generated hazardous, radioactive, mixed (those wastes containing both hazardous and radioactive components), and solid wastes. From 1945 to 1988 most of these wastes were disposed of at SNL at numerous locations, which have been classified by the NMED as Solid Waste Management Units (SWMUs) or Areas of Concern (AOCs). The SWMUs and AOCs include unpermitted landfills, septic-system drainfields and seepage pits, outfalls, waste piles, and test areas. Past waste management activities at SNL have caused the release of hazardous and radioactive contaminants into the environment. The Mixed Waste Landfill is classified as SWMU 76.

DESCRIPTION AND HISTORY OF THE MIXED WASTE LANDFILL

The MWL was opened as the "TA-3 low-level radioactive waste dump" in March 1959. The MWL accepted low-level radioactive waste and mixed waste from SNL research facilities and off-site generators from March 1959 to December 1988. Approximately 100,000 cubic feet of radioactive waste containing 6,300 curies (Ci) of activity (at the time of disposal) were disposed of at the MWL in unlined trenches and pits.

Investigations at the landfill indicate that tritium is the primary contaminant that has been released from the landfill. Results of a risk assessment prepared by the Permittees indicate that releases of contaminants from the MWL pose little risk to human health or the environment under an industrial land use scenario. Tritium activities at the MWL will decrease steadily with time due to its relatively short half-life of 12.3 years. Because of tritium's short half-life and in consideration of current activity levels, the NMED does not believe that tritium releases at the MWL pose a threat to groundwater, human health, or the environment.

REGULATORY BACKGROUND

NMED issued a RCRA Permit for storage of hazardous waste at SNL on August 6, 1992. On February 6, 2002, the Permittees applied to the NMED to renew their RCRA permit (the current Permit remains in effect until a final decision is made on the renewal request). On October 11, 2001, the NMED directed the Permittees to conduct a Corrective Measures Study (CMS) for the MWL because of concerns raised by the public. The CMS Work Plan was approved with conditions by the NMED on October 10, 2002.

After approval of the CMS Work Plan, the CMS was conducted by the Permittees to identify, develop, and evaluate corrective measures alternatives and to recommend a final remedy to be taken at the MWL. The results of the CMS were documented in a CMS Report following completion of the study; the report was transmitted to the NMED on May 21, 2003. The CMS Report was deemed complete by the NMED on January 5, 2004.

On January 23, 2004, the Permittees proposed a Class 3 modification of the SNL RCRA Permit, requesting that the NMED select a final remedy for the MWL. As part of a 60-day public notice and comment period initiated by the Permittees, a public meeting was held on February 26, 2004 in Albuquerque, New Mexico. Following completion of the Permittees public comment period, the NMED issued a public notice and began a public comment period starting August 11, 2004.

A public hearing on the selection of a final remedy for the MWL was held on December 2-3 and 8-9, 2005 in Albuquerque. The NMED public comment period was held from August 11, 2004 to December 2, 2004, and extended until December 9, 2004. Based on the administrative record and the Hearing Officer's Report, on May 26, 2005, the NMED Secretary approved a final permit and ordered a final remedy for SNL's Mixed Waste Landfill, selecting a vegetative soil cover with bio-intrusion barrier as the final remedy. In addition to selection of the final remedy, the final permit decision requires, among other deliverables, a CMI Work Plan. The CMI Work Plan must address the following:

a. A description of the selected remedy;
b. A description of the remediation system objectives;
c. An identification and description of the qualifications of key persons, consultants, and contractors that will be implementing the remedy;
d. Detailed engineering design drawings and systems specifications for all elements of the remedy;
e. A construction and construction quality assurance work plan;
f. An operation and maintenance plan;
g. The results of any remedy pilot tests, such as landfill cover test plots;
h. A schedule for submission to the Administrative Authority of periodic progress reports;
i. A schedule for implementation of the remedy;
j. A health and safety plan;
k. A comprehensive fate and transport model that studies and predicts future movement of contaminants in the landfill and whether they will eventually move further down the vadose zone and/or to groundwater; and
l. Triggers for future action that identify and detail specific monitoring results that will require additional testing or the implementation of an additional or different remedy.

The Secretary's order requires that the NMED review, consider and respond to public comments prior to

approving certain documents related to the MWL, including the CMI Work Plan. The purpose of this public notice is for the NMED to solicit such public comment on the CMI Work Plan, including the fate and transport model.

PUBLIC REVIEW OF THE CORRECTIVE MEASURES WORK PLAN

The CMI Work Plan (including the fate and transport model) may be reviewed by any member of the public at the following locations during the public comment period:

NMED – Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
(505) 428-2500
Monday - Friday from 8:00 a.m. to 5:00 p.m.

NMED-District 1 Albuquerque Office
5500 San Antonio NE
Albuquerque, New Mexico 87109
(505) 222-9500
Monday - Friday from 8:00 a.m. to 5:00 p.m.

The CMI Work Plan, including the fate and transport model (as Appendix E), are also available electronically on the NMED website at: http://www.nmenv.state.nm.us/HWB/snlperm.html under Mixed Waste Landfill. A separate report, *SAND 2005-6888*, entitled *Probabilistic Performance-Assessment Modeling of the Mixed Waste Landfill at Sandia National Laboratories*" is also included on the web page and contains much of the same information as that in Appendix E of the CMI Work Plan. Although the *SAND 2005-6888* report is included on the web page for convenience, the NMED is only seeking public comment on the CMI Work Plan, including Appendix E and all of the other appendices.

To obtain a copy of the CMI Work Plan or a portion thereof, in addition to further information, please contact Ms. Pam Allen at (505) 428-2500, or at the Santa Fe address given above. NMED will provide copies, or portions thereof, at a charge to the requester.

NMED issues this public notice on **December 9, 2005,** to announce the beginning of a 60-day comment period that will end at **5:00 p.m., February 7, 2006**. Any person who wishes to comment should submit written or electronic mail (e-mail) comment(s) with the commenter's name and address to the respective address below. Only comments received on or before **5:00 p.m., February 7, 2006** will be considered.

John E. Kieling, Program Manager
Hazardous Waste Bureau - New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303
Ref: Sandia National Laboratories – MWL CMI Work Plan
E-mail: john.kieling@state.nm.us

Written comments must be based on the MWL CMI Work Plan (including the fate and transport model).

The NMED must ensure that the approved CMI Work Plan will be consistent with the New Mexico Hazardous Waste Management Regulations. All written comments submitted will become part of the administrative record, will be considered in formulating a final decision, and may cause the CMI Work Plan to be modified. NMED will respond in writing to all significant public comment. The response will

specify which provisions, if any, of the CMI Work Plan have been changed in the final decision, and the reasons for the change. This response will also be posted on the NMED website in addition to NMED notifying all persons providing written comments.

After consideration of all written public comments received, NMED will approve, or approve with modifications the CMI Work Plan. If NMED modifies the CMI Work Plan, the Permittees shall be provided by mail a copy of the modified CMI Work Plan and a detailed written statement of reasons for the modifications. The NMED will make the final decision publicly available and shall notify the Permittees by certified mail. All persons on the mailing list, or that provided written comments, or who requested notification in writing, will be notified of the final decision by mail.

The final decision will become effective immediately upon service of the decision to the Permittees, unless a later date is specified.

ARRANGEMENTS FOR PERSONS WITH DISABILITIES

Any person with a disability requiring assistance or auxiliary aid to participate in this process should contact Judy Bentley by 10 days prior to the end of the public comment period at the following address: New Mexico Environment Department, Room N-4030, P.O. Box 26110, 1190 St. Francis Drive, Santa Fe, New Mexico 87502-6110, (505) 827-9872. TDD or TDY users please access Ms. Bentley's number via the New Mexico Relay Network at 1-800-659-8331.

Volume I

TAB 6

Response to Public Comments Regarding The Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005

From: SNL/Wagner
To: NMED/Bearzi

Back of Tab 6

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

APR 2 4 2006

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Rd. East, Building 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

On behalf of the Department of Energy (DOE) and Sandia Corporation (Sandia), DOE is submitting responses to public comments received by the New Mexico Environment Department (NMED) regarding the Mixed Waste Landfill (MWL) Corrective Measures Implementation (CMI) Plan. The public comments on the MWL CMI Plan were submitted to NMED during the 60-day public comment period, which ended on February 7, 2006. These responses to the public comments were informally requested by NMED on February 28, 2006.

Enclosed please find two documents containing our response. Enclosure 1, entitled "SNL Responses to Public Comments on the Mixed Waste Landfill Corrective Measures Implementation Plan", briefly summarizes the various public comments, and provides Sandia's responses. Enclosure 2, entitled "SNL Responses to Citizen Action Comments", includes more detailed responses to the fairly extensive comments submitted by Citizen Action.

If you have any questions, please contact me at (505)845-6036 or John Gould, (505) 845-6089, of my staff.

Sincerely,

Kimberly A Davis

Patty Wagner for
Manager

Enclosures (2)

cc w/enclosures:
W. Moats, NMED (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
J. Volkerding, NMED-OB

cc w/o enclosures:
M. Martin, NNSA/NA-56
A. Blumberg, SNL/NM, Org. 11100, MS 0141
F. Nimick, SNL/NM, Org. 6140, MS 1089
P. Freshour, SNL/NM, Org. 6140, MS 1089
R. E. Fate, SNL/NM, Org. 6147, MS 1089
J. Peace, SNL/NM, Org. 1525, MS 0372
T. Goering, SNL/NM, Org. 6147, MS 1089
M. J. Davis, SNL/NM, Org. 6147, MS 1089
R. Finley, SNL/NM, Org. 6115, MS 0735
C. Ho, SNL/NM, Org. 6115, MS 0735
J. Estrada, NNSA/SSO, MS 0184

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **SNL Responses to Public Comments and Citizen Action Comments on the Mixed Waste Landfill Corrective Measures Implementation Plan, April 2006**

Document authors: **Cliff Ho, Dept. 6115 and Tim Goering, Dept. 6147**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 4/20/06

Peter B. Davies
Director
Geoscience & Environment Center
Division 6100
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

Date

and

Signature: _____ for 4/21/06

Patty Wagner
Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Date

SNL RESPONSE TO PUBLIC COMMENTS AND CITIZEN ACTION COMMENTS ON THE MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION PLAN

April 20, 2006

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.

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SNL RESPONSE TO PUBLIC COMMENTS AND CITIZEN ACTION COMMENTS ON THE MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION PLAN

April 20, 2006

INTRODUCTION

On May 26 2005, the Secretary of the New Mexico Environment Department (NMED) approved a remedy and a Class 3 permit modification request for corrective measures for the Mixed Waste Landfill at Sandia National Laboratories, New Mexico (NMED, 2005). As part of their decision, the NMED required that the Department of Energy (DOE) and Sandia Corporation (Sandia) prepare, for NMED review and public comment, a Corrective Measures Implementation (CMI) Plan, which included a Fate and Transport Model for the MWL. The CMI Plan was prepared in the Fall of 2005, and NMED established a public comment period which ended February 7, 2006. A number of parties submitted comments, including an extensive set of comments from Citizens Action (CA), dated February 7, 2006 (Robinson, 2006).

This document presents Sandia National Laboratories' response to the public comments received by the New Mexico Environment Department regarding the Mixed Waste Landfill Corrective Measures Implementation Plan. The first portion of this document, titled "SNL Responses to Public Comments on the Mixed Waste Landfill Corrective Measures Implementation Plan," briefly summarizes the various public comments and provides Sandia's responses. The second portion of this document, titled "SNL Responses to Citizen Action Comments on the Mixed Waste Landfill Corrective Measures Implementation Plan and Fate and Transport Model," includes more detailed responses to the fairly extensive comments submitted by Citizen Action. The original Citizen Action comments are presented in bold font, and DOE/Sandia responses are presented in italic font.

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Enclosure 1

SNL Response to Public Comments on the Mixed Waste Landfill Corrective Measures Implementation Plan

(www.nmenv.state.nm.us/hwb/snlperm_comments.htm)

Clifford K. Ho and Timothy J. Goering
Sandia National Laboratories
April 20, 2006

Some comments are paraphrased for brevity

Comment from Donna Detweiler (received 1/27/2006):

General comment regarding the "possible contamination of groundwater resulting from spread of toxins now lodged in the SNL Mixed Waste Landfill". If indeed the Fate & Transport Model is correct and this could happen in as little as 50 years, then my investments could easily be trashed, and the whole neighborhood dependent on Burton Well is likely to be only the first of many to be abandoned."

SNL Response:

Of all the contaminants of concern simulated in the performance-assessment model, only tetrachloroethylene (PCE) was predicted to reach the groundwater in 1,000 years. In those simulations that showed PCE reaching the groundwater, 70% of the runs showed that the groundwater concentration immediately beneath the landfill (no dilution) would be less than 1 microgram per liter (detectable limit). Only 1% of the runs showed that the groundwater concentration would exceed the regulatory metric of 5 micrograms per liter. Thus, the models show that the probability of "contaminating" the aquifer with concentrations large enough to pose health risks is very small. Furthermore, long-term groundwater monitoring will be conducted at the MWL. If contamination is detected in the future, the NMED may impose additional measures.

Comments from Floy J. Barrett (received 1/31/2006):

These comments replicate the comments submitted by Citizen Action. Please see the responses to the Citizen Action comments.

Comments from David M. Brugge (received 1/31/2006):

1. **In addition to intrusion and disruption by plants, animals, and insects identified by Citizen Action, other species of insects, spiders, worms, and similar invertebrates must be identified. Subsurface fungi, molds, bacteria, and related**

species (especially those that can become airborne) need to be taken into consideration. The agent that causes valley fever may be subject to mutation in the radioactive environment of the landfill.

2. **Human intrusion is a serious matter, especially in light of the potential for domestic terrorism and the creation of a "dirty bomb" at the landfill.**
3. **Just the knowledge, threat, or perception that inadequate attention to the dangers of the landfill could cause serious impact to land values for the Mesa del Sol development, as well as potential liability for the University of New Mexico and the state.**

SNL Response:

1. *The current performance-assessment model scenarios included processes and pathways considered to be the most significant and probable.*

2. *See response to #1.*

3. *SNL is responsible for adhering to the requirements of the NMED for the MWL. All the requirements ensure the protection of public health and the environment.*

Comments from Maurice A. Weisberg (received 2/5/2006):

The comments from Maurice Weisberg include a number of general observations and opinions. Specific comments relevant to the results of the performance-assessment model are addressed here:

1. **Biotransport of radioactive contaminants, including vegetative, animal, and insect uptake, is likely to occur over time.**
2. **"At the rate tritium is moving laterally and deeply through the soil, we could expect contamination of the aquifer in less than ten years."**
3. **Contaminants can move much faster through the vadose zone than predictions show, possibly because of torrential rains (episodic events).**

SNL Response:

1. *The current performance-assessment model scenarios included processes and pathways considered to be the most significant and probable. Sandia has conducted a study of the root depths and density in the vicinity of the MWL (Peace et al, November 2004), and care will be taken during long-term monitoring to prevent deep-rooting plant species from establishing themselves on the MWL cover. In addition, the rock biointrusion barrier will be constructed with the intent to prevent intrusion by burrowing animals, and it should restrict root growth so long as the underlying materials are relatively dry (Anderson and Forman, 2002).*

2. *This assertion is not supported by our studies. Our studies show that no detectable levels of tritium will reach the groundwater. Some MWL wastes have been in place now for nearly 50 years, yet groundwater is not contaminated by tritium.*

Furthermore, recently collected data indicate tritium emissions from the landfill are decreasing with time as a result of radioactive decay and other natural processes (Anderson, 2004), further reducing the potential to contaminate groundwater over time.

3. *Our models included a broad range of percolation rates based on detailed modeling studies and precipitation data spanning over 60 years, including heavy rainfall periods. In addition, future climate states were considered where the precipitation was projected to increase to twice the current values. Field evidence shows that even after heavy rainfall events, water penetrates only the upper foot or two of the soil, and is subsequently removed from the soil profile by evapotranspiration.*

Comments from Albuquerque Center for Peace and Justice and Citizens for Alternatives to Radioactive Dumping (received 2/6/2006):

These comments support the comments submitted by Citizen Action. Please see the responses to the Citizen Action comments.

SNL Response:

The triggers proposed for soil, air, the vadose zone, and groundwater are at low concentrations and are based on EPA and DOE regulatory standards. Triggers were not proposed for concentrations in plants and animals because there are no applicable regulatory standards, and their populations may vary significantly from year to year. Nevertheless, biota will be monitored to ensure that they do not provide a significant mechanism for contaminant transport.

Comments from Penelope McMullen (received 2/6/2006):

These comments replicate the comments submitted by Citizen Action. Please see the responses to the Citizen Action comments.

SNL Response:

Regarding revision of the CMI Plan, the objective of the CMI Plan was to present a detailed design of the remedy selected by the NMED for the MWL. The proposed design meets the full intent of RCRA Subtitle C regulations, which include requirements for minimizing water migration through the cover, minimizing maintenance and erosion, accommodating subsidence, and having a permeability less than or equal to that of the natural subsurface soils. The Fate and Transport model results do not show any need to modify the proposed design in the CMI Plan.

Long-term monitoring and maintenance at the MWL will be discussed in more detail in the MWL's Long-Term Monitoring and Maintenance Plan, which will be developed after implementation of the remedy.

Comments from John Tauxe (received 2/7/2006):

1. **The uncertainty distribution for the inventory of radionuclides in the MWL is undefended. It is highly unlikely that all inventory constituents share the exact same uncertainty distribution. A more thorough analysis of these distributions should be performed.**
2. **The contaminant transport modeling of the MWL lacks any contributions by biotic activity, including plant uptake and animal redistribution (e.g., ants).**
3. **Current modeling of radon-222 release to the surface assumes the parent (radium-226) remains at depth. If constituents are biotically transported to the surface, the parent of radon-222 could also be transported to the surface. More sophisticated techniques are needed to model the subsequent radon-222 release to the atmosphere.**
4. **The decay products of radon-222 (e.g., lead-210) must be accounted for in assessing dose from exposure to radionuclides involved in surface processes. Diffusing radon-222 gas will decay to lead-210 near the surface and within the cap, which will provide additional exposure to potential future receptors.**
5. **Exposures from radionuclides in the ground surface and near surface (known as "shine") should be included along with inhalation of gases and particulates and incidental ingestion of soils by potential future receptors.**
6. **A reasonable potential future receptor scenario is that of a residence built directly atop the MWL. This would trigger additional exposure pathways, such as exposure to indoor air with concentrations of gaseous radionuclides and VOCs.**
7. **The period of performance of 1,000 years may not be sufficient to model peak doses.**
8. **The future releases and decay products of PCE should be considered.**
9. **The model touts itself as being conservative in its assumptions, but this philosophy was applied inconsistently. Large infiltration rates may be conservative for the groundwater pathway, but not for surface-based exposure.**
10. **Monitoring of tritium and radon as triggers should occur directly above the MWL as opposed to on the perimeter.**
11. **The sensitivity analyses are rather *ad hoc*. Selection of the parameters for the sensitivity analyses may not have included all parameters in the model.**

SNL Response:

1. *We assumed that the minimum inventory was equal to the values recorded in SNL (1993), and that the maximum inventory was equal to twice the recorded inventory values (except for PCE, which was increased to ten times measured concentrations for calibration). Lacking any additional information regarding the uncertainty of the recorded values, we chose a uniform distribution. Comparisons between simulated soil concentrations and measured soil concentrations for tritium showed that this assumed inventory range was adequate (and even conservative) in allowing simulated concentrations to match (and even exceed) measured tritium soil concentrations. In addition, results of sensitivity analyses showed that the inventory was <u>not</u> an important parameter for mobile constituents.*

2. *The current performance-assessment model did not consider scenarios associated with intrusion, uptake, transformation, or disruption by humans, animals, plants, insects, or other biota. The scenarios that were studied included processes and pathways considered to be the most significant and probable.*

   Sandia has conducted a study of the root depths and density in the vicinity of the MWL (Peace et al, November 2004), and care will be taken during long-term monitoring to prevent deep-rooting plant species from establishing themselves on the MWL cover. In addition, the rock biointrusion barrier will be constructed with the intent to prevent intrusion by burrowing animals, and it should restrict root growth so long as the underlying materials are relatively dry (Anderson and Forman, 2002).

3. *Our probabilistic analysis already accounts for the possibility that the radium-226 source term is at the surface (with no cover). The thickness of the cover is allowed to vary between 0 and the designed value. Therefore, the simulations already include the effect of the radon-222 source term being at the surface. Results of the sensitivity analysis shows that the impact of the cover thickness is small, relative to the uncertainty in the emanation factor, which is governed by the assumed containment integrity of the sealed radium-226 sources.*

   Additionally, most of the potential source term for Rn-222 is in hermetically sealed stainless steel source capsules. The potential release of Rn-222 from these capsules was "allowed" for modeling purposes with an assumption that up to 100% of these capsules will fail, allowing their contents to be released. Even in the event of this unlikely scenario, the area-weighted average MWL contents "vulnerable to biotic CT" would be a very small fraction of the area/volume of the MWL.

4. *Decay products of Rn-222 were not considered in the model of Rn-222 transport to the surface, but the steady decay of Rn-222 was included. Accumulation and accountability of Rn-222 decay products would require a transient model, but a steady-state model was chosen to accommodate the long-lived parent products of Rn-222 and to accommodate liquid-phase advection in the analytical solution. It should be noted that the simulations of radon-222 leaching to the groundwater (using FRAMES/MEPAS) did include evaluation of the decay products.*

5. *The current performance assessment did not include exposure due to "shine" or incidental ingestion of surface soils. However, indirect ingestion of radionuclides through consumption of vegetables and animals irrigated or fed by contaminated water was accounted for by assigning a large intake of water (10 L/day).*

6. *The atmospheric-transport scenario in the current performance assessment assumed a "worst-case" scenario, where a receptor was inhaling air above the MWL 24 hours a day, 7 days a week. This is even more conservative than assuming a home on top of the MWL, where the structure would provide additional resistance to exposure.*

7. *The 1,000-year performance period was used for those constituents that peaked well before 1,000 years (e.g., tritium, PCE). For radionuclides and heavy metals, simulations were run past 10,000 years, and these results are presented in the study. For radon, steady-state simulations were assumed, which conservatively assumes the instantaneous transport of radon to the surface.*

8. *Future releases of PCE are not considered because the entire inventory of PCE is assumed to be available for release at time zero. PCE was used as a proxy for all other VOCs because of its relatively large Henry's Constant and mobility. Several decay products of PCE, including TCE and 1,1- dichloroethene, have already been proposed for long-term monitoring in groundwater, and triggers have been established for these constituents. Vinyl chloride (VC) has never been detected in soils or groundwater at the MWL.*

9. *Parameters were not conservatively estimated if they could have a confounding effect on other processes. For example, a conservative assumption was made that the receptor drinks 10 L/day of water (as opposed to the EPA-recommended 2 L/day). This was to conservatively reflect indirect ingestion from irrigated vegetation or animals. In contrast, the range of infiltration was based on past historic data and was an accurate reflection of the range we believe will occur in the future, including climate change. Another conservative assumption was that groundwater concentration at the base of the vadose zone was compared against the regulatory metric, and did not account for dilution caused by mixing within the aquifer.*

10. *The proposed locations were selected to be consistent with the last 26 years of environmental monitoring at the MWL. However, the locations for tritium and radon monitoring could certainly be placed directly on top of the MWL cover, if considered appropriate by the NMED. Specific details on long-term monitoring at the MWL, including parameters and locations, will be determined in consultation with the NMED in the MWL Long-Term Monitoring and Maintenance Plan (LTMMP). The LTMMP is scheduled to be completed after implementation of the final remedy.*

11. *All stochastic parameters used in the model were included in the sensitivity analyses. The results of the sensitivity analyses (presented in charts) only included those parameters that were found to be statistically significant.*

Comments from Citizen Action (received 2/7/2006):

The following includes an abbreviated list of comments submitted by Citizen Action regarding the fate and transport (performance-assessment) model. A separate document, Enclosure 2, entitled "SNL Responses to Citizen Action Comments", contains additional responses to the detailed comments submitted by Citizen Action..

1. The model fails to consider biological transport of contaminants.

2. **The model fails to consider human intrusion.**
3. **The model fails to consider beryllium and metallic sodium as potential contaminants of concern, among others.**
4. **The model fails to consider new compounds formed as a result of radiolysis.**
5. **The model fails to consider animals, plants and humans as "triggers."**
6. **The model fails to consider "trigger levels" for the entire inventory of contaminants in the known inventory of the landfill.**
7. **The model fails to consider conducting a risk assessment for the F & T model.**
8. **The model fails to use current data for current levels of radionuclides, heavy metals and volatile organic releases.**
9. **The model fails to consider the deterioration of waste containers.**

SNL Response:

1. *The model did not specifically address biological uptake and transport of contaminants by plants and animals. The intent of the biointrusion barrier is to prevent this occurrence. Sandia has conducted a study of the root depths and density in the vicinity of the MWL (Peace et al, November 2004), and care will be taken during long-term monitoring to prevent deep-rooting plant species from establishing themselves on the MWL cover. In addition, the intent of the rock biointrusion barrier is to prevent intrusion by burrowing animals, and it should restrict root growth so long as the underlying materials are relatively dry (Anderson and Forman, 2002). .*
2. *Human intrusion was not considered in the model as the model was necessarily limited to conservative, reasonable scenarios. For modeling purposes, we assumed that the exposed individual was located at the landfill. Inhalation and dermal exposure was assumed to occur 24/7 above the landfill. In addition, drinking water was assumed to be taken directly beneath the landfill and consumed at a rate of 10 L/day (2 L/day recommended by EPA for risk assessments).*
3. *The constituents that were modeled were chosen because of their high relative mobility and/or their large inventory. Beryllium and metallic sodium were not evaluated in the current model. Beryllium is a relatively minor component of the MWL inventory, and metallic sodium is not listed in the inventory.*
4. *Radiolysis was not considered in the current model. Radiolysis is considered unlikely at the MWL, as it is not significant in low-level radioactive waste.*
5. *Our recommended triggers include surface-concentration measurements for radon gas and tritium in soil pore water. Long-term monitoring will include monitoring of biota to ensure that they do not provide a significant mechanism for contaminant transport.*
6. *Triggers were specified for the constituents that were found to potentially exceed performance metrics. For PCE, which was a proxy for all VOCs, triggers were specified for all VOCs measured at the site since PCE was found to potentially exceed the groundwater concentration metric.*
7. *Our study does provide a risk-based performance-assessment analysis using relevant regulatory performance standards as metrics (e.g., dose, groundwater concentrations). Probabilistic, uncertainty analyses are performed to develop distributions of scenario results that are compared against the metrics. Sensitivity*

analyses are also performed to identify the most important parameters and processes that impact the simulated performance metrics. Standard conversion factors (U.S. EPA slope factors) can be used to convert dose (which is reported in our analysis) to risk of cancer incidence or fatality.

8. *The latest data that were available to evaluate concentrations of tritium and PCE at various depths beneath the MWL were from 1993. These data provided the necessary calibration for the models. Additional data will be collected during long-term monitoring of the MWL, and these data can be used to update the MWL Fate and Transport model, if necessary. Groundwater concentrations are taken much more frequently (on an annual basis), and there is no evidence of groundwater contamination from the MWL.*
9. *All of the constituents (except for radium-226, which are contained in "sealed sources") were conservatively assumed to be uncontained and available for leaching.*

REFERENCES:

Anderson, February 2004, *"Results of Tritium Emission Flux Measurements for Sandia National Laboratories Mixed Waste Landfill,"* URS Corporation, Austin, Texas.

Anderson, J.E. and A.D Forman, March 2002. *"The Protective Cap/Biobarrier Experiment. A Study of Alternative Evapotranspiration Caps for the Idaho National Engineering and Environmental Laboratory,"* prepared by Stoller for U.S. Department of Energy – Idaho Field Office Environmental Surveillance, Education and Research Program, Contract DE-AC07-00ID13658, Idaho Falls, Idaho.

Peace, J.L., P.J. Knight, T.S. Ashton, and T.J. Goering, November 2004, *"Vegetation Study in Support of the Design and Optimization of Vegetative Soil Covers, Sandia National Laboratories, Albuquerque, New Mexico,"* SAND2004-6144, Sandia National Laboratories, Albuquerque, NM.

Enclosure 2:

SNL Responses to Citizen Action Comments on the Mixed Waste Landfill Corrective Measures Implementation Plan and Fate and Transport Model

(www.nmenv.state.nm.us/hwb/snlperm_comments.htm)

Clifford K. Ho and Timothy J. Goering
Sandia National Laboratories
April 20, 2006

Introduction

This document contains SNL responses to comments submitted by Citizen Action regarding the MWL Corrective Measures Implementation Plan and Fate and Transport model. The complete set of Citizen Action comments is presented below, along with Sandia responses in italics.

All public comments, including the Citizen Action comments, are also available on the NMED website, at www.nmenv.state.nm.us/hwb/snlperm_comments.htm

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Review of Sandia National Laboratories'
Mixed Waste Landfill Corrective Measure Implementation Plan
and
Fate and Transport Model:

Comments and Recommendations

February 7, 2006

Prepared on behalf of:
Citizen Action New Mexico
Sue Dayton, Director
P.O. Box 262
Albuquerque, NM 87047
Sue Dayton, Coordinator
505-262-1862
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Prepared by
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INTRODUCTION

These Comments and Recommendations address portions of the Sandia National Laboratories' (SNL) Mixed Waste Landfill (MWL) Corrective Measure Implementation Plan (CMIP) and Fate and Transport Models (FTM) posted on the New Mexico Environment Department (NMED) Website. NMED required SNL to provide these documents as part of the Permit Modification issues to SNL regarding the MWL in May, 2005.

The Corrective Measure Implementation Plan ("CMIP") is posted at http://www.nmenv.state.nm.us/hwb/SNL/MWL/SNL_Mixed_Waste_Landfill_CMI_Work_Plan_(11-2005).pdf. The Fate and Transport Model ("FTM"), titled "Probabilistic Performance-Assessment Modeling of the Mixed Waste Landfill at Sandia National Laboratories" Document Number SAND 2005-6888 is posted at http://www.nmenv.state.nm.us/hwb/SNL/MWL/Fate_and_Transport_(Probabilistic_Performance-Assessment_Modeling_of_the_MWL;%2011-2005).pdf).

The Permit Modification issued by New Mexico Environment Department for the Mixed Waste Landfill (posted at http://www.nmenv.state.nm.us/hwb/SNL/MWL/Final_Decision/Permit_Language_for_the_Mixed_Waste_Landfill.pdf) requires that Sandia/DOE submit a CMIP that "shall, at a minimum, include:

a. A description of the selected remedy;
b. A description of the remediation system objectives;
c. An identification and description of the qualifications of key persons, consultants, and contractors that will be implementing the remedy;
d. Detailed engineering design drawings and systems specifications for all elements of the remedy;
e. A construction and construction quality assurance work plan;
f. An operation and maintenance plan;
g. The results of any remedy pilot tests, such as landfill cover test plots;
h. A schedule for submission to the Administrative Authority of periodic progress reports;
i. A schedule for implementation of the remedy;
j. A health and safety plan;
k. A comprehensive fate and transport model that studies and predicts future movement of contaminants in the landfill and whether they will eventually move further down the vadose zone and/or to groundwater;
l. Triggers for future actions that identify and detail specific monitoring results that will require additional testing or the implementation of an additional or different remedy."

In response to comments identified during review of the FTM and CMIP, recommendations regarding specific revisions to the FTM and CMIP are identified. The recommendations include revising the CMIP to reflect modifications proposed for the FTM.
Due to the technical nature of the FTM, the reliance of NMED on a contractor to conduct a technical review of the FTM, and the numerous areas of deficiency in the FTM noted in these comments it is also strongly recommended that NMED convene a "technical discussion group"

to serve as a public meeting to provide for an exchange among interested stakeholders regarding the adequacy of the FTM and CMIP. It is recommended that such a technical discussion group include representatives of the permittee, the NMED and members of the public who have expressed an interest in the studies conducted by SNL and/or submitted comments to the NMED on the CMIP and/or FTM. It is recommended that this technical discussion group be convened prior to the determinate that the FTM and CMIP are either "comprehensive" or "complete" with respect to the technical requirements applicable to the wastes at the MWL.

I. Fate and Transport Model Comments and Recommendations

A. General Comments: The document submitted to comply with the FTM requirements in the Permit Modification is not comprehensive with respect to:

1. The volume of each individual waste product and physical state of containers for the full range of contaminants at the Mixed Waste Landfill;
2. Potential for releases including vadose zone and groundwater contamination due to transport not considered in the FTM including mechanisms such as biological transport of contaminants through the ground surface, human intrusion, and movement of contaminants by wind/air;
3. Modeling for the complete suite of radionuclides and daughter products, metals, and volatile and semi-volatile organic compounds in the known inventory of the MWL.

RECOMMENDATION: The FTM should be revised to provide the "comprehensive" model required by the Permit Modification and the CMIP should be modified to reflect the findings of the revised FTM following its acceptance as technically complete and comprehensive by NMED.

SNL Response: See response to each of the detailed items below.

B. Areas not addressed in the FTM:

1. The FTM fails to address biological transport of contaminants resulting from plant and animal uptake of contaminants and subsequent dispersion of soil, plant and animal material by wind, including vertebrate and invertebrate animals entering the landfill and plants transporting contaminants taken up through their root systems. Data presented at the December 2004 MWL Public Hearing by SNL demonstrate that deer mice and vegetation at the MWL show contamination with low levels of tritium and radon.

SNL Response: The model did not specifically address biological uptake and transport of contaminants by plants and animals. However, the biointrusion barrier will be constructed with the intent to prevent this pathway for uptake and transport.

2. The FTM fails to address transport of contaminants resulting from human intrusion associated with accidental events and the eventual failure of the land use restriction portions of the institutional controls proposed by SNL for the MWL. Accidental or unforeseen events that could be included in FTM model assumptions should be understood to include discharges of large volumes of water at the site on the order of disposal of more than 270,000 gallons of reactor cooling water at the site or the

pooling of snow melt and rain water above trenches, circumstances that occurred at the MWL while it was an active disposal site.

SNL Response: Land-use restrictions are recorded on the facility property legal documentation for notification purposes in accordance with regulation. Further, the institutional controls are to be carried out under the Long-Term Monitoring and Maintenance Plan (LTMMP). Inhalation and dermal exposure was assumed to occur continuously (24/7) above the landfill. In addition, drinking water was assumed to be taken directly beneath the MWL, and dilution caused by mixing within the aquifer was neglected (groundwater concentrations were taken to be equal to the concentration at the base of the vadose zone). Finally, the reactor cooling water was placed within the MWL when placement could occur as an active disposal site and no such additional placement will occur in the now-closed unit.

3. The FTM fails to provide a comprehensive fate and transport analysis as it does not include calibrated model "realizations" for the full range of radioactive and hazardous constituents identified at the MWL including: a wide range of radionuclides, a wide range of metals and inorganic compounds including beryllium, nickel, chromium, sodium, lithium, and the range of volatile organic compounds already demonstrated to have been escaped from the MWL. A comprehensive list of radionuclides, metals and volatile organic compounds can be found in what is identified in the CMIP at p. 4-2 as "[a] detailed MWL waste inventory, by pit and trench, … provided in the Environmental Restoration Project "Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Dated September 1996" (SNL 1998)."

SNL Response: The constituents modeled were chosen conservatively because of their high relative mobility and/or larger quantity identified in the inventory.

4. The FTM fails to identify or address fate and transport dynamics associated with the potential for formation of mobile, potential hazardous compounds by radiolysis - the process by which radionuclides can mix with non-radioactive constituents and form new compounds – to occur among waste constituents of the MWL.

SNL Response: Radiolysis is the molecular decomposition of a substance as a result of radiation. The modeling of constituents (amount and characteristics) formed as a result of radiolysis is highly uncertain and speculative. In addition, radiolysis is more likely to occur from high-level radioactive waste, rather than the low-level waste disposed of at the MWL.

5. The "triggers" identified in the FTM fail to include monitoring mechanisms to reflect either human intrusion, biological transport, or the waste constituents identified at the MWL, but not considered in the FTM.

SNL Response: Our recommended triggers include surface-concentration measurements for radon gas and tritium in soil pore water. Specific details on long-term monitoring of the MWL will be addressed in the MWL Long-Term Monitoring and Maintenance Plan (LTMMP). The LTMMP will be developed in consultation with the NMED following implementation of the final

remedy at the site, and is scheduled for completion in 2008.

The FTM fails to identify means to monitor, model and assure the effectiveness of institutional controls or the consequences of the failure of such passive site protection measures.

SNL Response: Institutional controls or the consequences of the failure of such passive protection measures are not appropriate for inclusion in the FTM. The Long-Term Monitoring and Maintenance Plan (LTMMP) will address these issues.

> **The FTM fails to provide a risk assessment/performance assessment analysis in its evaluation of the potential for release of contaminants from the MWL. RECOMMENDATION: In order for the FTM to be fully "comprehensive," NMED should require that the FTM be revised and expanded to address each of the areas of incompleteness identified above.**

SNL Response: Our study does provide a risk-based performance-assessment analysis using relevant regulatory performance standards as metrics (e.g., dose, groundwater concentrations). Probabilistic, uncertainty analyses are performed to develop distributions of scenario results that are compared against the metrics. Sensitivity analyses are also performed to identify the most important parameters and processes that impact the simulated performance metrics. Standard conversion factors (U.S. EPA slope factors) can be used to convert dose (which is reported in our analysis) to risk of cancer incidence or fatality.

C. Areas addressed inadequately in the FTM:

1. **The FTM relies on data regarding releases of radionuclides, heavy metals and VOCs ("volatile organic compound") from the Phase 1 and Phase 2 RCRA Feasibility Investigation (RFI) gathered 1993 – 1995. FTM at 14. No new data gathering was conducted. No new data gathering is proposed to calibrate or verify the modeling conducted**.

SNL Response: Our analysis also uses information and results from site studies conducted by Wolford (1997, 1998), WERC (2001), Peace et al. (2002), Peace et al. (2003), and Peace and Goering (2005).

Data gathering continues at the MWL, and will continue into the future under the long-term monitoring program. Currently, groundwater is sampled on an annual basis at the site, and analyzed for a wide suite of potential contaminants, including volatile organic compounds, tritium, and uranium. Sandia's Environmental Monitoring Program collects soil and vegetation samples along the MWL perimeter annually (since 1980). The soil and vegetation samples are analyzed for tritium and gamma-emitting radionuclides.

Data collected during long-term monitoring at the MWL will be used to update the fate and transport model for the site on a 5-year basis, and to re-evaluate the likelihood of contaminants reaching groundwater.

RECOMMENDATION: The NMED should require that SNL conduct a monitoring program to verify the accuracy of the model parameters and model results identified in the FTM. This program should include sampling of the vadose zone at and beneath the MWL to determine if the FTM's predictions and assumptions accurately reflect conditions at the MWL.

SNL Response: The FMT used realistically conservative data and sensitivity analyses to identify potential data gaps that additional data would be needed to fill. No additional data needs were identified during this process.

The NMED Class 3 Permit Modification for the MWL requires Sandia to develop a Long Term Monitoring and Maintenance Plan (LTMMP) for the MWL within 180 days after NMED's approval of the Corrective Measures Implementation Report. The LTMMP will be developed in consultation with the NMED, and will provide details of the monitoring program for the MWL, and triggers for the site. Data collected during long-term monitoring at the MWL will be used to evaluate the continued effectiveness of the remedy selected for the MWL. These data will also be used to update the fate and transport model for the site every 5 years, as required by the State of New Mexico Final Order, dated May 26, 2005.

2. **The FTM appears to have failed to identify or consider either the mechanisms for deterioration of waste containers or the consequences of the deterioration of waste containers in any manner during development of the input parameters and assumptions for its VOC, heavy metal and radionuclide models, with the single exception of the radon model runs in which radium-226 containers were determined to deteriorate in 1,000 years**.

SNL Response: This assertion is incorrect as all constituents were assumed to be exposed in the landfill WITHOUT containment. For the analysis of radon-222 transport, we assumed the source of anthropogenic radon-222 (radium-226) was contained in sealed sources.Up to 100% of these sealed sources were assumed to be exposed (broken) in the realizations.

The failure to address container deterioration systematically in the FTM results in the model using inappropriate, non-conservative assumptions about the "source terms" of waste constituents. The MWL waste containers, or the MWL waste containers SNL is aware of, include 55-gallon drums, plastic bags and other short-lived containers with an identifiable lifespan that is very short, a few decades in the case of 55-gallon drums, compared to the extremely long-lived hazards associated with the MWL contents other than tritium and cobalt-60.

The failure to address the limits on the durability containers due to deterioration mechanisms and resulting contaminant releases ignores a primary critique of SNL's data presented at the December 2004 MWL Public Hearing, as identified by the Hearing Officer, that SNL studies and models to date have failed to address the inevitable deterioration of waste containers.

RECOMMENDATION: To reflect the intent of the Hearing Officer as stated in her Final Report and Proposed Final Order, the FTM should be revised to identify and address fate and

transport dynamics that would occur as a result of the deterioration of all VOC, heavy metal and radionuclide containers at the MWL.

Also, the FTM's analysis of potential radon movement should be revised to both identify mechanisms that would result in deterioration of the radium-226 containers and conduct model realizations for container deterioration faster than the 1000-year period reported such as deterioration within 100-years of disposal.

3. **The FTM concludes that PCE, the one organic compound modeled in the FTM, would reach groundwater for all 100 model runs ("realizations") with the majority of the model runs showing PCE reaching groundwater within 50 years**.

The FTM states: "Figure 22 [on p. 55] shows the simulated PCE concentrations in the groundwater as a function of time for all 100 realizations. **The majority of the realizations show the aquifer concentrations peaking before 50 years**. **Depending on the time of disposal, this corresponds to peak concentrations occurring by 2010 – 2040.** [emphasis added]. To date, no detectable amounts of PCE have been found in the groundwater at the MWL. This is still consistent with the simulations which show a large amount of variability in the simulated concentrations resulting from uncertainty included in the input parameters." FTM at pp. 54-55. Figure 22 is attached these comments as APPENDIX A.

Thus, the FTM confirms that a volatile organic compound already shown to have escaped from the MWL, tetrachloroethylene (PCE), is likely to reach the groundwater aquifer within 50 years in most model runs. This finding should serve as a basis for NMED to focus a substantially higher degree of attention on the need for a corrective measure at the MWL that can be demonstrated to effectively control releases of VOCs.

Figure 23 in the FTM shows the concentration of PCE anticipated in the groundwater by the model realizations. This figure shows that the vast majority of the realizations – about 80% - show PCE levels in the groundwater in the range of 1 – 5 micrograms per liter, equivalent to parts per billion. Prediction of those concentrations of PCE reaching the groundwater represent a prediction of significant contamination as PCE is not naturally occurring and therefore **zero** PCE would be predicted to have reached groundwater if no PCE were already shown to have escaped from the MWL. Figure 23 is attached to these comments in APPENDIX A.

SNL Response: In contrast to the statement above, only 30% (not 80%) of the realizations results in groundwater concentrations ranging from 1 – 5 micrograms per liter. Only 1% of all the realizations show a groundwater concentration that exceeds the regulatory metric of 5 micrograms per liter.

The FTM shows that PCE reaches groundwater based on data from previously detected releases of VOCs at the MWL as, the FTM notes: "Although no quantitative estimates of the volumes of these contaminants disposed of in the MWL exist, soil samples provide an estimate of the extent and concentration of the region contaminated with VOCs at the MWL." FTM at p. 52.

SNL Response: No PCE has been detected in the groundwater at the MWL. The quote above refers to measured values of PCE in soil-gas samples taken at 10 and 30 feet below the surface.

The lack of information about this highly mobile contaminant in the MWL inventory, or the form and condition of containers used for disposal of PCE and other VOCs and SVOCs, prevents SNL from conducting analyses based on accurate estimates of the amount of VOCs and SVOCs in the MWL. The lack of recent or current VOC and SVOC monitoring data since the 1993 Phase 2 RFI prevents SNL from accurately reflecting the current extent of VOC and SVOC releases from the MWL in the FTM.

SNL Response: The extent of contamination by VOCs and SVOCs in subsurface soils at the MWL was characterized during the Phase 2 RFI. Concentrations of contaminants were found to be at low levels, below risk thresholds, and the MWL was proposed for No Further Action in 1996. Because the nature and extent of contamination had been adequately characterized during the Phase 2 RFI, and because contaminant levels were so low, monitoring was not continued for VOCs and SVOCs in soil.

There is little information about PCE in the MWL inventory because only small quantities of solvents such as PCE were disposed of at the site (primarily on rags and contaminated equipment).

See response below.

As SNL has no information available about the VOC waste volume and disposal practices the FTM used the: "[M]aximum measured gas concentration (5,900 ppb) … as a minimum value in a uniform distribution increasing to ten times this value to develop a range of equilibrium aqueous concentrations." FTM at p. 52. In other words, since the MWL permittee acknowledges that it has no information on the amount or form of the PCE (and other VOCs and SVOCs) in the landfill or how the containers they were disposed in have aged, the model used the amount of VOCs and SVOCs more than a decade ago that had already leaked from the landfill for the "source term."

SNL Response: The maximum inventory for PCE was increased (from the minimum value estimated from measured values) by a factor of 10; with this distribution, the simulation results fell within the range of measured values in 1993 at 10 and 30 feet below the subsurface. This calibrated the model for the latent period between emplacement (which is unknown) until the time of measurement in 1993.

This method of identifying the "source term" for the PCE FTM does not account for the likelihood that the amount of PCE, and other VOCs, leaking from waste containers may have increased significantly since 1993 when the VOC releases used to develop the FTM were detected.

The FTM only modeled one organic compound, PCE, though a dozen VOCs and SVOCs were demonstrated to have been released from the landfill by 1995. In spite of the demonstration that PCE would reach groundwater within 50 years in all model realizations, the FTM failed expand

its modeling study to address the fate and transport of other organics detected in the Phase 2 RFI monitoring data.

SNL Response: PCE was chosen conservatively because of its relatively large Henry's Constant and relatively high mobility. Because results showed that PCE could reach the groundwater, all other VOCs that have been measured in the soil gas at the site have been marked as "triggers" for monitoring in the groundwater.

Similarly the FTM fails to identify or present model realizations for the decay products of PCE and the other VOCs and SVOCs demonstrated to have escaped the MWL in 1993. This is particularly problematic as at least one decay product of PCE, vinyl chloride, has a maximum contaminant level (MCL) established by EPA of 2 ppb, less than the proposed trigger level of 2.5 ppb proposed for PCE in the FTM at p. 62. See EPA "National Primary Drinking Water Regulations" at http://www.epa.gov/safewater/contaminants/dw_contamfs/vinylchl.html.

SNL Response: PCE was modeled as a proxy for all VOCs, including its decay products. Biodegradation of PCE (and TCE) to vinyl chloride in groundwater would occur only under anaerobic conditions, which do not exist at the MWL.

As no information is presented in the FTM regarding fate and transport model realization data for any PCE decay product, no information is presented regarding concentrations of any decay products in groundwater that may have been predicted by the FTM model realizations.
The FTM should be revised to correct inconsistencies in data presented regarding PCE releases from the MWL. The FTM states that the maximum PCE detected in 1993 was 5,900 ppb at p. 52, but lists the maximum concentration of PCE in 1993 as 5,200 ppb on Figure 21 at p. 53.

SNL Response: The numbers reported are correct. Figure 21 shows the maximum concentration measured at 10 feet, which was 5,200 ppb. Figure 22 shows the maximum concentration measured at 30 feet, which was 5,900 ppb. The higher of the two values was used for inventory calibration.

RECOMMENDATION: Because PCE was shown to reach groundwater in all model realizations within approximately 50 years, the FTM should be revised to include model realizations reflecting future movement of all VOCs and SVOCs found to have been released from the landfill in 1993. These additional models and model realizations should be revised to include consideration of the decay products of PCE and the other VOC s and SVOCs that were shown to have escaped the MWL by 1993. Decay products modeled should include any decay products, such as vinyl chloride, that may have MCLs as low or lower than that established for PCE.

The FTM should be revised to reflect the potential for container deterioration to have resulted in significant additional VOC and SVOC releases from the MWL at rates well beyond the "ten times" indicated in the FTM at p. 52. As substantial additional deterioration of VOC and SVOC containers is likely to have occurred since 1993, it is reasonable for the FTM to be revised to include consideration of VOC and SVOC source terms 100x and 1000x the maximum values detected in the vadose zone in 1993 for all VOCs and SVOCs detected at the landfill. Model

realizations considering source terms 100 – 1000 times concentrations detected in 1993 will allow the FTM to address the potential for additional releases since 1993 or releases not detected in 1993.

The FTM should be revised to include evaluation of the vapor phase transport mechanism attributed to the VOCs that reached the groundwater at the Chemical Waste Landfill at SNL. This revision should be included to ensure that the assumptions regarding PCE movement used in the FTM reflect real world conditions at as demonstrated at other landfills at SNL.

The FTM should be revised to include a VOC and SVOC detection and monitoring system to provide real world data to verify results of model realizations.

The NMED should request a revision of the FTM that corrects any inconsistencies in data used and presented in the FTM. The indication that the FTM authors may have understated the maximum PCE gas concentrations in 1993 by more than 10% (the difference between 5,900 and 5,200) in one of its models (as reflected in Figure 21) should serve as a basis for the NMED to require verification that the appropriate, higher value was used in the FTM. In addition, the NMED should require that SNL verify that model realizations were indeed conducted with using values "ten times" the 1993 maximum gas concentration of PCE as neither Figure 21 or any other portion of the FTM discussion of VOC model realizations appear to reflect the use of values "ten times" 1993 maximum gas concentrations asserted by the FTM at p. 52.

The NMED should consider requiring improvements in the Corrective Measure proposed for the MWL to prevent future releases of VOCs and SVOCs from the MWL as the FTM (and a 1995 Argonne National Laboratory study cited in the FTM, as discussed below) demonstrates the high probability of VOCs reaching groundwater beneath the MWL at values at or near applicable maximum contaminant level standards.

SNL Response: See detailed responses above regarding these recommendations.

4. **The FTM identifies a 1995 Argonne National Laboratory [cited as Johnson 1995 in the FTM] report at p. 16 that showed that VOCs released from the MWL could reach the water approximately 250 years from the time of disposal. This study was not provided to NMED as part of either the Corrective Measures Study (CMS), Corrective Measure Implementation Plan (CMIP) or the references for either of those reports**.

The FTM at p. 16 states: "The [Argonne National Laboratory study report as Johnson, 1995] study also included screening calculations for aqueous-phase transport of PCE and TCE, and predicted that these VOCs could reach the water table approximately 250 years from time of disposal. No calculations were conducted for vapor-phase transport, which has proven to be the most significant transport mechanism for organic compounds in the vadose zone at nearby ER sites, including the Chemical Waste Landfill."

This 1995 study is cited as: "Johnson, R., D. Blunt, D. Tomasko, H. Hartmann, and A. Chan, 1995, A Human Health Risk Assessment for the Mixed Waste Landfill, Sandia National Laboratories, Albuquerque, New Mexico, Argonne National Laboratory, Argonne, IL." Though the FTM asserts that the Argonne Study used a "worst case scenario" approach, the failure of the 1995 Study to consider vapor-phase transport mechanisms, which has been shown to have resulted in VOCs escaping the Chemical Waste Landfill at SNL reaching the groundwater aquifer, appears to contradict that assertion.

The combination of the 1995 Argonne study with the FTM demonstrates that the high mobility of VOCs is not controlled by the proposed Corrective Measure at the MWL and the likelihood that VOCs will reach the groundwater aquifer beneath the MWL even if the currently approved Corrective Measure is installed at the MWL.

RECOMMENDATION: The NMED should require SNL to provide the agency with copies of the 1995 Argonne Study, review the Study, and consider its relevance regarding the adequacy of the Corrective Measure identified in the Permit Modification since SNL failed to present the Study to NMED or the public or consider it during the development of the Corrective Measure Study.

The NMED should review the Corrective Measure approved in the Permit Modification as the conclusions of the 1995 Argonne Report are contrary to the conclusions presented in the CMS and MWL hearing by SNL that contaminants such as VOCs *could not* reach groundwater at the MWL site. See statement "Contaminants are unlikely to reach groundwater …" CMS at 29.

<u>SNL Response</u>*: Neither the Argonne National Laboratory report by Robert Johnson nor the early modeling results by Sandia National Laboratories provide any new information to the case, and details on these reports have been included in public documents for years. Both reports are discussed in depth in Section 5.6 of the Mixed Waste Phase 2 RCRA Facility Investigation Report (SNL/NM, 1996). In addition, the Argonne report was provided to WERC and to the public during the first WERC peer review of the MWL in 2001 (Reference No. 53, Appendix D, WERC 2001). The results of the Argonne National Laboratory study, and the modeling results by Sandia are also summarized in Appendix E of the Mixed Waste Landfill Corrective Measures Implementation Plan (SNL/NM, 2005).*

The "trigger levels" identified in the FTM fail to provide for early detection and early response to releases prior to the exceedence of health–based standards. The proposed trigger levels fail to provide either early detection or early response as they are set at values at or near regulatory standards rather than at levels that would demonstrate the "edge of the plume," which is the purpose of trigger levels as identified by the MWL Hearing Officer's Final Report at pp. 35 – 40.

<u>SNL Response</u>*: Triggers for contaminant releases to the surface were set at values that are orders of magnitude below values that were simulated to yield exceedances to regulatory metrics. The triggers for groundwater concentration were chosen to be half the MCLs. These values are considered conservative, as MCLs are typically health-based standards.*

The trigger levels identified in the FTM are values that are well above background concentrations for the constituents identified and fail to identify levels that would demonstrate that the "edge of a plume" has reached a location of concern or that statistically significant increases in the concentration of contaminants have been detected by monitoring activities.

Exceedences of the proposed trigger levels identified in the FTM would demonstrate that significant and extensive contamination has already occurred, not conditions at the "edge of the plume," and would result in subsurface contamination that would be much more expensive to remedy than contamination detected at trigger levels set at concentrations exceeding background by a statistically significant value, such as 25% or 50%, above locally appropriate background values.

Though neither the Permit Modification or the Secretary's Final Order provide a specific definition for "trigger levels," several sources can be identified that demonstrate that the appropriate understanding of "trigger level" as identified in the MWL Hearing Officer's Final Report is a concentration of a constituent designated to "detect contamination" or the "edge of a plume," rather than an exceedence of a regulatory standard.

In her Final Report, the Hearing Officer identified an example of trigger levels as: "one trigger could be that if contaminants moved a specific distance deeper under the landfill, then this might result in NMED ordering future excavation" at p. 40.

At the MWL Public Hearing in December 2004, NMED's technical witness Willam Moats stated, "…triggers themselves would be designed around detection of contamination in the vadose zone and the groundwater." MWL Hearing Transcript at p. 1141.

RECOMMENDATION: To insure that trigger levels identify the "edge of a plume" and "detect contamination," rather than the exceedence of regulatory standards, the trigger levels applied to the monitoring systems at the MWL should be set at concentrations that reflect a significant increase above background values rather than at a concentrations that approach regulatory standards and are many times higher than background conditions. The location of the monitoring systems at which the trigger levels would apply should be beneath the landfill, but well above the groundwater level for the trigger levels to serve as an "early warning system" rather than confirmation of groundwater contamination by applying proposed trigger levels at an elevation at which groundwater is found as proposed in the FTM.

To provide "detection of contamination," trigger levels should be established at a level 25 – 50% above initial concentrations for contaminants of concern. Verification of contaminant concentrations when detected will provide assurance that values that exceed background concentrations by a significant amount are not anomalous or indicative of analytic error.

SNL Response: The trigger levels proposed in the MWL CMI Plan represent conservative values that were selected based on regulatory metrics. They were selected based on the objectives of minimizing false positive detections, while still protecting human health and the environment. The final trigger levels for the MWL will be selected in consultation with the NMED, and will be presented in Sandia's Long Term Monitoring and Maintenance Plan for the MWL.

5. **The trigger levels proposed in the FTM fail to identify trigger levels for waste constituents that apply at the edge of the MWL or in the vadose zone below the site but above the water table**.

The FTM lists recommended "trigger levels" in Section 4.2.1 at pp. 61 – 62. The list fails to include vadose zone trigger levels for contaminants identified in the MWL and only lists vadose zone trigger level for "infiltration" as measured by moisture content increase.

RECOMMENDATION: The FTM should be revised to provide for a vadose zone monitoring program that includes analysis of all of the constituents identified on pp. 61 – 62 and other constituents that may be identified based on these comments or other recommendation provided to the NMED to insure that all transport mechanisms, both anticipated and unanticipated, are addressed by the trigger levels implemented at the MWL.

SNL Response: The proposed vadose zone monitoring program consists of neutron moisture monitoring to assess changes in infiltration over time. Vadose zone monitoring parameters, frequencies and locations will be determined in consultation with the NMED during the development of the Long-Term Monitoring and Maintenance Plan (LTMMP).

6. **The FTM discussion of "Trigger Levels"' does not address the degree to which monitoring for moisture content changes would reflect vapor phase movement of VOCs**.

Vapor phase movement of VOCs is noted as the mechanism for VOC transport to groundwater at the Chemical Waste Landfill at SNL. See quote from Johnson 1995, FTM at p. 16.

RECOMMENDATION: The FTM should identify effective technologies for detection of vapor phase movement of VOCs into the vadose zone beneath the MWL. These technologies should be included in an expanded monitoring system to provide for detection of VOC and SVOC releases from the MWL.

SNL Response: See detailed response to Comment No. 5, above.

7. **A broad range of sources of uncertainty in the FTM were identified by the FTM lead author Dr. Clifford Ho in a powerpoint presentation at a DOE-sponsored public meeting on the FTM in January 2006. The "uncertainty variables" identified by Dr. Ho included: waste inventory and size; thickness of cover and vadose zone; and transport parameters including: infiltration, adsorption coefficient, saturated conductivity, moisture content; tortuosity coefficients, and boundary-layer thickness.**

The FTM Report posted at on the NMED site does not identify the "uncertainty variables" in as clear and succinct a manner as the presentation by Dr. Ho and does not identify the range of

values use for each of the "uncertainty variables" parameters used in model realizations to account for those sources of uncertainty for each of the contaminants modeled.

RECOMMENDATION: The FTM should be revised to identify the full range of uncertainty variables associated with each of the constituents addressed in the FTM.

The FTM should be revised to identify the range of values used in model realizations to account for the uncertainty associated with each variable.

SNL Response: The report includes a description of all the uncertain variables and their ranges (see Tables 2-5 (pp. 26-29).

II. Corrective Measures Implementation Plan Comments and Recommendations

A. **The CMIP fails to effectively incorporate the content and findings of the FTM in either the evaluation or design of the Corrective Measure proposed for the MWL**.

While the CMIP includes the full text of the FTM as Appendix E in the CMIP as posted by NMED, the body of the CMIP does not appear to refer to or incorporate any of the information identified in the FTM in the substance of the CMIP.

Neither the "Regulatory Basis" (Section 3), "MWL Characteristics" (Section 4), "Technical Basis" (Section 5), "Vadose Zone Moisture Monitoring" (Section 7), "Conclusions" (Section 8) nor "References" (Section 9.0) sections of the CMIP identify or refer to the FTM or the data it contains.

RECOMMENDATION: The CMIP should be revised to incorporate the analyses and findings in the FTM - when it is determined to be comprehensive and meet the requirements of the Permit Modification and associated guidelines and regulations by NMED - in the design, operation and monitoring and maintenance plans proposed by the permittee for the MWL.

SNL Response: The objective of the CMI Plan was to present a detailed design of the remedy selected by the NMED for the MWL. The proposed design meets the full intent of RCRA Subtitle C regulations, which include minimizing water migration through the cover, minimizing maintenance and erosion, accommodating subsidence, and having a permeability less than or equal to that of the natural subsurface soils. The Fate and Transport model results do not show any need to modify the proposed design in the CMI Plan.

B. **The CMIP fails to provide a comprehensive or detailed long-term operation and maintenance plan for public comment or review**.

While the MWL Permit Modification requires the permittee to provide an operation and maintenance plan, the CMIP only provides information about vadose zone instrumentation and defers the presentation of information on the duration and frequency of the operation and maintenance plan until the conclusion of an unspecified consultation process with NMED. That approach is identified as the process for development of a MWL long-term monitoring and

maintenance plan. No aspects of a MWL monitoring program other than vadose zone monitoring are identified or addressed in the CMIP. See CMIP p. 7-1.

RECOMMENDATION: The CMIP should be revised to include a comprehensive long-term monitoring and maintenance program for public review and comment. The proposed long-term monitoring and maintenance program should include: all parameters to be monitored, all media – including air, soil, vadose zone, groundwater and biota (plants and animals); recommended limits of detection for analytic equipment to be use; frequency of sampling and analysis; quality control and quality assurance measures; monitoring and maintenance cost estimates; MWL cover inspections and maintenance activities; and measures to verify that all institutional control aspects of the proposed corrective measure are in place and enforced for the full closure and post-closure period at the MWL.

SNL Response: The NMED Class 3 Permit Modification for the MWL requires Sandia to submit a Long-Term Monitoring and Maintenance Plan to the NMED within 180 days after the NMED's approval of the CMI Report, following remedy implementation. Additional details on the proposed long-term monitoring and maintenance program will be presented in the Long Term Monitoring and Maintenance Plan, which will be developed in consultation with the NMED after implementation of the remedy.

C. The CMIP proposes only three vadose zone monitoring sites – boreholes - and does not provide a demonstration that such an arbitrary and limited number of instruments will provide comprehensive vadose zone monitoring.

The CMIP at p. 7-1 describes a vadose zone monitoring program that includes three access holes based on the "simplicity, low cost and long-term viability" of the approach. Unfortunately, the permittee did not consider it appropriate to provide a vadose zone monitoring program that is comprehensive enough to comply with the MWL Permit Modification or capable of monitoring the vadose zone beneath all of the MWL. This shortcoming in the CMIP is particularly significant in light of the FTM demonstrations that groundwater contamination due to VOC releases is inevitable as it occurs in all model realizations.

In its analysis, the CMIP fails to identify locations where contaminants from the MWL have been shown to have migrated from their point of disposal into the vadose zone in the Phase 2 RFI investigation nor does it correlate those locations with the three vadose zone monitoring sites in the CMIP. These locations are identified in the record of the MWL public hearing and include data from the "RFI Phase 2" conducted in the early 1990s.

No information is available on the extent of the migration of contaminants since the RFI Phase 2 investigations as such an investigation has not been required by NMED or attained and reported by SNL.

RECOMMENDATION: The CMIP should be revised to incorporate data from an investigation of the current extent of migration of contaminants into the vadose zone. The NMED should require SNL to conduct investigations using technologies such as ground penetrating radar and other geophysical methods to detect moisture distribution in addition to soil borings and other

methods to insure that the vadose zone monitoring program can be demonstrated to be comprehensive and addresses the full extent of vadose zone contamination beneath and adjacent to the MWL.

The CMIP should be revised to include additional vadose zone monitoring that is capable of providing a comprehensive capacity to detect contaminants released from the MWL.

In the alternative, the CMIP should be revised to demonstrate that the proposed vadose zone monitoring system is configured in a manner that can detect all potential routes of migration of contaminants, including volatile and semi-volatile organic compounds, identified beneath or adjacent to the MWL in the RFI Phase 2 investigation.

SNL Response: See response to Recommendation B above. Vadose zone monitoring will be addressed in more detail in the Long-Term Monitoring and Maintenance Plan (LTMMP), which will be developed following implementation of the remedy.

D. **The CMIP fails to address the technical literature related to bio-intrusion barriers or identify monitoring systems appropriate for detect of release associated with bio-intrusion into the MWL**.

An extensive body of technical literature has been developed on bio-intrusion barriers as well as releases of contaminants through vertebrates, invertebrates and plants that have been shown to have penetrated bio-intrusion barriers. This data was summarized in a report by a leading international expert on bio-intrusion barrier design and function prepared for Citizen Action New Mexico and presented to the NMED as part of its comments on SNL's proposed corrective measure at the MWL. This report, "Review of Sandia National Laboratories/New Mexico Evapotranspiration Cap Closure Plans for the Mixed Waste Landfill," by Tom Hakonson, Ph.D., Environmental Evaluation Services, LLC, is available at http://www.radfreenm.org/pages/hakonson_full.htm.

In his report, Dr. Hakonson's asserted that assumption that "tritium is now present in vegetation and animals that now occupy the MWL" was correct. He also cited investigations in which Sr-90, Cs-137 and Pu - all contaminants found at the MWL - have been discovered in animals occupying similar landfills containing mixed wastes and further states that biological transport of radioactive contaminants is likely to occur over time and increase over the long-term.

Information presented at the Mixed Waste Landfill Public Hearing in December 2004 by SNL confirms Dr. Hakonson's assertion regarding deer mice and vegetation at the MWL which show contamination with low levels of tritium and radon. See MWL Hearing Record Transcript at pp. 102 - 104 as noted in Hearing Officer Final Report at pp. 7 and 35.

Regarding biological transport of contaminants, Dr. Hakonson's report states: "Both plants and animals have the potential to transport buried waste to the ground surface. Plants do so via roots that can penetrate several meters into the landfill. Furthermore, most plant species have the capability to penetrate the relatively thin cover soil layer proposed for the MWL. This means that the term, "shallow rooted" as used by the SNL/NM ET cap designers is inappropriate given that the grass species that they propose to use to revegetate the ET cover all have the capability to

send roots several meters into the soil. If soil moisture penetrates beyond the existing rhizosphere, plant root distribution will extend downward to capture moisture at the deeper depths.

"Roots in contact with waste can incorporate soluble constituents and transport them to the ground surface. This uptake process is analogous to a one-way valve in that contaminants are pumped upward to above ground vegetation that eventually senesces and deposits associated contaminants on the ground surface. Burrowing by animals and insects also has the potential to access buried waste several meters below the ground surface. This can lead not only to chemical and radiation exposures to the organisms but also to physical transport of the waste upward in the soil profile and to the ground surface.

"This leads to what I believe is one of the more important deficiencies in the proposed MWL closure, namely the assumption that vertical and horizontal transport of site contaminants resulting from biological processes is not an important contributor to exposure pathways. My review suggests that relevant data from the MWL on contaminants in vegetation, animals, and soil cast to the surface by burrowing animals apparently do not exist. The reason biointrusion may be important is that it represents the major mechanism leading to vertical transport of contaminants to the ground surface and through the drying effect of plant transpiration on cover soils, plays a major role in the evolution of volatile contaminants from the ground surface. While vertical transport by biota may be small on a short time scale, over many decades these processes may become dominant in mobilizing buried waste.

"It is my opinion that the soil sampling done by SNL/NM in 1990 as a part of the Phase 2 RFI provides little information that can be used to answer questions about the effects of biointrusion in transporting MWL contaminants to the soil surface. The RFI soil sampling grid resulted in evenly spaced samples (i. e., that were non-randomly distributed), that provided coarse spatial resolution of contaminant concentrations, and that involved sampling locations that were recently disturbed such as Trench F where backfill was added just months before the soil samples were taken. Furthermore, those samples that were taken in 1990 represent a single snap shot in time and depending on the degree of past mechanical disturbances that occurred within the MWL boundaries, they may represent a snap shot with little elapsed time between soil surface disturbance and when the soil samples were taken.[emphasis added]."

RECOMMENDATION: The CMIP should be revised to include a thorough investigation and re-sampling of the soil at the MWL to identify bio-intrusion mechanisms and biological transport of contaminants, and consider the relationship of these findings of such investigations to the Corrective Measure for the MWL. The NMED should consider revisions to the Corrective Measure permitted for the MWL based on information concerning biological transport in Dr. Hakonson's report and sampling data collected from the flora and fauna at the MWL by SNL since biological transport of contaminants has occurred - and continues to occur - at the dump.

The implementation of a comprehensive sampling program designed to detect levels of radioactive contamination in plants and animals living at the MLW is strongly recommended as a part of the CMIP with appropriate trigger levels to be used to determine future corrective actions at the MWL.

SNL Response: The objective of the Corrective Measures Implementation (CMI) Plan was to present a detailed engineering design for the MWL remedy.

Biological transport is a potential mechanism for contaminant migration from the MWL. Tritium, the most mobile radionuclide disposed of in the MWL, has been detected at low levels in vegetation and small mammals at the MWL. The tritium levels measured to date are consistent with levels in the soil, and are not present at concentrations that represent a concern to environmental health. Tritium concentrations in soil and vegetation are decreasing over time due to radioactive decay and other natural processes.

The remedy selected by the NMED includes a rock biointrusion barrier. The intent of the rock barrier is to prevent any intrusion by burrowing animals, and it should restrict root growth so long as the underlying materials are relatively dry (Anderson and Forman, 2002). Care will be taken during long-term monitoring to prevent the establishment of deep-rooted species on the cover.

Additional details for long-term monitoring of biota will be presented in the MWL Long-Term Monitoring and Maintenance Plan (LTMMP), which will be developed in consultation with the NMED and completed once the MWL remedy has been implemented.

APPENDIX A

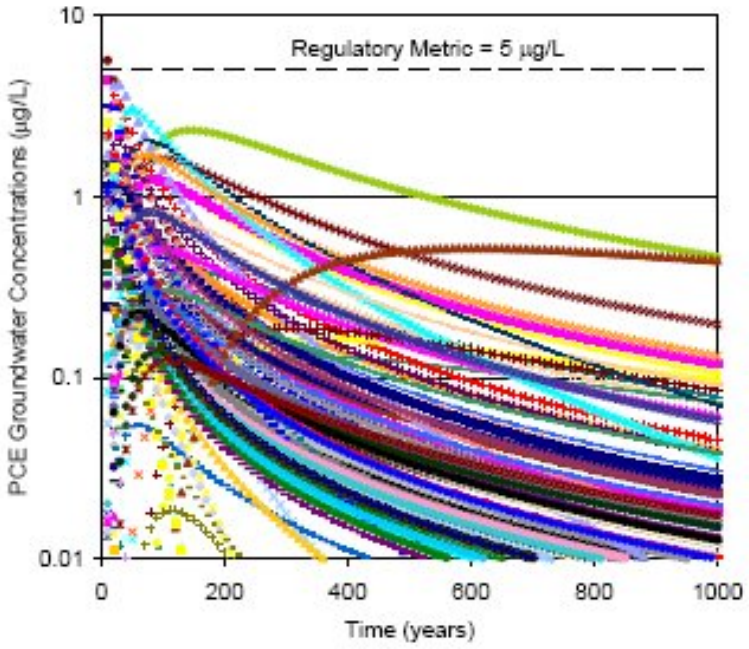

Figure 22. Simulated PCE groundwater concentrations for 100 realizations.

"Figure 22 shows the simulated PCE concentrations in the groundwater as a function of time for all 100 realizations. The majority of the realizations show the aquifer concentrations peaking before 50 years. Depending on the time of disposal, this corresponds to peak concentrations occurring by 2010 – 2040. So far, no detectable amounts of PCE have been found in the groundwater at the MWL. This is still consistent with the simulations, which show a large amount of variability in the simulated concentrations resulting from uncertainty included in the input parameters (see next section)." FTM at 54 –55.

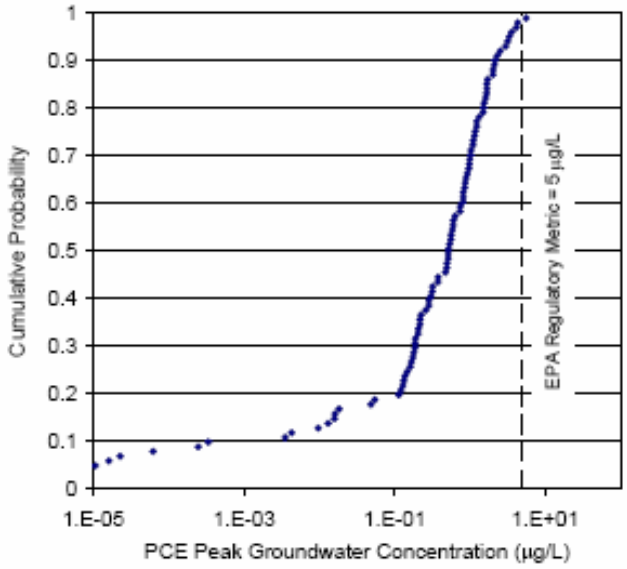

Figure 23. Cumulative probability for simulated PCE peak groundwater concentrations for 100 realizations.

REFERENCES for DOE/SNL Responses

Anderson, J.E. and A.D Forman, March 2002. *"The Protective Cap/Biobarrier Experiment. A Study of Alternative Evapotranspiration Caps for the Idaho National Engineering and Environmental Laboratory,"* prepared by Stoller for U.S. Department of Energy – Idaho Field Office Environmental Surveillance, Education and Research Program, Contract DE-AC07-00ID13658, Idaho Falls, Idaho.

NMED, 2005. *"Final Order, State of New Mexico before the Secretary of the Environment in the Matter of Request for a Class 3 Permit Modification for corrective measures for the Mixed Waste Landfill, Sandia National Laboratories, Bernalillo County, New Mexico, EPA ID #5890110518,"* May 26, 2005.

Robinson, P. February 2006. *"Review of Sandia National Laboratories' Mixed Waste Landfill Corrective Measures Implementation Plan and Fate and Transport Model,"* prepared on behalf of: Citizen Action, New Mexico by Paul Robison, Research Director, Southwest Research and Information Center, February 7, 2006.

Sandia National Laboratories/New Mexico (SNL/NM), November 2005. *"Mixed Waste Landfill Corrective Measures Implementation Plan,"* prepared at Sandia National Laboratories by J. Peace, T. Goering, C. Ho and M. Miller for the U.S. Department of Energy, Albuquerque, NM.

Sandia National Laboratories/New Mexico (SNL/NM), September 1996. *"Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation, Sandia National Laboratories, Albuquerque, New Mexico,"* report prepared by Sandia National Laboratories for the U.S. Department of Energy.

WERC, A Consortium for Environmental Education and Technology Development, *"Final Report, Independent Peer Review of the U.S. Department of Energy Sandia National Laboratories' Mixed Waste Landfill,"* August 31, 2001.

Volume I

TAB 7

Notice of Public Dialogue on the Corrective Measures Implementation Plan for the Mixed Waste Landfill, November 2005

From: NMED/Kieling
To: Interested Citizen

Back of Tab 7

State of New Mexico
ENVIRONMENT DEPARTMENT
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Telephone (505) 428-2500
Fax (505) 428-2567
www.nmenv.state.nm.us

BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

May 4, 2006

SUBJECT: NOTICE OF PUBLIC DIALOGUE ON THE CORRECTIVE MEASURES IMPLEMENTATION PLAN FOR THE U. S. DEPARTMENT OF ENERGY/SANDIA NATIONAL LABORATORIES' MIXED WASTE LANDFILL

Dear Interested Citizen:

The New Mexico Environment Department (NMED) will host a public dialogue to discuss technical issues related to the implementation of the vegetative soil cover for Sandia National Laboratories' Mixed Waste Landfill. The public dialogue will be held at the Los Griegos Health and Social Services Center, 1231 Candelaria Road, NW, from **9:00 a.m. to 5:00 p.m.**, on **May 25, 2006**. All members of the public are invited to attend this forum.

Enclosed is a public meeting notice providing additional information on the subject meeting. If you need further information regarding this forum please contact Mr. William Moats of my staff at (505) 284-5086.

Sincerely,

John E. Kieling
Program Manager
Permits Management Program
Hazardous Waste Bureau

MAY 25, 2006 PUBLIC DIALOGUE ON THE SANDIA NATIONAL LABORATORIES' CORRECTIVE MEASURES IMPLEMENTATION PLAN FOR THE MIXED WASTE LANDFILL

The public is invited to attend a forum on technical issues related to implementation of the vegetative soil cover of the Sandia National Laboratories Mixed Waste Landfill. The New Mexico Environment Department is hosting this public dialogue on Thursday, May 25, 2006 from 9:00 a.m. to 4:30 p.m. at the Los Griegos Health and Social Services Center located at 1231 Candelaria Road, NW. The documents related to this meeting are available at: http://www.nmenv.state.nm.us/HWB/snlperm.html under Mixed Waste Landfill. For further information regarding this meeting and the availability of documents, please contact the New Mexico Environment Department at (505) 428-2500.

State of New Mexico
ENVIRONMENT DEPARTMENT
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
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BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

PUBLIC MEETING NOTICE

NEW MEXICO ENVIRONMENT DEPARTMENT
HAZARDOUS WASTE BUREAU
Santa Fe, New Mexico
May 4, 2006

NOTICE OF PUBLIC DIALOGUE ON THE CORRECTIVE MEASURES IMPLEMENTATION PLAN FOR THE U. S. DEPARTMENT OF ENERGY/SANDIA NATIONAL LABORATORIES' MIXED WASTE LANDFILL

The New Mexico Environment Department (NMED) will host a public dialogue to discuss technical issues regarding the Corrective Measures Implementation (CMI) Plan for the U. S. Department of Energy/Sandia National Laboratories (SNL) Mixed Waste Landfill (MWL). A fate and transport model is included as part of the CMI Plan. The public dialogue will be held at the Los Griegos Health and Social Services Center, 1231 Candelaria Road, NW, from 9:00 a.m. to 5:00 p.m., on May 25, 2006. The public is invited to attend this forum on the technical issues related to the implementation of the vegetative soil cover.

The MWL occupies approximately 2.6 acres and is located in Technical Area III of Sandia National Laboratories, approximately 5 miles southeast of the Albuquerque International Sunport. Radioactive and mixed waste from SNL research facilities and off-site generators was disposed in the MWL from March 1959 to December 1988. Mixed waste has both radioactive and hazardous components. Approximately 100,000 cubic feet of radioactive waste containing 6,300 curies (Ci) of activity (at the time of disposal) were disposed of at the MWL.

On May 26, 2005, following a public hearing on the Corrective Measures Study for the landfill, the Secretary of the NMED selected a vegetative soil cover with bio-intrusion barrier as the remedy for the MWL. In addition, the DOE and Sandia were required to submit to the NMED for approval a CMI plan. The CMI Plan describes how the remedy will be implemented, including construction of the vegetative soil cover. The public meeting to be hosted by the NMED will focus on technical issues concerning the adequacy of the CMI Plan and the included fate and transport model. Both the plan and the model can be viewed on the NMED's web page at: http://www.nmenv.state.nm.us/hwb/snlperm.html under Mixed Waste Landfill.

For further information on this forum please contact Mr. William Moats of the New Mexico Environment Department at (505) 284-5086.

Any person with a disability requiring assistance or auxiliary aid to participate should contact Judy Bentley by 10 days prior to the meeting at the following address or phone number: New Mexico Environment Department, Room N-4030, P.O. Box 26110, 1190 St. Francis Drive, Santa Fe, New Mexico 87502-6110, (505) 827-9872. TDD or TDY users please access Ms. Bentley's number via the New Mexico Relay Network at 1-800-659-8331.

Volume I

TAB 8

Notice of 14 Day Public Comment Period for the Mixed Waste Landfill Corrective Measures Implementation Work Plan, November 2005

From: NMED/Kieling
To: SNL/Wagner

Back of Tab 8

State of New Mexico
ENVIRONMENT DEPARTMENT
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
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BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

May 25, 2006

SUBJECT: NOTICE OF 14-DAY PUBLIC COMMENT PERIOD FOR SANDIA NATIONAL LABORATORIES' MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN (INCLUDING FATE AND TRANSPORT MODEL)

Dear Interested Citizen:

Enclosed is a **Public Notice** regarding the U. S. Department of Energy (DOE)/Sandia Corporation's (Permittees) Corrective Measures Implementation (CMI) Work Plan for the Sandia National Laboratories (SNL) Mixed Waste Landfill (MWL). The CMI Work Plan includes the results of a fate and transport model that predicts the future movement of contaminants at the MWL. This 14-day Public Comment Period is in addition to the earlier 60-day comment period that ended on February 2, 2006.

The DOE is owner, and with Sandia Corporation, co-operator of SNL. The Permittees are located at the following addresses: SNL, 1515 Eubank SE, Albuquerque, NM, 87123; and NNSA/DOE, Sandia Site Office, KAFB-East, Pennsylvania & H Street, Albuquerque, NM 87116.

The enclosed Public Notice provides locations where the CMI Work Plan and the associated fate and transport model may be reviewed by any member of the public. Comments on the CMI Work Plan will be received through **5:00 p.m.** on **June 8, 2006**.

Any person seeking additional information may contact:

Mr. William Moats
NMED - District 1 Albuquerque Office
5500 San Antonio NE
Albuquerque, NM 87109
E-mail: william.moats@state.nm.us
Telephone: (505) 222-9551

Mr. John E. Kieling, Program Manager
NMED - Hazardous Waste Bureau
2905 Rodeo Park Dr. East, Bldg 1
Santa Fe, NM 87505
E-mail: john.kieling@state.nm.us
Telephone: (505) 428-2500

Sincerely,

John E. Kieling
Program Manager
Permits Management Program
Hazardous Waste Bureau

State of New Mexico
ENVIRONMENT DEPARTMENT
Hazardous Waste Bureau
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www.nmenv.state.nm.us

BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

DERRITH WATCHMAN-MOORE
DEPUTY SECRETARY

PUBLIC NOTICE NO. 06-10

NEW MEXICO ENVIRONMENT DEPARTMENT
HAZARDOUS WASTE BUREAU
SANTA FE, NEW MEXICO
May 25, 2006

NOTICE OF 14-DAY PUBLIC COMMENT PERIOD FOR SANDIA NATIONAL LABORATORIES MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN (INCLUDING FATE AND TRANSPORT MODEL)

The federal Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §§ 6901 to 6992(k), provides for the regulation of hazardous waste. Congress waived the immunity of the United States for actions brought under state hazardous and solid waste laws as well as under RCRA. Pursuant to Section 3006 of RCRA, 42 U.S.C § 6926, the U.S. Environmental Protection Agency (EPA) delegated to the New Mexico Environment Department (NMED), on April 16, 1985 by delegation numbers 8-31 and 8-32, the authority to enforce the Hazardous Waste Act (HWA) and its implementing regulations, the New Mexico Hazardous Waste Management Regulations (HWMR), 20.4.1 NMAC, in lieu of EPA enforcement through RCRA. NMED has maintained its delegation from EPA over hazardous waste management in New Mexico and from time to time has amended its state program to conform to statutory or regulatory changes in RCRA. The HWMR require corrective action at solid waste management units (SWMUs) where releases of hazardous waste or hazardous constituents have or may have occurred.

The U. S. Department of Energy, owner and operator, and Sandia Corporation, co-operator, (hereinafter referred to as the Permitees) have been issued a RCRA Permit for the Sandia National Laboratories (SNL) Facility, located in Bernalillo County, New Mexico, EPA ID# NM5890110518. The Permittees must comply with the HWA, the HWMR, and the SNL RCRA Permit and must conduct corrective action as necessary to protect human health and the environment.

On May 26, 2005, the NMED Secretary approved a final permit and ordered a final remedy for SNL's Mixed Waste Landfill. As part of these actions, the Permittees were required to submit to the NMED a Corrective Measures Implementation (CMI) Work Plan, which is to include a fate and transport model predicting the future movement of contaminants. The CMI Work Plan was submitted to the NMED on November 3, 2005 and includes a fate and transport model. Pursuant to the Secretary's order, the NMED is seeking public comment on the CMI Work Plan prior to making a final decision on whether to approve the plan.

LOCATION OF THE SNL FACILTY AND THE MWL

The Permittees are located at the following addresses: SNL, 1515 Eubank SE, Albuquerque, NM, 87123; and NNSA/DOE, Sandia Site Office, KAFB-East, Pennsylvania & H Street, Albuquerque, NM 87116. The Permittee's primary contact for this action is Mr. John Gould, NNSA/Sandia Site Office, DOE, at P.O. Box 5400, Albuquerque, NM 87185.

SNL is located within the boundaries of Kirtland Air Force Base (KAFB), south of Albuquerque in Bernalillo County, New Mexico. KAFB occupies 52,233 acres. SNL research and administration facilities occupy 2,842 acres and are divided into five Technical Areas (TAs), (designated 1 through 5) and several test areas. TA-1, TA-2, and TA-4 are separate research facilities in the north-central portion of KAFB. TA-3 and TA-5 are contiguous research facilities forming a 4.5-square-mile rectangular area in the southwestern portion of KAFB. TA-3 alone encompasses 2,000 acres.

The Mixed Waste Landfill (MWL) is located approximately 5 miles southeast of the Albuquerque International Sunport and 4 miles south of TA-1. The landfill occupies 2.6 acres in the north-central portion of TA-3.

FACILITY OPERATIONS

SNL, in operation since 1945, is engaged in research and development of conventional and nuclear weapons, alternative energy sources, and a wide variety of national security related research and development. As a result of these activities, SNL has generated hazardous, radioactive, mixed (those wastes containing both hazardous and radioactive components), and solid wastes. From 1945 to 1988 most of these wastes were disposed of at SNL at numerous locations, which have been classified by the NMED as Solid Waste Management Units (SWMUs) or Areas of Concern (AOCs). The SWMUs and AOCs include unpermitted landfills, septic-system drainfields and seepage pits, outfalls, waste piles, and test areas. Past waste management activities at SNL have caused the release of hazardous and radioactive contaminants into the environment. The Mixed Waste Landfill is classified as SWMU 76.

DESCRIPTION AND HISTORY OF THE MIXED WASTE LANDFILL

The MWL was opened as the "TA-3 low-level radioactive waste dump" in March 1959. The MWL accepted low-level radioactive waste and mixed waste from SNL research facilities and off-site generators from March 1959 to December 1988. Approximately 100,000 cubic feet of radioactive waste containing 6,300 curies (Ci) of activity (at the time of disposal) were disposed of at the MWL in unlined trenches and pits.

Investigations at the landfill indicate that tritium is the primary contaminant that has been released from the landfill. Results of a risk assessment prepared by the Permittees indicate that releases of contaminants from the MWL pose little risk to human health or the environment under an industrial land use scenario. Tritium activities at the MWL will decrease steadily with time due to its relatively short half-life of 12.3 years. Because of tritium's short half-life and in consideration of current activity levels, the NMED does not believe that tritium releases at the MWL pose a threat to groundwater, human health, or the environment.

REGULATORY BACKGROUND

NMED issued a RCRA Permit for storage of hazardous waste at SNL on August 6, 1992. On February 6, 2002, the Permittees applied to the NMED to renew their RCRA permit (the current Permit remains in effect until a final decision is made on the renewal request). On October 11, 2001, the NMED directed the Permittees to conduct a Corrective Measures Study (CMS) for the MWL because of concerns raised by the public. The CMS Work Plan was approved with conditions by the NMED on October 10, 2002.

After approval of the CMS Work Plan, the CMS was conducted by the Permittees to identify, develop, and evaluate corrective measures alternatives and to recommend a final remedy to be taken at the MWL. The results of the CMS were documented in a CMS Report following completion of the study; the report was transmitted to the NMED on May 21, 2003. The CMS Report was deemed complete by the NMED on January 5, 2004.

On January 23, 2004, the Permittees proposed a Class 3 modification of the SNL RCRA Permit, requesting that the NMED select a final remedy for the MWL. As part of a 60-day public notice and comment period initiated by the Permittees, a public meeting was held on February 26, 2004 in Albuquerque, New Mexico. Following completion of the Permittees public comment period, the NMED issued a public notice and began a public comment period starting August 11, 2004.

A public hearing on the selection of a final remedy for the MWL was held on December 2-3 and 8-9, 2005 in Albuquerque. The NMED public comment period was held from August 11, 2004 to December 2, 2004, and extended until December 9, 2004. Based on the administrative record and the Hearing Officer's Report, on May 26, 2005, the NMED Secretary approved a final permit and ordered a final remedy for SNL's Mixed Waste Landfill, selecting a vegetative soil cover with bio-intrusion barrier as the final remedy. In addition to selection of the final remedy, the final permit decision requires, among other deliverables, a CMI Work Plan. The CMI Work Plan must address the following:

a. A description of the selected remedy;
b. A description of the remediation system objectives;
c. An identification and description of the qualifications of key persons, consultants, and contractors that will be implementing the remedy;
d. Detailed engineering design drawings and systems specifications for all elements of the remedy;
e. A construction and construction quality assurance work plan;
f. An operation and maintenance plan;
g. The results of any remedy pilot tests, such as landfill cover test plots;
h. A schedule for submission to the Administrative Authority of periodic progress reports;
i. A schedule for implementation of the remedy;
j. A health and safety plan;
k. A comprehensive fate and transport model that studies and predicts future movement of contaminants in the landfill and whether they will eventually move further down the vadose zone and/or to groundwater; and
l. Triggers for future action that identify and detail specific monitoring results that will require additional testing or the implementation of an additional or different remedy.

The Secretary's order requires that the NMED review, consider and respond to public comments prior to

approving certain documents related to the MWL, including the CMI Work Plan. The purpose of this public notice is for the NMED to solicit such public comment on the CMI Work Plan, including the fate and transport model. NMED requested public comment on the CMI Work Plan during a 60-day public comment period that ended on February 2, 2006 and is again requesting public comment during this 14-day public comment period.

PUBLIC REVIEW OF THE CORRECTIVE MEASURES WORK PLAN

The CMI Work Plan (including the fate and transport model) may be reviewed by any member of the public at the following locations during the public comment period:

NMED – Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
(505) 428-2500
Monday - Friday from 8:00 a.m. to 5:00 p.m.

NMED-District 1 Albuquerque Office
5500 San Antonio NE
Albuquerque, New Mexico 87109
(505) 222-9500
Monday - Friday from 8:00 a.m. to 5:00 p.m.

The CMI Work Plan, including the fate and transport model (as Appendix E), are also available electronically on the NMED website at: http://www.nmenv.state.nm.us/HWB/snlperm.html under Mixed Waste Landfill. A separate report, *SAND 2005-6888*, entitled *Probabilistic Performance-Assessment Modeling of the Mixed Waste Landfill at Sandia National Laboratories*" is also included on the web page and contains much of the same information as that in Appendix E of the CMI Work Plan. Although the *SAND 2005-6888* report is included on the web page for convenience, the NMED is only seeking public comment on the CMI Work Plan, including Appendix E and all of the other appendices.

To obtain a copy of the CMI Work Plan or a portion thereof, in addition to further information, please contact Ms. Pam Allen at (505) 428-2500, or at the Santa Fe address given above. NMED will provide copies, or portions thereof, at a charge to the requester.

NMED issues this public notice on **May25, 2006,** to announce the beginning of a 14-day comment period that will end at **5:00 p.m., June 8, 2006**. Any person who wishes to comment should submit written or electronic mail (e-mail) comment(s) with the commenter's name and address to the respective address below. Only comments received on or before **5:00 p.m., June 8, 2006** will be considered.

John E. Kieling, Program Manager
Hazardous Waste Bureau - New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303
Ref: Sandia National Laboratories – MWL CMI Work Plan
E-mail: john.kieling@state.nm.us

Written comments must be based on the MWL CMI Work Plan (including the fate and transport model).

The NMED must ensure that the approved CMI Work Plan will be consistent with the New Mexico Hazardous Waste Management Regulations. All written comments submitted will become part of the

administrative record, will be considered in formulating a final decision, and may cause the CMI Work Plan to be modified. NMED will respond in writing to all significant public comment. The response will specify which provisions, if any, of the CMI Work Plan have been changed in the final decision, and the reasons for the change. This response will also be posted on the NMED website in addition to NMED notifying all persons providing written comments.

After consideration of all written public comments received, NMED will approve, or approve with modifications the CMI Work Plan. If NMED modifies the CMI Work Plan, the Permittees shall be provided by mail a copy of the modified CMI Work Plan and a detailed written statement of reasons for the modifications. The NMED will make the final decision publicly available and shall notify the Permittees by certified mail. All persons on the mailing list, or that provided written comments, or who requested notification in writing, will be notified of the final decision by mail.

The final decision will become effective immediately upon service of the decision to the Permittees, unless a later date is specified.

ARRANGEMENTS FOR PERSONS WITH DISABILITIES

Any person with a disability requiring assistance or auxiliary aid to participate in this process should contact Judy Bentley by 10 days prior to the end of the public comment period at the following address: New Mexico Environment Department, Room N-4030, P.O. Box 26110, 1190 St. Francis Drive, Santa Fe, New Mexico 87502-6110, (505) 827-9872. TDD or TDY users please access Ms. Bentley's number via the New Mexico Relay Network at 1-800-659-8331.

Volume I

TAB 9

NOD (Part 1 and 2 Comments): Mixed Waste Landfill Corrective Measures Implementation Work Plan November 2005, and Requirement for Soil-Vapor Sampling and Analysis Plan

From: NMED/Bearzi
To: SNL/Wagner

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State of New Mexico
ENVIRONMENT DEPARTMENT
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BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

CERTIFIED MAIL -- RETURN RECEIPT REQUESTED

November 20, 2006

Ms. Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P. O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Mr. Les E. Shephard
Vice President
Energy, Information and Infrastructure Surety
Sandia National Laboratories
P. O. Box 5800, MS 0724
Albuquerque, NM 87185

RE: NOTICE OF DISAPPROVAL: MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN, NOVEMBER 2005, AND REQUIREMENT FOR SOIL-VAPOR SAMPLING AND ANALYSIS PLAN SANDIA NATIONAL LABORATORIES EPA ID NM5890110518, HWB-SNL-05-025

Dear Ms. Wagner and Mr. Shephard:

The New Mexico Environment Department (NMED) has reviewed the subject Corrective Measures Implementation (CMI) Work Plan for the U.S. Department of Energy/Sandia Corporation's (Permittees) Mixed Waste Landfill (MWL) and has found a number of deficiencies.

The deficiencies are described in the comments below, which are divided into two parts based on subject. Comments in Part 1 are related to the construction plans and cover performance modeling. The Permittees shall address these comments within 30 days of receipt of this letter. Comments in Part 2 are related to the fate and transport model and monitoring triggers. The Permittees shall address the comments in Part 2 within 60 days of receipt of this letter.

Part 1, Comments on Landfill Construction Plans and Performance Modeling

The following comments shall be addressed by the Permittees within 30 days of receipt of this letter.

1. Executive Summary, Page iii, last bullet – Define the term "climax ecological community".

2. Section 2.1 – Provide a more detailed schedule that, at a minimum, indicates completion times for the following cover and project elements: subgrade, bio-intrusion barrier, native soil layer, topsoil layer, seeding, fencing, overall completion of project, and submittal of Corrective Measures Implementation (CMI) Report to NMED. As the actual start time is dependent on when the CMI Plan is approved, the completion times can be proposed as the number of days from the start time (assume the start time = 0 days).

3. Section 5.2.2.1.1, last paragraph – Describe the rainfall event that was simulated in the second *in situ* test.

4. Section 5.2.2.2, 1st paragraph on page 5-4 – Specify whether the degree of compaction was measured using the standard or modified proctor test.

5. Section 5.3.2.4, next to last sentence – This sentence refers to a sand layer with an initial water content of 0.036 cubic centimeters being used for a boundary condition. Normally, water content of soil is expressed as a percentage (of the ratio of the mass of water per the mass of solids, or in the case of volumetric water content the ratio of the volume of water to the total volume of soil). Confirm whether this value and unit of measurement are correct.

6. Section 5.7.1 – Specify the values used for the variables R, K, LS, VM and sources of the values used in the MUSLE equation to predict soil loss by water erosion.

7. Section 5.7.2 - Specify the values used for the variables I, k, C, l, V and sources of the values used in the WEQ equation to predict soil loss by wind erosion.

8. Section 7.0 – The NMED expects the vadose zone to be monitored for volatile organic compounds, tritium, and radon, in addition to soil moisture. The NMED may also require soil-gas monitoring to be conducted at depths other than at 173 feet, as implied by the Permittees in the second paragraph of Section 7.1. Monitoring details will need to be included in the long-term monitoring and maintenance plan, due within 180 days following approval of the CMI Report. No response is required at this time.

9. Figure 5-1 – Clarify which curves are representative of the PET data from the four National Weather Service stations in New Mexico and which are representative of the predicted PET data.

10. Appendix A, Construction Specifications, Section 02930, Reclamation seeding and Mulching, Part 3.1.2, #1 – Explain why the TA-3 borrow pits are not to be reseeded by the contractor, given that erosion of the borrow pits should be prevented.

11. Appendix A, Construction Specifications, Section 02200, Earthwork Part 3.3.3, #4 – The Permittees should consider changing the requirement that no proof rolling be conducted within 2 feet of any groundwater monitoring well, measuring device, or other placed surface. The NMED strongly suggests changing the requirement to preclude all heavy equipment from operating within 3 feet of wells or other measuring devices.

12. Appendix A, Construction Specifications, Section 02200, Earthwork Part 3.3.4, #8 and Part 3.3.6, #9 – Both of these sections contain language stating that nonconforming work shall be redone until the specifications are attained "or the Operator accepts the placement conditions". Please note that the NMED expects construction of the cover to comply substantially with the specifications in the approved CMI Plan. Failure to achieve the specifications in the approved CMI Plan, or obtain an NMED-approved change, could lead to disapproval of part or all of the constructed cover.

13. Appendix A, Construction Specifications, Section 02200, Earthwork Part 3.3.6 – The NMED strongly recommends that the Permittees add to the specifications for construction of the native soil layer a requirement for a minimum number of passes with compaction equipment.

14. Appendix B, Construction Quality Assurance Plan, Section 2.6.3, first sentence – Clarify what is meant by the first sentence: "The CQA Certifying Engineer is responsible for ....certifying the CQA document has been approved by the NMED". Did the Permittees intend, instead, to require that the CQA Certifying Engineer be responsible for certifying the results of the CQA Report that is to be submitted for NMED approval? If so, the first sentence should be revised to state "The CQA Certifying Engineer is responsible for certifying in a statement to the owner and the NMED that, in his or her opinion, the cover has been constructed in accordance with all plans and specifications". The next sentence of the paragraph explains further that the certification statement would normally be included in a CQA Report.

15. Appendix B, Construction Quality Assurance Plan, Section 8.7 – The Final Report must be submitted to the NMED as part of the CMI Report. The Final Report must include copies of all quality control data generated by the construction contractor as well as the quality assurance data generated by the CQA contractor.

16. Demonstrate with calculations and other information whether run-off and run-on controls have been adequately designed to handle peak precipitation events. Evaluate and discuss whether additional run-on controls should be constructed at locations further away from the landfill (e.g., at distances of 25 to 50 meters) to provide more protection for the cover from heavy rainfall events.

17. Identify the criteria to be applied to determine whether the establishment of vegetation on the final cover is acceptable, including, but not limited to, species diversity, plant survival, and the extent of ground cover. Explain how measurements will be conducted in the field to assess these criteria.

Part 2, Comments on the MWL Fate and Transport Model (Appendix E)

The following comments shall be addressed by the Permittees within 60 days of receipt of this letter. These comments concern Appendix E (Probabilistic Performance Assessment Modeling of the Mixed Waste Landfill at Sandia National Laboratories) of the CMI Plan.

1. Section 2.1.2.2 -- The last paragraph of Section 2.1.2.2 states, "Present conditions were simulated by modeling infiltration through various thicknesses of an engineered cover, while future conditions were simulated by modeling infiltration through various thicknesses of soil under natural conditions (i.e., the 'natural analog')." This description implies that present and future conditions are simulated using different designs (in the near term an engineered cover which in the future eventually degrades to the conditions of natural soil). Section 3.4.2 states that the engineered soil cover reverts to the natural soil conditions around the landfill. Provide clarification in Section 2.1.2.2 regarding the evolving soil conditions within the cover. Explain what soil conditions are expected to evolve, why and when they will evolve, and what will they evolve to.

2. The first paragraph of Section 3.2.1 states that lead, cadmium, and radionuclides (except radon) were modeled using the Framework for Risk Analysis in Multimedia Environmental Systems (FRAMES) and Multimedia Environmental Pollutant Assessment System (MEPAS) simulation tools. Section 3.2.2 states, "A separate model was used to model the transient transport of tritium at the MWL". The reader, however, does not learn until Section 3.7.1 that tritium was also modeled using FRAMES and MEPAS. Revise the text of Section 3.2.1 to indicate tritium was modeled using FRAMES and MEPAS, as well as the separate transient transport model.

The second paragraph of Section 3.2.1 indicates MEPAS is capable of computing contaminant fluxes for multiple routes, including radioactive decay and contaminant degradation. The paragraph states further that MEPAS was used only for the source-term and vadose-zone models, suggesting MEPAS was not used to model radioactive decay. In contrast, Section 3.2.2 indicates that the transient model for tritium and perchloroethene (PCE) accounts for contaminant decay. Clarify whether the modeling of radionuclide transport through the vadose zone at the MWL accounts for contaminant decay.

3. The first paragraph of Section 3.3 references Table E-2, which provides a summary of input parameters and distributions of constituents used in the modeling. Footnotes "b" and "d" reference an EPA fact sheet for tetrachloroethene; the fact sheet was reportedly accessed on the U.S. EPA website at www.epa.gov/WGWDW/dwh/t-voc/tetrachl.html, but it is not referenced in Section 6, References, of the report. The fact sheet was not available at the web address

provided, so the input parameters could not be verified. Provide the fact sheet as an attachment to the report and update the website address, if available, for the fact sheet. Also, revise Section 6 to include this fact sheet among the references. In addition, provide all other internet-referenced data as attachments to the report and cite these sources in Section 6.

4. Section 3.4.2, page E-35, 2nd paragraph – Explain why future infiltration rates would be less than current rates.

5. Section 3.6, Fate and Transport of Radon – Radon was modeled as originating from radium-226 sources. Explain why radon originating from the decay of depleted uranium was not incorporated into the radon fate and transport model.

6. Section 4, Pages E-59 and E-59a – Revise the trigger evaluation process to follow the corrective action process described in the Consent Order (April 29, 2004) if a trigger level is exceeded (step 3A), provided the Consent Order is still in force at the time the trigger level is exceeded. If the Consent Order has terminated, the trigger evaluation process should follow the standard RCRA corrective action process.

7. Section 3.3 -- The fourth paragraph of Section 3.3 discusses the dose via inhalation and dermal adsorption for gas-phase tritium, but a similar discussion is not presented for radon gas or gas-phase PCE. Clarify whether this dose discussion is applicable to all gas-phase constituents considered in the Report. If the dose discussion is only applicable to gas-phase tritium, then explain why this is the case. Alternatively, discuss inhalation and dermal adsorption doses for radon gas and gas-phase PCE.

8. Section 3.4.1 -- The first paragraph of Section 3.4.1 states the modeling study of water infiltration through the cover was "discretized by placing computational nodes at predetermined vertical spacing in a conceptual soil profile to evaluate the performance of a cover 3 ft in thickness." The model evaluated a soil profile that was actually 6 feet thick in order to avoid impacts due to boundary conditions, but these impacts and boundary conditions are not discussed. Thirty nodes were located within this 6-foot-thick soil profile. However, the discussion does not describe how or why the 30 node locations were predetermined within this soil profile. Explain the specific impacts caused by boundary conditions. Clarify how and why the computational node locations were predetermined.

The conceptual soil profile for the infiltration model, as discussed in Section 3.4.1, is presented side-by-side in Figure E-3 with nodal discretization used in the UNSAT-H model. As illustrated, the conceptual soil profile does not correspond to the components of the MWL soil cover cross-section. The soil profile illustration is dimensionless; i.e., it is not clear whether the soil profile is 6 feet thick. Also, only 23 of the 30 computational nodes within the cross-section are shown. In addition, the nodal depth locations can not be determined from the illustration. Revise the Figure E-3 conceptual model to clearly indicate the components of the MWL soil cover (i.e., subgrade layer, biointrusion barrier, native soil layer, topsoil layer, and vegetation) and their location relative to the MWL waste zone. Revise Figure E-3 to include a vertical scale for depth

(i.e., inches or feet below the cover surface) and the locations of all 30 computational nodes. Clarify the soil type specified for each component of the soil cover.

9. Section 4.2.2 -- Section 4.2.2 discusses the proposed neutron probe system for monitoring moisture content beneath the MWL. However, for the neutron probes to detect percolation through the soil cover, water will have to move through the bio-intrusion barrier, the waste zone, and a portion of the vadose zone prior to detection, which would be expected to require a considerable amount of time. The neutron probe system is thus more reliably a vadose-zone monitoring system rather than a tool to determine loss of integrity of the soil cover. If the Permittees want to monitor the cover for performance, the neutron probes should be placed just below the cover in the subgrade.

10. Figures -- Figures E-13, E-15, E-19, and E-24 present a graphical illustration of the sensitivity analyses performed for some of the constituents. The figures present histograms to compare ΔR^2 for constituent concentration and dose. Clarify why actual concentrations and doses were not presented in the sensitivity analyses.

11. General Comment on the Fate and Transport Model -- Compared to typical reports for modeling studies, the report as presented is brief, particularly when considering the complexity of using a Monte Carlo approach with multiple models, scenarios, and constituents of concern. In general, the report provides a narrative of a probabilistic model that is presented as a "black box." The report discusses the input parameters and selectively presents output results, but there is not adequate information to assess whether the "black box" is operating satisfactorily. The report does not present a discussion regarding software quality assurance – it is not known how well the various models work separately or together. Also, the report does not provide a critique of the modeling runs, except for an occasional qualitative statement. In contrast, a typical modeling report is a detailed and exhaustive presentation that addresses the conceptual development and construction of the model (e.g., the data quality objectives, the software code), the software quality assurance performed (including software validation and verification) to assess model performance both separately and when working together, the details regarding specific inputs and outputs for all runs of every scenario, and a quantitative analysis of the sensitivities of the input parameters, including an assessment of the bias of the model toward specific outputs. The report, however, does not provide this level of information. The Permittees must provide additional information to address the deficiencies mentioned above.

12. Provide information evaluating the risk to ecological receptors for tritium, radon, and radon daughter products, which are expected to be released to surface soil and the atmosphere.

13. Provide information evaluating the risk to human receptors for tritium, radon, and radon daughter products that would be expected to be released to surface soil and the atmosphere. Include external exposures.

14. The NMED expects surface soil surrounding animal borrows (including ant nests) to be monitored for radionuclides and metals. Develop triggers that are protective of both human health and the environment for radionuclides and metals in soil.

15. Develop triggers for tritium, radon, PCE and total VOCs as soil vapor. The NMED expects soil-gas in the vadose zone to be monitored for these constituents.

16. Table E-6 – The proposed trigger value for "infiltration" is 25% by volume. Specify whether "infiltration" means moisture content. Also, the proposed trigger is too high, as it likely represents conditions whereby there is near complete saturation of the soil.

17. Provide NMED a copy of the reference: Johnson et al (1995), *A Human Health Risk Assessment for the Mixed Waste Landfill, Sandia National Laboratories, Albuquerque, New Mexico*, Argonne National Laboratories, Argonne, IL.

18. Table E-6, the proposed trigger levels for 1,1,1-TCA, ethylbenzene, styrene, toluene, and total xylenes in groundwater are set too high. For these unnatural constituents, the levels of detection normally achieved by laboratories are much lower than groundwater standards set by the New Mexico Water Quality Control Commission (WQCC). The trigger levels can be set to much lower levels, and still allow for a given trigger level to be sufficiently above the limit of detection such that the constituent can be readily quantified with a high degree of confidence. Additionally, trigger levels should be set well below WQCC standards or below U. S. Environmental Protection Agency Maximum Contaminant Levels so that there will be time to react to prevent unacceptable levels of contamination should any trigger levels be exceeded.

19. Propose some additional monitoring to be conducted at locations within the landfill where contaminants were detected at their highest levels during the RFI. These locations should be subject to the same triggers as those proposed as points of compliance in Table E-6.

20. Expand the listing of proposed monitoring triggers in Table E-6, giving consideration of the following table:

Environmental Medium	**Monitoring Parameters**	**Main Potential Receptors**	**Sampling Points**
Air	radon, tritium	humans	landfill perimeter and interior stations
Surface Soil	radon, tritium, other radionuclides, metals	humans and ecological receptors	landfill perimeter, interior stations, and animal burrows located on cover
Subsurface Soil	moisture	humans via groundwater	neutron probe monitoring wells
Subsurface Soil Gas	radon, tritium, VOCs	humans via groundwater	beneath landfill
Groundwater	tritium, radon, isotopic uranium,VOCs	humans	down gradient groundwater monitoring wells

Radionuclides (other than radon and tritium) and metals should be the same as those listed in Table E-2. VOCs should include PCE, all organic constituents listed in Table E-6, and all other organic constituents normally detected by method 8260. NMED reserves the right to require additional monitoring pending review of the long-term monitoring and maintenance plan to be submitted later by the Permittees and pending receipt and review of public input of this latter mentioned plan.

General Comments and Requirements for Soil-Gas Sampling

As the Permittees are aware, most site characterization data for the MWL (other than groundwater data) dates before the mid 1990's. Because the rupturing of containers and the leaking of their contents could have occurred since the mid 1990's, the NMED requires more current soil-gas data to help resolve this issue. The Permittees shall therefore collect and analyze active soil-gas samples taken at depths of 10 and 30 feet at a minimum of three locations within the landfill where previous sampling has detected the highest soil-gas concentrations in the past. The soil-gas samples shall be analyzed for volatile organic compounds, tritium, and radon. Pursuant to Section VI.A of the Order on Consent (April 29, 2004), the Permittees shall provide for approval to the NMED within 30 days of receipt of this letter a work plan to conduct the active soil-vapor sampling described above. The work plan shall be prepared in accordance with Section X.B of the Consent Order.

Please contact William Moats of my staff at (505) 222-9551 if you have any questions.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

JPB:wpm

cc: J. Kieling, NMED, HWB
W. Moats, NMED, HWB
L. King, EPA-Region 6 (6PD-N)
J. Gould, DOE/NNSA/SSO, MS 0184
P. Freshour, SNL, MS 1087
File: Reading and SNL, 2006

Volume I

TAB 10

NMED Responses to Public Comments on the Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005

From: NMED/Kieling
To: Interested Citizen

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State of New Mexico
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BILL RICHARDSON
GOVERNOR

RON CURRY
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November 21, 2006

SUBJECT: NMED RESPONSES TO PUBLIC COMMENTS ON THE SANDIA NATIONAL LABORATORIES' MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION PLAN

Dear Interested Citizen:

On November 3, 2005, Sandia National Laboratories (SNL) submitted to the New Mexico Environment Department (NMED) for approval a Corrective Measures Implementation (CMI) Plan pursuant to Sections IV.D and XI of the Compliance Order on Consent (April 29, 2004), and the Secretary's Final Order (May 26, 2005), *In the Matter of Request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill, Sandia National Laboratories, Bernalillo County, New Mexico, EPA ID No. NM5890110518.*

A public meeting was conducted on the technical merits of the CMI Plan on May 25, 2006. A public comment period was held from December 9, 2005 to February 7, 2006, and from May 25, 2006 to June 8, 2006. NMED's responses to public comment on the CMI Plan are available at the NMED web page at *http://www.nmenv.state.nm.us/hwb/snlperm.html* under Mixed Waste Landfill.

NMED's review of the CMI Plan has revealed several deficiencies that must be corrected before implementation of the CMI work. The letter addressing these deficiencies is available on the NMED web page as noted above.

Sincerely,

John E. Kieling
Program Manager
Permits Management Program
Hazardous Waste Bureau

Index of Public Comments Received:
Sandia National Laboratories Mixed Waste Landfill Corrective Measures Implementation Plan
November 2006

Commenter ID	Date of Letter or e-mail	Association/Commenter
A	1/25/06 (rec'd 1/27/06)	Citizen, Donna Detweiler
B	1/28/06 (rec'd 1/31/06)	Citizen, Floy J. Barrett
C	1/28/06 (rec'd 1/31/06)	Citizen, David M. Brugge
D	1/28/06 (rec'd 1/31/06)	Citizen, Maurice Weisberg, MD
E	Not dated (rec'd 2/06/06)	Albuquerque Center for Peace and Justice and Citizens for Alternatives to Radioactive Dumping, Dorelen Bunting and Janet Greenwald
F	2/06/06 (rec'd 2/06/06)	Loretto Community of Catholic Sisters and Co-members, Penelope McMullen
G	2/07/06 (rec'd 2/07/06) (rec'd 5/03/060	Citizen, John Tauxe, Ph.D., PE
H	2/07/06 (rec'd 2/07/06)	Citizen Action New Mexico, Susan Dayton (Comments compiled by Paul Robinson, Southwest Research and Information Center)
I	6/07/06 (rec'd 6/07/06) Meeting 7/19/06	Citizen Action New Mexico, Susan Dayton (Comments compiled by Paul Robinson, Southwest Research and Information Center)
J	6/08/06 (rec'd 6/08/06) Meeting 7/19/06	Citizen, Robert H. Gilkeson
K	6/08/06 (rec'd 6/08/06)	Nuclear Watch of New Mexico, Scott Kovac (Comments compiled by Paul Robinson, Southwest Research and Information Center; and Robert H. Gilkeson)
L	6/08/06 (rec'd 6/08/06)	Citizens for Alternatives to Radioactive Dumping, Janet Greenwald
M	6/08/06 (rec'd 6/08/06)	Embudo Valley Environmental Monitoring Group, Sheri Kotowski (Comments compiled by Paul Robinson, Southwest Research and Information Center; and Robert H. Gilkeson)
N	6/08/06 (rec'd 6/08/06)	Concerned Citizens for Nuclear Safety, Joni Arends

Commenter ID	Date of Letter or e-mail	Association/Commenter
O	6/08/06 (rec'd 6/08/06)	Citizen, Jamie Wells
P	5/30/06	Citizen, Krishan Wahi
Q	6/08/06 (rec'd 6/08/06)	Citizen, Willard Hunter

NMED Response to Public Comments on the Mixed Waste Landfill (MWL) Corrective Measures Implementation (CMI) Plan November 2006

Commenter ID	Commenter / Association	Topic Area	Comment Summary	NMED Response Number	NMED Response
A	**Citizen, Donna Detweiler**	Groundwater Contamination	The commenter was concerned regarding possible contamination of groundwater resulting from releases from the MW, particularly contamination of the Burton Well serving the Kirtland Addition neighborhood. Commenter stated that the fate and transport model (FTM) indicates contamination may reach groundwater in as little as 50 years. The commenter believes there is "much good housing stock here," an apparent reference to the Kirtland Addition neighborhood, and expresses concern that it will be condemned as unlivable in the future.	R1	The low levels of contaminants released from the Mixed Waste Landfill (MWL) have not caused groundwater to become contaminated beneath the landfill and are unlikely to cause groundwater contamination in the future. The fate and transport model (FTM) recently completed by Sandia predicts little chance that groundwater contamination will occur. None of the modeled radionuclides and heavy metals was simulated by the FTM to reach groundwater during the 1,000-year performance period or the extended 10,000-year period. Tritium is the primary radiological contaminant released from the landfill. Both the FTM and modeling done by the WERC predict that the tritium released into the vadose zone will not contaminate groundwater. Furthermore, the FTM suggests that concentrations of perchloroethene (PCE) will peak in less than 50 years for the majority of the model runs. While only 1% of the model runs indicates that PCE concentrations will exceed the regulatory maximum contaminant level (MCL) of 5µg/L, the modeled contamination should have already occurred. Groundwater monitoring during the past 16 years has not detected contaminants in groundwater from the MWL at any level. This is strong evidence that the FTM may be overly conservative. Of the 100 runs, about 40% resulted in predicted PCE concentrations that were below the level of detection. Given that the FTM is conservative (e.g., it ignores dilution of PCE once groundwater is reached; is one-dimensional and thus allows only vertical migration of PCE; it uses PCE source levels up to 10 times that of the maximum level actually detected; the
D	**Citizen, Maurice Weisberg, MD**		The commenter stated that the protection of the integrity of our aquifers is a matter of urgent national security for public health and economic stability. The commenter referenced the National Academy of Science, which reported in 2000 that most of the nuclear bomb sites will never be cleaned up enough to allow public access to the land and the plan for guarding these sites cannot guarantee the safety of the public.		

Commenter ID	Commenter / Association	Topic Area	Comment Summary	NMED Response Number	NMED Response
			The commenter is also concerned about the leaching of radioactive materials from the MWL and their transport through the vadose zone to groundwater. The commenter references the SNL Chemical Waste Landfill and the Liquid Waste Disposal System as sources of groundwater contamination through a similar pathway. Additionally, the commenter is concerned that liquid waste was disposed in the MWL prior to 1972 and that it has leached from the MWL to groundwater. The commenter also states that tritium is expected to contaminate groundwater is less than ten years, and that it is well known that all landfills leak in wet or dry areas, especially if they are unlined and in porous or sandy soils. The commenter also states that movement of nuclear debris through soil is more rapid than DOE and the nuclear labs have maintained. Contaminants like Sr-90, tritium, and PCE move rapidly in plumes, and that plutonium has different rates of migration depending on local geologic conditions and preferred pathways.		low levels of contaminants released from the MWL have not caused groundwater contamination over the 57-year life of the landfill,) the NMED believes that PCE will not reach groundwater at any detectable level. Although vapor phase migration has played an important role in the contamination of groundwater at the Chemical Waste Landfill, aqueous transport was the dominant mode of migration of contaminants at the Liquid Waste Disposal System (LWDS). Thus, the LWDS site is dissimilar to the MWL. The CWL is also different in that the maximum VOC concentrations of soil gas observed at the Chemical Waste Landfill were several orders of magnitude higher than that detected at the MWL. NMED agrees that all landfills are expected to leak contaminants. However, not all releases pose threats to human health and the environment. PCE and tritium can migrate rapidly in the vadose zone in the vapor phase, and have done so at the MWL. However, as has been mentioned numerous times by the NMED, the levels of PCE and tritium detected at the MWL do not pose significant risk to human health and the environment. Plutonium and Sr-90 migrate with water. The cover proposed for the MWL will reduce the amount of water percolating through the landfill, and thus will prevent the migration of Sr-90 and plutonium. Furthermore, based on what is known about the inventory, it is highly unlikely that there is a sufficient amount of plutonium and Sr-90 in the landfill to threaten groundwater. As mentioned previously, none of the modeled radionuclides and heavy metals was simulated by the FTM to reach groundwater during the 1,000-year performance period or the extended 10,000-year period. See also NMED response R5.

Commenter ID	Commenter / Association	Topic Area	Comment Summary	NMED Response Number	NMED Response
F	**Loretto Community of Catholic Sisters and Co-members, Penelope McMullen**		The commenter states the FTM concluded that contaminants from the MWL will reach Albuquerque's sole-source aquifer within 50 years. The commenter considers the seriousness of potentially contaminated drinking water and states that the FTM and the Corrective Measure Implementation Plan are dangerously inadequate.		
H	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)		The commenter states the model concludes that PCE, the only organic compound modeled, would reach groundwater for all 100 model runs ("realizations") with the majority of the model runs showing PCE reaching groundwater within 50 years.		
A	**Citizen, Donna Detweiler**	Excavation as a remedy	The commenter would like to see the waste removed and disposed elsewhere away from a large population area.	R2	The NMED previously held a public comment period and public hearing regarding the corrective measures study (CMS) conducted for the MWL. After carefully considering public comment and evidence presented at the public hearing, the Secretary determined that the MWL should be immediately stabilized using a vegetative cover with bio-intrusion barrier in order that Albuquerque's groundwater be protected, to ensure protection of human heath and the environment from radiation emanating from waste in the landfill, and to protect workers from needless exposure to radiation. While groundwater beneath the landfill is not contaminated by releases from the landfill, and likely will never be, the DOE is
B	**Citizen, Floy J. Barrett**		The commenter stated that the people of New Mexico deserve to have the laboratories of this state comply with every possible safety procedure. The commenter believes the MWL model for containment does not insure long-term safety of groundwater and soil.		

Commenter ID	Commenter / Association	Topic Area	Comment Summary	NMED Response Number	NMED Response
			The commenter also stated there is still time to continue to study and reassess the issues noted by the commenter. The commenter also stated NMED has an obligation to require that Sandia National Laboratories complete reassessments.		required to monitor both the landfill and the groundwater to ensure a timely response in the unlikely event of significant contaminant migration or groundwater contamination. The final order signed by the Secretary requires that the effectiveness of the cover and the feasibility of excavation be re-evaluated every five years; the FTM is also to be updated. The vegetative soil cover with bio-intrusion barrier is feasible to implement, will maintain a low and thus acceptable level of risk to the public, workers, and the environment, is a proven reliable and effective technology, and will further reduce waste mobility. The remedy will prevent wastes from endangering our citizens, our ground water, and our environment by minimizing the infiltration and percolation of moisture into the landfill, by preventing the intrusion of small animals into waste, and by shielding people and the environment from harmful radiation. There is no new information in the FTM that suggests that the NMED should defer approval of the CMI Plan. The FTM's prediction that there is only a small chance that groundwater will become contaminated at levels exceeding regulatory standards corroborates and validates NMED's existing testimony presented at the hearing held on the Corrective Measures Study. Hence, there is no new information generated by the FTM that would form the basis for a different remedy for the landfill. The results instead strongly support the NMED's chosen remedy (cover with bio-intrusion barrier) as an acceptable alternative that is protective of human health and the environment.
C	**Citizen, David M. Brugge**		The commenter states that he had heard that the plan considered economy over safety.		
D	**Citizen, Maurice Weisberg, MD**		The commenter supports the excavation of all mixed wastes buried in unlined, unregulated, and unpermitted pits and trenches and their transfer for storage in hardened facilities above ground. The commenter also referenced Dr. Arjun Makhijani, of the Institute of Energy and Environmental Research (IEER), who supports excavating buried nuclear waste sites as a priority for shipment to a repository.		
F	**Loretto Community of Catholic Sisters and Co-members, Penelope McMullen**		The commenter supports the excavation of the MWL and development of a comprehensive clean up plan to contain the waste in a safer area.		
H	**Citizen Action**		The commenter requests that NMED		

Commenter ID	Commenter / Association	Topic Area	Comment Summary	NMED Response Number	NMED Response
	New Mexico, Susan Dayton (Comments compiled by Paul Robinson, Southwest Research and Information Center)		consider requiring improvements in the Corrective Measure proposed for the MWL to prevent future releases of VOCs and SVOCs.		
I	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)		The commenter states that NMED should defer final approval of Mixed Waste Landfill CMI Plan pending review of a remedy based on new information in the FTM and additional information provided in response to NMED queries.		
Q	**Citizen, Willard Hunter**		The commenter states that he has rarely seen a more proud organization than SNL and notes that he is a former employee. The commenter states, however, that money should be spent on proper waste disposal. The commenter also states that DOE has experience with clean-up alternatives, including rehabilitation of nuclear waste sites, which could be applied to the MWL.		

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B	**Citizen, Floy J. Barrett**	Bio-transport of contaminants	The commenter is concerned that Sandia's FTM is not comprehensive and does not consider biological transport of contaminants.	R3	The model did not address biological transport. The NMED questions whether source terms and biological transport rates can be reasonably and realistically estimated to generate meaningful results. Models, even as powerful as the ones used for the MWL FTM, have limitations. It is unreasonable to expect the Permittees to evaluate the migration of contaminants caused by what might be thousands of individual species of fungi, mold, bacteria, viruses, and microbes that can be found at the MWL site. NMED agrees that burrowing animals and roots can cause the migration of contaminants to the ground surface. Once on the surface, such contaminants can continue to migrate by the activities of other animals, wind erosion, and surface-water erosion/solution. In the case of the MWL, bio-intrusion, even by ants, is not expected to play a major role in the migration of contaminants because the wastes are relatively insoluble and the debris items mostly large in size. Analytical results of surface-soil samples have demonstrated that since closure of the landfill and the beginning of its operation in 1958, the bio-transport of contaminants has been essentially nonexistent as contaminants migrating by this method, if any, have not been detected above background conditions. Given that the bio-transport of contaminants has not been an important factor for the migration of contaminants in the past, the required bio-intrusion barrier should limit even more so the ability of burrowing animals to bring debris contaminated with chemical and radiological constituents (such as radon-222, radium-226, and uranium-238) to the surface. The barrier should also help limit root penetration which would otherwise assist in the movement of tritium to the surface. As a matter of precaution, the NMED nevertheless intends to require the Permittees to monitor surface soil, including animal burrows and ant mounds.
C	**Citizen, David M. Brugge**		The commenter states that biological transport of contaminants is not limited to reptiles, mammals, birds, and amphibians. The commenter believes that invertebrates, surface and subsurface flora, fungi, molds, bacteria, and other species should be considered. The commenter suggests that the model should address soil bacteria and possibly viruses that become airborne during windy drought conditions at the MWL area. The commenter also suggested that the agent responsible for valley fever may mutate in the MWL area.		
D	**Citizen, Maurice Weisberg, MD**		The commenter stated that biotransport of radioactive contaminants is likely to occur over time and increasingly over the long term. The commenter also referenced Dr. Peter Montague, director of Rachel's Environment and Health Weekly, who indicated 5 or 6 reasons why dirt caps and vegetative covers fail. Among the problems are deep root systems extending as much as 20-30 feet below the surface, burrowing		

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			rodents and insects, erosion, and cave-ins due to collapsing wastes, drums, and debris.		The NMED believes that the rock intrusion barrier will be very effective in preventing animals from burrowing into the landfill. After subgrade preparation, the actual depth to waste will average about two times the thickness of the cover.
F	**Loretto Community of Catholic Sisters and Co-members, Penelope McMullen**		The commenter states the FTM needs to be revised to consider possible transport of contaminants through animals and plants. The commenter also states the FTM needs to be revised to consider the ineffectiveness of a rock bio-intrusion barrier.		It is common practice to construct bio-intrusion barriers from rock; an exhaustive search of the literature concerning the design of rock bio-intrusion barriers is unnecessary. Monitoring systems will be justified and their designs presented in the long-term monitoring and maintenance plan. After a long-term monitoring plan is approved, additional surface-soil sampling will be conducted and the level of risk re-evaluated at a minimum of every five years.
G	**Citizen, John Trauxe, Ph.D., PE**		The commenter believes that the most significant oversight in the contaminant transport modeling of the MWL is the lack of any contributions to transport by biotic activity. The commenter believes this should have been identified in the preliminary exercise of identifying significant features, events, and processes affecting contaminant transport at the site. The commenter notes that recent work at other DOE sites (including Los Alamos National Laboratory and Nevada Test Site) has found that biotic activity in the form of plant uptake and redistribution of contaminants and animal translocation of bulk (contaminated) materials can be significant or even dominant modes of contaminant transport. The commenter states that		

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			in arid environments, plants tend to extend roots to significant depths in search of water, while ants have been found to construct nests to depths of several meters. The commenter believes that a cap thickness of a meter is ineffective at keeping these biota out of the waste in the MWL. The commenter also notes that the model document includes the development of a method for predicting the ground surface flux of radon-222 (^{222}Rn) above the MWL, as a linear function of the concentration of its parent, radium-226 (^{226}Ra), at depth in the MWL. The commenter believes this model is fine under the assumption that all the ^{226}Ra stays at depth, but notes that if biotically-induced transport of waste materials is included as a contaminant transport process, the ^{226}Ra parent material (as well as its parents, such as uranium-238 [^{238}U]) will move into the cap itself and onto the ground surface. The commenter notes that this does not fit the current radon diffusion model assumptions, and suggests that this modeling must employ more sophisticated techniques. The commenter also states that decay cascades can produce		

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			significant doses, and should not be neglected in the dose assessment process. The commenter notes that when coupled with biotic processes in the cap, there is a possibility of bringing radionuclides to the surface. In a May 3, 2006 e-mail to the NMED, the commenter repeats his concern that bio-transport may be significant and that the rock bio-intrusion barrier will not prevent ants and roots from penetrating to depths below the barrier. He also repeats that radionuclides can be brought to the surface by bio-transport, and that the decay products of such radionuclides may pose a threat.		
H	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)		The commenter stated that the FTM is not comprehensive with respect to the potential for releases including vadose zone and groundwater contamination due to transport not considered in the model, including mechanisms such as biological transport of contaminants through the ground surface, human intrusion, and movement of contaminants by wind/air. The commenter also stated that the fate and transport model does not address biological transport of		

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			contaminants resulting from plant and animal uptake of contaminants and subsequent dispersion of soil, plant and animal material by wind. The commenter believes this information is required for a comprehensive model. The commenter also states that the CMI plan does not address the technical literature related to bio-intrusion barriers or identify monitoring systems appropriate for detection of releases associated with bio-intrusion into the MWL. The commenter requests revision of the CMI plan to include a thorough investigation and re-sampling of the soil at the MWL to identify bio-intrusion mechanisms and biological transport of contaminants, and consider the applicability of findings of such investigations to the Corrective Measure for the MWL.		
O	**Citizen, Jamie Wells**		The commenter recommends establishing a program to monitor plants and animals to ensure bioaccumulation and/or transportation of constituents of concern from the MWL do not occur.		

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B	**Citizen, Floy J. Barrett**	Human intrusion and institutional controls	The commenter is concerned that Sandia's FTM is not comprehensive and does not consider human intrusion.	R4	The model does not address human intrusion. Institutional controls will be implemented to prevent human intrusion onto and into the landfill. Under EPA regulations, there is no requirement that a facility must assume a loss of institutional controls and evaluate the construction and occupation of a residence constructed on a landfill. This is a reasonable approach as land zoned as industrial tends to remain industrial. Moreover, should SNL choose to change the land use, enforceable provisions in SNL's RCRA permit require public notice and NMED approval of any cleanups that would need to be conducted, given the new land use. Although the NMED can not say with certainty whether a terrorist act could be successfully launched against the landfill, the MWL site is undoubtedly more secure than most landfills given the nature of the classified work that takes place within Technical Area 3, and is a far less desirable target compared to other facilities at KAFB and SNL.. NMED intends to enforce institutional controls through the Permittees' permit as long as such controls are needed. The FTM makes predictions concerning the future migration of contaminants from the landfill. The model does not make regulatory decisions regarding the implementation of institutional controls, ensuring such controls remain in force in the future, and what must be done in the event of a failure of the remedy.
C	**Citizen, David M. Brugge**		The commenter believes that human intrusion into the MWL is a serious issue requiring further consideration. The commenter suggested there is potential for terrorist explosion in or adjacent to the MWL, which would effectively create a "dirty bomb."		
F	**Loretto Community of Catholic Sisters and Co-members, Penelope McMullen**		The commenter states FTM needs to be revised to consider the comprehensive modeling of institutional controls against human intrusion.		
G	**Citizen, John Trauxe, Ph.D., PE**		The commenter believes that a reasonable potential future receptor scenario includes a residence built directly on top of the MWL. The commenter notes that with ongoing development in the Albuquerque area and a precedent of residential construction on old landfills (e.g., Love Canal, New York), this would trigger the analysis of additional exposure pathways as well, such as exposure to indoor air with its elevated concentrations of gaseous radionuclides and volatile organic compounds (VOCs).		

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H	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)		In a May 3, 2006 e-mail to the NMED, the commenter repeats his concern that one should assume a loss of institutional controls and that structures could be built on the landfill in the future. The commenter stated that the FTM is not comprehensive with respect to the potential for releases including vadose zone and groundwater contamination due to transport not considered in the model, including human intrusion. The commenter also stated that the FTM does not address transport of contaminants resulting from human intrusion associated with accidental events and the eventual failure of the land use restriction portions of the institutional controls proposed by Sandia for the MWL. The commenter believes this information is required for a comprehensive model. The commenter also stated that the FTM does not identify means to monitor, model and assure the effectiveness of institutional controls or the consequences of the failure of such passive site protection measures.		

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Q	**Citizen, Willard Hunter**		The commenter states that he is concerned regarding the level of security provided for the MWL.		
B	**Citizen, Floy J. Barrett**	Model does not consider all waste types present in the landfill	The commenter is concerned that Sandia's FTM is not comprehensive and does not consider beryllium and metallic sodium as potential contaminants of concern. The commenter is also concerned that Sandia's FTM is not comprehensive and does not consider appropriate "trigger levels" for all contaminants in the known inventory.	R5	The model generally considers only those waste types that have the highest potential for migration and pose an unacceptable risk to the environment. The modeled waste types are chiefly those that are known to occur in large amounts in the landfill, and/or those that migrate easily in the vapor phase. There are hundreds of waste types in the landfill that occur in small quantities and most of these waste types have limited ability to migrate in the absence of water. It would be a poor use of time and money for the Permittees to model and develop triggers for all waste types when in reality few, if any, are likely to pose unacceptable risk to the environment. Based on the inventory, beryllium, sodium, lithium, and probably all SVOCs do not occur in sufficient quantities in the landfill such that if released they would pose unacceptable risk. For this reason, MNED does not believe it necessary to include them with the important waste types that should be modeled. The FTM utilized PCE as a surrogate VOC due to its presence in the MWL as the VOC with the highest *average* concentration in soil vapor, its greater mobility in the environment, and its tendency to migrate downward towards groundwater. A constituent with a greater maximum concentration than PCE is not necessarily a potentially more significant problem because the constituent may not be as mobile, as abundant, or toxic as PCE.
E	**Albuquerque Center for Peace and Justice and Citizens for Alternatives to Radioactive Dumping, Dorelen Bunting and Janet Greenwald**		The commenter supports consideration of all the contaminants for trigger levels.		
F	**Loretto Community of Catholic Sisters and Co-members, Penelope McMullen**		The commenter states the FTM needs to be revised to consider the modeling of all hazardous chemicals and volatile organic compounds known or suspected to be in the MWL.		

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			The commenter also states the FTM needs to be revised to consider the modeling of all potential new compounds which could be formed as a result of mixing radionuclides with non- radioactive materials.		
H	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)		The commenter stated that the FTM is not comprehensive with respect to the modeling for the complete suite of radionuclides and daughter products, metals, and volatile and semi-volatile organic compounds in the known inventory of the MWL, including beryllium, nickel, chromium, sodium, lithium, and the range of volatile organic compounds (VOCs) present at the MWL.		
I	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)		The commenter recommends that an enhanced version of the FTM be run for the full range of VOCs identified in soil in the MWL RFI Phase 2 Report including, but not limited to dichloro-difluoromethane; trichloroethene; 1,1,1-trichlorethane (TCA), toluene, ethylbenzene, xylene, 1,1,2-tri-chloro-trifluoroethane, dichloroethyne, acetone, isopropyl ether, 1,1-dichloroethene and styrene. The MWL RFI Phase 2 Report identifies dichloro-difluoromethane concentrations of 29,000 ppb at 10 feet and 21,500 ppb at 30 feet at Fig. 4.5 – 16 and Fig. 4.5-22, which		

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			are 4-5 times higher than the concentrations of PCE detected at those depths in the same report.		
B	**Citizen, Floy J. Barrett**	Triggers associated with the model do not include monitoring plants, animals, and humans	The commenter is concerned that Sandia's FTM is not comprehensive and does not consider animals, plants, and humans as "triggers."	R6	Triggers are not included for the monitoring of plants, animals, and humans because there are no regulatory standards under RCRA for comparison, and more useful triggers can be established for surface soil by using conventional methods that consider human and ecological risk factors. This is why surface soils rather than plant, animals, and humans, will be monitored for contaminants. Additionally, the NMED can not require the monitoring of humans if the people involved do not wish to be subjected to testing.
E	**Albuquerque Center for Peace and Justice and Citizens for Alternatives to Radioactive Dumping, Dorelen Bunting and Janet Greenwald**		The commenter believes that plants and animals, if found to be contaminated, should be considered a trigger.		
O	**Citizen, Jamie Wells**		The commenter recommends establishing human population level triggers and corrective actions if these trigger are reached.		
B	**Citizen, Floy J. Barrett**	Risk Assessment	The commenter is concerned that Sandia's FTM is not comprehensive and does not consider conducting a risk assessment for the FTM that includes all waste types buried at the MWL, not just the risk posed by tritium as currently considered by	R7	Risk assessments for the MWL are found in the Phase II RCRA Facility Investigation and the Corrective Measures Study Reports. The purpose of the FTM is to predict the future movement and fate of contaminants from the landfill. Although the FTM makes comparisons to regulatory standards which are based on human health risk assessment, the FTM is not a risk assessment.

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			the assessment.		See also NMED response R5 concerning the issue that the FTM does not consider all waste types present in the landfill.
E	**Albuquerque Center for Peace and Justice and Citizens for Alternatives to Radioactive Dumping, Dorelen Bunting and Janet Greenwald**		The commenter requests consideration of all contaminants in the MWL when calculating the risk to the surrounding community.		
F	**Loretto Community of Catholic Sisters and Co-members, Penelope McMullen**		The commenter states the FTM needs to be revised to consider performing a risk assessment for all waste types buried in the MWL.		
H	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)		The commenter stated that FTM does not provide a risk assessment/performance assessment analysis in its evaluation of the potential for release of contaminants from the MWL.		
B	**Citizen, Floy J. Barrett**	New data is needed for model input	The commenter is concerned that FTM is not comprehensive and uses data that are outdated. Commenter believes new data should be gathered to verify the validity of the	R8	Groundwater data has been collected through April 2006, and several sampling events were conducted in the early to late 1990's to characterize surface soil for radionuclides, metals, and tritium emissions.

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			modeling.		Additional data, including soil and soil vapor data, will be acquired once the long-term monitoring and maintenance plan is approved and implemented. Cover construction and preparation of a long-term monitoring and maintenance plan must be completed so that new monitoring data can be obtained to update the FTM as required by the NMED Secretary's Order.
F	**Loretto Community of Catholic Sisters and Co-members, Penelope McMullen**		The commenter states FTM needs to be revised to consider recent data to verify the validity of FTM, since the data used are outdated by at least 10 years.		
H	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)		The commenter states that the model relies on data regarding releases of radionuclides, heavy metals, and volatile organic compounds from the Phase 1 and Phase 2 RCRA Feasibility Investigation (RFI) gathered in 1993 – 1995. The commenter states that no new data was gathered or proposed to calibrate or verify the modeling.		
I	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)		The commenter recommends implementation of a subsurface sampling program to identify distribution of VOCs detected in the MWL RFI Phase 2 Report to verify and/or refine FTM model results, applying appropriate QA/QC methods including split sampling with NMED incorporating duplicates and blank samples to verify analytic accuracy.		
O	**Citizen, Jamie Wells**		The commenter recommends verification of the FTM after acquiring new data.		

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C	**Citizen, David M. Brugge**	Duration of NMED oversight	The commenter acknowledges New Mexico's oversight is limited to the effects that are predictable during the next 30 years. The commenter suggests that the State should review the threat of adverse impacts on water, air, and safety within the Mesa del Sol development area and possibly impacts to land values, even though the critical stages of these threats are beyond the 30-year oversight period. The commenter suggests that impacts to land values will prevent the University of New Mexico from receiving the full benefit of the Mesa del Sol development. The commenter suggests that the university and the State may have potential liability for any damages.	R9	The NMED intends to enforce controls on the MWL for as long as they are needed. The NMED considered the future migration of contaminants when selecting the remedy for the MWL, and did not limit its consideration of this matter to a 30 year period, as many contaminates could take hundreds of years to reach groundwater. The NMED considered the types and amounts of waste known or suspected to be buried in the landfill, the potential for waste and waste constituents to migrate and their pathways, the levels and risk of current releases of contaminants, and the geologic, hydrologic, and climatic conditions present at the MWL. Using this information, and an assessment of the current and expected future risk, the NMED concluded that the MWL did not pose a current or future threat to human health and the environment. The FTM validates this conclusion.
C	**Citizen, M. Brugge**	Endorses comments made by Citizen Action	The commenter states that he agrees with all comments made by Citizen Action.	R10	See NMED responses to Citizen Action Comments, Commenter identification “H” and “I”.
E	**Albuquerque Center for Peace and Justice and Citizens for Alternatives to Radioactive Dumping, Dorelen Bunting and Janet Greenwald**		The commenter supports the comments submitted by Citizen Action concerning the MWL at Sandia National Laboratories and specifically the FTM.		

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K	**Nuclear Watch of New Mexico, Scott Kovac** (Comments compiled by Paul Robinson, Southwest Research and Information Center; and Robert H. Gilkeson)		The commenter states that Nuclear Watch of New Mexico endorses the recommendations of the comments submitted to NMED by Citizen Action.		
L	**Citizens for Alternatives to Radioactive Dumping, Janet Greenwald**		The commenter states that Citizens for Alternatives to Radioactive Dumping endorses Citizen Action's recommendations concerning the MWL.		
M	**Embudo Valley Environmental Monitoring Group, Sheri Kotowski**		The commenter states that the Embudo Valley Environmental Monitoring Group endorses the recommendations of the comments submitted to NMED by Citizen Action.		
N	**Concerned Citizens for Nuclear Safety, Joni Arends**		The commenter states that the CMI Plan should be denied until all recommendations made by Citizen Action are resolved to Citizen Action's satisfaction.		
E	**Albuquerque Center for Peace and Justice and Citizens for Alternatives to Radioactive**	Vadose zone Monitoring	The commenter believes that contaminants in the vadose zone should be a trigger.	R11	The NMED agrees that soil gas in the vadose zone should be monitored for tritium, radon, and VOCs. The NMED will require the Permittees to develop triggers for soil gas for these radiological and chemical constituents, and include them in the long-term monitoring and maintenance plan. This plan is due 180 days following approval of the CMI Report.

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	Dumping, Dorelen Bunting and Janet Greenwald				The NMED has no authority to enforce DOE Orders, but does have the authority under State law to require the installation of vapor monitoring wells at the MWL. If the commenter believes that requirements of DOE Orders are not being met, the commenter should direct these particular concerns to the DOE.
H	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)		The commenter states that the model does not identify trigger levels for waste constituents that apply at the edge of the MWL or in the vadose zone below the site, but above the water table.		
I	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)		The commenter recommends establishment of a shallow (less than 50 foot depth) subsurface monitoring program in the vadose zone for detection of VOCs as part of long-term a maintenance and monitoring plan and apply triggers at those sites.		
J.	**Citizen, Robert H. Gilkeson**		The commenter states that the wells are not installed and are needed in the unsaturated strata beneath the landfill to monitor the levels of toxic volatile contaminants (e.g., PCE, TCE, TCA, etc.) and tritium that are released over time from the landfill. The commenter also indicates that		

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			monitoring wells in the vadose zone are required by DOE Order 450.1 for early identification of the release of contamination from the MWL.		
O	**Citizen, Jamie Wells**		The commenter recommends conducting characterization of the site to understand the current situation of the landfill inventory before conducting work, including vadose zone sampling.		
F	**Loretto Community of Catholic Sisters and Co-members, Penelope McMullen**	Long-term monitoring	The commenter states the FTM needs to be revised to consider a plan for monitoring, testing and dealing with contaminants that may show up in the future. The commenter also states the CMI plan should be revised to include full long-term monitoring and maintenance program for public review and comment.	R12	The Secretary's Order requires the Permittees to submit a long-term monitoring and maintenance (LTM) plan within 180 days after approval of the Corrective Measures Implementation Report. The monitoring plan will be designed after the remedy is completed and, thus, the end state of the landfill is known. This is an entirely appropriate sequence. The FTM is not a long-term monitoring and maintenance plan, nor was it intended to be one. The Order states that the long-term monitoring and maintenance plan shall be subject to public review and comment.
H	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)		The commenter stated that the "triggers" identified in the model do not include monitoring mechanisms to reflect either human intrusion, biological transport, or the waste constituents identified at the MWL. The commenter also states that the model discussion of "Trigger Levels"' does not address the degree to which monitoring for moisture content changes would reflect vapor		The scope of the monitoring, sampling and analysis, quality control, frequency, triggers, and the technologies to be utilized are to be detailed in the long-term monitoring and maintenance plan. However, sampling and analysis will be required for a wide range of potential contaminants, and will not be limited to just tritium. Sampling will include animal burrows and ant mounds to assess bio-transport of contaminants, if any. The plan will include monitoring of air, surface soil, subsurface soil gas, and groundwater, but not the monitoring of plants and animals unless required by the DOE (see NMED response R6). The plan must contain contingency procedures should the remedy fail to be protective.

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			phase movement of VOCs. The commenter requests that the model identify technologies that could be used to monitor moisture content. The commenter is also concerned that the CMI plan does not provide a comprehensive or detailed long-term operation and maintenance plan for public comment or review. The commenter requests that the CMI plan include a long-term monitoring and maintenance program that addresses: all parameters to be monitored, all media – including air, soil, vadose zone, groundwater and biota (plants and animals); recommended limits of detection for analytic equipment to be used; frequency of sampling and analysis; quality control and quality assurance measures; monitoring and maintenance cost estimates; MWL cover inspections and maintenance activities; and measures to verify that all institutional control aspects of the proposed corrective measure are in place and enforced for the full closure and post-closure period at the MWL. The commenter also states that the CMI plan proposes only three vadose zone monitoring boreholes and does not provide a demonstration that this number of		See also NMED response R8 above concerning the acquisition of new data. The monitoring of moisture content of subsurface soil by the neutron probe method will not detect VOCs. Soil-gas monitoring is done by different means. The three monitoring stations for subsurface soil moisture content are adequate for their purpose. However, the NMED does not consider the monitoring of deep subsurface soil for moisture content to be the most important type of monitoring that should be done at the MWL; it is only one component of a comprehensive monitoring strategy. The effectiveness of the CMI Plan does not rely on the LTM Plan. In fact, the opposite is true. Furthermore, as pointed out by comments from Citizen Action, the CMI Plan does not include much of the essential elements of a LTM Plan. Simply put, the CMI Plan is not a LTM Plan, and it is not intended to be a LTM Plan. As mentioned before, the end state of the landfill must be known before the LTM plan can be finalized. The NMED suggests that commenters may wish to resubmit their comments during the public comment period to be held in the future for the LTM Plan, as many of the suggestions are relevant, and should be considered in the development of the final LTM Plan. Replacement wells can be installed through a vegetative soil cover without risking damage to the cover, as such covers are by nature of simple design.

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I	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)		instruments will provide comprehensive vadose zone monitoring. The commenter states that NMED should revise its MWL "Permit Modification" to require submittal, review, and approval of a LTM Plan on a schedule parallel to the schedule for the remaining portions of the CMI Plan rather than deferring the submittal of the LTM Plan until 180 days following completion of the construction of the corrective measure. The commenter also states that the effectiveness of the CMI Plan is dependent on the implementation of the LTM Plan. The commenter states that the CMI Plan already provides substantial information regarding critical portions of the LTM Plan, including trigger levels and moisture monitoring systems. The commenter also indicates that the LTM Plan should include, but not be limited to: • Bio-monitoring program, including establishment of bio-monitoring triggers at a significant increase over background to establish baseline and identify bio-accumulation, if any, in plant, animal and		

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			insects species in and around the MWL for as long as the waste remains in place. The commenter proposes that this program should include the identification of specific species to be monitored, frequency of sampling, and type of contaminants to be monitored [radiological, volatile organic compounds (VOCs), and heavy metals]. • Require SNL/DOE to establish and maintain site access controls and use restrictions as identified in the CMS and Administrative Order on Consent Based immediately. • Vadose zone monitoring of VOCs, moisture, and an appropriate suite of radionuclides and metals to verify model outputs; establishment of a statistically defensible baseline; and consideration of continuous monitoring. • Reinstalled monitoring wells before any cover is installed to insure that drilling equipment does not damage the evapotranspirative cover for the MWL.		
O	**Citizen, Jamie Wells**		The commenter recommends developing, establishing, and		

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			approving a Long-Term Monitoring and Maintenance Plan before construction of the cover.		
F	**Loretto Community of Catholic Sisters and Co-members, Penelope McMullen**	Container deterioration	The commenter states the FTM needs to be revised to consider the analysis of possible deterioration of each type of "container" for each type of waste buried in the MWL.	R13	The model assumes known releases from the landfill are available to migrate, except for sealed radium-226 sources where the model considered various degrees of container leakage. The number of intact containers in the MWL that contain fluids is unknown; however, the inventory suggests that the quantity of such containers is probably not large. NMED believes that many of the steel containers within the landfill have or will eventually rust. Any liquids contained within the containers could migrate from the landfill if conditions are appropriate; however, this does not necessarily mean that any release would pose a risk to human health and the environment. It also does not mean that the landfill would need to be excavated to mitigate a release. Due to uncertainty associated with the inventory, NMED recognizes that continued monitoring is necessary to ensure protection of human health and the environment. New data from monitoring will be used to update the results of the FTM and to screen for any unexpected releases, should any occur.
G	**Citizen, John Trauxe, Ph.D., PE**		The commenter believes that transport and fate of tetrachloroethylene (or perchloroethylene, PCE) is modeled reasonably, including decay from biotic degradation, but notes that future releases of PCE from as-yet unbreached containers was not performed.		
H	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)		The commenter stated that the FTM is not comprehensive with respect to the physical state of containers for the full range of contaminants at the MWL. The commenter also states that the model does not appear to identify or consider either the mechanisms for deterioration of waste containers or the consequences of the deterioration of waste containers during development of the input parameters and assumptions for its		

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I **O**	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center) **Citizen, Jamie Wells**		VOC, heavy metal and radionuclide models, with the exception of the radon model runs in which radium-226 containers were determined to deteriorate in 1,000 years. The commenter recommends the identification, compilation, and review of container deterioration data applicable to containers identified at or likely to have been disposed of at the MWL including information from other SNL, Lockheed, and DOE sites to determine container patterns applicable to the MWL. The commenter recommends conducting research and testing to understand and model container decay in the landfill.		
G	**Citizen, John Tauxe, Ph.D., PE**	General comment on fate and transport model	The commenter stated that the general approach taken by the fate and transport model is proper and commendable. The commenter stated the model is aimed at identifying appropriate locations and properties or constituents for long-term monitoring, and that the stochastic (probabilistic) modeling provides information for performing a sensitivity analysis, which in turn informs the monitoring program. The commenter believes this is an example of appropriate application	R14	NMED agrees that the general approach using a probabilistic model, as opposed to a deterministic model, is appropriate. The probabilistic modeling approach taken by Sandia is likely the only way that any reasonable model could be generated for the MWL and attempt to account for uncertainties. However, because of the myriad of assumptions and input parameters that could be chosen, there will always be questions that can be raised about the results. However, no matter the results of the model, the NMED will only rely on empirical data acquired from monitoring the landfill to evaluate the remedy's effectiveness.

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			of stochastic modeling, but also noted that several technical flaws (presented below) bring the overall results into question.		
G	**Citizen, John Tauxe, Ph.D., PE**	Modeled inventory distributions	The commenter states that the uncertainty distribution for the inventory of radionuclides in the MWL is undefended, applying a uniform distribution with a minimum at the values reported in SNL (1993) (from the document references) and a maximum of only twice the minimum. Commenter notes that no justification for this distribution is provided in the document, and believes the distribution is narrow based on the uncertainties regarding the inventory that are apparent in the source document. The commenter believes it is highly unlikely that all inventory constituents share the exact same uncertainty distribution, so the uniform (x,2x) distribution seems *ad hoc*. The commenter notes that inventory uncertainty is often the greatest source of modeling uncertainty at other DOE sites and suggests that a more thorough analysis of these distributions should be performed. The commenter repeats this comment in additional comments sent to the NMED by e-mail, May 3, 2006.	R15	The uniform distribution (for the radionuclides considered by the model) was used because there is no indication within the inventory to indicate that each radionuclide required its own uncertainty distribution. Additionally, the quantities of radionuclides disposed of in the landfill are better known than the amounts of chemical constituents. Comparative analyses were performed between simulated and measured soil levels for tritium and PCE, and modeling results matched reasonably the actual levels found in the field. Also, sensitivity analyses indicated that the inventory parameter was not the most significant factor in mobility of radionuclides.

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G	**Citizen, John Tauxe, Ph.D., PE**	External radiation exposure	The commenter notes that external exposures from radionuclides in the ground surface and near surface was overlooked in the model and that this is a potentially significant exposure pathway. The commenter believes this exposure should be included with inhalation of gases and particulates and incidental ingestion of soils by potential future receptors that would have access to the site.	R16	Only tritium and radon are expected to penetrate the cover. Based on characterization studies, existing activity levels of tritium and radon are sufficiently low that they do not pose unacceptable risk to human health and the environment, accounting for both external exposure and ingestion. Because of radioactive decay, the levels of radionuclides seen currently at the surface are unlikely to increase in the future. See also NMED response R4.
G	**Citizen, John Tauxe, Ph.D., PE**	Modeling time	The commenter notes that the period of performance for the model is 1,000 years, but suggests that modeling for peak dose analysis should be done to provide perspective on the long-term significance of waste disposal.	R17	None of the modeled radionuclides and heavy metals was simulated to reach groundwater during the 1,000-year performance period or the extended 10,000-year period. However, the model predicts that aquifer concentrations of PCE will peak in less than 50 years for the majority of the model runs. NMED believes 10,000 years is sufficient and is consistent with conservative model calculations done for other facilities (e.g. Waste Isolation Pilot Plant).
G	**Citizen, John Tauxe, Ph.D., PE**	PCE degradation products	The commenter notes that PCE decay products are not modeled and yet can be significant sources of cancer risk. The commenter states that some of these decay products have higher hazard indices than that of PCE, and cancer risk from them should be included in the model, as well as consideration of variable biodegradation rates, which will vary with location in the model.	R18	The FTM assumes that the entire inventory of PCE was released at one time. Consequently, phased future releases are not considered, as this would be a less conservative approach.. In addition, long-term monitoring parameters proposed by SNL include several PCE breakdown products. Given the low levels of PCE expected to reach the water table according to the model, and the low levels of PCE that actually exists, the NMED believes that PCE degradation products will likely not be of concern. See also NMED response R5.
H	**Citizen Action New Mexico, Susan Dayton** (Comments		The commenter states that the model also does not identify or present model realizations for the decay products of PCE and the other VOCs		

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	compiled by Paul Robinson, Southwest Research and Information Center)		and semi-volatile compounds (SVOCs) that were known to have escaped the MWL in 1993.		
G	**Citizen, John Tauxe, Ph.D., PE**	Model should be realistic in all assumptions	The commenter notes that the model indicates it is conservative in its assumptions, but this philosophy was applied inconsistently between groundwater infiltration and surface water runoff pathways. When one is modeled conservatively, the other is not conservative, if the pathways are linked to the same conditions. The commenter recommends abandoning the attempt to be "conservative" in favor of trying to be realistic in all assumptions.	R19	Whenever the precipitation rate exceeds the infiltration rate, surface-water runoff occurs. In the case of infiltration rate (in this case, the term is used interchangeably with “percolation rate”), the minimum value of the range is based on present-day climate, while the maximum value assumes climate change will occur, based on history, and is based on about twice as much precipitation as currently received at the MWL. The maximum and minimum values chosen for the infiltration rate appear to be realistic. The NMED agrees that assumptions should be realistic, but strives to be conservative, and therefore more protective.
G	**Citizen, John Tauxe, Ph.D., PE**	Monitoring locations	The commenter notes that the model document proposes monitoring of tritium and radon at the site boundary. The commenter, however, suggests that more valuable and interesting data will be obtained by monitoring these constituents on the MWL as they emanate from the cover. The commenter believes monitoring on the MWL cover will provide a more immediate and sensitive indication of gas emanation than can be provided by monitoring at the boundary.	R20	The NMED agrees with this comment. Some monitoring should be done at stations located on the cover. Monitoring stations will be considered in detail in the long-term monitoring and maintenance plan to be submitted by SNL at a later date.

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G	**Citizen, John Tauxe, Ph.D., PE**	Sensitivity analysis	The commenter notes that the sensitivity analysis performed for the FTM attempts to identify those model parameters and processes that most influence the results and recommends them for future monitoring. The commenter believes, however, that the sensitivity analysis is *ad hoc*, rather than comprehensive. The commenter recommends performance of a comprehensive sensitivity analysis and that the inventory distributions should be revisited, or if this was done, that sufficient details be provided for the reader to understand the method.	R21	The sensitivity analyses consider all parameters, but the results of these analyses, which are graphically presented in figures, only present the parameters with statistical significance. NMED also believes that additional details may be needed in the explanation of the sensitivity analyses, as presently explained in Section 2.2.1 of the report. The comment will be considered further after Sandia submits additional information for the FTM.
G	**Citizen, John Tauxe, Ph.D., PE**	Cover design	In a May 3, 2006 e-mail to the NMED, the commenter states "In these arid environments, the best cap is a simple monofill of natural materials such as the alluvium surrounding the MWL. The trick is to make it thick enough to act as a sponge for episodic infiltrating water, and encourage plant growth to keep it dry. Specification of a RCRA Subtitle C type cap is misguided. The optimal cap should be based on performance, not on a rigid design".	R22	The proposed cover (cap) is essentially a monofill as suggested by the commenter. Performance modeling was conducted to arrive at a design intended to limit infiltration to no more than 2.5-3 mm/year.
H	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul	Convening a technical discussion group	The commenter requests that NMED convene a "technical discussion group" to serve as a public meeting to provide a forum for interested stakeholders regarding the adequacy	R23	NMED convened such a group on May 25, 2006, at the Los Griegos Health and Social Services Center in Albuquerque, New Mexico. The public was given an opportunity at the meeting to discuss any technical issues about the MWL CMI Plan that interested them. NMED also opened another 14-day public

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	Robinson, Southwest Research and Information Center)		of the FTM and the CMI plan. The commenter recommends that this technical discussion group include representatives of the permittee, the NMED, and members of the public who have expressed an interest in the studies conducted by Sandia and/or submitted comments to the NMED on the CMI plan and/or the FTM. The commenter also recommends convening this technical discussion group prior to determining that the CMI plan and the FTM are either "comprehensive" or complete".		comment period on that day, giving the public even more opportunity for input. The NMED, facility representatives from DOE and SNL, and members of the public were in attendance. The NMED had not taken any final action with the CMI Plan or FTM prior to this meeting.
H	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)	1995 Argonne study and report on MWL	The commenter states that the model identifies a 1995 Argonne National Laboratory report [cited as Johnson 1995 in the FTM] at p. 16 that showed that VOCs released from the MWL could reach the water approximately 250 years from the time of disposal. This study was not provided to NMED as part of the CMS, CMI plan, or the references for either of those reports. The commenter states that NMED should require Sandia to provide the agency with copies of the 1995 Argonne study, review the study, and consider its relevance regarding the adequacy of the Corrective Measure identified in the Permit Modification since Sandia did not present the study to NMED or the public or consider it during the development of the CMS.	R24	NMED will request SNL to provide a copy of the 1995 Argonne National Laboratory study for review. However, the model does not change the result of site characterization studies completed for the landfill. See also NMED response R1.

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			The commenter requests that NMED review the Corrective Measure approved in the Permit Modification as the conclusions of the 1995 Argonne Report are contrary to the conclusions presented in the CMS and Sandia's MWL hearing, i.e., that contaminants such as VOCs could not reach groundwater at the MWL site.		
H	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)	Trigger levels set too high	The commenter states that the "trigger levels" identified in the model do not provide for early detection and early response to releases prior to the exceedance of health–based standards. The commenter states that the proposed trigger levels do not provide either early detection or early response as they are set at values at or near regulatory standards, rather than at levels that would demonstrate the "edge of the plume." The commenter suggests trigger levels that provide "detection of contamination," which would be established at a level 25–50% above initial concentrations for contaminants of concern.	R25	The trigger levels for releases to the atmosphere as proposed are orders of magnitude less than the modeled values that would result in noncompliance with regulatory standards or DOE Orders. The proposed trigger levels for groundwater constituents mostly are set at one-half of their corresponding MCL values; a few constituents are set at one-half the New Mexico Water Quality Control Commission standards in cases where MCLs do not exist. The NMED will require that the trigger levels for the latter constituents be set to lower levels.
I	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson,		The commenter recommends establishment of trigger levels for agency and public notification and initiating responsive action at values 50% - 100% above background and/or 50% above detection limit for		

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	Southwest Research and Information Center)		VOCs identified in 1993-4 and technogenic radionuclides, and an appropriate suite of metals and naturally-occurring radionuclides		
H	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)	Uncertainties in the fate and transport model	The commenter states that a broad range of sources of uncertainty in the model were identified by the model's lead author Dr. Clifford Ho in a PowerPoint presentation at a DOE-sponsored public meeting on the model in January 2006. The "uncertainty variables" identified by Dr. Ho included: waste inventory and size; thickness of cover; and vadose zone and transport parameters including: infiltration, adsorption coefficient, saturated conductivity, moisture content; tortuosity coefficients, and boundary-layer thickness. The commenter suggests that the model should be revised to identify the full range of uncertainty variables associated with each of the constituents addressed in the FTM, as well as to identify the range of values used in model realizations to account for the uncertainty associated with each variable.	R26	Tables E-2 through E-5 of Appendix E present the variables used in the FTM and their respective range in values. The range in values for each variable is intended to address uncertainty through use of the Monte Carlo approach, whereby many runs of the FTM are made to create many outcomes based on the use of different combinations of input parameters. The results of each model run are equally probable, and the collection of results yields a cumulative probability distribution that can be compared to performance objectives or to assess risk. The commenters did not specify which of the variables were considered by them to be problematic, and for what reason. The NMED believes that the range of the variables shown in tables E-2 through E-5 are reasonable and comprehensive given the dimensions of the landfill; the geologic, hydrologic, and climatic conditions of the landfill; and what is known of the inventory and current releases of contaminants.
I	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson,		The commenter also recommends a revised and expanded FTM to address the range of parameters associated with "model uncertainties/sensitivities" – including vadose zone profile (Kd),		

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	Southwest Research and Information Center)		half-life (degradation), inventory of VOCs, as identified at FTM p. 57.		
H	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)	Relationship between the cover design and fate and transport model	The commenter states that the CMI plan does not effectively incorporate the content and findings of the model in either the evaluation or design of the Corrective Measure proposed for the MWL. The commenter requests revision of the CMI plan to incorporate the analyses and findings in the model when it is determined to be comprehensive and meet the requirements of the permit modification and associated guidelines and regulations by NMED.	R27	Regulations for permitted and interim status landfills require closure of a landfill to meet certain performance standards, including minimizing over the long term the migration of liquids through a closed landfill (for example, 40 CFR 264.310). Using these regulations as guidance for the MWL (the MWL is not a permitted or interim status landfill), the cover design is based on the results of performance modeling, not the FTM. Performance modeling is conducted to predict how much moisture can infiltrate into and percolate through the cover over a specified period of time for various proposed cover designs. The FTM predicts the future migration of contaminants, based in part on using the results of the landfill performance model that was done for the MWL. If the FTM had predicted a high chance that groundwater would become contaminated, the Permittees could conduct further performance modeling in an attempt to improve the cover design to eliminate the predicted threat. However, because the FTM predicts little chance that groundwater contamination will occur at levels exceeding a regulatory standard, no design changes are warranted.
H	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)	PCE concentrations in error	The commenter states “The FTM states that the maximum PCE detected in 1993 was 5900 ppb at pg.52, but lists the maximum concentration of PCE in 1993 as 5200 ppb on Figure 21 at pg. 53”.	R28	The comment may be incorrectly citing site information. The maximum PCE concentration for 1993 data (at 30 feet) is shown correctly as 5900 ppb on Figure E-21. The maximum PCE concentration of 5200 ppb (at 10 feet) is shown on Figure E-20.

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I	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)	New wells are needed	The commenter recommends that the ground water monitoring wells at the MWL be replaced with wells that meet regulatory standards, including RCRA standards capable of meeting applicable data quality objectives and providing reliable and verifiable water quality and soil column data. The commenter also recommends that NMED conduct an independent analysis of the effectiveness of the monitoring wells to identify the occurrence of VOCs and other constituents of concern, including those modeled in the FTM. In a meeting on July 19, 2006, the commenter repeated that new wells should be installed at the MWL to replace wells impacted by drilling mud and additives.	R29	The NMED disagrees with this comment and believes that groundwater data obtained from the monitoring wells at the Mixed Waste Landfill (MWL) are generally representative of formation water (see also NMED report by Moats, Mayerson, and Salem, 2006, entitled *Evaluation of the Representativeness and Reliability of Groundwater Monitoring Well Data, Mixed Waste Landfill, Sandia National Laboratories*). A total of seven ground-water monitoring wells have been installed at the MWL (BW1, MW1, MW2, MW3, MW4, MW5, and MW6). Wells MW1, MW5 and MW6 were installed using the air-rotary casing hammer (ARCH) method. Well MW4 was drilled using sonic resonant technology; whereas, wells BW1, MW2 and MW3 were completed via the mud rotary drilling method. In the above mentioned report, groundwater data from the mud rotary wells (BW1, MW2, and MW3) were compared to corresponding data from wells completed by other drilling methods (MW1 and MW4) and to background hydrochemistry data representative of the Kirtland Air Force Base area. The results of this effort finds that the mud rotary wells, in addition to the other wells at the MWL, yield representative groundwater samples and that comments to the contrary are incorrect. The groundwater data representing water quality at the MWL can be relied upon for characterization purposes and remedy selection.
J	**Citizen, Robert H. Gilkeson**		The commenter states that the strategy to leave chemical and radioactive waste at the Sandia mixed waste landfill and to assure protection of the regional aquifer by long-term monitoring of the existing set of monitoring wells is unacceptable because of the poor quality of the water samples produced from the wells. The commenter believes there are many important factors for why the wells do not meet the regulatory		There is no evidence that the hydrochemistry of groundwater samples from MWL monitoring wells has been significantly impacted by the use of drilling mud or additives. Just because drilling mud or additives have the *potential* to adversely impact water quality results does not mean that this has actually happened at the MWL. Decades of monitoring well installations around the world through a variety of methods show that with proper well development, wells drilled by the mud rotary method or other methods are capable of yielding representative water samples.

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N	**Concerned Citizens for Nuclear Safety, Joni Arends**		requirements for detection monitoring: • Drilling additives with well known chemical properties to mask the detection of contamination were allowed to invade the strata that surround the wells. • The drilling additives lowered the permeability of the strata surrounding the wells so that the wells produce stagnant water that was in contact for a long period of time with the strata affected by the drilling additives. In a July 19, 2006 meeting with the NMED, the commenter repeated his comments on this topic. The commenter recommends that NMED deny the CMI Plan, including the FTM, until such time as the recommendations made by Citizen Action are resolved to their satisfaction. The commenter states that issues related to the quality of the groundwater monitoring data must be resolved before NMED provides any type of approval of the CMI Plan. The commenter also recommends that the issues and comments raised		Although the practice is somewhat dated, it is clear that one commenter is referring to saturated hydraulic conductivity (Ksat) when using the term permeability. Note that the NMED responses will use the term "Ksat" rather than the less precise and dated term "permeability", as the latter term is often confused with a different physical property of rock formations. Because of the depth to the water table (about 460 feet), nearly all drilling methods capable of being successfully employed at the MWL will impact to some degree and at least temporarily the pristine environment of the saturated zone. This is because at minimum, for the common drilling methods either water or air must be injected to lubricate and/or cool the drill bit, and to transport cuttings to the surface. While desirable to have ideal and pristine conditions, one must accept the natural conditions that exist at sites and the limits of technology, and their influence on data quality objectives. The development of wells is a standard practice intended to restore the natural properties of the saturated zone to the extent *reasonably* possible. The NMED believes that wells that are properly and timely developed, including those installed using the mud rotary method, can yield representative water samples. The monitoring of groundwater in any given well over several years is also standard practice to allow for the restoration of water quality. A number of the wells at the MWL have sampled periodically for more than a decade. Although not prohibited by regulation, the NMED discourages the use of the mud rotary method for well installations because of its *potential* impacts on water quality and formation properties. A report prepared by the NMED in 1993 on the MWL monitoring well network makes this point, and subsequently, other wells completed at the MWL have been installed by other drilling methods. No evidence has been provided that the Ksat of the sediments surrounding any well at

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			by Robert H. Gilkeson must be addressed by Sandia National Laboratories and NMED prior to any type of approval of the CMI Work Plan is made by NMED. The commenter states that Concerned Citizens for Nuclear Safety has been involved with groundwater issues at Los Alamos National Laboratory (LANL) for many years. As the Department of Energy (DOE) owns both LANL and Sandia, the commenter was not surprised to learn that the same types of problems exist at Sandia as at LANL.		the MWL has been decreased by drilling mud or additives. The low Ksat of the sediments surrounding the shallower wells drilled by any method was expected given the geologic logs indicate that silty fine-grained sands make up the uppermost part of the saturated zone. Wells MW1 and MW4, drilled using the ARCH method without using drilling mud or additives (beyond water and air) also encountered the same silty sands as the wells drilled by the mud rotary method. These latter wells are also low yield wells due to the low Ksat of the saturated sediments they are screened in. There are no regulatory requirements or technical reasons that mandate that wells be screened only in high Ksat strata. In fact, such a requirement at the MWL would mean that the uppermost aquifer (i.e., the geologic unit that, in the event of a release, would be affected first) would go unmonitored. NMED strongly disagrees with this approach. The FTM predicts little chance of groundwater contamination. Soil and soil vapor data collected during the RCRA Facility Investigation demonstrate that there is no significant contamination in the vadose zone beneath the MWL. Given the latter, it is inconceivable that groundwater contamination is being masked by drilling additives when there is no expression of that contamination in the vadose zone. The vadose zone must be significantly contaminated before one would expect any groundwater contamination to be present, a condition which simply does not occur at the MWL. Because the well network is reliable, the NMED will not require replacement of wells except on a case-by-case basis as wells become useless for sampling due to the dropping water table. Note that not all wells are likely to be replaced after going dry, and that the NMED may choose different locations to install replacement wells.

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I	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)	New geophysical surveys needed	The commenter recommends that NMED require a revised set of geophysical surveys of the MWL to update and enhance the Phase 2 data to provide detailed information about the shape, distribution and content of containers in the MWL, the distribution of metals and other materials in landfill, and otherwise expand knowledge of inventory. This updated geophysical baseline should include replication of geophysical investigations in the RFI Phase 2 Report with contemporary equipment and analytic capabilities, as well as conduct of additional geophysical analyses including, but not limited to, sonar, ground penetrating radar, and magnetic resonance.	R30	Geophysical surveys are conducted chiefly to determine the trenches/pits and boundaries of a landfill by locating buried metal. The MWL and the trenches contained within it have been adequately characterized by geophysical surveys conducted during the Phase 2 RCRA Facility Investigation. There is no need to conduct other geophysical surveys of the MWL. Individual containers could not be well delineated, even with the benefit of the latest geophysical methods.
O	**Citizen, Jamie Wells**		The commenter recommends conducting characterization of the site to understand the current situation of the landfill inventory before conducting work, including: • Noninvasive geophysical characterization using magnetic resonance and radar, and the latest instrumentation, which has a higher data resolution and different frequencies (older instrumentation use one frequency) than when the previous geophysical surveys were performed. The		

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			commenter suggests that this data should be maintained in the appropriate format so they can be used in the future as refinements in technology and algorithms advance in this field. This could assist in a better understanding of the waste and containers.		
I	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)	Model input data	The commenter recommends full disclosure of FTM model input data.	R31	Tables E-2 through E-5 of Appendix E present the variables used in the FTM and their respective range in values.
I	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)	VOC levels modeled	The commenter recommends that enhanced FTM realizations include considerations of VOC concentrations 100x and 1000x the concentrations identified in soil the MWL RFI Phase 2 Report.	R32	The model assumed PCE concentrations up to 10 times that of the maximum level actually detected. Inputs to the FTM should be not only conservative, but also reasonable and realistic. If PCE levels were increased to 100 to 1000 times of the maximum actually detected, the model would undoubtedly predict significant groundwater contamination for a much larger percentage of modeling runs. There is no basis to model such high concentrations based on the actual releases of VOCs reported in the Phase 2 RCRA Facility Investigation Report.
I	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson,	Other models of VOC fate and transport	The commenter recommends the identification and submittal to NMED and review of other models of VOC movement conducted by Sandia for other waste sites at SNL including, but not limited to, the	R33	Modeling must be done on a site by site basis, as every site generally has different source terms, and geologic, hydrologic, and climatic conditions. Sandia has modeled vapor-phase migration of VOCs at the Chemical Waste Landfill. The modeling results have been

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	Southwest Research and Information Center)		Chemical Waste Landfill, Liquid Waste Disposal System, and Lurance Canyon sites located at SNL.		submitted to and have been reviewed by the NMED. However, the FTM is more appropriately tailored for the MWL as it utilizes site-specific information to the extent possible. Contaminant migration at the Liquid Waste Disposal System was primarily by aqueous-phase transport. This is probably also true for contaminant migration at the Lurance Canyon Burn Site. Neither of these sites is a close match with the MWL with respect to the conditions mentioned above, thus the modeling done for these sites would not be particularly useful for the MWL.
O	**Citizen, Jamie Wells**		The commenter recommends validation of the FTM by using the code at other sites selected by the NMED.		
I	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)	Run-on/run-off controls	The commenter recommends locating run-off and run-on collection and diversion canals and swales approximately 25 to 50 meters away from the perimeter of cover system to manage flows from peak precipitation events.	R34	This point was considered and discussed during the Technical Discussion Public Meeting sponsored by NMED on May 25, 2006. NMED declined to act on this recommendation, because due to a 3,000-foot long sled track located east of the MWL, overland flow of surface water would be mostly prevented by the sled track from reaching the eastern edge of the future landfill cover. The sled track is elevated above the surrounding ground surface and thus acts as a barrier to westerly directed surface water flow.
I	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)	Wind erosion	The commenter recommends including an erosion resistant layer (armor) to reduce wind erosion effects.	R35	This point was considered and discussed during the Technical Discussion Public Meeting sponsored by NMED on May 25, 2006. The topsoil used for the cover will include a 25 percent mix of gravel that will help reduce wind and water erosion prior to vegetation becoming established on the cover. The topsoil/gravel mix is an erosion resistant layer. Further enhancements to the cover to deal with this issue are therefore unnecessary.
I	**Citizen Action New Mexico, Susan Dayton**	Defining seeding success	The commenter recommends identifying specific vegetative cover standards for determination of re-	R36	The NMED agrees with this comment. NMED will require SNL to define the criteria that will be used to assess whether vegetation of the cover has been successfully accomplished.

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	(Comments compiled by Paul Robinson, Southwest Research and Information Center)		vegetation success including, but not limited to, species diversity, plant survival, and ground cover parameters.		
I	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)	Endorses comments made by Robert Gilkeson	The commenter presented recommendations submitted by Robert H. Gilkeson to the NMED.	R37	See NMED responses to Robert Gilkeson Comments, commenter identification "J".
K	**Nuclear Watch of New Mexico, Scott Kovac**		The commenter states that Nuclear Watch of New Mexico endorses the recommendations of the comments submitted to NMED by Robert H. Gilkeson.		
M	**Embudo Valley Environmental Monitoring Group, Sheri Kotowski**		The commenter states that the Embudo Valley Environmental Monitoring Group endorses the recommendations of the comments submitted to NMED by Robert H. Gilkeson.		
J	**Citizen, Robert H. Gilkeson**	Sampling procedures	The wells are sampled with procedures that strip from the water the volatile chemical solvent contaminants that are known to be	R38	Several of the wells at the MWL are constructed such that their screens straddle the water table. This is a common practice that is effective for monitoring the uppermost part of the saturated zone and to account for potential seasonal variations in water

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			released from the landfill (e.g., PCE, TCE, and TCA). The wells are sampled with procedures that expose the water to oxygen and therefore, many metal and radioactive contaminants known to be disposed of at the landfill are hidden from being detected. The commenter states that the collection of water samples after the wells are purged dry is unacceptable because of aeration and oxidation of the water that trickles into the wells, and therefore, a loss of many contaminants from the water and especially volatile solvents. The commenter suggests that PCE, one of the parameters for compliance monitoring, is a volatile solvent that will be stripped from the groundwater that recharges into the wells after they are purged dry. It is essential for the monitoring wells at the Sandia mixed waste landfill to provide a continuous flow of water for monitoring of sensitive water parameters with a closed flow-through cell with the collection of water samples after the sensitive parameters stabilize and during the continuous flow of water. In a July 19, 2006 meeting with the		levels and contaminant concentrations. The surface of the water contained in any given well is in contact with air (and thus oxygen). The formation water at the water table surrounding the wells is also in contact with air. No matter what sampling procedures are employed, some of the water that flows into the wells will have been exposed to oxygen in air. Not all of the wells at the MWL are low yield wells (will purge dry). Additionally, applicable regulations or guidance do not state that low yield wells are unacceptable. It is a standard EPA procedure to purge low yield wells dry, and then to collect water samples from them as soon as possible after they have sufficiently recovered. Low yield wells at the MWL are now sometimes taking days to recover after being purged dry. The fact that it takes so much time for the wells to recover indicates that the groundwater flow into these wells is not turbulent, hence there is less concern that appreciable volatile organic compounds are being stripped from the water samples. In the case of the MWL, it is known from soil-gas surveys and subsurface soil samples that volatile organic compounds are unlikely to reach groundwater, especially at detectable levels. This has been confirmed by the FTM. Regardless, the pumping and sampling procedures employed by Sandia are appropriate, and in fact are a necessity given the natural conditions that exist at the MWL. The majority of the wells at the MWL are “low yield wells” because the saturated sediments that they intercept have low Ksat – Ksat is a physical property that essentially is a measure of how easy groundwater can flow through the aquifer. The NMED and EPA both recognize that low yield wells exist in the real world and sometimes that the desired ideal sampling conditions can not be obtained. Because low yield wells are a reality, and contamination is not always in high Ksat zones, the sampling of low yield wells is not prohibited by regulation and procedures for sampling them are found in EPA guidance. See also NMED response R29.

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			NMED, the commenter repeated his comments on this topic.		As mentioned previously, in order to conduct a technically sound groundwater investigation at the MWL, SNL has had to construct some wells such that their well screens straddle the water table. The wells must monitor the water at the water table no matter the Ksat of the sediments that are encountered there. Sediments at the water table beneath the MWL have low Ksat. At the MWL, because the water does not flow into the wells easily because of low Ksat, the wells are purged dry even though the purging rate is only about 1 gallon per minute or less. Also, because the water does not flow into the wells easily, it may take several days before sufficient amounts of water will recharge the well to allow the collection of samples. Depending on the well, the time it takes for recovery has increased from a few hours to days as water levels have dropped over the years. Although ideal sampling procedures can not be achieved with the low yield wells at the MWL, no-purge sampling conducted at TA-V and the Tijeras Arroyo leads NMED to conclude that volatile organic compounds would still be detected.
J	**Citizen, Robert H. Gilkeson**	Regulatory requirements for wells	The commenter indicates that the existing network of monitoring wells at the Sandia mixed waste landfill does not meet the requirements of the RCRA Statute, the NMED Sandia Consent Order, or the DOE Orders for the detection of contamination released from the waste buried in the landfill. In a July 19, 2006 meeting with the NMED, the commenter repeated his comments on this topic.	R39	NMED disagrees with this comment and believes that the monitoring wells at the MWL substantively meet regulatory requirements under the New Mexico Hazardous Waste Management Regulations, requirements pursuant to the Sandia Consent Order issued April 29, 2004, and guidance issued by the U. S. Environmental Protection Agency. NMED has no authority to enforce DOE Orders, and so considers them irrelevant to a state-enforced cleanup action. The Mixed Waste Landfill is subject to corrective action under the New Mexico Hazardous Waste Management Regulations, 20.4.1 NMAC, which for the most part incorporate federal regulations promulgated under the Resource Conservation and Recovery Act (RCRA). NMED has negotiated a Consent Order with Sandia and the U. S. Department of Energy which contains groundwater monitoring well installation, development, purging,
O	**Citizen, Jamie Wells**		The commenter recommends conducting characterization of the		

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			site to understand the current situation of the landfill inventory before conducting work, including groundwater monitoring that meets 40 CFR 264 Subpart F.		and sampling requirements that is consistent with the New Mexico regulations and guidance. The EPA and the NMED have published guidance on how to properly construct monitoring wells and to collect and analyze groundwater samples. The monitoring wells at the MWL and the sampling procedures employed at the landfill by Sandia meet both NMED and EPA regulatory requirements, guidance, and requirements of the Consent Order. Neither the Consent Order nor any other applicable standard prohibits the installation of wells using the mud rotary method or any other method. The Consent Order appropriately requires development of a well to create an effective filter pack, correct damage to the formation caused by drilling, remove fine particles from the formation near the borehole, and assist in restoring water quality. The Consent Order applies to wells installed after the effective date of the Order. The existing wells at the MWL were all installed prior to this date. When new wells are installed at the MWL as replacement wells, they would need to meet the requirements of the Consent Order, provided the Order is still in effect at that time. Although the regulatory requirements of 20.4.1.500 NMAC incorporating 40 CFR 264 Subpart F can be used as guidance, nearly all of the requirements of Subpart F do not apply to the MWL because it is not a permitted unit. Instead, the landfill is regulated as a Solid Waste Management Unit subject to corrective action pursuant to 20.4.1.500 NMAC incorporating 40 CFR 264.101. Although not required by regulation, Sandia commonly uses flow-through cells while purging to measure certain field parameters (pH, temperature, and specific conductance). See also NMED responses R5 and R40.

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J	**Citizen, Robert H. Gilkeson**	Wells are set in sediments with low hydraulic conductivity	The commenter states that the wells are not installed in the aquifer strata with high permeability – the strata where the highest levels of contamination are expected and the strata that are fast pathways for horizontal travel of contaminated groundwater over great distance. The commenter states that there is a fundamental requirement of RCRA Subpart F is for the monitoring wells to be installed in the geologic strata that have a sufficient permeability to provide a continuous flow of groundwater with a minimum of drawdown of the water level in the well during the collection of groundwater samples. In a July 19, 2006 meeting with the NMED, the commenter repeated his comments on this topic.	R40	NMED agrees that groundwater will travel faster in strata with higher Ksats (given the hydraulic gradient is constant), and that such lithologic units have the potential to transport contaminants most quickly. However, as indicated above, most of the wells at the MWL are constructed such that their screens straddle the water table in order to monitor the uppermost water in the saturated zone (first water), regardless of the Ksat of the sediments that make up that part of the aquifer. If contamination is not detected in the uppermost zone of saturation at the MWL, then contamination is unlikely to occur at deeper levels where Ksat values at the MWL tend to be higher. Groundwater in lithologic units having low Ksat values (like aquitards) will still flow if subject to a hydraulic gradient (the normal case) and thus these units are subject to becoming contaminated. Based on slug tests, typical Ksat values for sediments in the uppermost part of the saturated zone at the MWL range from about 10^{-7} to 10^{-5} cm/s. These are relatively low Ksat values. As previously stated, some of the regulatory requirements of 20.4.1.500 NMAC incorporating 40 CFR 264 Subpart F may be considered useful guidance. However, the bulk of the requirements of Subpart F do not apply to the MWL because it is not a permitted unit. Instead, the landfill is regulated as a Solid Waste Management Unit pursuant to corrective action under 20.4.1.500 NMAC incorporating 40 CFR 264.101. The regulations in Subpart F do not mandate that monitoring wells be installed in geologic strata with high Ksat. The regulations also do not require that wells be capable of supplying water at rates that will minimize drawdown. The regulations do not specifically address Ksats or drawdown because sediments exhibiting high Ksat and that are capable of supporting low drawdown conditions at high pumping rates simply do not occur at all sites. See also NMED response R29.

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J	**Citizen, Robert H. Gilkeson**	PCE standard	The commenter states "Because of health concerns, the Environmental Protection Agency (EPA) has set the Drinking Water Standard for PCE at a Maximum Contaminant Level (MCL) of 5 ug/L (5 parts per billion). In addition, because of the danger to health, the EPA has set a Maximum Contaminant Level Goal of ZERO for the presence of PCE in groundwater".	R41	The EPA drinking-water MCL for PCE is 5 µg/L, and is an enforceable standard. The EPA MCL goal of 0 (zero) is not a standard, and therefore is not enforceable.
J	**Citizen, Robert H. Gilkeson**	Iron and Turbidity	With regard to well MW1, the commenter states "The water that recharged the well and was collected for the analytical suite had a turbidity slightly higher than the recommended upper limit of 5 NTUs in the RCRA guidance. The elevated turbidity may be responsible for the large difference between total iron and dissolved iron. However, the microbial processes greatly increase the level of colloidal iron in the groundwater and the high level of colloidal iron is probably the cause of both the high turbidity and the high level of total iron".	R42	The commenter provides no evidence that large volumes of iron precipitates are present in the sediments surrounding well MWL-MW1, and are plugging up formation materials, reducing their Ksat. MW1 was drilled using the ARCH method without the use of organic drilling additives. A reducing environment does not occur in the groundwater (See NMED response R29). See also NMED report by Moats, Mayerson, and Salem, 2006, entitled *Evaluation of the Representativeness and Reliability of Groundwater Monitoring Well Data, Mixed Waste Landfill, Sandia National Laboratories*. Although the turbidity of the groundwater samples from MW1 (median of 6.59 NTU) is slightly higher than 5 NTU, it causes no significant problems. At Sandia, the turbidity of samples of natural spring water is often much higher; obviously, the springs have not been impacted by organic drilling additives. Water samples from well MW1 yield a median total iron concentration of 0.24 mg/L and a median dissolved iron concentration of 0.11 mg/L. These are background levels. At MW1, the turbidity of the water and the moderately higher levels of total iron observed are caused by suspended sediment

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					and corrosion of the stainless steel well screen. The suspended sediment occurs in the well because the filter pack is too coarse to prevent the finest particles of formation material from entering the well, and because small pieces of corroded well screen are suspected to be present in the well, mixed in with sediment. Higher turbidity can cause higher concentrations of metals to be detected in groundwater because suspended sediments contain much higher concentrations of metals compared to water. The metals in the suspended sediments, including iron, are leached into the water sample when the sample is preserved with nitric acid, elevating the amounts of metals beyond that actually present in formation water.
J	**Citizen, Robert H. Gilkeson**	Nickel and Turbidity	With regard to MW1, the commenter states "In addition, nickel is at an anomalous high level in the water produced from the well. The nickel may have been leached from the stainless steel well screen. Nevertheless, the high nickel values are evidence that the water produced from the well is from a stagnant zone surrounding the well screen and is not representative of the groundwater in the aquifer".	R43	The moderately high nickel levels seen in groundwater samples from this well are likely derived from leaching of the stainless-steel well screen. This is based on the fact that soil sample results from borings completed under the landfill do not indicate the existence of nickel contamination in the vadose zone. Although some groundwater adjacent to and down gradient of the well may be contaminated with dissolved nickel from leaching of the well screen, the zone of dissolved nickel is likely to be almost negligible in extent given the very small average linear velocity of the groundwater. Furthermore, whenever any low yield well is purged, it is not possible to remove all water that is present within the well. Even if purged dry, some stagnant water in the sump and below the level of the pump intake will remain in the well. For MW1, some stagnant water containing dissolved nickel will be trapped in the well below the pump intake and will mix with larger amounts of fresh formation water entering the well during recovery. Because there is no way to avoid this, water samples from MW1 will always contain moderately high levels of nickel for the rest of the life of the well.

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J	**Citizen, Robert H. Gilkeson**	Problems with wells at Los Alamos Laboratories (LANL)	The commenter states "The effects of the bentonite clay and the organic additives to mask the detection of contamination is a concern for the monitoring wells installed at the Los Alamos National Laboratory (LANL). See Appendix A with particular attention to reports A-4 and A-5 by the EPA and the DOE IG for the mud rotary monitoring wells at LANL". In a July 19, 2006 meeting with the NMED, the commenter repeated his comments on this topic.	R44	SNL and LANL are two different sites. Just because a problem may exist for some LANL monitoring wells does not mean that the same problem exists for wells at SNL. The MWL is over 60 miles from LANL, so problems with wells at LANL are not relevant to issues of groundwater monitoring at the MWL. The most significant problems with wells at LANL involve complexly-built wells in complex geology with small multiple screens which were not adequately developed. In contrast, wells at the MWL are simpler, constructed in relatively simple geology, have larger screens, and except for MW4, have but one screened interval. See also NMED report by Moats, Mayerson, and Salem, 2006, entitled *Evaluation of the Representativeness and Reliability of Groundwater Monitoring Well Data, Mixed Waste Landfill, Sandia National Laboratories*.
J	**Citizen, Robert H. Gilkeson**	Separating screened intervals, MW4	The commenter states "Well MW4 has two screened intervals with each screen having a length of 20 feet. The rehabilitation of MW4 shall include installation of a low-flow submersible pump between two inflatable packers to restrict the interval of aquifer strata that produce water from the well".	R45	The lower screened interval is currently always separated from the upper screened interval by an inflatable packer, including during times of sampling.
J	**Citizen, Robert H. Gilkeson**	Eh and dissolved oxygen levels, MW5 and MW6	The commenter states "For the water produced from well MW5, the Eh and dissolved oxygen levels are much lower than the levels measured in the background groundwater. Furthermore, the water produced from MW6 has a negative Eh and a low level of dissolved oxygen. The	R46	The negative Eh values from the one sampling event quoted by the commenter are almost certainly errors. Eh measurements for water samples collected at the MWL are typically made using a flow-through cell. Wells MW5 and MW6 were drilled using the air rotary casing driven (ARCH) method. Organic drilling additives were not used to complete these wells. The hydrochemistry of

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			negative Eh and presence of dissolved oxygen do not occur together in groundwater and show the need to improve the measurement procedures with monitoring a continuous flow of water from the well using a closed flow-through cell". In a July 19, 2006 meeting with the NMED, the commenter repeated his comments on this topic.		groundwater water samples obtained from both wells are indicative of oxidizing conditions, not reducing conditions. The median Eh values for MW5, MW6, and BW1 are 78.6, 129.0, and 141.8 millivolts, respectively. The median dissolved oxygen values for MW5, MW6, and BW1 are 2.49, 2.43, and 6.8 mg/L, respectively. Both Eh and dissolved oxygen are lower for MW5 and MW6 because the groundwater encountered in these wells occurs deeper in the aquifer. Deeper groundwaters are typically older groundwaters, and older groundwaters tend to have lower dissolved oxygen levels and lower Eh compared to younger groundwaters. See also NMED report by Moats, Mayerson, and Salem, 2006, entitled *Evaluation of the Representativeness and Reliability of Groundwater Monitoring Well Data, Mixed Waste Landfill, Sandia National Laboratories*.
J	**Citizen, Robert H. Gilkeson**	Iron and manganese concentrations, MW5	The commenter states "An additional indication that well MW5 does not produce representative water is that the concentrations of iron and manganese are much higher than the concentrations measured in the background well MWL-BW1. The elevated iron and manganese levels in well MW5 may be due to chemical processes from the organic drilling additives. As explained above, the chemical processes will create iron coatings on the aquifer strata that have enhanced properties to remove contaminants of concern for the compliance monitoring from the groundwater produced from well MW5. The coatings also lower the	R47	Although well MW5 was drilled using the air rotary casing driven method without the use of drilling mud or organic additives, sodium-bentonite grout inadvertently infiltrated the filter pack and screen of the well during installation. The median concentrations of total iron (0.133 mg/L) and manganese (0.116 mg/L) of water samples collected from MW5 are representative of background levels. Organic additives were not used to construct the well, thus, the levels of iron and manganese do not represent the reduction of iron and manganese minerals. Moderately oxidizing conditions are present in the well, not reducing conditions, as demonstrated by a median dissolved oxygen concentration of 2.49 mg/L, as well as the presence of nitrate and sulfate in water samples. NMED therefore concludes that the grout was successfully removed prior to placing the well into service. See NMED report by Moats, Mayerson, and Salem, 2006,

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			permeability of the strata that surround the well screen".		entitled *Evaluation of the Representativeness and Reliability of Groundwater Monitoring Well Data, Mixed Waste Landfill, Sandia National Laboratories*.
J	**Citizen, Robert H. Gilkeson**	Zinc concentrations	The commenter states "The zinc data for water samples collected from the mixed waste landfill monitoring wells in April 2005 are summarized below. The NMED Approved Background Value for total zinc and dissolved zinc is 260 ug/L (parts per billion). Note that the total zinc concentrations measured in the seven monitoring wells are over an order of magnitude lower than the NMED approved natural background concentration of total zinc in groundwater. Of more importance are the very low levels of dissolved zinc in the groundwater produced from the monitoring wells. The very low dissolved zinc levels are evidence that the wells are surrounded by a reactive contaminant capture barrier that prevents the wells from producing representative water samples: 1). for the *in situ* groundwater chemistry, and 2). for the presence of contamination from waste released	R48	NMED disagrees. The zinc levels are representative of background concentrations and are consistent with those seen in groundwater samples from numerous wells and springs located across the Kirtland Air Force Base area. The median values of total and dissolved zinc detected in water samples from BW1, MW2, and MW3 (wells drilled by the mud rotary method) are higher than the median value for samples collected from MW1 (drilled using the ARCH method). Additionally, the median values of total zinc detected in water samples from BW1, MW2, and MW3 are generally higher than the median values representing water samples from MW4 , MW5, and MW6 (drilled by sonic resonant or ARCH methods). These statistics are opposite of what would be the case if reducing conditions were prevalent in the wells as suggested by the commenter. The wells do not need to be replaced. See also NMED report by Moats, Mayerson, and Salem, 2006, entitled *Evaluation of the Representativeness and Reliability of Groundwater Monitoring Well Data, Mixed Waste Landfill, Sandia National Laboratories*. See also NMED response R29.

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			from the mixed waste landfill. The low levels of dissolved zinc and the low permeability of the strata surrounding the monitoring wells are evidence of the need to replace the wells."		
J	**Citizen, Robert H. Gilkeson**	Well development	The commenter states "The ASTM guidance for successful well development does not guarantee that all or even most of the drilling fluids are removed from the aquifer strata that are in contact with groundwater samples that are collected from the monitoring wells for contaminant analyses. The small diameter of the Sandia monitoring wells, the great depth of the wells, the short screen length, the small slot size of the screen openings, and the small size of the filter pack sediments that surround the well screen are factors that prevent removal of most of the bentonite clay muds and drilling fluids that are entrained into the aquifer strata".	R49	Proper well development can remove much, and ideally, nearly all drilling fluids. However, small amounts of drilling fluids would be expected to remain in the formation and filter pack following even the best efforts to develop a well. However, the drilling fluids that remain after proper well development must have limits to their ability to adsorb contaminants. Many water-supply wells are drilled using the mud rotary method because it is readily available and cost-effective. According to the commenter's position, which NMED disagrees with, one would never expect to see VOC or metal contaminants in the groundwater at such wells because of the unlimited capabilities of these reactive barriers to adsorb these contaminants. Unfortunately, this is not true as there are many examples of water-supply wells were groundwater contamination with VOCs or metals have been detected, and in fact, Safe Drinking Water Act compliance is based in many cases on samples from wells installed in such a manner. The installation of wells to depths of hundreds of feet always has an affect on water quality. This is one reason why the NMED typically requires sampling and analysis of groundwater over a period of several years. For example, it is well known that the introduction of air in the saturated zone using the air rotary drilling method can remove (air sparge) VOCs from groundwater in the vicinity of wells, and thus it may take several quarterly sampling events before VOCs will be detected in the groundwater. Water sampling has been conducted at the MWL

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					for as much as 16 years for some wells. NMED disagrees with the argument that the diameter, depth, screen lengths, and screen slot size of the wells, and the grain size of the filter packs conspire to prevent the removal of drilling fluids. The diameters of monitoring wells at the MWL are not especially small, but instead are typical for wells installed to depths of several hundred feet or more. The wells are as deep as they need to be in order to monitor the groundwater at the water table. The screen lengths of the wells (20 feet), with originally typically 15 feet of saturated length, are typical of monitoring wells employed throughout New Mexico (with dropping water levels at the MWL, the saturated portion of the screened intervals have actually decreased since the wells were installed). In fact, rather than being short, the screen lengths of the MWL wells are on the large end of the range recommended by EPA guidance. The slot size of the well screens, typically 0.010 inch for the older wells, is common among wells installed in the KAFB area. There is also nothing particularly unusual about the filter pack dimensions for wells located at the MWL. In the case of the MWL, the NMED believes that the low Ksats of the aquifer sediments presented the biggest challenge with respect to adequately developing the wells. Based on well development records, considerable effort was made to properly develop the wells at the MWL, and this effort was successful.
J	**Citizen, Robert H. Gilkeson**	Drilling fluids plugging saturated zone	The commenter states "The features of the Sandia monitoring wells at the mixed waste landfill that prevent the recovery of most of the drilling fluids that have invaded the aquifer strata where screens are installed include 1). because of the great depth to the	R50	NMED disagrees that drilling fluids are easy to emplace within the saturated zone surrounding the well, but at the same time, are nearly impossible to remove. If this were the case, no well anywhere in the world over a few hundred feet deep could ever be used to monitor groundwater. Drilling fluids that enter sediments in the vadose zone are of less importance than those penetrating the saturated zone, because

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			water table of the regional aquifer, the mud rotary drilling method operated as a powerful injection pump for invasion of the bentonite clay into the strata that surround the well screens, 2). the great depth of the monitoring wells limits the pumping energy for development, 3). the small inside diameter for well casing of 4.5 inches limits the size (power) of submersible pumps, 4). the short length of the well screens, 5). the small spacing of 0.01 inch for the slots on the well screens, and 6). the medium-grained sand in the filter pack that surrounds the well screens. Factors 2 through 6 restrict the energy for recovering the drilling fluids compared to the much greater energy of the mud rotary drilling method for invading the strata with the drilling additives". In a July 19, 2006, meeting with the NMED, the commenter repeated his comments on this topic.		the former fluids will not impact groundwater quality. Although the column of drilling mud above the saturated zone is large and can exert considerable pressure, there is a limit to the rate, and thus the extent, that drilling mud can penetrate into the saturated zone. Drilling mud, like water, can only migrate into the saturated zone as fast as the Ksat allows, this being the Ksat *for mud with respect to the formation materials* (not the Ksat for water). The Ksat for mud will be lower than that of water because Ksat is inversely proportional to the viscosity of a fluid, and mud has a higher viscosity than water. Thus, the mud will advance into the formation at a slower rate than if the fluid was water assuming other hydraulic properties remain constant. As mentioned previously, proper well development can remove much of the drilling fluids which penetrate into the saturated zone. Following displacement of the drilling mud from a well once well construction begins, the groundwater will apply hydraulic pressure against the drilling mud that has penetrated into the formation. As a consequence, pressure exerted by groundwater will help force drilling mud out of the formation and back into the well where it can be removed by development. As development continues, dilution of the mud by the groundwater will continuously lower its viscosity, further assisting in the removal of mud from the formation. The key is timely and effective development, which was accomplished at the MWL. The commenter implies that a large region surrounding the wells would be invaded by drilling mud. The rate at which drilling mud was able to penetrate the saturated zone in the uppermost part of the aquifer was estimated by the NMED to be only 8.6 cm/hour. The calculations for this figure are based on a Ksat of 10^{-6} cm/s, a hydraulic gradient of 475 feet, a porosity of 25%, density of drilling mud of 1.2 g/cm^3, a dynamic viscosity for drilling mud of 30 cp, and a dynamic viscosity of water (at 20

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					°C) of 1 cp. At the calculated rate, it would take 11.6 hours for the drilling mud to advance 1 meter into the saturated zone.
J	**Citizen, Robert H. Gilkeson**	Turbidity too high, MW3	The commenter states "An additional problem is that the water produced from well MW-3 is at a turbidity level three times greater than the maximum level allowed in the RCRA guidance".	R51	NMED disagrees. The median turbidity value for groundwater samples from MW3 is 2.99 NTU, which is less than the maximum recommended value of 5 NTU.
J	**Citizen, Robert H. Gilkeson**	Negative Eh and purging, MW4	The Commenter states "… the chemical data show that the water produced from the well has a negative Eh and is possibly anaerobic instead of the high positive Eh and aerobic chemistry of the background groundwater at well BW1. For well MW4, the measurements that show dissolved oxygen in the water with negative Eh are in conflict and show the need to improve the methods that are used for measuring these sensitive water parameters. The trend in Eh and dissolved oxygen measurements show that the necessary amount of groundwater was not purged from the well before samples were collected for the analytical suite. In a July 19, 2006 meeting with the NMED, the commenter repeated his comments on this topic.	R52	The median Eh of groundwater samples from MW4 is 285 millivolts; whereas the median Eh of samples from BW1 is 141.8 millivolts. Thus, the median Eh of water samples from MW4 actually exceeds that from BW1, opposite of what was argued by the commenter. The commenter did not consider all the relevant data. Well MW4 was drilled using the sonic resonant method, and without using organic drilling additives. As organic drilling additives were not used, a reducing groundwater environment would not be expected, and is not present. See also NMED report by Moats, Mayerson, and Salem, 2006, entitled *Evaluation of the Representativeness and Reliability of Groundwater Monitoring Well Data, Mixed Waste Landfill, Sandia National Laboratories*. Because of potential errors in Eh measurements (see response R46), some SNL personnel may need more training or may need to exercise more care in obtaining Eh measurements, as negative Eh measurements should not be expected from water samples collected at the MWL.

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J	**Citizen, Robert H. Gilkeson**	Wells improperly located relative to groundwater flow direction	In a meeting with NMED on July 19, 2006, the commenter expressed concern that the MWL wells are worthless for samples because the groundwater flows from east to west.	R53	There are two newer wells, not considered by the commenter, located west of the landfill that were installed by the Permittees and required by the NMED. These wells were installed primarily with the intent to augment the monitoring well network with respect to determining the direction and gradient of groundwater flow. There is also an additional well drilled beneath Trench D, and three older wells located along the west-central boundary, and near the northwestern and northeastern corners of the landfill. These older wells were placed in these positions because early regional water levels were taken into account, suggesting north-directed groundwater flow. However, it is noteworthy that the northern part of the landfill is especially important from an environmental perspective because this is the portion of the landfill known to have had the most disposal of liquid and tritium wastes, and also where the highest concentrations of VOCs in soil gas have been detected. The older wells are therefore situated at very useful locations.
J	**Citizen, Robert H. Gilkeson**	Major ion chemistry is not reliable	In a meeting with NMED on July 19, 2006, the commenter expressed concern water samples are not reliable for major ion chemistry, as well as contaminants because sensitive water parameters have not stabilized.	R54	The NMED disagrees with this comment. Piper and stiff diagrams show that all major ions have maintained consistent concentrations throughout the 16 years of monitoring done at the MWL. See also the NMED report by Moats, Mayerson, and Salem, 2006, entitled *Evaluation of the Representativeness and Reliability of Groundwater Monitoring Well Data, Mixed Waste Landfill, Sandia National Laboratories*.
J	**Citizen, Robert H. Gilkeson**	Sampling procedures are not the same as those specified by the LANL Consent Order.	In a meeting with NMED on July 19, 2006, the commenter expressed concern the sampling procedures employed at the MWL do not meet those required by the LANL Consent Order, and thus do not meet industry standards.	R55	The groundwater sampling methods employed at the MWL meet substantively guidance issued by the EPA and NMED. Industry follows guidance issued by the EPA. The wells are purged prior to sampling. Eh, pH, specific conductance, and temperature are generally measured during purging and sampling, and using a flow-through cell.

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					The LANL Consent Order controls activities at LANL, not the MWL.
J	**Citizen, Robert H. Gilkeson**	Downward trends for Eh	In a meeting with NMED on July 19, 2006, the commenter states that most wells are trending to lower values of Eh which indicates a chemistry affected by drilling additives or contamination from the mixed waste dump.	R56	The NMED disagrees with this comment. There are no notable trends in Eh values for any water samples from MWL wells. See also NMED report by Moats, Mayerson, and Salem, 2006, entitled *Evaluation of the Representativeness and Reliability of Groundwater Monitoring Well Data, Mixed Waste Landfill, Sandia National Laboratories*.
P	**Citizen, Krishan Wahi**	Delay not protective	The commenter recommends approval of the CMI Plan recognizing that parameter and model uncertainty can be reduced, but not eliminated, no matter how much money is spent. The commenter states that more complicated facilities use the principle of ALARA (as low as reasonably achievable) to provide the balance in protecting human health. The commenter states that indefinite delays do not contribute to public health and safety.	R57	The NMED agrees that it is not possible to remove all uncertainty with respect to site investigations and models based upon them. The NMED also agrees that indefinite delays are not protective of human health and the environment. NMED is cognizant of strategies that dwell on uncertainty to undermine any scientific conclusions. Such strategies have been effective at delaying Congressional action on climate change that could be costly to industry. Of course, the scientific community is unanimous in its concurrence that global warming is a reality, despite the uncertainties in science. NMED believes this is a useful analogy in considering comments about uncertainly in scientific results.
Q	**Citizen, Willard Hunter**	Seismic threat	The commenter is concerned that the potential for a seismic threat does not appear to be addressed by the CMI Plan and the FTM. The commenter indicates that DOE requires new seismic design requirements in SNL buildings and questions why similar seismic	R58	Analogous, but not controlling, environmental regulations would not prohibit the construction of a hazardous waste landfill at the MWL site based on seismic threat because there is no evidence of Holocene fault movement within 200 feet of the site. The vegetative soil cover to be employed at the MWL, being a simple design of essentially a monolithic layer, would be expected to survive intact if an earthquake occurred nearby.

Commenter ID	Commenter / Association	Topic Area	Comment Summary	NMED Response Number	NMED Response
			analysis does not apply to the MWL.		
H	**Citizen Action New Mexico, Susan Dayton** (Comments compiled by Paul Robinson, Southwest Research and Information Center)	Sampling of landfill surface	The commenter also states that a consultant working for Citizen Action opined that sampling of the landfill surface was not random and grid locations too coarse, and that some sampling occurred over the most recent trenches dug at the MWL.	R59	The NMED disagrees with the comment that adequate surface-soil sampling was not done and was not random. This issue was dealt with in much detail during the hearing on the MWL Corrective Measures Study. A grid of random spacing and orientation was placed over the landfill surface. Analytical results of the surface soil sampling detected plutonium in surface soil which was caused by undocumented spills from containers of mixed waste stored on the landfill's surface. The levels of plutonium contamination found on the surface of the MWL do not pose unacceptable risk to human health or the environment.

Volume I

TAB 11

Evaluation of the Representativeness and Reliability of Groundwater Monitoring Well Data, Mixed Waste Landfill

(referenced as part of 11/21/2006 NMED Responses to Public Comments on Corrective Measures Implementation Plan)

From: D Moats et. al
To: Interested Citizen

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Evaluation of the Representativeness and Reliability of Groundwater Monitoring Well Data, Mixed Waste Landfill, Sandia National Laboratories

New Mexico Environment Department/Hazardous Waste Bureau
By: William P. Moats, David L. Mayerson[1], and Brian L. Salem
November 2006

Introduction

The Mixed Waste Landfill (MWL) was operated by Sandia National Laboratories (SNL), whose research facilities are within the area occupied by Kirtland Air Force Base (KAFB). The MWL was operated for land disposal from 1959 to 1988, and included at various times throughout its operational history disposal of radioactive, hazardous, and mixed wastes. It is comprised of two contiguous areas - the classified and the unclassified waste areas - which together occupy approximately 2.6 acres in the north-central portion of Technical Area 3. During operation of the MWL, classified wastes were buried in small pits, and unclassified wastes were disposed in seven trenches. SNL estimates that the landfill received a total of approximately 100,000 cubic feet of waste containing about 6,300 curies of activity at the time of disposal (SNL, 09/1996).

The MWL is subject to corrective action as a solid waste management unit (SWMU) under the New Mexico Hazardous Waste Management Regulations 20.4.1.500 NMAC, incorporating 40 CFR 264.101. Under the regulatory framework mandated by these regulations, and upon consideration of the Corrective Measures Study for the MWL (SNL, 05/2003), the Secretary of the New Mexico Environment Department (NMED) ordered construction of an evapotranspiration cover with bio-intrusion barrier over the landfill, and the subsequent development and implementation, upon NMED approval, of a long-term monitoring and maintenance plan (NMED, 05/26/2005).

Public comments submitted to NMED on the MWL Corrective Measures Implementation Plan (SNL, 11/2005) include concerns that the groundwater samples from the existing MWL monitoring wells have not yielded representative hydrochemical data due to the effects of residual drilling mud and organic additives. Commenters assert that residual organic additives can induce the formation of iron and manganese precipitates, which, like residual drilling mud, can remove (adsorb) contaminants from the groundwater before they enter a well bore and can reduce the local aquifer permeability in the vicinity of a well. Additionally, commenters maintain that residual organic additives may cause localized reducing conditions around a well bore, which is expressed by low values of Eh, nitrate, and sulfate; undetectable values of dissolved oxygen, and elevated concentrations of ammonia, sulfide, manganese and iron. They maintain that all of these circumstances exist at the MWL.

[1] Now employed with the NMED Ground Water Quality Bureau

The concerns expressed by the public were based in part upon groundwater investigations conducted at Los Alamos National Laboratory (LANL), where these circumstances were found to be true in some monitoring wells (LANL, 11/2005). Given the seriousness of these concerns relative to the NMED Hazardous Waste Bureau's (Bureau) mission and statutory mandates, the Bureau conducted a detailed study of the quality of groundwater data derived from MWL monitoring well samples. This document reports the results of that study.

Purpose

The purpose of this report is to evaluate whether or not groundwater samples from the MWL monitoring wells have produced metals and general chemistry concentration and field parameter data that are reliable and representative of groundwater underlying the MWL. NMED has relied upon these data, in part, to determine the appropriate remedy for the MWL. Other information was considered in the remedy selection process, including the waste inventory (types, amounts, and migration potential and pathways of waste) geologic and climatic conditions, current levels of chemical and radiological contaminants released into the vadose zone, surface soil, and the atmosphere, and short and long term risk to human health and the environment. These facets are not addressed in this study.

Background

The MWL overlies unconsolidated sediments within the Albuquerque Basin that generally can be grouped into two major lithologic units. The upper unit, the Alluvial Fan (AF) Facies, is composed chiefly of medium-grained to fine-grained sediments that are derived from the erosion of Precambrian and Paleozoic rocks forming the uplands east of the landfill. The unit generally becomes finer-grained with depth, and forms the uppermost portion of the saturated zone beneath the MWL. The AF Facies is characterized by low saturated hydraulic conductivity (10^{-7} cm/s), especially in its lower parts (Goering et al., 12/2002).

Underlying the AF Facies are somewhat coarser-grained fluvial sediments believed to have been deposited by an ancestral Rio Grande. This lower unit, the Ancestral Rio Grande (ARG) Facies, is characterized by saturated strata having a larger degree of lateral continuity and having hydraulic conductivities about two orders of magnitude higher than those of the AF Facies (Goering et al., 12/2002).

A total of seven groundwater monitoring wells have been installed at the MWL to monitor whether or not underlying groundwater has been affected by any contamination emanating from the MWL. Wells BW1, MW1, MW2, and MW3 each have a single well screen, and are all completed within the AF Facies (Goering et al., 12/2002). Well MW4 is installed in an angled borehole, and was completed with two well screens that are 20 feet apart and which are separated by a removable packer (Goering et al., 12/2002). The uppermost screen of this well is completed in the AF facies, while the lower screen is completed across the boundary of the AF facies and the underlying ARG Facies. Monitoring well MW5 is also completed across this facies boundary, while MW6 is

screened wholly within the ARG facies (Goering et al., 12/2002). Both MW5 and MW6 are completed with single screens. All of the groundwater underlying the MWL is within the low total dissolved solids (low-TDS) hydrochemical facies as described by Moats and Winn (01/1995).

Nitrate concentrations from MW4 groundwater samples are lower than those observed in groundwater samples from the four monitoring wells that are completed solely within the AF facies (*i.e.*, BW1, MW1, MW2, and MW3), and are very similar to the corresponding analyte data from MW5 and MW6 (see Appendices A and B). The presence of nitrate in the shallower facies groundwater is attributed to contamination from septic systems within the vicinity of Tech Area 3 (IT, 04/1999, cited in Goering et al., 12/2002), as no significant nitrate sources from the MWL are known to exist. This difference in nitrate concentrations between the upper screened zone of MW4 and the other shallow wells may be indicative of small hydrochemical differences related to local areas of lower hydraulic conductivity within the AF facies (Goering, 09/21/2006).

Three drilling methods were used to install monitoring wells at the MWL: mud rotary, air-rotary casing hammer (ARCH), and sonic resonance. According to SNL records, the mud rotary method, which utilizes drilling mud, drilling additives, or both was employed only in the installation of MWL monitoring wells BW1, MW2, and MW3, all of which are completed in the AF Facies (Ecology and Environment, 12/1989). These three wells will be collectively referenced herein as the *mud rotary wells*.

Bentonite drilling mud is composed primarily of the clay mineral montmorillonite, (Na, Ca)(Al, $Mg)_6(Si_4O_{10})_3(OH)_2 \cdot nH_2O$. Bentonite drilling muds also contain other minor components. For example, LANL found drilling mud could include various leachable components such as sulfate, uranium, and fluoride (LANL, 11/2005, Table A-10). The presence of residual drilling mud or additives in a well bore or surrounding aquifer material can affect the properties of groundwater samples. For example, in some cases, alkalinity levels of groundwater contaminated with organic drilling additives may be higher than those of formation water due to the oxidation of organic matter to form bicarbonate.

The only documented drilling additives that have been used in installation of the mud rotary wells are soda ash (Na_2CO_3), sodium carboxymethylcellulose (CMC: used to stabilize drilling fluid), and lost circulation material (Ecology and Environment, 12/1989, p. 3-3). Soda ash was used in the redrilling of BW1 and MW3 (Ecology and Environment, 12/1989, p. 3-4)[2], and was added to increase the pH of the mud when the viscosity could not be controlled by simple water addition. Lost circulation material (*e.g.*, ground fragments and pieces of cedar wood and cellophane) was used only in drilling BW1 (Ecology and Environment, 12/1989, p. 3-4 and Appendix D). CMC was used in the drilling of all three mud rotary wells to control water loss, increase viscosity, and

[2] A typographic error on this page of the referenced report identifies the former as MW1; however Sections 4.1 and 4.4 and Appendix D drilling fluid reports clearly indicate that this well should have been identified as BW1.

inhibit clay swelling. Because of the properties of CMC, it was expected to be easily flushed from the borehole during well development.

Data on the construction of all MWL monitoring wells are summarized in Table 1. Well MW4 was drilled by the sonic resonance method (SNL, 12/07/1992), with the introduction of potable water during well installation (Goering, 07/17/2006). For wells installed using the ARCH method (MW1, MW5, and MW6), only air and potable water were introduced during installation (Ecology and Environment, 12/1989; SNL, 12/07/2000; and SNL, 10/19/2000). However, according to field notes, small quantities of sodium-bentonite grout infiltrated into the filter pack and well screen of MW5 during construction of this particular well.

Compared to the variability of regional background water quality in the low-TDS hydrochemical facies, minor hydrochemical differences exist in the relative concentrations of major ions between groundwater from the AF facies and that of the underlying ARG Faces. Stiff diagrams are commonly used as a means for the rapid comparison of the abundance of major ions between groundwater samples due to their distinctive graphical shapes. Figure 1 represents groundwater data from a sampling event conducted in April 2001 at the MWL. It shows that ARG Facies groundwater has relatively higher concentrations of magnesium (Mg), calcium (Ca), sodium (Na) plus potassium (K), alkalinity (bicarbonate and carbonate), and chloride (Cl) compared to groundwater from the AF Facies. Overall, groundwater from both facies is similar, as shown by a Piper trilinear diagram of major ion chemistry of groundwater samples from all MWL monitoring wells (Figure 2; Goering et al., 12/2002). Piper diagrams are useful for comparing water samples based on their proportions of major ions, and are especially useful for revealing whether or not mixing of groundwater from different sources is occurring. The Piper diagram in Figure 2 indicates that groundwater from both the AF and ARG Facies can be classified as a calcium-sodium bicarbonate water.

Time series concentration plots (Appendix B) show that groundwater alkalinity, sodium and sulfate concentrations have remained stable since sampling began at the MWL. Piper and stiff diagrams prepared by Goering et al. (12/2002) for sampling events conducted from 1993 -2001 further demonstrate that the overall hydrochemistry of groundwater at the MWL has remained generally stable over the time period for which groundwater data are available.

Based on analysis of soil samples from investigational boreholes as well as passive and active soil-gas surveys (SNL, 09/1996), detectable contaminant releases from the MWL are limited to low levels of tritium, radon, and volatile organic compounds in the vadose (*i.e.*, unsaturated) zone. Cadmium has been detected at low concentrations in the vadose zone, but only along the western boundary of the landfill. The fate and transport model of Ho et al (11/2005) predicts that groundwater is unlikely to be affected in the future by any of these contaminants occurring in the vadose zone. The results of up to 14 years of groundwater monitoring conducted at the MWL further support this conclusion.

Data sources

Available historical groundwater hydrochemical and field parameter data for each of the MWL groundwater monitoring wells were compiled from periodic SNL groundwater monitoring data reports (Goering et al., 12/2002; Lyon and Goering, 01/ 2006) and an NMED study (Moats and Winn, 01/1995). Appendix A presents a tabular compilation of available historical data for the analytes used in this evaluation.

Background hydrochemistry, which is used for comparison purposes with corresponding data from the monitoring wells, is taken from a comprehensive study of background groundwater quality throughout the area encompassed chiefly by Kirtland Air Force Base (KAFB), which includes the SNL research facilities (Moats and Winn, 01/1995). Only uranium concentration data are taken from a separate background study (IT Corporation, 03/1996).

Data analysis method

For this study, NMED has modified an effective method utilized by LANL in a similar investigation of the quality of LANL groundwater monitoring data (LANL, 11/2005). The LANL study employed a tiered assessment strategy in which selected key analyte concentrations from the three most recent groundwater sampling events were compared to local background concentrations. The specific analytes used were chosen considering common effects on groundwater samples from the presence of residual drilling mud and organic drilling additives (see Figure 3 for an overview of the LANL process). These effects, if they exist, would be shown by analyte concentrations that are either decreased or increased in comparison to corresponding regional background values by the adsorption or desorption of specific chemical species, by localized alteration of reduction-oxidation (redox) conditions, or both.

The NMED tiered evaluation method is shown as modifications to the LANL process in Figures 4 and 5. Data flag codes used to indicate that data reliability or representativeness may be compromised by the potential presence of residual drilling mud, additives, or both are explained in Table 5. An additional modification to the LANL process is the use of the median concentration values from the entire data set for any specific analyte where possible. This is a major enhancement of the LANL process, as use of median values allows for assessment of the reliability and representativeness of the *entire* data set for the subject wells, while discounting the effects of extreme (*i.e.*, very high or low) data values. For analytical results that are reported by the laboratory as below the analytical detection limit (DL), the NMED generally has used a value equal to one-half the value of the DL in the calculation of the median value. Because all concentration values for ammonia are reported as below the DL, no median concentration has been calculated for this analyte.

As an additional check on data reliability beyond that built into the LANL process, the NMED compared the median value of each analyte for each mud rotary well to the median values for the same analytes from groundwater samples from wells MW1 and

MW4. As stated above, these two wells are completed in the same AF facies, but were drilled without the use of mud or organic additives. Thus, neither of the two wells can possibly demonstrate any of the possible adverse effects of residual drilling mud and or organic additives, including the formation of iron or manganese precipitates that could mask the measurement of groundwater contaminants. Both of these wells should therefore provide analytical data that are representative of aquifer hydrochemistry. For purposes of this study, the NMED assumed that the median analyte concentration from a given mud rotary well that is within one standard deviation of the corresponding median from *either* MW1 or MW4 is strongly indicative of acceptable data representativeness and reliability. The range representing +/- one standard deviation from the median value of a given constituent will be hereinafter referred to as the *target comparison range*. However, small differences outside of the target comparison range do not automatically imply that samples from a well are not representative or reliable, as the background range for any given groundwater constituent generally encompasses an even larger degree of variance. For example, alkalinity in the low-TDS facies ranges from 101.0 to 291.0 mg/L, with a median of 169.5 mg/L and a standard deviation of 52.8 mg/L (Moats and Winn, 01/1995). This establishes a target comparison range of 116.7 to 222.3 mg/L, which excludes the maximum and minimum background values for alkalinity. In such cases, additional analysis may be required to decide whether or not any suspect data are representative and reliable.

As mentioned above, the LANL evaluation process is predicated on inferred geochemical and biochemical interactions among residual drilling mud and/or additives, groundwater, and aquifer materials. However, in some cases the LANL process used different groundwater constituents from those used by the NMED for the MWL. For NMED's examination of the MWL mud rotary wells, the LANL method was modified to utilize extant MWL groundwater data. For example, very little data for strontium are available for the MWL for use as a possible indicator of adsorption onto residual bentonite (see Figure 4, Tier 2.1-2). However, cadmium could be expected to be significantly adsorbed by residual bentonite, as the average adsorption coefficient for cadmium (560 mL/g) is about the same order of magnitude as that for strontium (110 mL/g) (LANL, 11/2005, Table 4-4, p. 62). Cadmium was therefore substituted for strontium in the NMED evaluation. Similarly, there are no analytical data for analytes specified in the LANL Tier 2.2-1 evaluation process available for MWL monitoring wells (see Figure 5), other than ammonia. However, oxidation of residual organic drilling additives would be expected to increase the level of alkalinity (LANL, 11/2005, p. 15). NMED has therefore substituted this analyte in this part of the tiered evaluation method.

MWL monitoring well samples have occasionally yielded low concentrations of acetone. Most of these detections are below the laboratory practical quantitation limit, and are associated with the detection of acetone concentrations in blank samples, which would be indicative of laboratory contamination. Therefore, acetone concentration data were not used in the evaluative process (see Figure 5, Tier 2.2-1).

The NMED further modified the LANL process by evaluating total, rather than dissolved, metal concentrations. With the exception of dissolved zinc, generally no more than four

analyses for any dissolved metals analyte exist. Use of total metal concentrations could overestimate the effect of desorption (see Figure 4, Tier 2.1-1) and Fe/Mn reducing conditions (see Figure 5, Tier 2.2-2), thus producing overly conservative assessments. On the other hand, use of the total metal concentrations could underestimate the effect of adsorption (see Figure 4, Tier 2.1-2) if the turbidity of a sample appreciably exceeds 5 NTU.

Although MW1 should provide sample data that are representative of background hydrochemistry in the AF facies, the concentration of total nickel in MW1 groundwater samples has shown a marked increase over time (see Figure 6). This is inferred to indicate progressive corrosion of the stainless steel well screen in this well (Goering et al., 12/2002). In addition to nickel, stainless steel commonly is comprised of iron and chromium. Therefore total iron concentrations from MW1 groundwater samples were not used in evaluating the mud rotary well sample data (see Table 4, Tier 2.2-2: redox conditions -- iron/manganese reducing conditions evaluation; and Table 6).

For MW4, the majority of post-05/23/1994 groundwater sample data are derived from samples from the upper screen, which also samples the AF Facies. However, data from earlier groundwater samples were composites of groundwater from both screens, with groundwater hydrochemistry from the lower more-conductive ARG facies presumably dominant (Goering, 09/21/2006). Nevertheless, groundwater data from MW4 represent a reasonable comparison to correlative data from the mud rotary wells.

As noted above, sodium-bentonite grout inadvertently infiltrated into the filter pack and screen of MW5 during well installation. Based on review of the field notes documenting well construction, it appears that much of the grout was removed prior to completing installation, and that all of the grout residing at the bottom of the well was removed prior to well development. Any remaining smaller amounts of grout within the filter pack should have been fairly easy to evacuate during well development.

If any appreciable grout is still present within the filter pack of MW5, there is a potential that the sodium bentonite contained within the grout could adsorb contaminants in a fashion similar to bentonite drilling mud. The percentage of bentonite in the grout that was used in the construction of MW5 is unknown, but bentonite grouts typically contain 2 to 6% sodium-bentonite by weight (U. S. Environmental Protection Agency, 03/1991). Grout is made chiefly from Portland cement, which is a mixture of various calcium silicates and calcium aluminates and subordinate amounts of hydrated calcium sulfate. Calcium and aluminum are major constituents of sodium-bentonite drilling mud, and, as mentioned previously, sulfate was found to be a leachable constituent of drilling mud made from bentonite mined from Wyoming, the most common source of bentonite used in well installations in the United States (LANL 11/2005).

Because grout is composed chiefly of Portland cement rather than drilling mud, various groundwater constituents in samples from MW5 were specifically evaluated as indicators of the presence of grout. In this case, it is assumed that the presence of grout is strongly indicated in MW5 water samples if all of the median concentrations of calcium, total

aluminum, and sulfate exceed their respective regional background concentrations (Table 9, Tier 3.1). As an additional check, the adsorption of metals was evaluated with the same process used for bentonite drilling mud (Table 9, Tier 3.2), except that total barium was substituted for total cadmium. NMED made this substitution because the levels of cadmium detected in MW5 groundwater samples are significantly less than the detection limit used to establish background, so meaningful comparisons using cadmium are not possible. Dissolved zinc data are not evaluated as such data are not available for water samples from MW5.

Finally, relative to other wells at the MWL, the general hydrochemistry of samples from MW5 should be most comparable to that of samples from MW6, as both of these latter wells are screened at least in part in the ARG Facies. The stiff diagrams shown in Figure 1 are useful for making this comparison.

Discussion

A major objective of this study is to determine whether localized reducing conditions may have become established in well bores by the oxidation of residual organic drilling additives (see Figure 5, tier 2.2-2.). In natural settings, the redox potential of groundwater tends to decrease as groundwater moves along its flow path. Water in the form of rain or snow initially contains appreciable levels of dissolved (free) oxygen due to the interaction of precipitation with the atmosphere. In recharge areas exhibiting sandy or gravelly soils, cavernous limestone, or fractured bedrock, levels of dissolved oxygen can remain high over considerable distances along the flow path of a groundwater system. In the KAFB/SNL area, groundwater commonly contains free oxygen at concentrations exceeding 2 mg/L (Moats and Winn, 01/1995), which is considered here to be indicative of moderate levels of dissolved oxygen (the lower limit of detection for dissolved oxygen is typically about 0.1 mg/L).

Because the solubility of dissolved oxygen in water is low, and because oxygen is not easily replaced in subsurface environments, oxidation of only a small amount of organic matter can consume all of the free oxygen in groundwater. If not sufficiently removed via well development, residual organic drilling additives can take the place of natural organic matter and supply nutrients to oxygen-consuming bacteria. The consumption of dissolved oxygen by bacterially-catalyzed reactions can deplete oxygen levels in groundwater to those below the level of detection. However, once the free oxygen has been consumed, reactions with other constituents in groundwater can cause further decreases in redox potential of the groundwater.

In a closed system, the oxidation of organic matter first consumes free oxygen, then is followed by a reduction of nitrate and manganese oxide. These reactions may be followed, in turn, by the reduction of ferric iron minerals. After sufficiently negative redox levels have been reached, sulfate can be reduced to H_2S and HS^-, along with the reduction of organic matter to carbon dioxide ($CO_{2)}$ and methane (CH_4). However, in most groundwater systems, groundwater does not undergo all of the above redox stages

due to limitations on the availability of nutrients and conditions that allow bacteria to thrive.

Contaminants migrating from the MWL have not been detected in the groundwater beneath the landfill (Goering et al, 12/2002). Furthermore, the fate and transport model completed for the MWL shows that concentrations of contaminants in the vadose zone beneath the MWL are sufficiently low that groundwater is unlikely to be impacted in the future (SNL, 11/2005). Although contaminants do not occur in the groundwater presently (aside from nitrate from septic tanks as previously discussed), the ability of the MWL wells to provide high quality water samples useful for the detection of any unexpected future contamination is of paramount importance.

Tables 2 through 8 present the NMED's evaluation of the quality of MWL groundwater monitoring data using the tiered evaluation method. Wells MW1, MW4, and MW6 do not require further assessment because these wells were not installed with the mud rotary method. Although MW5 was also not installed using the mud rotary method, the quality of water samples from this well was assessed in this study due to the accidental intrusion of sodium-bentonite grout into the well's filter pack and screen. Additional assessment was therefore necessary for mud rotary wells BW1, MW2, and MW3, and ARCH well MW5.

For the mud rotary wells, the median concentrations of all of the analytes examined fall within the expected regional background ranges (Tables 3 and 4). Therefore, no data quality flags (Table 5) are assigned to any of these analytes. This part of the tiered evaluation process shows that there are no bentonite mud components in groundwater samples from the mud rotary wells, and similarly, that there is no evidence of adsorption of groundwater contaminants. This part of the evaluation also suggests that reducing conditions do not exist in the mud rotary wells.

Comparisons of median analyte values of the mud rotary wells to correlative values for MW1 and MW4 are shown in Tables 6 and 7. Analytes with median values that fall outside of the target comparison ranges for MW1 or MW4 are shown in Table 8. Of all of the analytes evaluated, only the median values for alkalinity (for MW3) and nitrate (for BW1, MW2, and MW3) fail to meet the target comparison ranges for both MW1 and MW4.

Relatively higher levels of alkalinity are expected in groundwater adversely affected by drilling mud. Higher alkalinity concentrations are also expected for groundwater subject to severely reducing conditions, such as those caused by the oxidation of organic matter, including organic drilling additives. However, the median value for alkalinity for the MW3 groundwater samples is actually less than the target comparison ranges for both MW1 and MW4. This, combined with the lack of other bentonite leaching indicators (Tier 2.2-1), strongly suggests that residual drilling mud is not affecting the quality of water samples collected from MW3. Additionally, the lower alkalinity in groundwater samples from this well, as well as moderate concentrations of sulfate and nitrate, high

levels of dissolved oxygen, and nondetectable levels of ammonia indicate that reducing conditions are not present within the well bore.

In general, higher values of nitrate are indicative of high redox potential. The median values for nitrate from MW2 and MW3 samples are slightly lower than the target comparison range for MW1. The median values of nitrate for samples from all three mud rotary wells are higher than the target comparison range for MW4. For all of the mud rotary wells, the levels of nitrate detected in water samples are relatively high compared to the background concentration of 4 mg/L and the median value for nitrate in the low-TDS facies (1.065 mg/L, Moats and Winn, 01/1995). These data, as well as moderate to high concentrations of dissolved oxygen, moderate levels of sulfate, and nondetectable levels of ammonia, further indicate that low redox conditions are not present in the groundwater at any of the mud rotary wells.

For the three mud rotary wells, the median values for total iron as compared to MW4, and the median values for total manganese as compared to both MW1 and MW4, are within their respective target comparison ranges, demonstrating that iron and manganese are not being dissolved into the groundwater as a result of reducing conditions. It is therefore no surprise that the formation of iron and manganese precipitates is not evident at any of the mud rotary wells. The median values for sulfate and ammonia (all non-detects) for these three wells are also within their respective target comparison ranges for both MW1 and MW4, further demonstrating that highly reducing conditions are not present in any of the mud rotary wells.

For ARCH well MW5, comparison of the median values for sulfate, calcium, and total aluminum to their respective maximum regional background concentrations indicate that grout contamination is not present in the well (see Table 9, Tier 3.1). Additionally, comparison of the median values for uranium, total zinc, and total barium to minimum regional background levels suggest that adsorption of contaminants is not taking place. Finally, Figure 1, as well as the series of stiff diagrams in Goering et al (12/2002), show that the general hydrochemistry of water samples from MW5 matches that of groundwater samples collected from MW6, providing yet further evidence that MW5 water samples are free from grout contamination.

Conclusions

MWL wells MW1, MW4, and MW6 were completed without the use of drilling muds and organic drilling additives. Water samples from these wells provide data that are reliable and representative of the hydrochemistry of the aquifer beneath the landfill. Evaluation of groundwater analytical data from MWL mud rotary well samples confirms that these data are not compromised. Therefore, none of the data examined is assigned a qualifying data flag. This study further shows that there are no bentonite drilling mud components that adversely affect sample chemistry in groundwater samples from the mud rotary wells, that there is no evidence of adsorption of groundwater contaminants or evidence of reducing conditions, and that grout contamination was adequately removed from ARCH well MW5 before the well was placed into service.

Nitrate in MWL groundwater samples is attributed to the oxidation of ammonia from Tech Area 3 septic systems. In particular, the consistent detection of relatively high concentrations of nitrate and moderate to high levels of dissolved oxygen in groundwater samples from the mud rotary wells provides strong evidence that localized reducing (low redox) conditions do not exist in the vicinity of these wellbores. Otherwise, concentrations of these analytes would be markedly lower or altogether absent under the slightest reducing conditions. The totality of evidence indicates that the three monitoring wells that were installed with mud rotary method (BW1, MW2, and MW3), and ARCH well MW5 have yielded reliable and representative hydrochemical data.

The NMED encourages the use of monitoring well installation methods that avoid potential impacts to groundwater quality. The NMED will evaluate new or replacement groundwater monitoring wells associated with the MWL long-term monitoring and maintenance plan in light of this recommendation. Nevertheless, the results of the tier evaluation process show that there are no adverse effects in any of the mud rotary wells caused by the presence of residual drilling mud and organic drilling additives. Thus, development of the mud rotary wells at the MWL was adequate, and the quality of water samples retrieved from these wells is representative of general aquifer chemistry.

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Figure 1: Stiff Diagrams of Major Ion Chemistry for all MWL Wells, April 2001
(Goering et al., 12/2002, Figure 4-14)

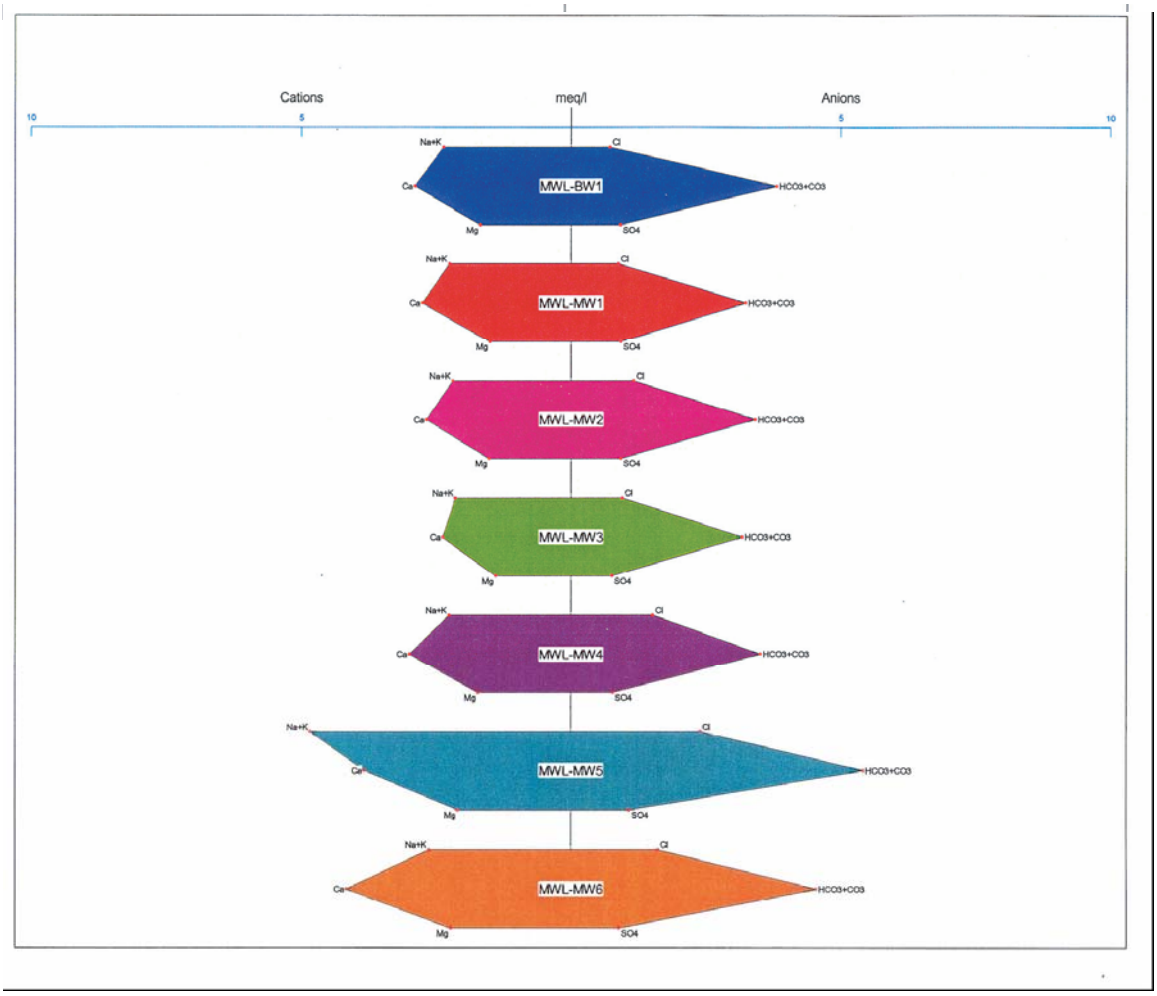


Figure 2: Piper trilinear diagram of major ion chemistry for all MWL wells, April 2001
(Goering et al, 12/2002, Figure 4-7)

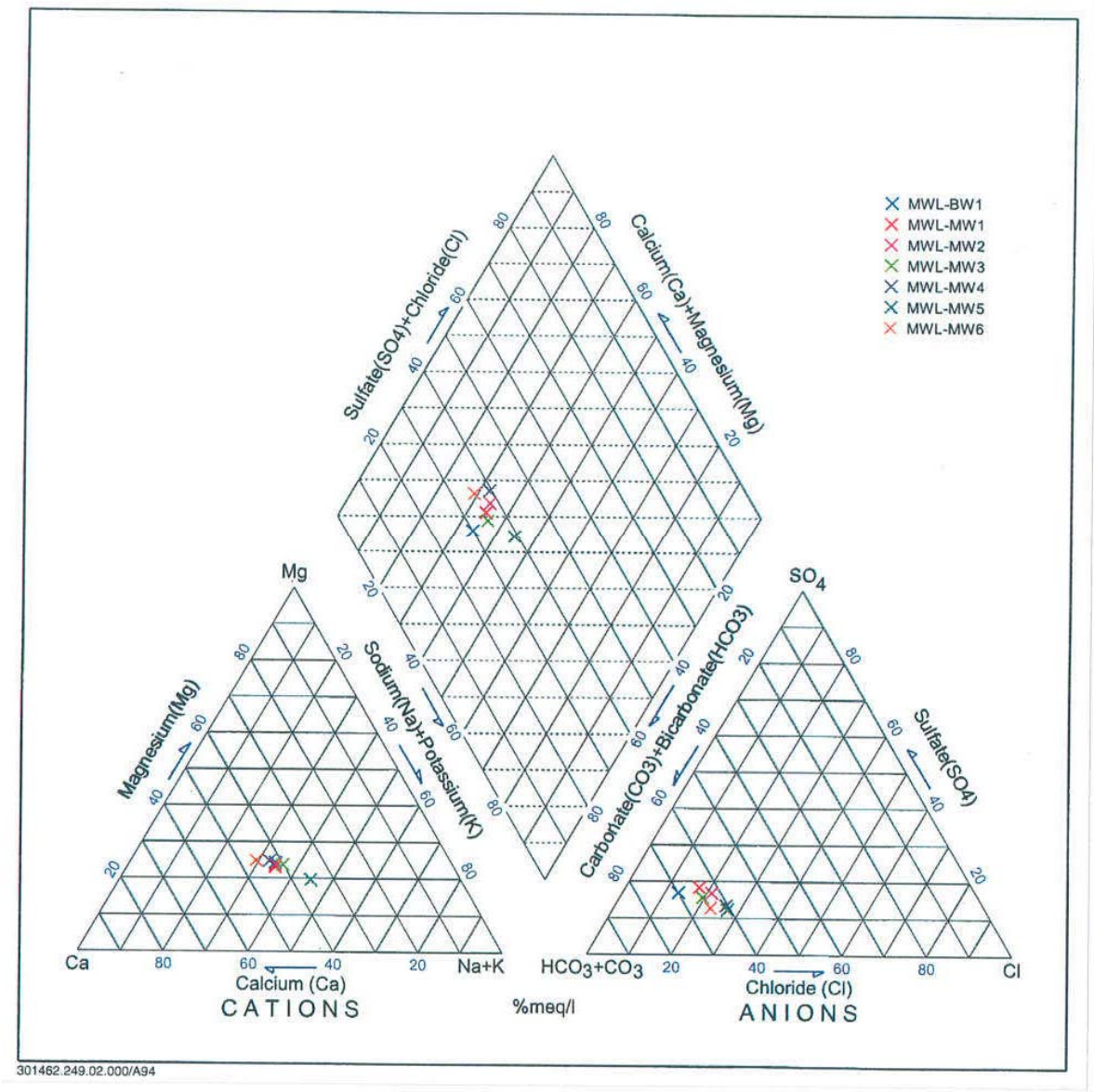


Figure 3: Overview of LANL evaluation process for monitoring well groundwater sample representativeness and reliability
(LANL, 11/2005, figure 4-1)

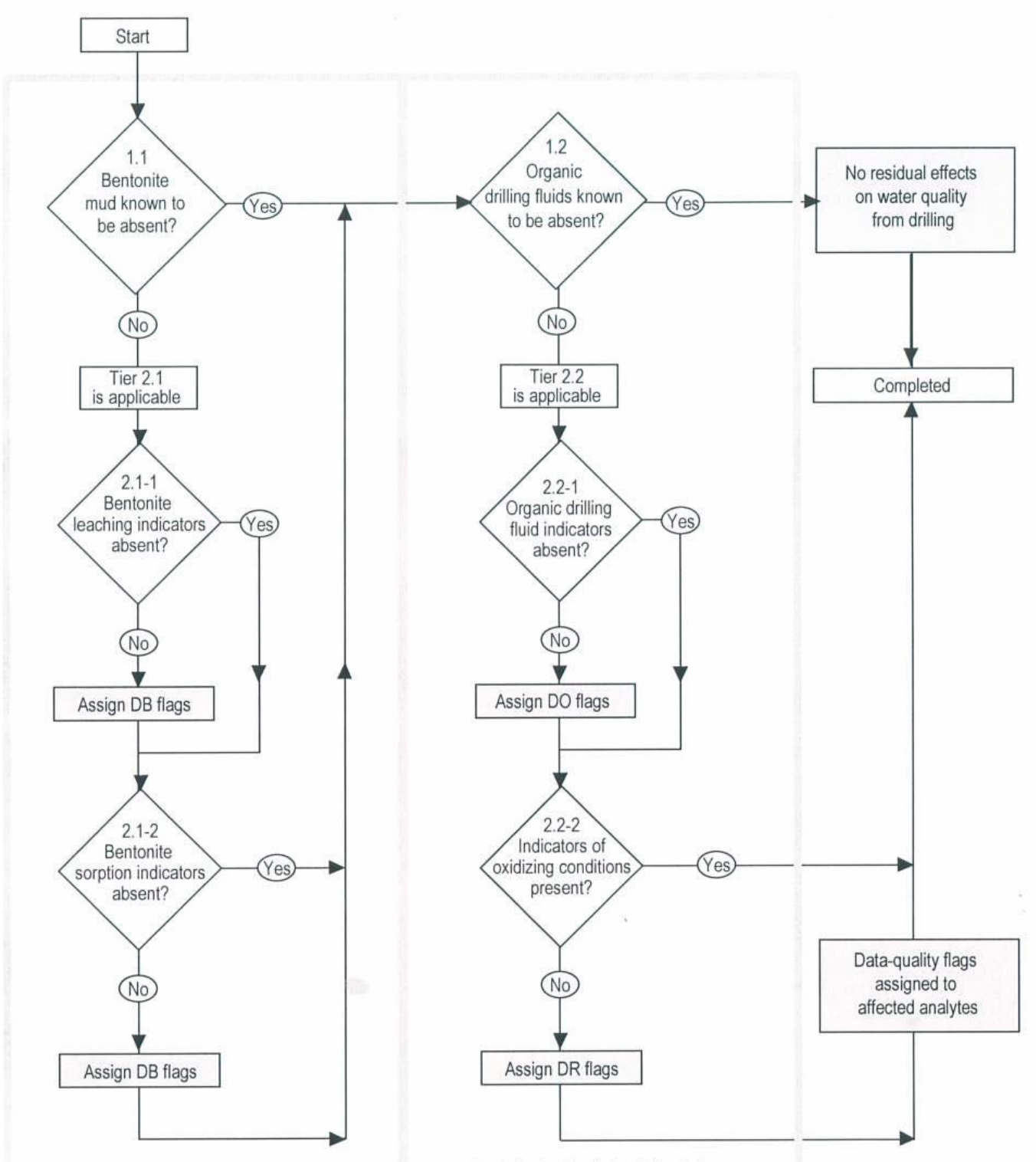


Figure 4: NMED modification of LANL Tier 2.1 evaluation process
(Modified from LANL, 11/2005, figure 4-3)

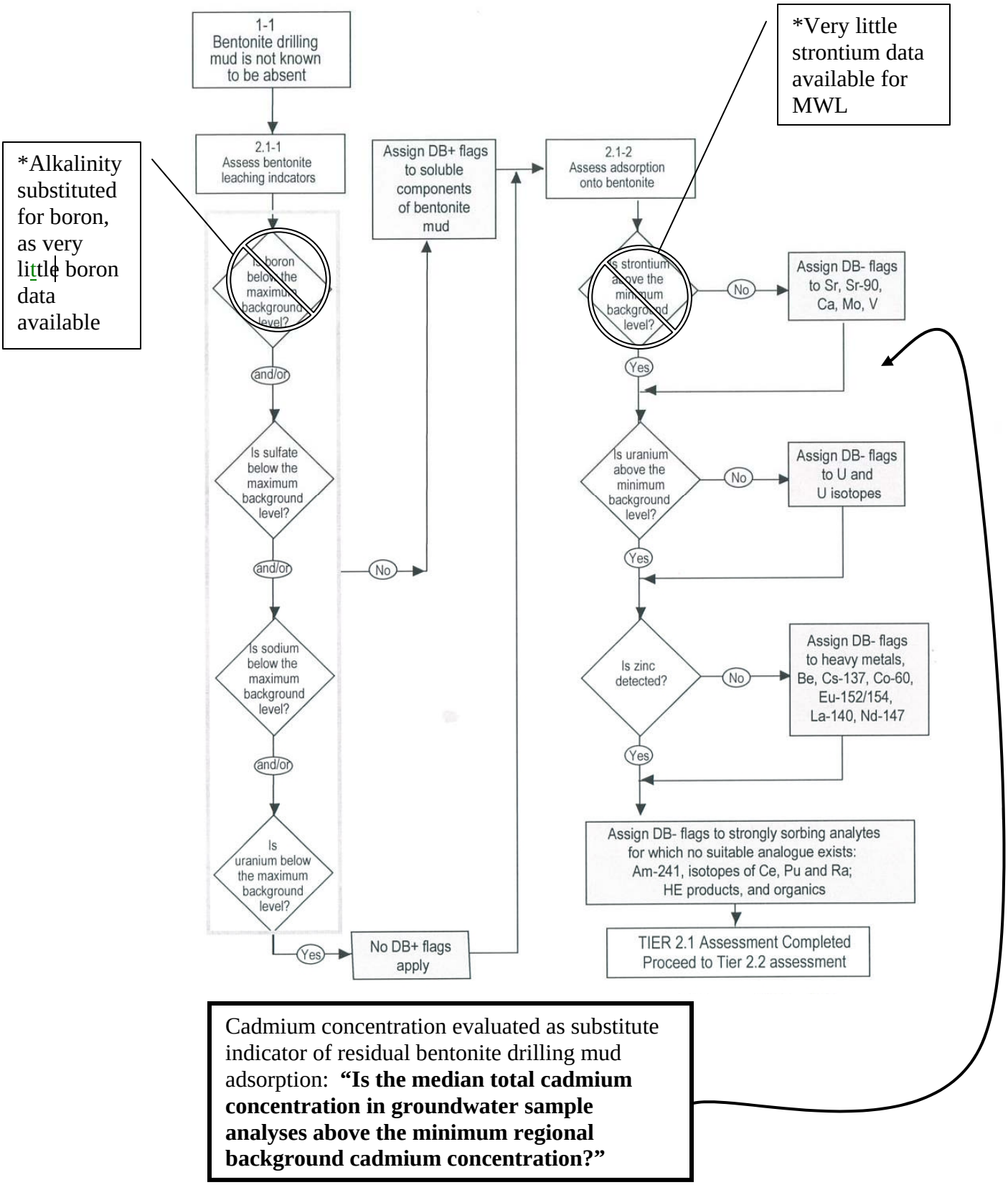


Figure 5: NMED modification of LANL Tier 2.2 evaluation process
(Modified from LANL, 2005, figure 4-10)

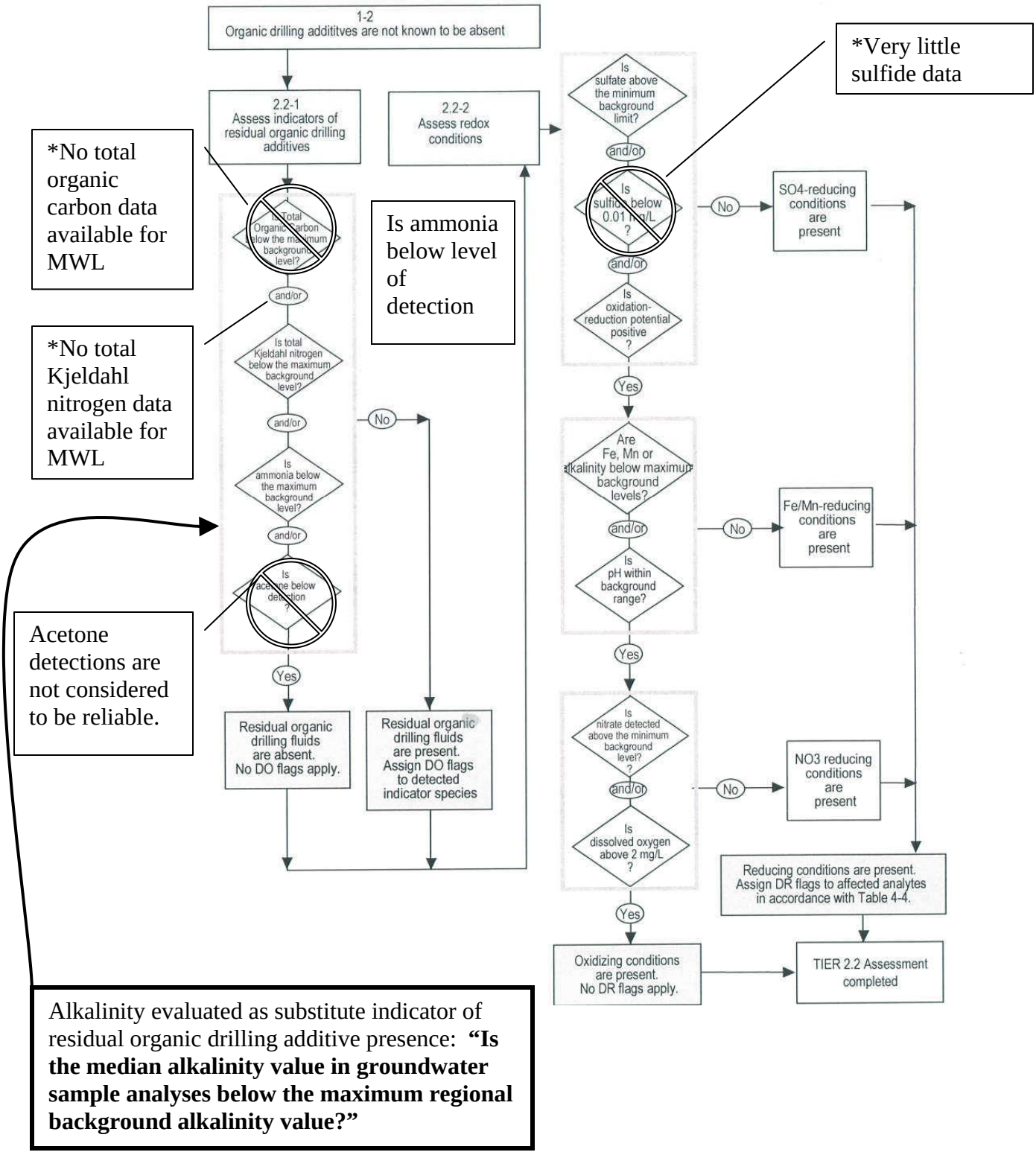


Figure 6: MWL--total nickel concentrations in groundwater samples vs. time

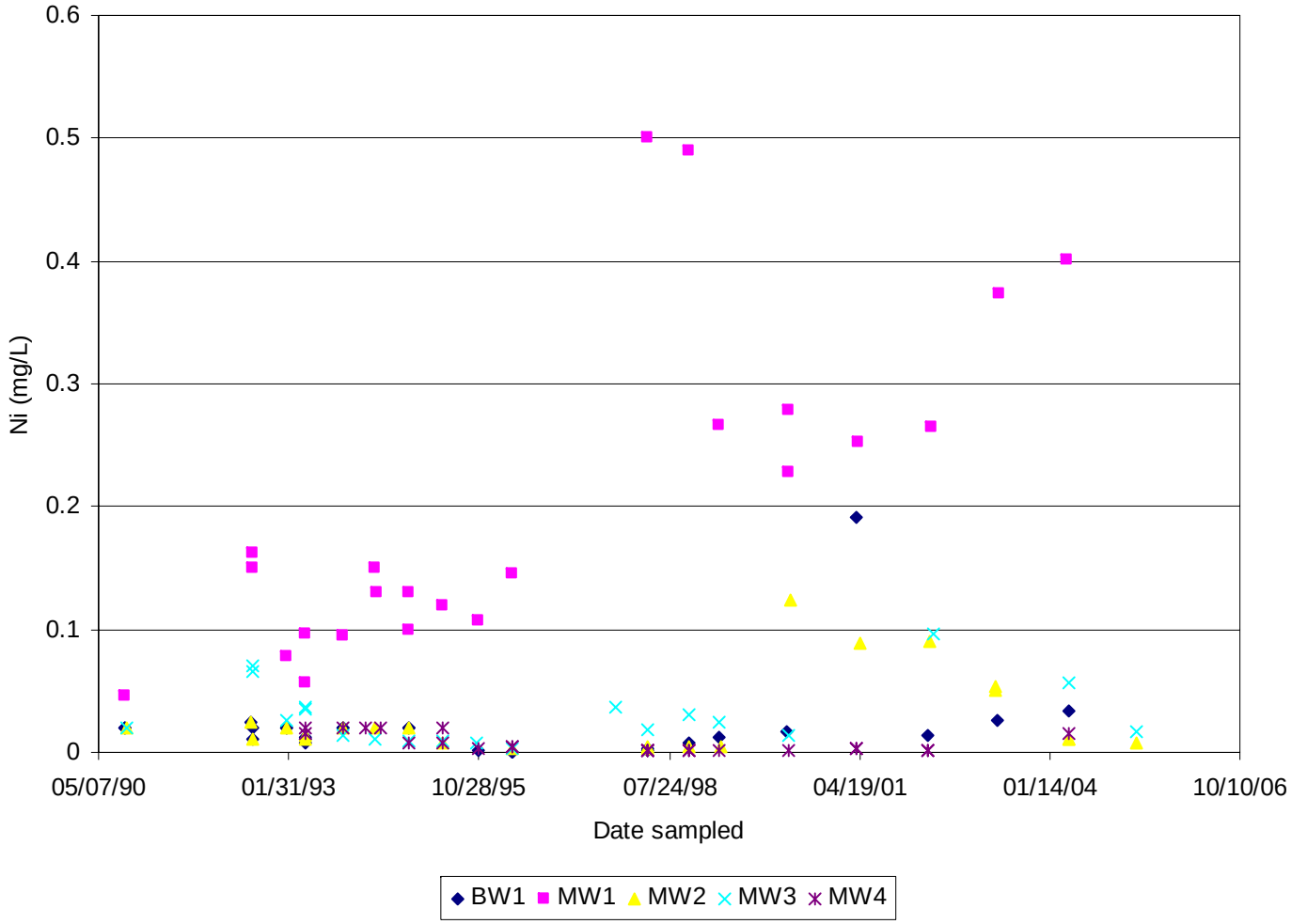


Table 1: MWL Monitoring well construction details

	BW1	MW1	MW2	MW3	MW4	MW5	MW6
Drilling method	mud rotary	air-rotary casing hammer	mud rotary	mud rotary	sonic resonance	air-rotary casing hammer	air-rotary casing hammer
Sedimentary facies at well screen	alluvial fan	alluvial fan	alluvial fan	alluvial fan	**top screen**: alluvial fan **bottom screen:** alluvial fan/ancestral Rio Grande	alluvial fan/ancestral Rio Grande	Ancestral Rio Grande
Screen interval (feet above mean sea level)	4930.53-4910.53	4923.12-4903.12	4923.71-4903.71	4927.67-4907.67	4904.75-4881.86 4861.97-4842.08	4881.15-4861.15	4864.46-4844.46
Date of completion	1989	1988	1989	1989	1993	2000	2000
Additional notes	Background monitoring well for MWL, located cross-gradient	cross-gradient	cross-gradient	down-gradient	6º angle well from vertical with dual completion. Sited beneath Trench D.	downgradient	downgradient

Table 2: Tier 1-1 evaluation

MWL monitoring well	Bentonite mud and/or soda ash known to be absent?	Organic drilling fluids (e.g., CMC) known to be absent?	Outcome
BW1	no		Tier 2.1 is applicable
MW1	yes	yes	no residual effects on water quality from drilling
MW2	no		Tier 2.1 is applicable
MW3	no		Tier 2.1 is applicable
MW4	yes	yes	no residual effects on water quality from drilling
MW5	yes	yes	no residual effects on water quality from drilling, but grout infiltrated filter pack and screen during well installation
MW6	yes	yes	no residual effects on water quality from drilling

Table 3: Tier 2.1 evaluation
(See Figure 4)

Tier 2.1-1: desorption

MWL monitoring well	Median sulfate concentration from groundwater sample analyses (mg/L)	Is the median sulfate concentration in groundwater sample analyses below the maximum regional background concentration (*i.e.*, 124.7 mg/L at 95% confidence level [Moats and Winn, 1995])?	DB flag?
BW1	43.5	yes	none
MW2	41.1	yes	none
MW3	39.2	yes	none

MWL monitoring well	Median total sodium concentration from groundwater sample analyses (mg/L)	Is the median total sodium concentration in groundwater sample analyses below the maximum regional background total sodium concentration (*i.e.*, 74.0 mg/L at 95% confidence level [Moats and Winn, 1995])?	DB flag?
BW1	52.8	yes	none
MW2	49.6	yes	none
MW3	50.7	yes	none

Table 3 continued

Tier 2.1-1: desorption (concluded)

MWL monitoring well	Median total uranium concentration from groundwater sample analyses (mg/L)	Is the median total uranium concentration in groundwater sample analyses below the maximum regional background total uranium concentration? (*i.e.*, 0.0149 mg/L [IT Corporation, March, 1996])?	DB flag?
BW1	0.0066	yes	none
MW2	0.0066	yes	none
MW3	0.0055	yes	none

MWL monitoring well	Median alkalinity (as $CaCO_3$) value from groundwater sample analyses (mg/L)	Is the median alkalinity value in groundwater sample analyses below the maximum regional background alkalinity value (*i.e.*, 289.5 mg/L at 95% confidence level [Moats and Winn, 1995])?	DB flag?
BW1	229	yes	none
MW2	200	yes	none
MW3	191	yes	none

Table 3 continued

Tier 2.1-2: adsorption

MWL monitoring well	Median total uranium concentration from groundwater sample analyses (mg/L)	Is the median total uranium concentration in groundwater sample analyses above the minimum background total uranium concentration, (*i.e.*, 0.0005 mg/L [IT Corp., 03/1996])?	DB flag?
BW1	0.0066	yes	none
MW2	0.0066	yes	none
MW3	0.0055	yes	none

MWL monitoring well	Median total cadmium concentration from groundwater sample analyses (mg/L)	Is the median total cadmium concentration in groundwater sample analyses above the minimum background total cadmium concentration (*i.e.*, <0.001 mg/L [Moats and Winn, 1995])?	DB flag?
BW1	0.0025	yes	none
MW2	0.001	yes	none
MW3	0.002	yes	none

Table 3 concluded

Tier 2.1-2: adsorption (concluded)

MWL monitoring well	Median total zinc concentration (mg/L)	Is total zinc detected?	DB flag?
BW1	0.046	yes	none
MW2	0.071	yes	none

MW3	0.030	yes	none

MWL monitoring well	Median dissolved zinc concentration (mg/L)	Is dissolved zinc detected?	DB flag?
BW1	0.040	yes	none
MW2	0.037	yes	none
MW3	0.038	yes	none

Table 4: Tier 2-2 evaluation
(See Figure 5)

Tier 2.2-1: indicators of residual organic drilling additive

MWL monitoring well	Median alkalinity (as $CaCO_3$) value from groundwater sample analyses (mg/L)	Is the median alkalinity value in groundwater sample analyses below the maximum regional background alkalinity value (*i.e.*, 289.5 mg/L as $CaCO_3$ at 95% confidence level [Moats and Winn, 1995])?	DO flag?
BW1	229	yes	none
MW2	200	yes	none
MW3	191	yes	none

MWL monitoring well	Ammonia value from groundwater sample analyses (mg/L)	Is ammonia below the level of detection?	DO flag?
BW1	< 0.1	yes	none
MW2	< 0.1	yes	none
MW3	< 0.1	yes	none

Table 4 continued

Tier 2.2-2: redox conditions—sulfate reducing conditions evaluation

MWL monitoring well	Median sulfate concentration from groundwater sample analyses (mg/L)	Is the median sulfate concentration in groundwater sample analyses above the minimum regional background sulfate concentration (*i.e.*, 22.0 mg/L [Moats and Winn, 1995])?	DR flag?
BW1	43.5	yes	none
MW2	41.1	yes	none
MW3	39.2	yes	none

MWL monitoring well	Median Eh value from groundwater sample analyses	Is the Eh value positive?	DR flag?
BW1	141.8	yes	none
MW2	151.0	yes	none
MW3	144.5	yes	none

Table 4 continued

Tier 2.2-2: redox conditions—iron/manganese reducing conditions evaluation

MWL monitoring well	Median total iron concentration from groundwater sample analyses (mg/L)	Is the median total iron concentration in groundwater sample analyses below the maximum regional background total iron concentration (*i.e., 8*.570 mg/L at 95% confidence level [Moats and Winn, 1995])?	DR flag?
BW1	0.05	yes	none
MW2	0.09	yes	none
MW3	0.24	yes	none

MWL monitoring well	Median total manganese concentration from groundwater sample analyses (mg/L)	Is the median total manganese concentration in groundwater sample analyses below the maximum regional background total manganese concentration (*i.e.*, 0.100 mg/L [Moats and Winn, 1995])?	DR flag?
BW1	0.005	yes	none
MW2	0.005	yes	none
MW3	0.01	yes	none

MWL monitoring well	Median pH value from groundwater sample analyses	Is the median pH value in groundwater sample analyses below the maximum regional background pH value (*i.e.*, 7.9 at 95% confidence level [Moats and Winn, 1995])?	DR flag?
BW1	7.62	yes	none
MW2	7.55	yes	none
MW3	7.65	yes	none

Table 4 concluded

Tier 2.2-2: redox conditions—nitrate reducing conditions evaluation

MWL monitoring well	Median nitrate concentration from groundwater sample analyses (mg/L, as nitrogen)	Is the median nitrate concentration in groundwater sample analyses above the minimum regional background nitrate concentration (*i.e.*, <0.100 mg/L, as nitrogen [Moats and Winn, 1995])?	DR flag? (*n.b.*, Presence suggests reducing conditions do not exist in wellbore vicinity)
BW1	5.68	yes	none
MW2	3.83	yes	none
MW3	4.03	yes	none

MWL monitoring well	Median dissolved oxygen concentration from groundwater sample analyses	Is the median dissolved oxygen concentration in groundwater sample analyses above 2 mg/L?	DR flag?
BW1	6.8	yes	none
MW2	3.9	yes	none
MW3	7.29	yes	none

Table 5: Validation flag codes to indicate that analyte concentrations may not be reliable or representative of groundwater predrilling conditions
(LANL, 11/2005, Table 4-3)

Flag	Definition	Applicable Tier
DB+	Analyte concentration may be elevated above that in predrilling groundwater due to leaching from bentonite drilling mud	2.1
DB-	Analyte concentration may be less than that in predrilling groundwater due to adsorption onto residual bentonite drilling mud	2.1
DB	[Uranium and uranium isotopes] Analyte concentration may not be the same as that in predrilling groundwater due to effects of residual bentonite drilling mud, but nature of effect is indeterminate	2.1
DO+	Analyte concentration may be elevated above that in predrilling groundwater due to presence of residual organic drilling fluids	2.2
DR+	Analyte concentration may be elevated above that in predrilling groundwater due to reducing conditions caused by residual organic drilling fluids	2.2
DR-	Analyte concentration may be less than that in predrilling groundwater due to reducing conditions caused by residual organic drilling fluids	2.2
DR	Analyte concentration may not be representative of that in predrilling groundwater due to reducing conditions caused by residual organic drilling fluids, but nature of effect is indeterminate	2.2

Table 6: Comparison of mud rotary well median analyte values to target comparison ranges for MW1

Is the median analyte concentration in groundwater sample analyses within 1 standard deviation of the median analyte concentration in groundwater sample analyses from **MW1**?							
Analyte	MW1 target comparison range (i.e., +/- 1 standard deviation) [mg/L except Eh and pH]	**BW1**		**MW2**		**MW3**	
		median value [mg/L except Eh and pH]	comparison result	median value [mg/L except Eh and pH]	comparison result	median value [mg/L except Eh and pH]	comparison result
alkalinity [as $CaCO_3$]	192 – 230	229	yes	200	yes	191	**no**
ammonia	all analyses below detection limit	all analyses below detection limit	yes	all analyses below detection limit	yes	all analyses below detection limit	yes
cadmium (total)	0 – 0.0094	0.0025	yes	0.001	yes	0.0019	yes
dissolved oxygen	6.05 – 7.03	6.8	yes	3.9	**no**	7.29	**no**
Eh	99.3-242.9	141.8	yes	151.0	yes	144.5	yes
iron (total)	not used	0.05		0.09		0.24	
manganese (total)	0.0048 – 0.0172	0.005	yes	0.005	yes	0.010	yes
nitrate (as nitrogen)	4.65 – 5.74	5.68	yes	3.83	**no**	4.03	**no**
pH	7.32 – 7.73	7.62	yes	7.55	yes	7.65	yes
sodium (total)	48.2 – 52.8	52.8	yes	49.6	yes	50.7	yes
sulfate	39.1 – 48.3	43.5	yes	41.1	yes	39.2	yes
uranium (total)	0.0036 – 0.0068	0.0066	yes	0.0066	yes	0.0055	yes
zinc (total)	0 – 0.034	0.046	**no**	0.071	**no**	0.030	yes
zinc (dissolved)	0.003 – 0.014	0.040	**no**	0.037	**no**	0.038	**no**

Table 7: Comparison of mud rotary well median analyte values to target comparison ranges for MW4

Is the median analyte concentration in groundwater sample analyses within 1 standard deviation of the median analyte concentration in groundwater sample analyses from **MW4**?							
Analyte	MW4 target comparison range (i.e., +/- 1 standard deviation) [mg/L except Eh and pH]	**BW1**		**MW2**		**MW3**	
		median value [mg/L except Eh and pH]	comparison result	median value [mg/L except Eh and pH]	comparison result	median value [mg/L except Eh and pH]	comparison result
alkalinity [as $CaCO_3$]	198.1 – 254.6	229	yes	200	yes	191	**no**
ammonia	all analyses below detection limit	all analyses below detection limit	yes	all analyses below detection limit	yes	all analyses below detection limit	yes
cadmium (total)	0 – 0.0019	0.0025	**no**	0.001	yes	0.0019	yes
dissolved oxygen	insufficient data	6.8		3.9		7.29	
Eh	190.4-380.0	141.8	**no**	151.0	**no**	144.5	**no**
iron (total)	0.0042 – 0.276	0.05	yes	0.09	yes	0.24	yes
manganese (total)	0 – 0.056	0.005	yes	0.005	yes	0.010	yes
nitrate (as nitrogen)	1.3 – 2.4	5.68	**no**	3.83	**no**	4.03	**no**
pH	7.01 – 7.45	7.62	**no**	7.55	**no**	7.65	**no**
sodium (total)	40.2 – 66.0	52.8	yes	49.6	yes	50.7	yes
sulfate	32.4 – 44.6	43.5	yes	41.1	yes	39.2	yes
uranium (total)	0.0056 – 0.0067	0.0066	yes	0.0066	yes	0.0055	**no**
zinc (total)	0 – 0.49	0.046	yes	0.071	yes	0.030	yes
zinc (dissolved)	insufficient data	0.040		0.037		0.038	

Table 8: Mud rotary well median analytes exhibiting concentrations outside of target comparison range from MW1 and/or MW4

	Mud rotary well affected					
Analyte	**BW1**	**MW2**	**MW3**	**Issue**	**Failure to MW1?**	**Failure to MW4?**
alkalinity			X	Median value is greater than one standard deviation below the comparative median value	X	X
cadmium (total)	X			Median value is greater than one standard deviation above the comparative median value		X
dissolved oxygen		X	X	Median value is greater than one standard deviation above or below the comparative median value	X	N/A
Eh	X	X	X	Median value is greater than one standard deviation below the comparative median value		X
nitrate		X	X	Median value is greater than one standard deviation above or below the comparative median value	X	X
pH	X	X	X	Median value is greater than one standard deviation above the comparative median value		X
uranium (total)			X	Median value is greater than one standard deviation below the comparative median value		X
zinc (total)	X	X		Median value is greater than one standard deviation above the comparative median value	X	
zinc (dissolved)	X	X	X	Median value is greater than one standard deviation above the comparative median value	X	N/A

Note: N/A means not analyzed.

Table 9: Indicator Constituents of Grout Contamination and Adsorption

Tier 3.1 Indicator Constituents of Grout Contamination

MWL monitoring well	Median sulfate concentration from groundwater sample analyses (mg/L)	Is the median sulfate concentration in groundwater sample analyses less than the maximum regional background sulfate concentration **(*i.e.,*** 124.7 mg/L at 95% confidence level [Moats and Winn, 1995]**)**?	Presence of Grout Indicated?
MW5	54.5	yes	no

MWL monitoring well	Median total calcium concentration from groundwater sample analyses (mg/L)	Is the median total calcium concentration in groundwater sample analyses less than the maximum regional background total calcium concentration (*i.e.*, 105.1 mg/L at 95% confidence level [Moats and Winn, 1995]**)**?	Presence of Grout Indicated?
MW5	79.5	yes	no

MWL monitoring well	Median total aluminum concentration from groundwater sample analyses (mg/L)	Is the median total aluminum concentration in groundwater sample analyses less than the maximum regional background total aluminum concentration? (*i.e.*, 3.6 mg/L [Moats and Winn, 1995]**)**?	Presence of Grout Indicated?
MW5	0.029	yes	no

Table 9 continued

Tier 3.2 Indicators of Adsorption

MWL monitoring well	Median total uranium concentration from groundwater sample analyses (mg/L)	Is the median total uranium concentration in groundwater sample analyses greater than the minimum background total uranium concentration, (*i.e.*, 0.0005 mg/L [IT Corp., 03/1996])?	DB flag?
MW5	0.0094	yes	none

MWL monitoring well	Median total zinc concentration (mg/L)	Is total zinc detected?	DB flag?
MW5	0.0057	yes	none

MWL monitoring well	Median total barium concentration from groundwater sample analyses (mg/L)	Is the median total barium concentration in groundwater sample analyses greater than the minimum background total barium concentration (*i.e.*, <0.100 mg/L [Moats and Winn, 1995])?	DB flag?
MW5	0.134	yes	none

Appendix A: MWL monitoring well groundwater analytical data for wells BW1, MW1, MW3, and MW4

Alkalinity (mg/L)

Date sampled	BW1	MW1	MW2	MW3	MW4
04/26/93			207.7		
04/26/93			200		
04/27/93		215.7			
04/27/93		220			
04/27/93				193.4	
04/27/93				197	
04/28/93	233				
04/28/93	257.3				
04/28/93	291				
04/30/93					231.7
11/08/93			208		
11/09/93		211			
11/09/93				193	
11/10/93	229				
11/11/93					218
10/24/94			185		
10/25/94		207			
10/25/94				177	
10/27/94	217				
10/28/94					234
03/14/95	230				
04/17/95			196		
04/17/95				182	
04/19/95		226			
04/19/95					266
04/19/95					267
10/16/95			199		
10/16/95				191	
10/20/95		234			
10/20/95					257
10/20/95					276
10/23/95	229				
04/15/96			195		
04/15/96				182	
04/16/96	212				
04/16/96					
04/18/96		220			
04/18/96					217
04/13/99	199				
04/05/01					215
04/06/01	233				
04/08/01				194	
04/13/01		198			
04/23/01			209		

Date sampled	BW1	MW1	MW2	MW3	MW4
04/15/02	246				
04/16/02					208
04/16/02					221
04/24/02			201		
04/30/02		191			
05/08/02				212	
04/08/03			204		
04/16/03					238
04/21/03		187			
04/22/03				186	
04/16/04		178			
04/20/04	214				
04/20/04					189
04/22/04				169	
04/26/04			187		
04/15/05	192				
04/19/05					185
count	13	11	11	11	14
Median values	229	211	200	191	226.35
1 STANDARD DEVIATION	26.76115	18.83997	8.43768	12.24745	28.28613
-1 STANDARD DEVIATION	202.2389	192.16	191.5623	178.7526	198.0639
+1 STANDARD DEVIATION	255.7611	229.84	208.4377	203.2474	254.6361

Ammonia (mg/L)

N.B., all analytical results are reported as below detection limit, except sample result for MW4 dated 5/31/94 (1.3 mg/L) which is likely erroneous.

Date sampled	BW1	MW1	MW2	MW3	MW4
11/08/93			0.05		
11/09/93		0.05			
11/09/93				0.05	
11/10/93	0.05				
11/10/93	0.05				
11/11/93					0.05
03/14/94					0.05
05/02/94			0.05		
05/03/94		0.05			
05/03/94				0.05	
05/04/94		0.05			
05/31/94					1.3
10/24/94			0.05		
10/25/94		0.05			
10/25/94		0.05			
10/25/94				0.05	
10/27/94	0.05				
10/27/94	0.05				
10/28/94					0.05
03/14/95	0.1				
10/16/95				0.0085	
10/20/95		0.0085			
10/20/95					0.0085
10/20/95					0.0085
10/23/95	0.009				
04/15/96			0.0085		
04/15/96				0.0085	
04/15/96				0.01	
04/16/96	0.009				
04/18/96		0.0085			
04/18/96					0.0085
04/18/96					0.0085
count	7	7	4	6	8
Median values	0.05	0.05	0.05	0.03	0.02925
1 STANDARD DEVIATION	0.030865	0.02025	0.02075	0.022463	0.450794
-1 STANDARD DEVIATION	0.019135	0.02975	0.02925	0.007537	-0.42154
+1 STANDARD	0.080865	0.07025	0.07075	0.052463	0.480044

Date sampled	BW1	MW1	MW2	MW3	MW4
DEVIATION					

Cadmium (mg/L)

Date sampled	BW1	MW1	MW2	MW3	MW4
09/27/90	0.0025				
09/27/90	0.0025				
09/27/90		0.046			
09/28/90			0.0025		
09/28/90				0.0025	
01/24/91	0.0025				
01/24/91	0.0025				
01/24/91		0.0025			
01/28/91			0.0025		
01/28/91				0.0025	
04/02/91			0.0025		
04/02/91				0.0025	
05/07/91	0.0025				
05/07/91	0.0025				
05/07/91		0.0025			
07/31/91		0.0025			
08/01/91			0.0025		
08/05/91				0.0025	
08/06/91	0.0025				
08/06/91	0.0025				
10/14/91			0.0025		
10/15/91		0.0025			
10/15/91				0.0025	
10/16/91	0.0025				
10/16/91	0.0025				
10/16/91	0.0025				
07/27/92			0.0025		
07/27/92			0.00025		
07/28/92		0.0025			
07/28/92		0.0006			
07/28/92				0.0025	
07/28/92				0.0024	
07/29/92	0.00025				
07/29/92	0.0025				
01/18/93			0.016		
01/19/93		0.0086			
01/19/93				0.029	
01/20/93	0.031				
01/20/93	0.023				
04/26/93			0.0025		
04/26/93			0.0008		
04/27/93		0.0005			
04/27/93		0.00025			
04/27/93				0.0025	

Date sampled	BW1	MW1	MW2	MW3	MW4
04/27/93				0.0014	
04/28/93	0.00025				
04/28/93	0.0025				
04/28/93					0.0025
04/28/93					0.0025
04/28/93					0.0025
11/08/93			0.0025		
11/09/93		0.0025			
11/09/93				0.0025	
11/10/93	0.0025				
11/10/93	0.0025				
11/10/93					0.0025
03/14/94					0.0025
05/02/94			0.0025		
05/02/94				0.0025	
05/03/94		0.0025			
05/04/94		0.0025			
05/31/94					0.0025
10/24/94			0.0025		
10/25/94		0.0025			
10/25/94		0.0025			
10/25/94				0.0025	
10/27/94	0.0025				
10/27/94	0.0025				
10/28/94					0.0025
04/17/95			0.0025		
04/17/95				0.0025	
04/19/95		0.0025			
04/19/95					0.0025
04/19/95					0.0025
10/16/95				0.0002	
10/20/95		0.00013			
10/20/95					0.00093
10/23/95	0.00012				
04/15/96			0.00017		
04/16/96	0.00005				
04/18/96		0.00005			
04/18/96				0.00005	
04/18/96					0.00005
04/28/96	0.00028				
04/23/97		0.00057			
04/23/97					0.00031
04/24/97			0.00065		
04/24/97				0.00046	
10/15/97		0.000105			
10/15/97		0.000105			

Date sampled	BW1	MW1	MW2	MW3	MW4
10/15/97				0.00022	
10/16/97			0.00045		
10/17/97	0.00024				
10/17/97					0.00035
03/31/98	0.0003				
03/31/98	0.00011				
04/01/98		0.000105			
04/01/98					0.0001
04/01/98					0.0001
04/01/98					0.0003
04/02/98			0.00032		
04/02/98			0.00025		
04/02/98				0.00011	
11/05/98	0.00011				
11/06/98		0.00086			
11/06/98			0.00028		
11/06/98				0.00011	
11/06/98					0.00026
11/06/98					0.00011
04/12/99				0.00011	
04/13/99	0.00011				
04/14/99		0.00011			
04/14/99					0.00025
04/19/99			0.00023		
04/06/00	0.00032				
04/07/00					0.00066
04/13/00				0.00064	
04/14/00		0.0012			
04/14/00		0.00032			
04/24/00			0.0011		
04/05/01					0.00033
04/05/01					0.00037
04/06/01	0.00067				
04/08/01				0.00011	
04/13/01		0.00013			
04/23/01			0.0004		
04/15/02	0.000578				
04/16/02					0.000126
04/16/02					0.000126
04/24/02			0.000488		
04/30/02		0.000387			
05/08/02				0.00111	
04/08/03			0.0152		
04/14/03	0.000181				
04/16/03					0.00309
04/16/03					0.00304

Date sampled	BW1	MW1	MW2	MW3	MW4
04/21/03		0.00222			
04/22/03				0.000508	
09/09/03		0.00168			
09/09/03			0.000502		
09/09/03					0.0017
04/16/04		0.000096			
04/20/04	0.000134				
04/20/04					0.000966
04/22/04				0.00036	
04/26/04			0.00013		
04/26/04			0.000143		
count	34	31	28	26	28
Median values	0.0025	0.0012	0.00095	0.0019	0.000795
1 STANDARD DEVIATION	0.006282	0.008165	0.003892	0.005517	0.001146
-1 STANDARD DEVIATION	-0.00378	-0.00696	-0.00294	-0.00362	-0.00035
+1 STANDARD DEVIATION	0.008782	0.009365	0.004842	0.007417	0.001941

Dissolved oxygen (mg/L)

Date sampled	BW1	MW1	MW2	MW3	MW4
04/28/93	6.8				
04/16/03		6.19			
04/20/03	6.16				
04/20/03					2.66
04/22/03				7.29	
04/26/03			3.9		
08/31/04		6.89			
09/01/04	7.99				
count	3	2	1	1	1
Median values	6.8	6.54	3.9	7.29	2.66
1 STANDARD DEVIATION	0.928673	0.494975	----	----	----
-1 STANDARD DEVIATION	5.871327	6.045025	----	----	----
+1 STANDARD DEVIATION	7.728673	7.034975	----	----	----

Eh (mV)

Date Sampled	BW1	MW1	MW2	MW3	MW4
01/18/93			86		
01/19/93		95		131	
01/20/93	109				
04/26/93			135		
04/27/93		162		112	
04/28/93	121				
11/08/93			39		
11/09/93		61		67	
11/10/93	85				
11/11/93					97
03/14/95	113				
04/17/95			279	279	
04/19/95		317			294
04/15/96			105	88	
04/16/96	77				
04/18/96		72			73
04/23/96					351
04/28/96	306				
04/23/97		146			
04/24/97			278	270	
10/15/97		228			317
10/16/97			235	230	
10/17/97	134				
03/31/98	217				
04/01/98		246			239
04/02/98			240	239	
11/05/98	201				
11/06/98		271	151	158	285
01/19/99		102			
01/20/99	120		130	117	
01/21/99					341
04/12/99				130	
04/13/99	168				
04/14/99		125			222
04/19/99			170		
04/06/00	194				
04/07/00					231
04/13/00				186	
04/14/00		224			
04/24/00			169		

Date Sampled	BW1	MW1	MW2	MW3	MW4
10/31/00					250
11/01/00	136				
02/07/01					195
02/09/01					192
04/06/01	200				
04/08/01				225	
04/13/01		180			
04/23/01			110		
11/13/01					301
04/16/02					334
04/24/02			204		
04/30/02		134			
05/08/02				128	
04/08/03			154.7		
04/14/03	123				
04/16/03					104.6
04/21/03		145.8			
04/22/03				253.2	
09/08/03		250.6			
09/09/03			220.8		376
04/16/04		222.9			
04/20/04	313				409.9
04/22/04				214	
04/26/04			144.3		
08/31/04		170.1			
09/01/04	157.3				
11/15/04	254.8				
11/16/04		215.7			
02/16/05	147.6				
02/21/05		172.1			
04/11/05		263.3			
04/12/05			75.6		
04/13/05				56	
04/06/06					290.5
04/10/06			68.3		
04/12/06		75.7			
04/13/06				83.6	
04/18/06	42.8				
count	20	22	19	18	19
Median values	141.8	171.1	151	144.5	285

1 Standard Deviation)	71.9670	71.8301	70.2655	73.1214	94.6265
-1 Standard Deviation	69.8329	99.2698	80.7344	71.3785	190.373
+1 Standard Deviation)	213.767	242.930	221.265	217.621	379.626

Iron (total) (mg/L)

Date sampled	BW1	MW1	MW2	MW3	MW4
01/24/91	0.28				
01/24/91	0.05				
01/24/91	0.05				
01/24/91	0.05				
01/24/91		0.44			
01/24/91		0.05			
01/28/91			0.85		
01/28/91			0.05		
01/28/91				0.05	
01/28/91				0.05	
04/01/91	0.02				
05/02/91			0.2		
05/02/91			0.05		
05/02/91				0.24	
05/02/91				0.05	
05/07/91	0.05				
05/07/91	0.05				
05/07/91	0.1				
05/07/91	0.05				
05/07/91		0.76			
05/07/91		0.05			
07/01/91	0.05				
07/01/91			0.05		
07/01/91				0.25	
07/31/91		0.71			
07/31/91		0.05			
08/01/91			0.085		
08/01/91			0.05		
08/05/91				0.25	
08/05/91				0.1	
08/06/91	0.05				
08/06/91	0.05				
08/06/91	0.05				
08/06/91	0.05				
10/14/91			0.12		
10/14/91			0.05		
10/15/91		0.49			
10/15/91		0.05			
10/15/91				0.14	
10/15/91				0.05	
10/16/91	0.05				
10/16/91	0.05				
10/16/91	0.05				
10/16/91	0.05				

Date sampled	BW1	MW1	MW2	MW3	MW4
07/27/92			0.1		
07/27/92			0.05		
07/28/92		0.19			
07/28/92		0.05			
07/28/92				1.3	
07/28/92				0.05	
07/29/92	0.23				
07/29/92	0.05				
07/29/92	0.05				
07/29/92	0.05				
01/18/93			0.045		
01/19/93				0.37	
01/20/93	0.058				
01/20/93	0.09				
04/26/93			0.05		
04/26/93			0.06		
04/27/93		0.05			
04/27/93		0.05			
04/27/93		0.118			
04/27/93				0.38	
04/27/93				0.315	
04/27/93				0.033	
04/28/93	0.121				
04/28/93	0.055				
04/28/93	0.15				
04/28/93					0.14
04/28/93					0.12
04/30/93					0.21
04/30/93					0.05
11/08/93			0.05		
11/09/93		0.22			
11/09/93				0.12	
11/10/93	0.054				
11/10/93	0.041				
11/11/93					0.1
03/14/94					0.1
05/02/94			0.048		
05/03/94		0.11			
05/03/94				0.25	
05/04/94		0.048			
05/31/94					0.036
10/24/94			0.05		
10/25/94		0.058			
10/25/94		0.05			
10/25/94				0.078	
10/27/94	0.057				

Date sampled	BW1	MW1	MW2	MW3	MW4
10/28/94					0.15
03/14/95	0.07				
04/17/95			0.024		
04/17/95				0.071	
04/19/95		0.094			
04/19/95					0.07
04/19/95					0.098
10/16/95				0.266	
10/20/95		0.565			
10/20/95					0.0134
10/20/95					0.0161
10/23/95	0.321				
04/15/96			0.273		
04/15/96				0.0608	
04/15/96				0.0608	
04/16/96	0.0462				
04/18/96		0.0051			
04/18/96		0.272			
04/18/96					0.011
04/18/96					0.0051
08/27/98		0.26			
08/27/98		1.8			
04/12/99				0.0993	
04/13/99	0.0967				
04/14/99		0.583			
04/14/99					0.0917
04/19/99			0.18		
04/19/99			0.0906		
04/14/00		0.96			
04/05/01					0.486
04/05/01					0.304
04/06/01	1.82				
04/08/01				0.248	
04/13/01		0.409			
04/23/01			0.169		
04/15/02	0.0304				
04/16/02					0.199
04/16/02					0.248
04/24/02			0.357		
04/30/02		0.272			
05/08/02				0.731	
04/08/03			0.31		
04/08/03			0.399		
04/14/03	0.115				
04/16/03					0.299
04/16/03					0.303

Date sampled	BW1	MW1	MW2	MW3	MW4
04/21/03		0.464			
04/22/03				0.669	
04/16/04		0.886			
04/20/04	0.271				
04/20/04					0.206
04/22/04				1.1	
04/26/04			0.21		
04/26/04			0.204		
04/11/05		0.697			
04/11/05		0.135			
04/12/05			0.235		
04/13/05				0.473	
04/15/05	0.2				
04/19/05					0.303
04/19/05					0.318
04/06/06					0.441
04/10/06			0.377		
04/12/06		1.67			
04/12/06		1.64			
04/13/06				0.422	
04/18/06	0.361				
count	40	34	29	29	25
Median values	0.05	0.24	0.0906	0.24	0.14
1 Standard deviation	0.285691	0.488327	0.173678	0.314261	0.135825
-1 STANDARD DEVIATION	-0.23569	-0.24833	-0.08308	-0.07426	0.004175
+1 STANDARD DEVIATION	0.335691	0.728327	0.264278	0.554261	0.275825

Manganese (total) (mg/L)

Date sampled	BW1	MW1	MW2	MW3	MW4
01/24/91	0.005				
01/24/91		0.019			
01/28/91			0.016		
01/28/91				0.005	
05/02/91			0.005		
05/02/91				0.005	
05/07/91	0.005				
05/07/91	0.005				
05/07/91		0.015			
07/01/91	0.005				
07/01/91			0.005		
07/01/91				0.005	
07/31/91		0.019			
08/01/91			0.005		
08/05/91				0.005	
08/06/91	0.005				
08/06/91	0.005				
10/14/91			0.005		
10/15/91		0.017			
10/15/91				0.005	
10/16/91	0.005				
10/16/91	0.005				
07/27/92			0.005		
07/28/92		0.005			
07/28/92				0.005	
07/29/92	0.005				
07/29/92	0.005				
01/18/93			0.005		
01/19/93		0.011			
01/19/93				0.005	
01/20/93	0.005				
01/20/93	0.005				
04/26/93			0.005		
04/26/93			0.005		
04/27/93		0.0095			
04/27/93				0.047	
04/27/93				0.056	
04/27/93				0.056	
04/28/93	0.005				
04/28/93	0.0098				
04/30/93					0.16
11/08/93			0.005		
11/09/93		0.005			
11/09/93				0.0043	

Date sampled	BW1	MW1	MW2	MW3	MW4
11/10/93	0.005				
11/10/93	0.005				
11/11/93					0.04
05/02/94			0.0089		
05/03/94		0.012			
05/03/94				0.012	
05/04/94		0.0078			
05/31/94					0.094
10/24/94			0.005		
10/25/94		0.011			
10/25/94				0.021	
10/27/94	0.005				
10/27/94	0.005				
10/28/94					0.045
04/17/95			0.0025		
04/17/95				0.0025	
04/19/95		0.0025			
04/19/95					0.028
04/19/95					0.027
10/16/95			0.00787		
10/16/95				0.013	
10/20/95		0.0128			
10/20/95					0.0284
10/20/95					0.0295
10/23/95	0.00955				
04/15/96			0.0121		
04/15/96				0.00341	
04/16/96	0.0019				
04/18/96		0.0109			
04/18/96					0.0166
04/18/96					0.016
04/12/99				0.0228	
04/13/99	0.00238				
04/14/99		0.00793			
04/14/99					0.00959
04/19/99			0.00802		
04/06/00	0.0324				
04/05/01					0.0198
04/05/01					0.0179
04/08/01				0.00983	
04/13/01		0.00655			
04/23/01			0.00197		
04/15/02	0.00535				
04/16/02					0.022
04/16/02					0.0212
04/24/02			0.00197		

Date sampled	BW1	MW1	MW2	MW3	MW4
04/30/02		0.00646			
05/08/02				0.00429	
04/08/03			0.00183		
04/08/03			0.00223		
04/14/03	0.00081				
04/16/03					0.00589
04/16/03					0.00609
04/21/03		0.00599			
04/22/03				0.0105	
04/16/04		0.0172			
04/20/04	0.00479				
04/20/04					0.00187
04/22/04				0.0157	
04/26/04			0.00278		
04/26/04			0.00279		
04/11/05		0.019			
04/12/05			0.0005		
04/12/05			0.00415		
04/13/05				0.0259	
04/15/05	0.00282				
04/19/05					0.00457
04/19/05					0.00483
04/06/06					0.00844
04/10/06			0.00551		
04/12/06		0.0236			
04/12/06		0.0232			
04/13/06				0.0771	
04/18/06	0.0054				
count	27	22	25	23	21
Median values	0.005	0.011	0.005	0.00983	0.0198
1 STANDARD DEVIATION	0.005582	0.0062	0.003395	0.020799	0.036183
-1 STANDARD DEVIATION	-0.00058	0.0048	0.001605	-0.01097	-0.01638
+1 STANDARD DEVIATION	0.010582	0.0172	0.008395	0.030629	0.055983

Nickel (total) (mg/L)

Date sampled	BW1	MW1	MW2	MW3	MW4
09/27/90	0.02				
09/27/90	0.02				
09/27/90		0.046			
09/28/90			0.02		
09/28/90				0.02	
07/17/92	0.025				
07/17/92			0.025		
07/27/92			0.01		
07/28/92		0.15			
07/28/92		0.162			
07/28/92				0.066	
07/28/92				0.07	
07/29/92	0.01				
07/29/92	0.02				
01/18/93			0.02		
01/19/93		0.078			
01/19/93				0.026	
01/20/93	0.02				
01/20/93	0.02				
04/26/93			0.014		
04/26/93			0.01		
04/27/93		0.097			
04/27/93		0.057			
04/27/93				0.037	
04/27/93				0.035	
04/28/93	0.01				
04/28/93	0.012				
04/28/93	0.0075				
04/28/93					0.016
04/28/93					0.02
11/08/93			0.02		
11/09/93		0.095			
11/09/93				0.014	
11/10/93	0.02				
11/10/93	0.02				
11/10/93					0.02
03/14/94					0.02
05/02/94			0.02		
05/02/94				0.011	
05/03/94		0.15			
05/04/94		0.13			
05/31/94					0.02
10/24/94			0.02		

Date sampled	BW1	MW1	MW2	MW3	MW4
10/25/94		0.1			
10/25/94		0.13			
10/25/94				0.0098	
10/27/94	0.02				
10/27/94	0.02				
10/28/94					0.0082
04/17/95			0.0075		
04/17/95				0.0093	
04/19/95		0.12			
04/19/95					0.02
04/19/95					0.0082
10/16/95				0.00799	
10/20/95		0.107			
10/20/95					0.00307
10/23/95	0.00196				
04/15/96			0.00342		
04/16/96	0.0004				
04/18/96		0.145			
04/18/96				0.00367	
04/18/96					0.004
04/18/96					0.004
10/15/97				0.0362	
03/31/98	0.0029				
03/31/98	0.00114				
04/01/98		0.5			
04/01/98					0.00114
04/01/98					0.00114
04/01/98					0.0008
04/02/98			0.00351		
04/02/98			0.005		
04/02/98				0.018	
11/05/98	0.00719				
11/06/98		0.49			
11/06/98			0.00449		
11/06/98				0.031	
11/06/98					0.00189
11/06/98					0.00159
04/12/99				0.0251	
04/13/99	0.0128				
04/14/99		0.266			
04/14/99					0.00093
04/19/99			0.00531		
04/06/00	0.0165				
04/07/00					0.00155
04/13/00				0.0141	
04/14/00		0.279			

Date sampled	BW1	MW1	MW2	MW3	MW4
04/14/00		0.228			
04/24/00			0.124		
04/05/01					0.00355
04/05/01					0.00355
04/06/01	0.191				
04/13/01		0.252			
04/23/01			0.0882		
04/15/02	0.0136				
04/16/02					0.00172
04/16/02					0.00115
04/24/02			0.0897		
04/30/02		0.265			
05/08/02				0.0961	
04/08/03			0.0512		
04/08/03			0.0529		
04/14/03	0.0266				
04/21/03		0.374			
04/16/04		0.401			
04/20/04	0.0332				
04/20/04					0.0159
04/22/04				0.056	
04/26/04			0.0105		
04/26/04			0.0106		
04/12/05			0.00802		
04/13/05				0.0173	
count	25	23	23	20	23
Median values	0.02	0.15	0.014	0.02255	0.00355

Nitrate (as nitrogen) (mg/L)

Date sampled	BW1	MW1	MW2	MW3	MW4
10/14/91			5.1		
10/15/91		5.5			
10/15/91				4.3	
10/16/91	5.6				
10/16/91	5.6				
07/29/92	5.4				
04/26/93			4.6		
04/26/93			4.5		
04/27/93		5.5			
04/27/93		5.0			
04/27/93				4	
04/27/93				3.7	
04/28/93	5.7				
04/28/93	5.4				
11/08/93			4.9		
11/09/93		5.4			
11/09/93				4.2	
11/10/93	5.9				
11/10/93	5.8				
11/11/93					1.9
03/14/94					1.5
05/02/94			4.70		
05/03/94		5.0			
05/03/94				3.9	
05/04/94		5.2			
05/31/94					1.2
10/24/94			4.90		
10/25/94		5.2			
10/25/94		5.2			
10/25/94				4.3	
10/27/94	5.6				
10/27/94	5.7				
10/28/94					0.6
10/31/94	5.7				
04/17/95			5.00		
04/17/95				4.7	
04/19/95		5.5			
04/19/95					0.14
04/19/95					0.15
04/15/96			4.65		
04/15/96				4.05	
04/15/96				4.05	
04/16/96	5.65				
04/18/96		5.2			

Date sampled	BW1	MW1	MW2	MW3	MW4
04/18/96					1.89
04/18/96					1.92
04/28/96	5				
04/23/97		5.2			
04/23/97					1.2
04/24/97			3.70		
04/24/97				2.8	
10/15/97		4.9			
10/15/97		5.1			
10/15/97					1.81
10/16/97			3.93		
10/16/97				4.05	
10/17/97	5.75				
03/31/98	6.08				
04/01/98		5.4			
04/01/98					1.71
04/01/98					1.92
04/02/98			3.44		
04/02/98				3.56	
11/05/98	5.36				
11/06/98		5.4			
11/06/98			4.00		
11/06/98				4.4	
11/06/98					2
11/06/98					2.05
11/06/98					2.05
04/12/99				4.08	
04/13/99	6.15				
04/14/99		5.2			
04/14/99					1.9
04/19/99			3.72		
04/06/00	5.55				
04/07/00					2
04/13/00				4.15	
04/14/00		4.5			
04/14/00		4.4			
04/24/00			3.45		
04/05/01					1.59
04/05/01					1.61
04/06/01	6.75				
04/08/01				2.59	
04/13/01		3.0			
04/23/01			3.35		
04/15/02	5				
04/16/02					1.85
04/16/02					1.75

Date sampled	BW1	MW1	MW2	MW3	MW4
04/24/02			2.20		
04/30/02		4.8			
05/08/02				3.75	
04/08/03			2.58		
04/14/03	5.7				
04/16/03					1.63
04/16/03					1.75
04/21/03		4.7			
04/22/03				3.7	
04/16/04		5.2			
04/20/04	5.9				
04/20/04					1.85
04/22/04				2.25	
04/26/04			2.75		
04/26/04			1.58		
04/12/05			1.83		
04/13/05				3.25	
04/15/05	2.82				
04/19/05					1.94
04/19/05					1.94
count	22	22	20	20	26
Median values	5.675	5.195	3.825	4.025	1.83
1 STANDARD DEVIATION	0.712971	0.547111	1.091544	0.628916	0.537181
-1 STANDARD DEVIATION	4.962029	4.647889	2.733456	3.396084	1.292819
+1 STANDARD DEVIATION	6.387971	5.742111	4.916544	4.653916	2.367181

pH

Date sampled	BW1	MW1	MW2	MW3	MW4
09/27/90	7.67				
09/27/90		7.49			
09/28/90			6.91		
09/28/90				7.59	
01/24/91	7.57				
01/24/91		7.46			
01/28/91			7.15		
01/28/91				7.9	
05/02/91			7.47		
05/02/91				7.46	
05/07/91		7.26			
07/31/91		7.34			
08/01/91			7.74		
08/05/91				7.51	
08/06/91	7.34				
10/14/91			7.84		
10/15/91		7.43			
10/15/91				7.57	
10/16/91	7.4				
01/13/92			8.05		
01/14/92				7.79	
01/15/92	7.65				
07/27/92			7.65		
07/28/92		7.33			
07/28/92				7.68	
07/29/92	7.45				
01/18/93			7.44		
01/19/93		7.45			
01/19/93				7.68	
01/20/93	7.52				
04/26/93			7.63		
04/27/93		7.6			
04/27/93				7.8	
04/28/93	7.62				
04/28/93	7.56				
04/28/93					7.23
11/08/93			7.36		
11/09/93		7.19			
11/09/93				5.58	
11/10/93	7.46				
11/11/93					7.16
04/28/94	7.75				
05/02/94			7.67		
05/03/94		7.67			

Date sampled	BW1	MW1	MW2	MW3	MW4
05/03/94				8.06	
05/04/94		7.59			
10/24/94			7.68		
10/25/94				7.69	
10/27/94	7.57				
10/28/94					7.25
03/14/95	7.63				
04/17/95			7.97		
04/17/95				7.88	
04/19/95		7.35			
04/19/95					7.21
10/16/95			7.6		
10/16/95				7.44	
10/20/95		7.54			
10/20/95					7.11
10/23/95	7.76				
04/15/96			7.39		
04/15/96				7.65	
04/16/96	7.53				
04/18/96		7.51			
04/18/96					7.23
04/18/96					7.09
04/28/96	7.66				
04/23/97		7.35			
04/24/97			7.46		
04/24/97				7.79	
10/15/97		7.45			
10/15/97					7.21
10/16/97			7.36		
10/16/97				7.57	
10/17/97	7.62				
03/31/98	7.43				
04/01/98		7.37			
04/01/98					6.92
04/02/98			7.16		
04/02/98				7.37	
11/05/98	7.62				
11/06/98		7.46			
11/06/98			7.04		
11/06/98				7.58	
11/06/98					7.11
01/20/99	8.17				
01/20/99			7.64		
01/20/99				7.81	
01/21/99					6.97
04/12/99				7.64	

Date sampled	BW1	MW1	MW2	MW3	MW4
04/13/99	7.68				
04/14/99		7.36			
04/14/99					7.3
04/19/99			7.49		
04/06/00	8.06				
04/07/00					7.23
04/13/00				7.72	
04/14/00		7.57			
04/14/00		7.57			
04/24/00			7.44		
10/31/00					7.29
11/01/00	7.4				
02/07/01					6.96
02/09/01					7.1
04/05/01					7.3
04/06/01	7.49				
04/08/01				7.57	
04/13/01		7.34			
04/23/01			7.35		
11/13/01					7.24
04/15/02	7.68				
04/16/02					7.2
04/24/02			7.44		
04/30/02		7.63			
05/08/02				7.87	
04/08/03			7.52		
04/14/03	7.98				
04/16/03		7.83			7.5
04/16/03					7.5
04/20/03					7.88
04/21/03		7.73			
04/22/03				7.4	
04/22/03				7.89	
04/26/03			7.93		
09/08/03		7.8			
09/09/03			7.57		
09/09/03					7.7
04/16/04		7.83			
04/20/04	8.06				
04/26/04			7.73		
08/31/04		8.19			
09/01/04	7.81				
11/15/04	8.02				
11/16/04		7.73			
02/16/05	8.21				
02/21/05		7.65			

Date sampled	BW1	MW1	MW2	MW3	MW4
04/11/05		7.75			
04/12/05			7.85		
04/13/05				7.1	
04/15/05	7.51				
04/19/05					7.07
04/06/06					7.39
04/10/06			7.78		
04/12/06		7.64			
04/13/06				7.56	
04/18/06	7.24				
count	32	32	30	28	25
Median values	7.62	7.525	7.545	7.645	7.23
1 STANDARD DEVIATION	0.242766	0.207255	0.269015	0.438812	0.219507
-1 STANDARD DEVIATION	7.377234	7.317745	7.275985	7.206188	7.010493
+1 STANDARD DEVIATION	7.862766	7.732255	7.814015	8.083812	7.449507

Sodium (total) (mg/L)

Date sampled	BW1	MW1	MW2	MW3	MW4
01/24/91		50.2			
01/28/91			56.5		
01/28/91				55.4	
04/01/91	51				
04/01/91		50.3			
04/02/91			55.4		
04/02/91				55.3	
10/14/91			55.1		
10/15/91		50.7			
10/15/91				55.9	
10/16/91	57				
01/15/92	49.1				
04/26/93			45.7		
04/26/93			55.4		
04/27/93		45.7			
04/27/93		52.8			
04/27/93				45.7	
04/27/93				55.5	
04/28/93	54.7				
04/28/93	46.9				
04/28/93	47.4				
04/30/93					46.9
11/08/93			55.4		
11/09/93		50.9			
11/09/93				51.5	
11/10/93	56				
11/11/93					46.2
10/24/94			53.9		
10/25/94		53.6			
10/25/94				53.2	
10/27/94	56.9				
10/28/94					67.1
03/14/95	51				
04/17/95			46.8		
04/17/95				49.9	
04/19/95		52.1			
04/19/95					80.7
04/19/95					75.9
10/16/95			47.9		
10/16/95				49.2	
10/20/95		52.2			
10/20/95					76.6
10/20/95					78.5

Date sampled	BW1	MW1	MW2	MW3	MW4
10/23/95	56.6				
04/15/96			49.5		
04/15/96				50.8	
04/16/96	55.5				
04/18/96		49.4			
04/18/96					53.1
04/05/01					49.9
04/05/01					48.9
04/06/01	52.5				
04/08/01				47.1	
04/13/01		50.1			
04/23/01			49.6		
04/15/02	54.2				
04/16/02					49.1
04/16/02					48.9
04/24/02			52.7		
04/30/02		53.0			
05/08/02				50.6	
04/08/03			49.4		
04/08/03			54.8		
04/14/03	52				
04/16/03					56.9
04/16/03					56
04/21/03		49.8			
04/22/03				50.7	
04/16/04		46.7			
04/20/04	52.8				
04/20/04					49.7
04/22/04				45.5	
04/26/04			46.9		
04/26/04			46.8		
04/12/05			47.9		
04/13/05				47.2	
count	15	14	17	15	15
Median values	52.8	50.5	49.6	50.7	53.1
1 STANDARD DEVIATION	3.345459	2.257503	3.845624	3.583494	12.93361
-1 STANDARD DEVIATION	49.45454	48.2425	45.75438	47.11651	40.16639
+1 STANDARD DEVIATION	56.14546	52.7575	53.44562	54.28349	66.03361

Sulfate (mg/L)

Date sampled	BW1	MW1	MW2	MW3	MW4
09/27/90	45.1				
09/27/90	43.9				
09/27/90		43.1			
09/28/90			44.7		
09/28/90				44.1	
01/24/91	41.7				
01/24/91	43.4				
01/24/91		42.3			
01/28/91			41.3		
01/28/91				41.1	
04/01/91	43.2				
05/02/91			45.2		
05/02/91				42.7	
05/07/91	42.6				
05/07/91	42.8				
05/07/91		42.4			
07/31/91		41.0			
08/01/91			41.2		
08/05/91				38.6	
08/06/91	43.3				
08/06/91	44.3				
10/14/91			42.7		
10/15/91		43.1			
10/15/91				40.0	
10/16/91	44.8				
10/16/91	44.6				
01/15/92	58.9				
07/27/92			38.4		
07/28/92		40.6			
07/28/92				37.5	
07/29/92	42.8				
07/29/92	42.5				
01/18/93			22.5		
01/19/93		22.9			
01/19/93				21.1	
01/20/93	23.9				
01/20/93	23.8				
04/26/93			47.3		
04/26/93			39		
04/27/93		43.7			
04/27/93		43.0			
04/27/93				39.7	
04/27/93				39.0	

Date sampled	BW1	MW1	MW2	MW3	MW4
04/28/93	43				
04/28/93	46.7				
04/28/93	46.7				
04/28/93					46.7
04/30/93					38.7
11/08/93			40.5		
11/09/93		41.9			
11/09/93				38.3	
11/10/93	43.5				
11/10/93	43.6				
11/11/93					34.8
03/14/94					49.6
05/02/94			40.5		
05/03/94				38.0	
05/04/94		43.7			
05/31/94					34.2
10/24/94			42.9		
10/25/94		45.4			
10/25/94		46.0			
10/25/94				40.5	
10/27/94	42.5				
10/27/94	42.7				
10/28/94					43.9
03/14/95	52				
04/17/95			42.4		
04/17/95				41.0	
04/19/95		44.4			
04/19/95					49.8
04/19/95					49.7
10/16/95			41.3		
10/16/95				39.1	
10/20/95		46.6			
10/20/95					52.2
10/20/95					52
10/23/95	46.9				
04/15/96			41.2		
04/15/96				39.3	
04/15/96				39.3	
04/16/96	42.7				
04/18/96		44.4			
04/18/96					35.5
04/18/96					35.7
04/05/01					37.1
04/05/01					37.1
04/06/01	44				
04/08/01				36.3	

Date sampled	BW1	MW1	MW2	MW3	MW4
04/13/01		44.3			
04/23/01			44.3		
04/15/02	47.1				
04/16/02					38.3
04/16/02					38.2
04/24/02			40.9		
04/30/02		45.6			
05/08/02				38.4	
04/08/03			41		
04/14/03	44.7				
04/16/03					41.5
04/16/03					42.5
04/21/03		44.9			
04/22/03				40.4	
04/16/04		45.0			
04/20/04	43.9				
04/20/04					42.4
04/22/04				36.9	
04/26/04			37.3		
04/26/04			37.5		
04/11/05		41.9			
04/12/05			33.7		
04/13/05				37.4	
04/15/05	42.2				
04/19/05					36.7
04/19/05					36.6
04/06/06					35.5
04/10/06			38.6		
04/12/06		43.6			
04/12/06		44.2			
04/13/06				39.2	
04/18/06	42.2				
count	32	23	22	22	22
Median values	43.45	43.7	41.1	39.15	38.5
1 STANDARD DEVIATION	6.079407	4.604608	4.95244	4.300239	6.089841
-1 STANDARD DEVIATION	37.37059	39.09539	36.14756	34.84976	32.41016
+1 STANDARD DEVIATION	49.52941	48.30461	46.05244	43.45024	44.58984

Uranium (total) (ug/L)

Date sampled	BW1	MW1	MW2	MW3	MW4
10/24/94			7.84		
10/25/94		1.34			
10/25/94		5.48			
10/25/94				4.82	
10/27/94	5.09				
04/17/95			6.64		
04/17/95				5.49	
04/19/95					6.17
04/19/95					6.5
04/05/01					5.37
04/05/01					5.53
04/06/01	5.9				
04/08/01				4.61	
04/13/01		5.27			
04/15/02	6.63				
04/16/02					6.24
04/16/02					6.19
04/24/02			6.72		
04/30/02		5.09			
05/08/02				5.68	
04/08/03			6.48		
04/08/03			6.78		
04/14/03	6.61				
04/16/03					6.45
04/16/03					6.52
04/21/03		5.12			
04/22/03				5.86	
04/16/04		5.45			
04/20/04	7.19				
04/20/04					5.12
04/22/04				5.55	
04/26/04			6.07		
04/26/04			6.2		
04/12/05			6.54		
04/13/05				5.14	
count	5	6	8	7	9
Median values	6.61	5.195	6.59	5.49	6.19
1 STANDARD DEVIATION	0.809308	1.617415	0.536828	0.463383	0.528772
-1 STANDARD DEVIATION	5.800692	3.577585	6.053172	5.026617	5.661228

Date sampled	BW1	MW1	MW2	MW3	MW4
+1 STANDARD DEVIATION	7.419308	6.812415	7.126828	5.953383	6.718772

Zinc (total) (mg/L)

Date sampled	BW1	MW1	MW2	MW3	MW4
09/27/90	0.096				
09/27/90	0.074				
09/27/90	0.097				
09/27/90	0.086				
09/28/90			0.18		
09/28/90			0.094		
09/28/90				0.029	
09/28/90				0.01	
07/27/92			0.094		
07/27/92			0.01		
07/27/92			0.105		
07/28/92		0.021			
07/28/92		0.01			
07/28/92		0.018			
07/28/92				0.06	
07/28/92				0.01	
07/28/92				0.071	
07/29/92	0.055				
07/29/92	0.01				
07/29/92	0.041				
07/29/92	0.01				
07/29/92	0.062				
01/18/93			0.075		
01/18/93			0.069		
01/19/93		0.01			
01/19/93				0.074	
01/20/93	0.11				
01/20/93	0.12				
04/26/93			0.01		
04/26/93			0.069		
04/26/93			0.073		
04/27/93		0.011			
04/27/93		0.0089			
04/27/93		0.038			
04/27/93				0.03	
04/27/93				0.036	
04/27/93				0.014	
04/28/93	0.036				
04/28/93	0.033				
04/28/93	0.045				
04/28/93					0.086
04/28/93					0.031
04/30/93					0.012

Date sampled	BW1	MW1	MW2	MW3	MW4
04/30/93					0.01
11/08/93			0.054		
11/09/93		0.016			
11/09/93				0.03	
11/10/93	0.048				
11/10/93	0.04				
11/11/93					0.0057
03/14/94					2.1
05/02/94			0.098		
05/03/94		0.017			
05/03/94				0.019	
05/04/94		0.016			
05/31/94					0.14
10/24/94			0.068		
10/25/94		0.028			
10/25/94		0.024			
10/25/94				0.043	
10/27/94	0.037				
10/28/94					0.07
03/14/95	0.04				
04/17/95			0.014		
04/17/95				0.0068	
04/19/95		0.0044			
04/19/95					0.07
04/19/95					0.069
10/16/95				0.018	
10/20/95		0.00673			
10/20/95					0.0597
10/20/95					0.0618
10/23/95	0.0636				
04/15/96			0.104		
04/15/96				0.011	
04/15/96				0.011	
04/16/96	0.0197				
04/18/96		0.00636			
04/18/96					0.0172
04/18/96					0.0179
08/27/98		0.023			
08/27/98		0.023			
04/12/99				0.0809	
04/13/99	0.0241				
04/14/99		0.00394			
04/14/99		0.00394			
04/14/99					0.507
04/19/99			0.0833		
04/14/00		0.023			

Date sampled	BW1	MW1	MW2	MW3	MW4
04/05/01					0.452
04/05/01					0.441
04/06/01	0.255				
04/08/01				0.0195	
04/13/01		0.0257			
04/23/01			0.0224		
04/15/02	0.214				
04/16/02					0.118
04/16/02					0.0969
04/24/02			0.0798		
04/30/02		0.0587			
05/08/02				0.25	
04/08/03			0.167		
04/08/03			0.159		
04/14/03	0.035				
04/16/03					0.0704
04/16/03					0.0705
04/21/03		0.0922			
04/22/03				0.02	
04/16/04		0.017			
04/20/04	0.0551				
04/20/04					0.0258
04/22/04				0.0576	
04/26/04			0.019		
04/26/04			0.0214		
04/11/05		0.0127			
04/11/05		0.0111			
04/12/05			0.0245		
04/13/05				0.0484	
04/15/05	0.0222				
04/19/05					0.023
04/19/05					0.0225
04/06/06					0.0197
04/10/06			0.0286		
04/12/06		0.0111			
04/12/06		0.0105			
04/13/06				0.126	
04/18/06	0.0455				
count	27	28	24	23	25
Median values	0.0455	0.016	0.071	0.03	0.069
1 STANDARD DEVIATION	0.056875	0.018312	0.049163	0.053245	0.423607
-1 STANDARD	-0.01138	-0.00231	0.021837	-0.02324	-0.35461

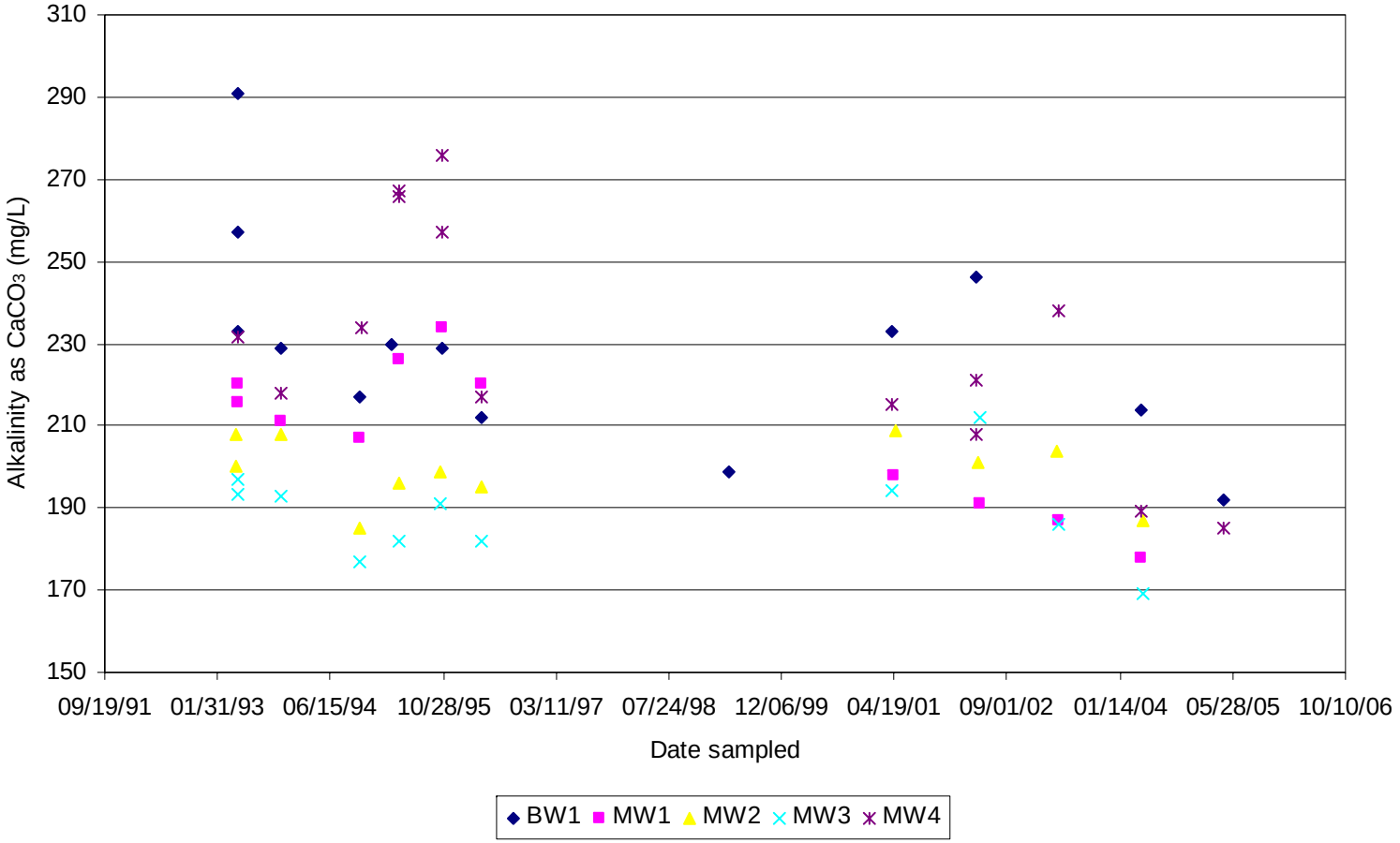
Date sampled	BW1	MW1	MW2	MW3	MW4
DEVIATION					
+1 STANDARD DEVIATION	0.102375	0.034312	0.120163	0.083245	0.492607

Zinc (dissolved) (mg/L)

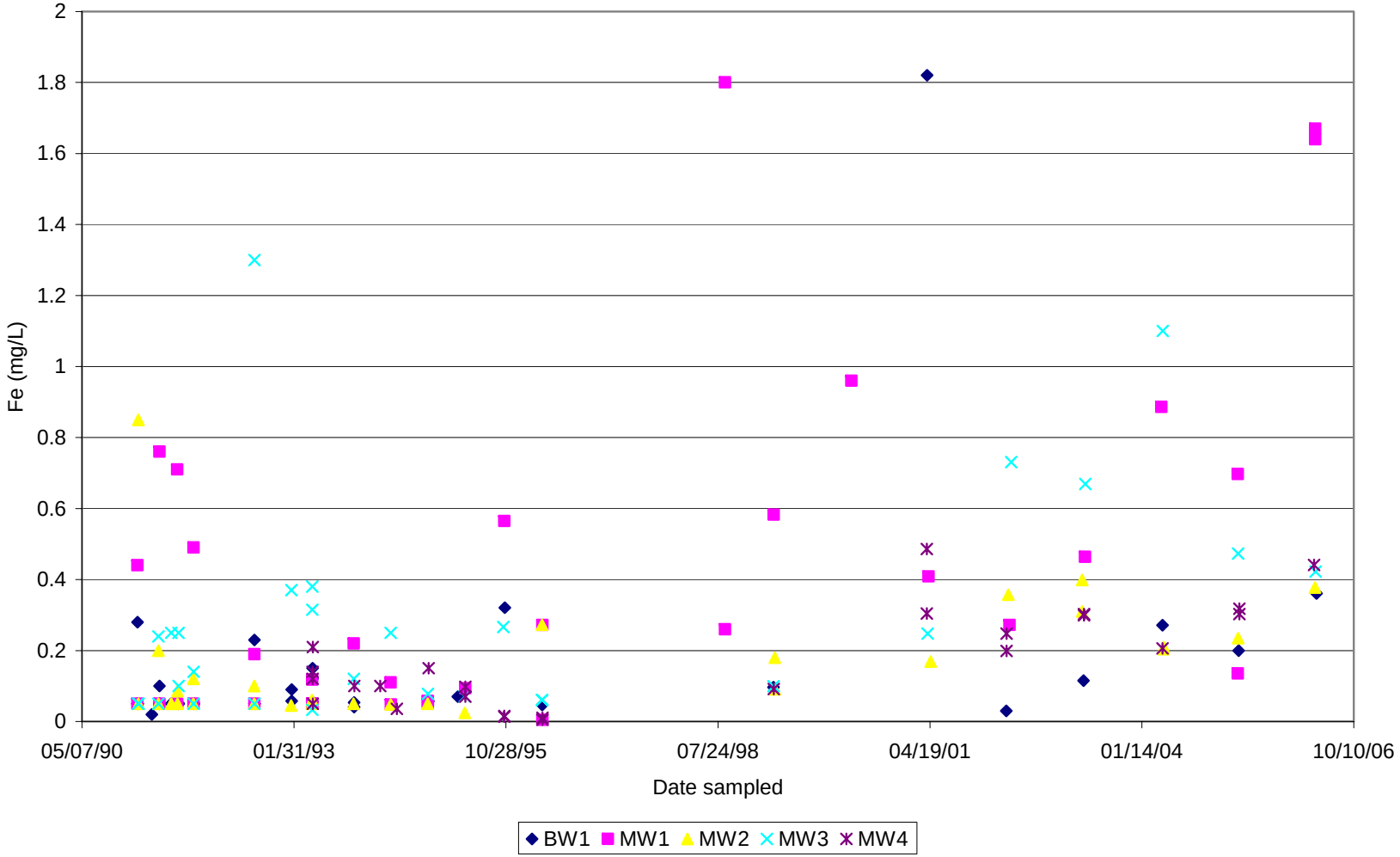
Date sampled	BW1	MW1	MW2	MW3	MW4
01/19/93		0.01			
01/20/93	0.11				
01/20/93	0.12				
04/28/93	0.012				
11/09/93		0.016			
11/10/93	0.048				
11/10/93	0.04				
05/03/94		0.017			
05/04/94		0.016			
10/27/94	0.037				
03/14/95	0.04				
04/19/95		0.0044			
10/20/95		0.00673			
10/23/95	0.0636				
04/16/96	0.0197				
04/18/96		0.00636			
04/12/99				0.0687	
04/13/99	0.015				
04/14/99					0.461
04/19/99			0.0657		
04/11/05		0.00513			
04/12/05			0.00886		
04/13/05				0.00658	
count	10	8	2	2	1
Median values	0.04	0.008365	0.03728	0.03764	0.461
1 STANDARD DEVIATION	0.037479	0.005341	0.040192	0.043925	----
-1 STANDARD DEVIATION	0.002521	0.003024	-0.00291	-0.00629	----
+1 STANDARD DEVIATION	0.077479	0.013706	0.077472	0.081565	----

Appendix B: time-series analytical data plots

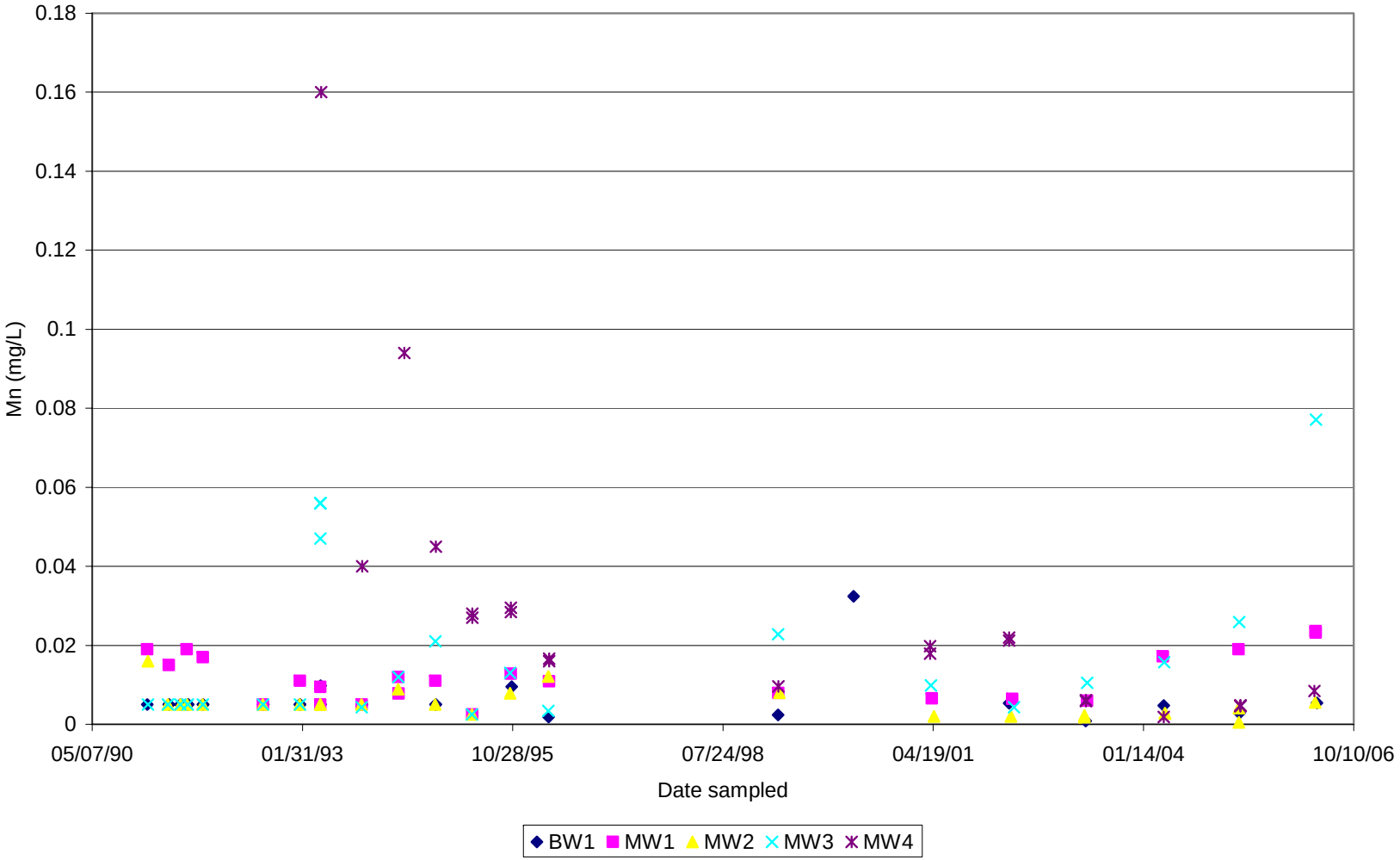
MWL--Alkalinity as $CaCO_3$



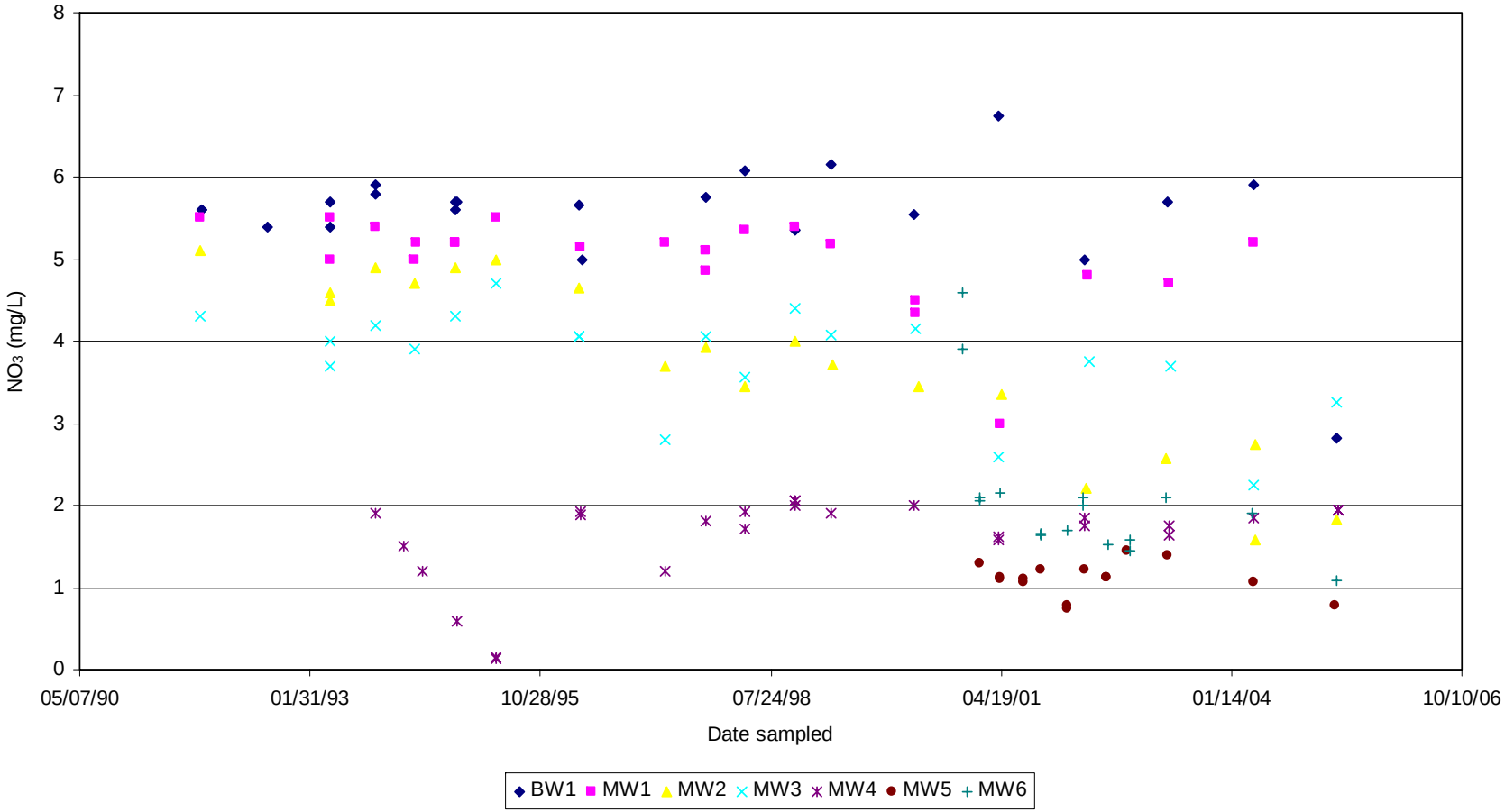
MWL--total Fe concentrations



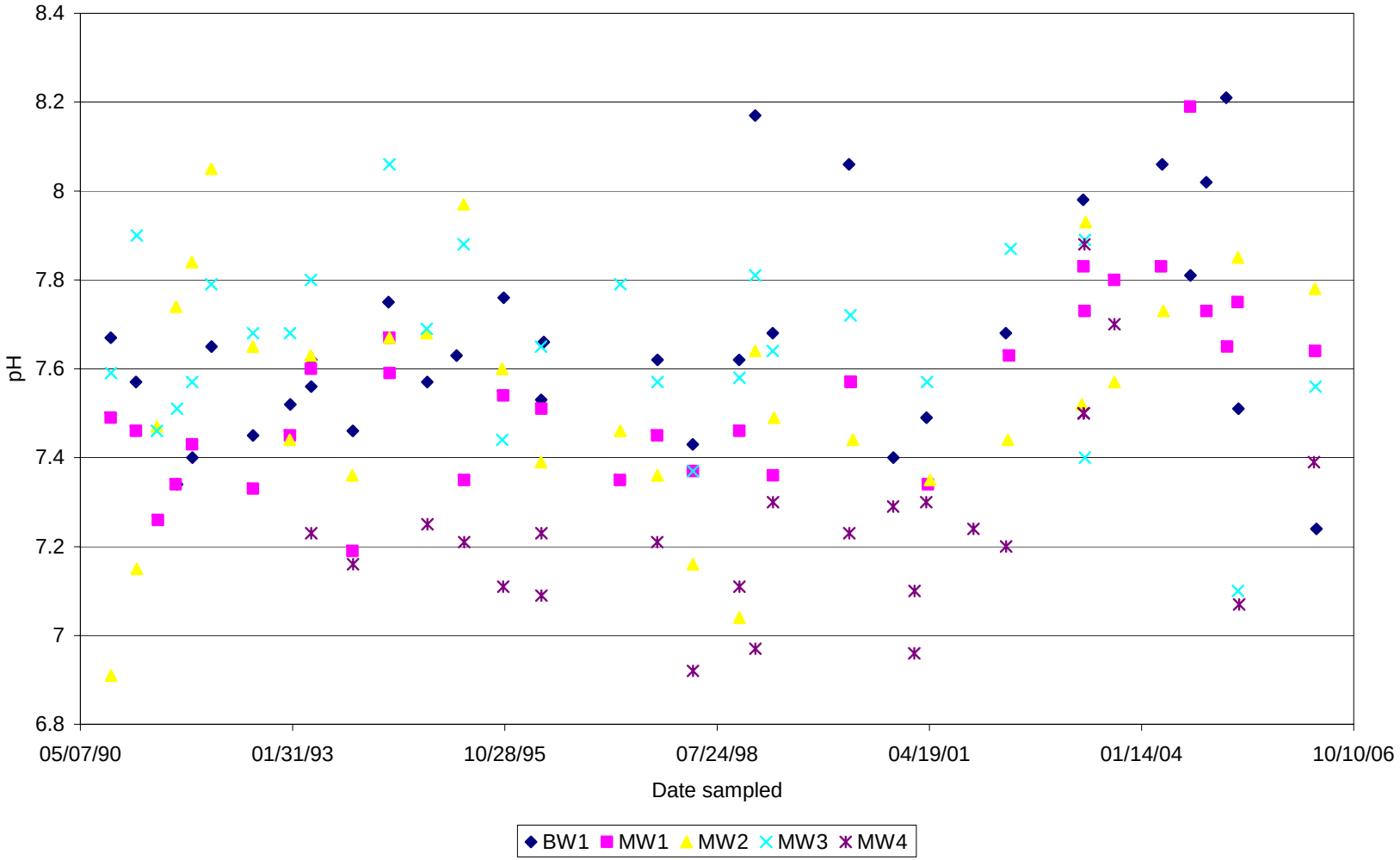
MWL--total Mn concentrations



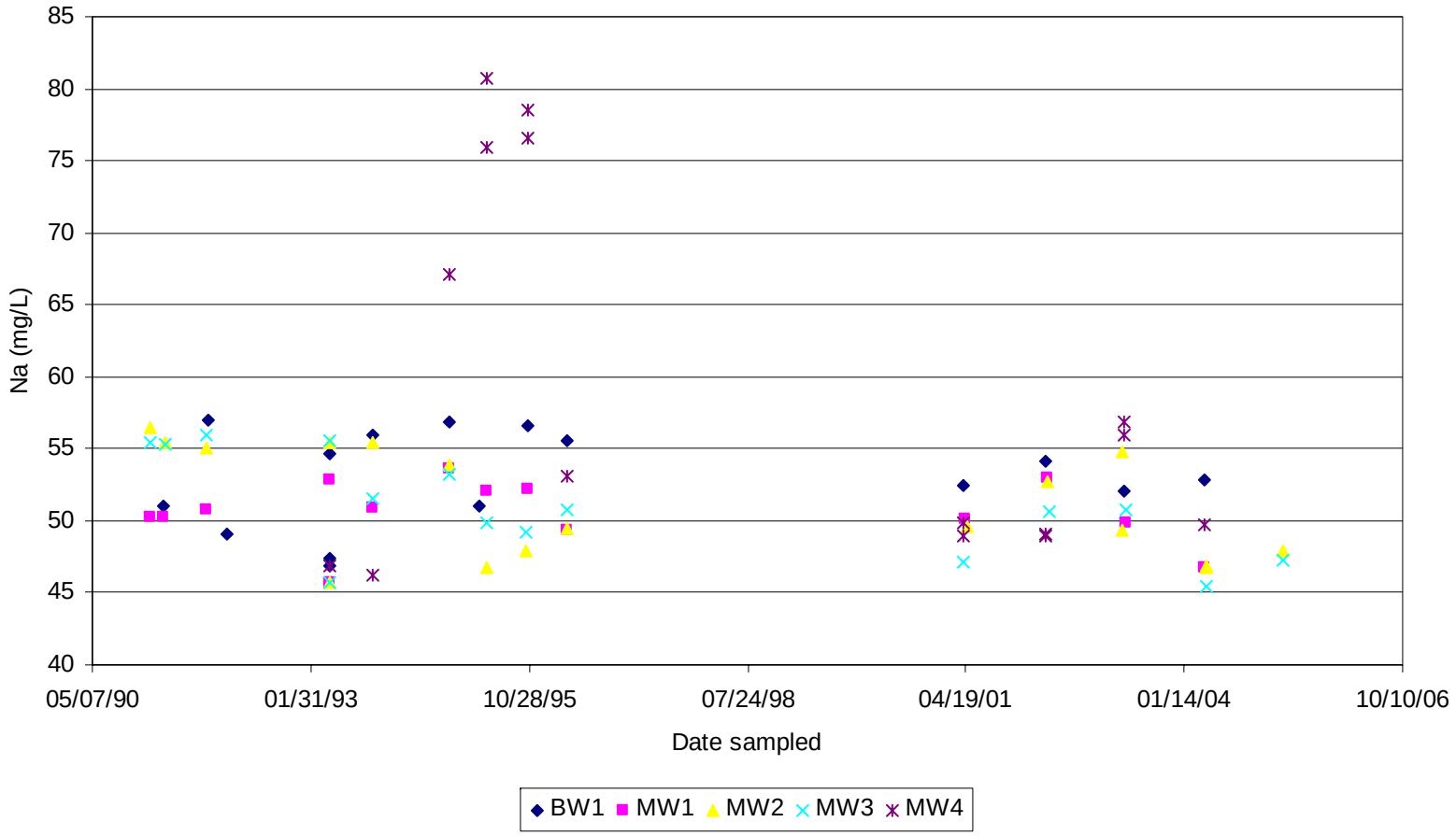
MWL--NO_3 concentrations



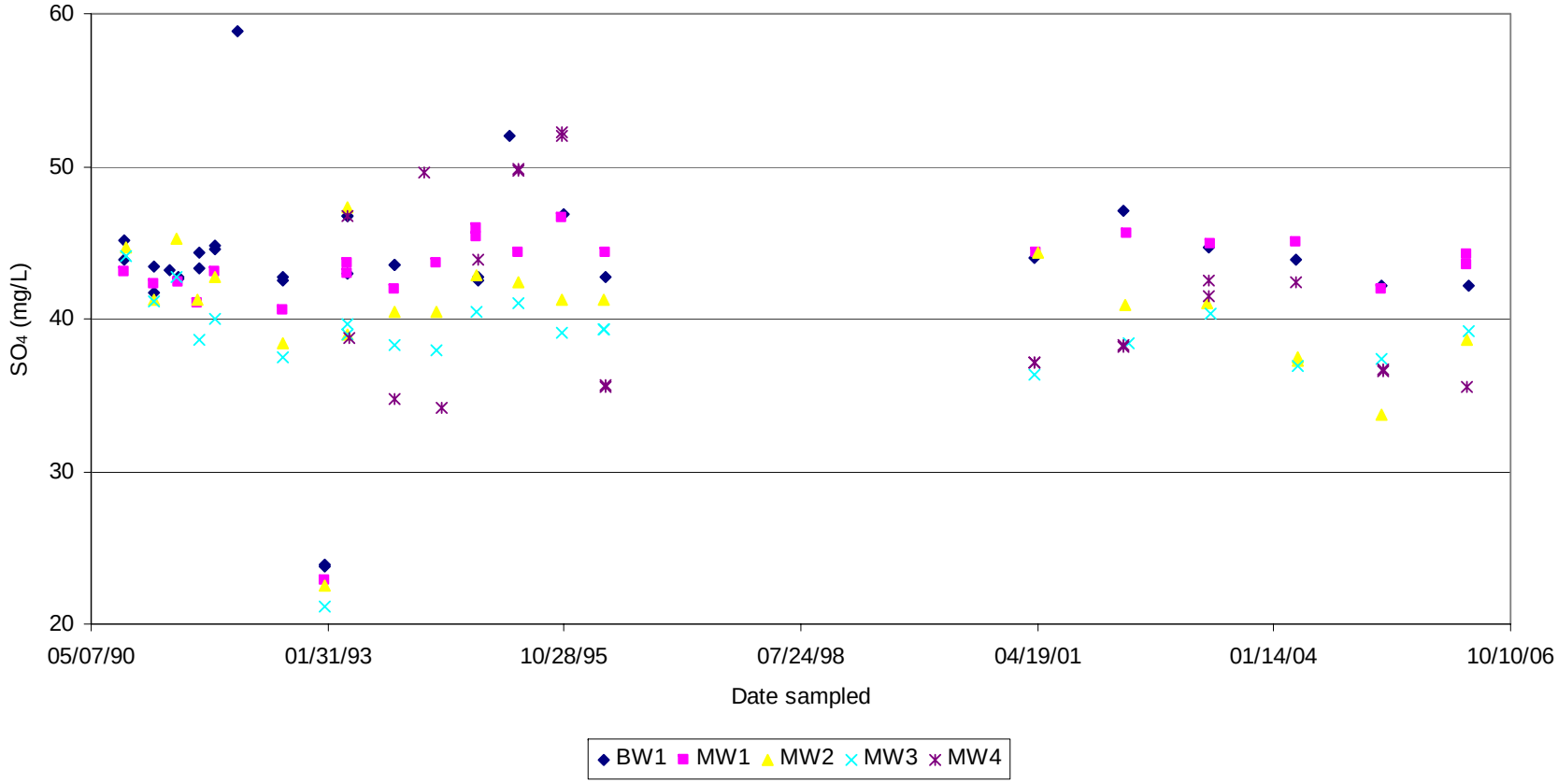
MWL--pH


8.4
8.2
8
7.8
7.6
7.4
7.2
7
6.8
pH
05/07/90
01/31/93
10/28/95
07/24/98
04/19/01
01/14/04
10/10/06
Date sampled
BW1
MW1
MW2
MW3
MW4

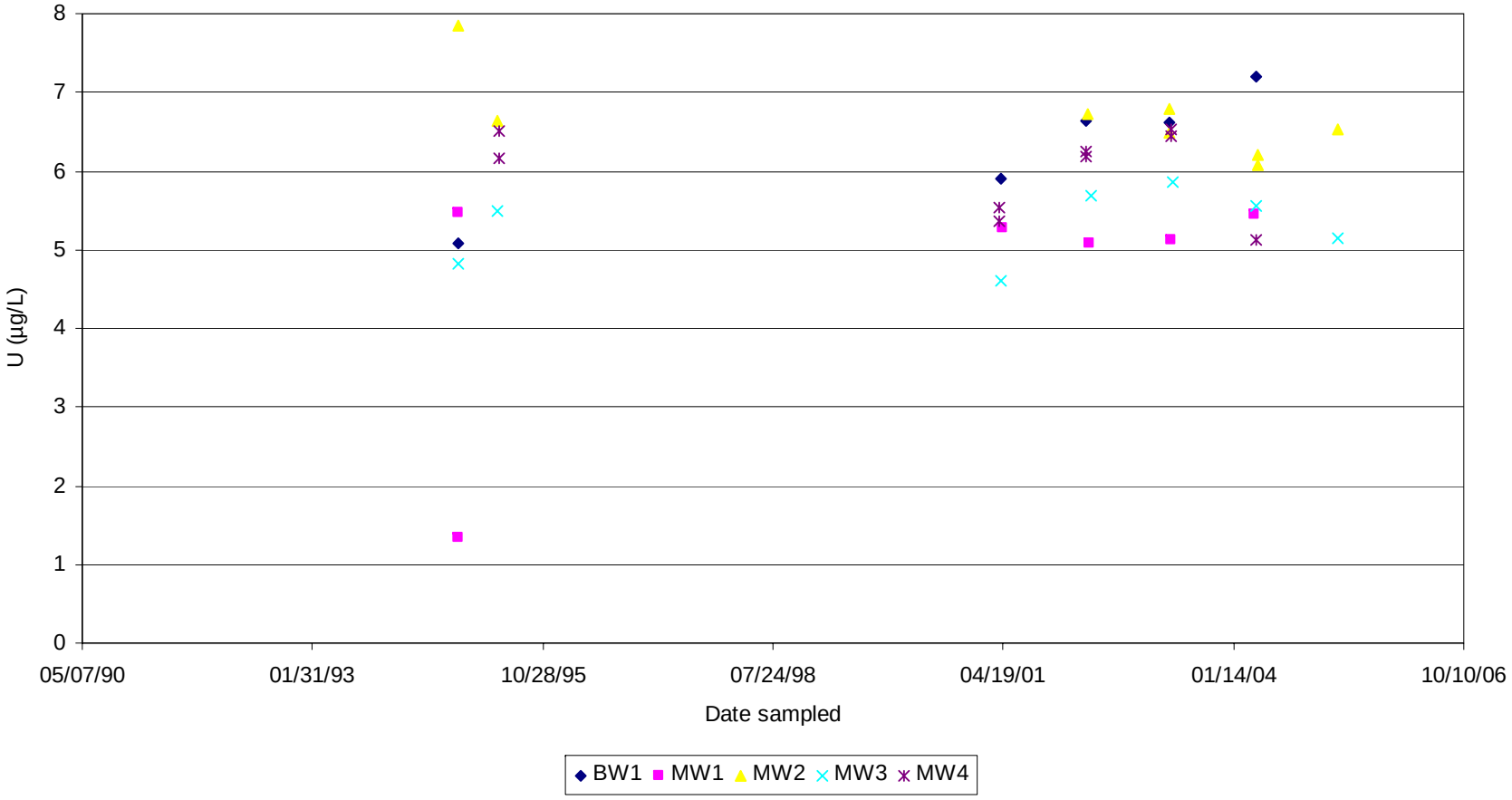
MWL--Na concentrations



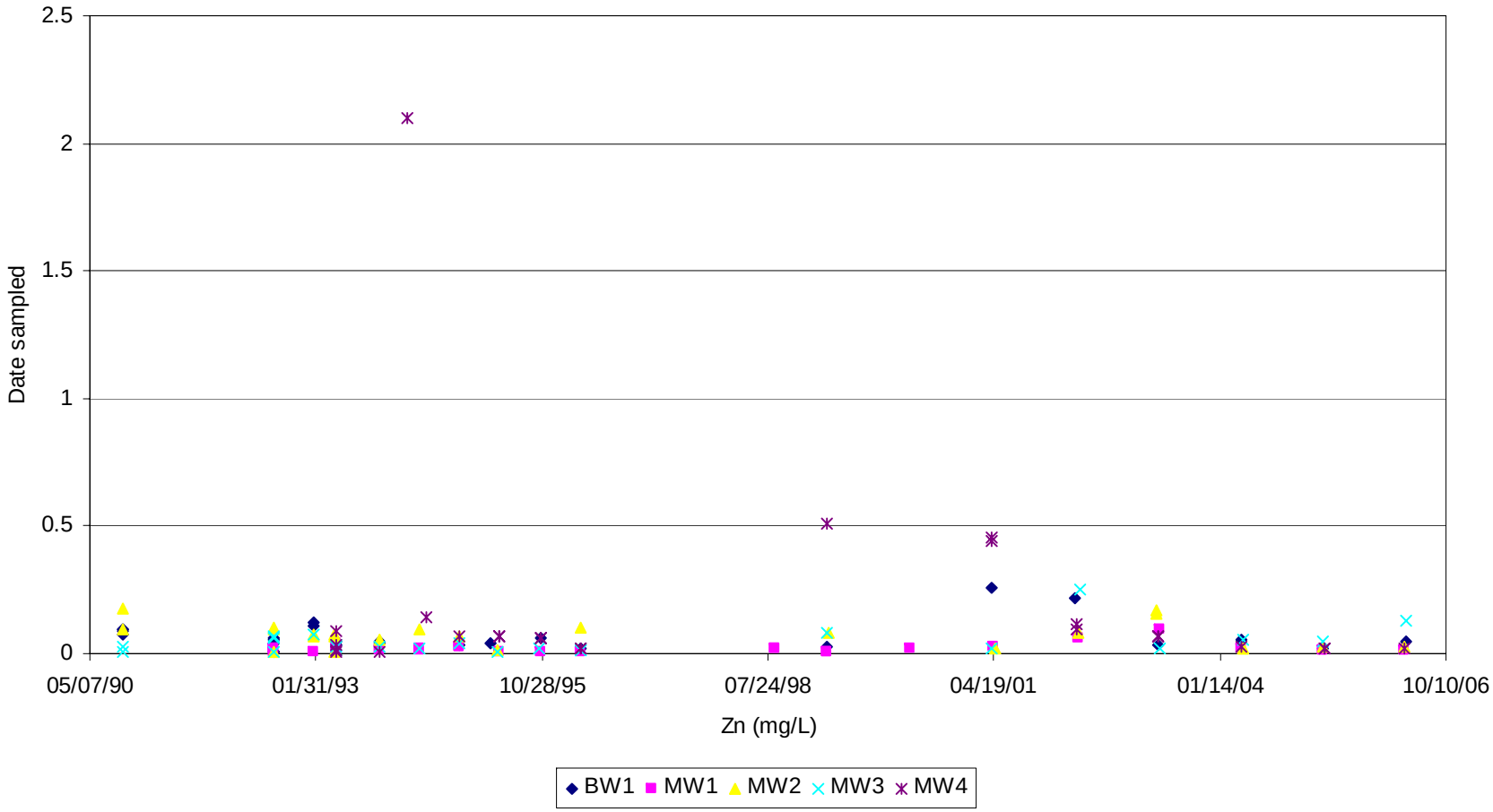
MWL--SO_4 concentrations



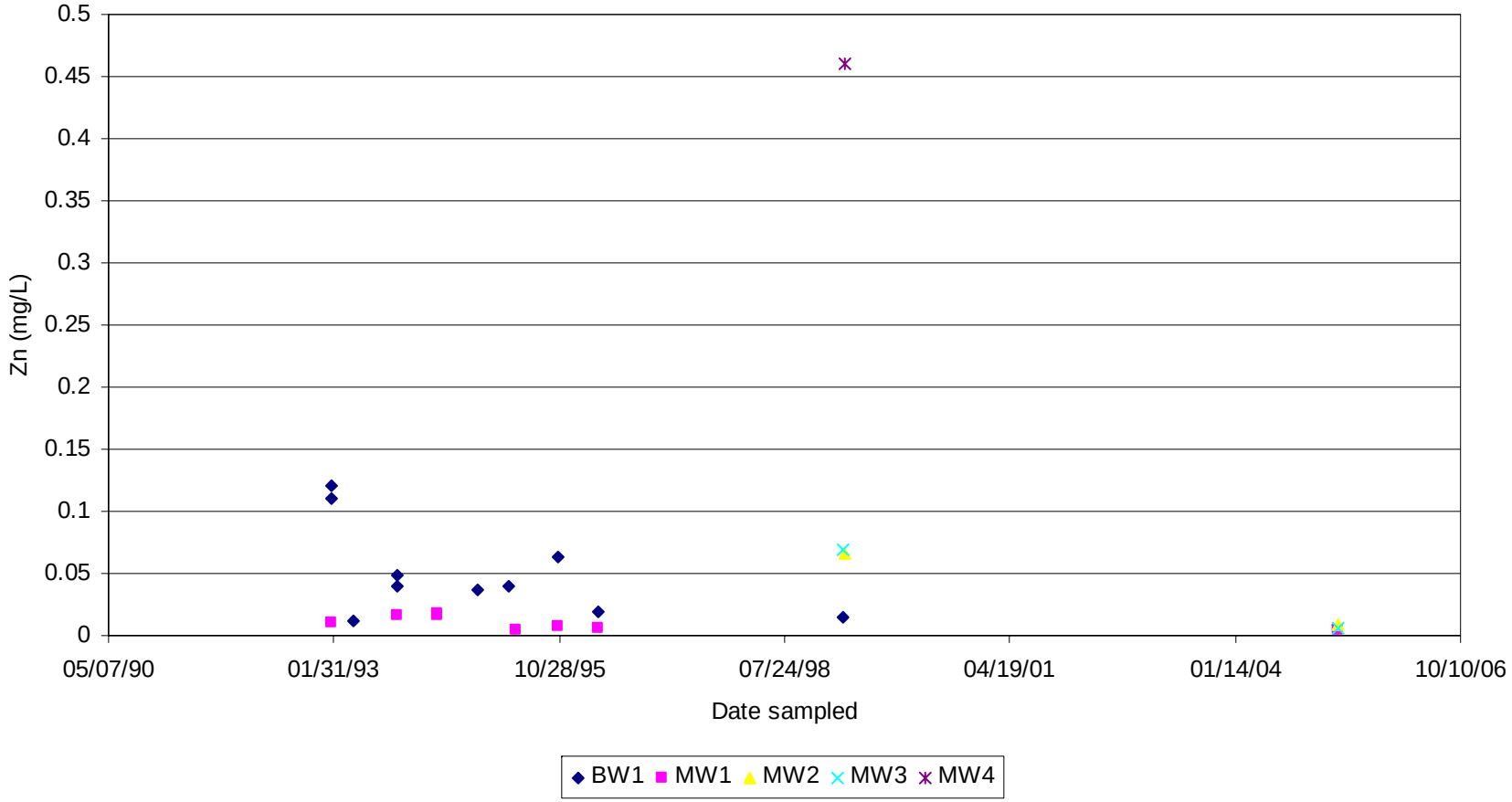
MWL--total U concentrations



MWL--total Zn concentrations



MWL--dissolved Zn concentrations



Appendix C: Groundwater monitoring data for MW5

Groundwater Monitoring Data for MW5

Sample Date	Calcium mg/L	Aluminum (total) mg/L	Sulfate mg/L	Barium (Total) mg/L	Uranium (Total) mg/L	Zinc (Total) mg/L
01/17/01		0.136	56.8	0.133		0.0092
01/17/01						
04/16/01		0.0766	52.0	0.134	9.23	0.00577
04/16/01		0.0911	52.4		9.03	0.00632
07/24/01		0.0172		0.133		0.00572
07/24/01		0.0172				0.0051
10/08/01	77.7	0.063	50.6	0.146	9.53	0.0124
01/30/02	73.3	0.0509	55.8	0.149	9.56	0.00839
01/30/02	72.7	0.0562	55.2	0.151	9.91	0.00774
04/17/02	84.1	0.0172	56.8	0.141	9.37	0.00392
07/23/02	79.5	0.0239	52.5	0.132	8.86	0.00362
07/23/02	78.9	0.0344	54.2	0.130	8.86	0.00366
10/15/02	84.6	0.00454	57.0	0.134	9.44	0.00525
04/09/03	88	0.0111	56.8	0.129	9.53	0.00513
04/21/04	86.8	0.00454	54.3	0.133	9.58	0.00514
04/06/05		0.0413	46.7			0.0173
04/14/06		0.0244	54.7			0.0077

Volume I

TAB 12

DOE/Sandia Responses to NOD Part 1 Comments and Submittal of Soil-Vapor Sampling and Analysis Plan: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005

From: SNL/Wagner
To: NMED/Bearzi

Back of Tab 12

Notes for Volume I, Tab 12:

The document included herein includes reference to a sampling and analysis plan that was appended to the "Mixed Waste Landfill Corrective Measures Implementation Work Plan, November 2005," developed in response to a November 2006 request by NMED to obtain more current soil-gas volatile organic compound (VOC) and tritium data, and to sample for possible radon emissions at the Mixed Waste Landfill (Justification Binder Volume I, Tab 9). The sampling and analysis plan, entitled "Appendix A, Sampling and Analysis Plan for Soil Gas Volatile Organic Compounds, Tritium, and Radon at the Mixed Waste Landfill" and dated December 2006 can be found in Justification Binder Volume II, Tab 1.

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

DEC 2 1 2006

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East
Building 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

On behalf of the Department of Energy (DOE) and Sandia Corporation, DOE is submitting a response to the Notice of Disapproval (NOD): Mixed Waste Landfill Corrective Measures Implementation Work Plan, November 2005 and Requirements for Soil-Vapor Sampling and Analysis Plan, Sandia National Laboratories, EPA ID NM5890110518, HWB-SNL-05-025. The enclosed responses address Part 1 comments. We have also enclosed a Soil-Vapor Sampling and Analysis Plan as directed by the NOD. Our response to Part 2 comments will be submitted under separate cover.

In our opinion, we do not consider our response to Part 1 and the soil-vapor plan as major documents in the corrective measures process and look forward to a timely review. It is our expectation that approval of this submittal will allow the start of the cover construction process. Sub-grade preparation activities are nearing completion and maintaining the experienced field crew is critical to that process.

If you have any questions, please contact me at (505) 845-6036 or Joe Estrada of my staff at (505) 845-5326.

Sincerely,

Kimberly A Davis for

Patty Wagner
Manager

Enclosures

DEC 1 1 2006

cc w/enclosures:
W. Moats, NMED (via Certified Mail)
J. Kieling, NMED, Santa Fe
L. King, USEPA, Region VI (via Certified Mail)
T. Skibitski, NMED-OB
T. Longo, NNSA/NA-56/HQ, GTN
UNM Zimmerman Library

cc w/o enclosure:
M. Reynolds, NNSA/SSO
J. Gould, NNSA/SSO
A. Blumberg, SNL/NM, Org. 11100, MS 0141
P. Freshour, SNL/NM, Org. 6765, MS 1087
D. Miller, SNL/NM, Org. 6765, MS 0718
D. Schofield, SNL/NM, Org. 6765, MS 1087
T. Goering, SNL/NM, Org. 6765, MS 1087
S. Griffith, SNL/NM, Org. 6765, MS 1087
M. J. Davis, SNL/NM, Org. 6765, MS 1087
Records, Center, SNL/NM, Org. 6765, MS 1087

Sandia Corporation
Albuquerque, New Mexico
December 15, 2006

DOE/Sandia Responses to NMED's "Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Work Plan, November 2005"

Comment Set 1

INTRODUCTION

This document responds to the first set of comments received in a letter from the New Mexico Environment Department (NMED) to the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia) on November 24th, 2006 regarding the Mixed Waste Landfill (MWL) Corrective Measures Implementation (CMI) Plan for Sandia National Laboratories (SNL). The letter is entitled "Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Work Plan, November 2005, and Requirement for Soil-Vapor Sampling and Analysis Plan, Sandia National Laboratories" [EPA ID NM5890110518, HWB-SNL-05-025].

The NMED letter contains two sets of comments, divided based on subject. The first set is entitled, "Part 1, Comments on Landfill Construction Plans and Performance Modeling". The second set is entitled, "Part 2, Comments on the MWL Fate and Transport Model (Appendix E)". The NMED letter also includes a request for a Soil-Gas Sampling Plan to obtain more current soil gas data.

This response document provides the first set of NMED comments, and DOE/Sandia's responses. NMED comments are listed in boldface, followed by the DOE/Sandia response, written in normal font under "Response". This document also contains a sampling and analysis plan (SAP) requested by NMED to obtain more current data on volatile organic compounds (VOCs), tritium, and radon at the MWL. The SAP is presented in Appendix A.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.

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Part 1. Comments on Landfill Construction Plans and Performance Modeling

1. -- Executive Summary, Page iii, last bullet -- Define the term "climax ecological community".

Response: The term “climax ecological community” is a term for a late or final stage in the development of an ecological community in which the composition of plants and animals is relatively stable and well-matched to environmental conditions. In the case of the MWL, the climax ecological community would be classified as Desert Grassland (Dick-Peddie, 1992), under current climatic conditions.

2. Section 2.1 -- Provide a more detailed schedule that, at a minimum, indicates completion times for the following cover and project elements: subgrade, bio-intrusion barrier, native soil layer, topsoil layer, seeding, fencing, overall completion of project, and submittal of Corrective Measures Implementation (CMI) Report to NMED. As the actual start time is dependent on when the CMI Plan is approved, the completion times can be proposed as the number of days from the start time (assume the start time = 0 days).

Response: A detailed schedule for the cover construction activities is presented below. Subgrade preparation activities should be completed by December 31, 2006. The cumulative schedule assumes approval to install the cover is received at start time T=0 days (T_0). Assumptions include the following:

1) NMED approves the SAP for soil gas VOCs, tritium, and radon at the MWL within fifteen days of receiving the document, allowing rapid implementation of the soil gas sampling activities.

2) DOE/SNL complete the soil gas and tritium sampling activities by mid-January, and cover construction activities are initiated shortly thereafter, allowing the current MWL field crew and heavy equipment to be retained.

3) The cover start time T_0 assumes full NMED approval of the MWL cover design presented in the CMI Plan (SNL/NM November 2005), as well as approval of the DOE/SNL responses to the Part 1 NOD comments.

TASK	Task Duration (Working Days)	Cumulative Time From T_0 (Calendar Days)
Receive Approval To Install Cover (T_0)	**0 days**	**0**
Screen Native Soils at the Borrow Areas	50 days	78
Extend MWL-MW4 Well Casing; Service Pump and Packer	20 days	44
Haul and Place Bio-Intrusion Barrier Rock	45 days	62
Haul Native Soil from Borrow Areas to MWL	30 days	47
Place Native Soil Layer	50 days	132
Procure 3/8" Crushed Gravel for Topsoil Layer	20 days	103
Stockpile Topsoil	14 days	93
Blend 3/8" Gravel with Topsoil	15 days	118
Haul and Place Topsoil Layer	30 days	190
Seed Cover and Surrounding Area	10 days	204
Install Fencing	10 days	218
Demobilize	20 days	225
Overall Completion of the Cover Construction Project	209 days	225
Submit Corrective Measures Implementation Report to NMED	130 days[2]	407

[1]Subgrade preparation should be completed by 12/31/2006
[2]180 calendar days

3. Section 5.2.2.1.1, last paragraph -- Describe the rainfall event that was simulated in the second in situ test.

Response: A short-duration rainfall-simulation study was undertaken in 1998 to estimate evapotranspiration rates following natural rainfall events, and to provide infiltration and percolation data useful for fitting unsaturated models (SNL, April 1999; Wolford, 1998). A 10 ft by 10 ft plot was established approximately 100 ft northwest of the MWL IP test plot, located approximately 500 ft west of the MWL. A neutron access tube was installed in the center of the plot, and initial moisture contents were measured using gravimetric samples and neutron logging prior to initiating the rainfall event.

The simulated rainfall event consisted of applying 80 gallons (303 liters) of water, equal to 1.28 inches over 100 ft2, to the plot over a period of 38 minutes during the afternoon of August 20, 1998. The water was distributed uniformly over the plot by subdividing the plot into 4 quarters, and sprinkling from a hose for known time periods on each section of the plot.

The soil within the plot was subsequently sampled at 3-inch depth increments between August 20 1998 and September 30, 1998 to obtain soil-water content values over time following application of the water. The data collected were used to fit infiltration and unsaturated flow parameters, as well as to estimate evapotranspiration rates for modeling

purposes. Additional details on the artificial rainfall experiment simulated in the second in situ test are presented in Wolford, 1998.

4. Section 5.2.2.2, 1st paragraph on page 5-4 -- Specify whether the degree of compaction was measured using the standard or modified proctor test.

Response: The degree of compaction was measured using Standard Proctor tests. The results are tabulated in Attachment C of Appendix A, "Geotechnical Report", in the document, "Deployment of an Alternative Cover and Final Closure of the Mixed Waste Landfill, Sandia National Laboratories, New Mexico" (SNL September 1999).

5. Section 5.3.2.4, next to last sentence —This sentence refers to a sand layer with an initial water content of 0.036 cubic centimeters being used for a boundary condition, Normally, water content of soil is expressed as a percentage (of the ratio of the mass of water per the mass of solids, or in the case of volumetric water content the ratio of the volume of water to the total volume of soil). Confirm whether this value and unit of measurement are correct.

Response: The units for initial water content in the next-to-last sentence in Section 5.3.2.4 were incorrect. This sentence should read, "Instead, a coarse sand layer with an initial water content of 0.036 cm^3/cm^3 was used for its lower boundary condition".

The text in this section has been revised accordingly.

6. Section 5.7.1 -- Specify the values used for the variables R, K, LS, VM and sources of the values used in the MUSLE equation to predict soil loss by water erosion.

Response: The calculation set for potential soil loss from the MWL cover using the Modified Universal Soil Loss Equation (MUSLE) was originally presented in Appendix D of the document, "Deployment of an Alternative Cover and Final Closure of the Mixed Waste Landfill, Sandia National Laboratories, New Mexico" (SNL/NM September 1999). A copy of this calculation set, entitled "Erosion and Slope Stability Calculations", is included as Attachment 1 to this NOD response. This calculation set includes copies of the tables and figures from which the variables R, K, LS, and VM were determined.

References used to prepare this calculation set include

- Geotechnology of Waste Management, 2nd Ed., Issa S. Oweis, Raj P. KHera, February, 1998.
- AGRA, Mixed Waste Landfill Cover, Tabulation of Test Results performed by AGRA Earth & Environmental on May 17, 1999.

Values used for the variables and sources for the values are shown in the table below.

Parameter	Variable	Value	Additional Information
Rainfall Factor	R	35	Determined from isoerodent map of the western United States, illustrating average annual values of the rainfall factor, R. See Figure 1, Sheet 9 of Attachment 1.
Soil Erodibility Factor	K	0.44	Approximate value of K, based on a loamy very fine sand with organic content < 0.5%. See tabulation of AGRA test results, Table 1, Sheet 10 of Attachment 1; K determined from Table 2, Sheet 12, of Attachment 1.
Topographic Factor for Cover (2% slope)	LS	0.28	See Sheets 5 and 6 of Attachment 1.
Topographic Factor for Sideslope (16.7% slope)	LS	1.32	See Sheets 5 and 6 of Attachment 1.
Erosion Control Factor for Cover (no vegetation)	VM	0.06	Assumes no vegetation was yet established; that straw mulch had been applied to the cover and side-slopes at 2 tons/acre, and that the mulch was crimped into soils with a disk. See Sheet 7 and Sheet 14 of Attachment 1.
Erosion Control Factor for Sideslope (no vegetation)	VM	0.11	Assumes no vegetation was yet established; that straw mulch had been applied to the cover and side-slopes at 2 tons/acre, and that the mulch was crimped into soils with a disk. See Sheet 7 and Sheet 14 of Attachment 1
Erosion Control Factor for Cover and Sideslope (vegetation established)	VM	0.01	Assumes that vegetation is established on both the cover and side-slopes 12 months after seeding, and assumes that one-half the straw mulch remained. See Sheet 8 and Sheet 15 of Attachment 1.

7. Section 5.7.2 -- Specify the values used for the variables I, k, C, L, V and sources of the values used in the WEQ equation to predict soil loss by wind erosion.

Response: The calculation set for potential soil loss from the MWL cover using the Wind Erosion Equation (WEQ) was originally presented in Appendix D of the document, "Deployment of an Alternative Cover and Final Closure of the Mixed Waste Landfill, Sandia National Laboratories, New Mexico" (SNL/NM September 1999). A copy of this calculation set, entitled "Erosion and Slope Stability Calculations", is presented as Attachment 2 to this NOD response. This calculation set includes copies of the tables and figures from which the variables I, k, C, L, and V were determined.

References used prepare this calculation set include

- Natural Resources Conservation Service (NRCS) National Agronomy Manual, 190-V-NAM, 2nd Ed., Part 502, March 1988.

- 2) N.P. Woodruff and F.H. Siddaway, 1965. "A Wind Erosion Equation," Soil Science Society of America Proceedings, Vol. 29, No. 5, Pages 607-608.

Values used for the variables and sources for the values are shown in the table below.

Parameter	Variable	Value	Additional Information
Soil Erodibility Index for Cover (2% slope)	I	134 tons/acre/year	Based on erodibility index for a loamy very fine sand, as determined by AGRA test results. See Sheet 2, 9 and 11 of Attachment 2.
Soil Erodibility Index for Sideslope (16.7% slope)	I	188 tons/acre/year	Based on erodibility index for a loamy very fine sand, as determined by AGRA test results. See Sheets 3, 9 and 11 of Attachment 2.
Total Surface Roughness (Cover and Sideslope)	k	1.0	Based on the assumption that the engineered cover and sideslopes will be smooth and without ridges. See Sheets 3, 4, 13 and 14 of Attachment 2.
Climatic Factor	C	120	Index of the relative erosivity by geographic location. See Sheets 5 and 15 in Attachment 2.
Unsheltered Distance (Cover)	L	524 ft	Field length along the prevailing wind direction. See Sheets 5 and 15 of Attachment 2.
Unsheltered Distance (Sideslope)	L	25 ft	Field length along the prevailing wind direction. See Sheets 5 and 15 of Attachment 2.
Vegetative Cover Factor (Cover)	V	4,500 small grain equivalent	Assumes no vegetation was yet established; that straw mulch had been applied to the cover and side-slopes at 2 tons/acre, and that the mulch was crimped into soils with a disk. See
Vegetative Cover Factor (Sideslope)	V	3,200 small grain equivalent	Assumes vegetation is established on cover and sideslopes 12 months after seeding, and one half the straw mulch remains. Also assumes that 400 small grain equivalent of native grass is established on cover and sideslopes.

8. Section 7.0 -- The NMED expects the vadose zone to be monitored for volatile organic compounds, tritium, and radon, in addition to soil moisture. The NMED may also require soil-gas monitoring to be conducted at depths other than at 173 feet, as implied by the Permittees in the second paragraph of Section 7.1. Monitoring details will need to be included in the long-term monitoring and maintenance plan, due within 180 days following approval of the CMI Report. No response is required at this time.

Response: DOE/Sandia are proposing a robust soil-gas monitoring system for long-term monitoring at the MWL. The soil-gas monitoring system will serve as an early-warning system to protect groundwater from potential migration of contaminants. Additional information regarding the proposed monitoring, including the parameters and depths to be monitored, will be included in the DOE/Sandia responses to the second set of comments within this NOD (Part 2). Further details will be included in the Long Term Monitoring and Maintenance Plan (LTMMP), to be submitted within 180 days of the NMED's approval of the MWL CMI Report.

9. Figure 5-1 -- Clarify which curves are representative of the PET data from the four National Weather Service stations in New Mexico and which are representative of the predicted PET data.

Response: The PET curves for the Cochiti, Elephant Butte, Socorro, and Bosque del Apache National Weather Service Stations are delineated by wider lines and have no symbols. The curves representing the PET data predicted by HELP-3 are delineated by much narrower

lines, and have symbols identifying the monthly PET values predicted by the model.

10. Appendix A, Construction Specifications, Section 02930, Reclamation seeding and Mulching, Part 3.1.2, #1 -- Explain why the TA-3 borrow pits are not to be reseeded by the contractor, given that erosion of the borrow pits should be prevented.

Response: Once the MWL cover has been constructed and the TA-3 borrow pits are no longer required for environmental restoration activities, they may be transferred over to Sandia Facilities for continued use at Sandia. However, if the TA-3 borrow pits are not needed by Facilities, they will be seeded and reclaimed as described in Appendix A, Construction Specifications, Section 02930, Reclamation Seeding and Mulching.

11. Appendix A, Construction Specifications, Section 02200, Earthwork Part 3.3.3, #4 -- The Permittees should consider changing the requirement that no proof rolling be conducted within 2 feet of any groundwater monitoring well, measuring device, or other placed surface. The NMED strongly suggests changing the requirement to preclude all heavy equipment from operating within 3 feet of wells or other measuring devices.

Response: The requirement will be changed to preclude all heavy equipment from operating within 3 feet of any monitoring well or measuring device.

12. Appendix A, Construction Specifications, Section 02200, Earthwork Part 3.3.4, #8 and Part 3.3.6., #9 -- Both of these sections contain language stating that nonconforming work shall be redone until the specifications are attained "or the Operator accepts the placement conditions". Please note that the NMED expects construction of the cover to comply substantially with the specifications in the approved CMI Plan. Failure to achieve the specifications in the approved CMI Plan, or obtain an NMED-approved change, could lead to disapproval of part or all of the constructed cover.

Response: Sandia fully expects to construct the MWL cover to meet all specifications identified in the CMI Plan. If these specifications cannot be met for any reason, the NMED will be informed of these discrepancies and a mutually-acceptable corrective action will be determined and implemented.

13. Appendix A, Construction Specifications, Section 02200, Earthwork Part 3.3.6 -- The NMED strongly recommends that the Permittees add to the specifications for construction of the native soil layer a requirement for a minimum number of passes with compaction equipment.

Response: Part 3.3.6 of Section 02200 describes the installation of the native soil layer. Item 5 of Part 3.3.6 states that for each lift "The Contractor shall compact to not less than 90 percent of maximum dry density at -2 to +2 percentage points of optimum moisture content, as determined by ASTM D698 (Standard Proctor testing)." Item 9 of the same section further states that "Lifts not compacted to the density and moisture content specifications or not meeting the requirements of this specification shall be reworked to the full depth of the lift and recompacted until the specifications are attained or the Operator accepts the

placement conditions."

With the requirement that the lifts be compacted, and tested to meet a specified compaction, it is not necessary to count the number of passes of compaction equipment, as long as the construction specifications are met.

14. Appendix B, Construction Quality Assurance Plan, Section 2.6.3, first sentence — Clarify what is meant by the first sentence: "The CQA Certifying Engineer is responsible for...certifying the CQA document has been approved by the NMED". Did the Permittees intend, instead, to require that the CQA Certifying Engineer be responsible for certifying the results of the CQA Report that is to be submitted for NMED approval? If so, the first sentence should be revised to state "The CQA Certifying Engineer is responsible for certifying in a statement to the owner and the NMED that, in his or her opinion, the cover has been constructed in accordance with all plans and specifications". The next sentence of the paragraph explains further that the certification statement would normally be included in a CQA Report.

Response: The first sentence will be revised to state "The CQA Certifying Engineer is responsible for certifying in a statement to the owner and the NMED that, in his or her opinion, the cover has been constructed in accordance with all plans and specifications."

15. Appendix B, Construction Quality Assurance Plan, Section 8.7 -- The Final Report must be submitted to the NMED as part of the CMI Report. The Final Report must include copies of all quality control data generated by the construction contractor as well as the quality assurance data generated by the CQA contractor.

Response: The Construction Quality Assurance Plan will include all quality control data generated by the construction contractor as well as quality insurance data generated by the CQA contractor. The Construction Quality Assurance Plan will be submitted to the NMED as part of the CMI Report.

16. Demonstrate with calculations and other information whether run-off and run-on controls have been adequately designed to handle peak precipitation events. Evaluate and discuss whether additional run-on controls should be constructed at locations further away from the landfill (e.g., at distances of 25 to 50 meters) to provide more protection for the cover from heavy rainfall events.

Response: Calculations have been prepared regarding the adequacy of the run-off and run-on controls for handling peak precipitation events. The complete calculation set and supporting exhibits are presented in Attachment 3. The calculation results are summarized below.

The site will be graded such that runoff from the site flows north, west and east. There is a high point on the north side of the site that prevents flow from running onto the site. Two swales will be provided to carry the flow to the north or the south. This may be seen in Exhibit 1: Mixed Waste Landfill Final Cover Grading Plan", included in the complete

calculation set (Attachment 3).

The watershed basin draining onto the site has been delineated and is shown on Exhibit 2 of Attachment 3. It is divided in to a north basin and a south basin that drain to the north and south swales respectively.

Runoff was calculated using the City of Albuquerque Development Process Manual (City of Albuquerque 2006) criteria for the 100 year –6 hour storm. The north basin generates 24 cfs and the north swale has the capacity for 79 cfs. The south basin generates 6.5 cfs and the capacity of the south swale is 58 cfs.

The swales are therefore sized with abundant capacity to prevent flow from entering the site and to carry the runoff around the site.

The general drainage pattern in this area is a gentle slope to the west. After the flow is discharged from the site, it drains westward and no additional controls are needed. Exhibit 2 shows the topography up to a minimum of 200 feet beyond the site to illustrate this.

17. Identify the criteria to be applied to determine whether the establishment of vegetation on the final cover is acceptable, including, but not limited to, species diversity, plant survival, and the extent of ground cover. Explain how measurements will be conducted in the field to assess these criteria.

Response: Establishment of the desired vegetation community on the MWL cover is anticipated to be the result of a successional process. Ecological succession is a generally predictable pattern of orderly changes in the composition or structure of an ecological community. Succession on the MWL will be initiated by the formation of this new, unoccupied habitat on the cover.

The MWL cover will be seeded with grass species that have been identified as native to the surrounding area. These grasses will eventually out-compete the weedy plants that dominate early in plant community succession. The final cover soil has been collected from the local area in order to provide the correct growing substrate for the seeded plant species. This soil is expected to contain a significant amount of weed seed, including large amounts of *Salsola tragus* seeds, commonly known as Russian thistle or tumbleweed. No supplemental watering is planned for the MWL, although supplemental watering is widely recommended to facilitate establishment of native plants in a chosen area. Due to a large amount of weed seeds and no supplemental watering, the early succession period is anticipated to be long.

Mature Plant Community Criteria

Vegetation on the MWL cover will be surveyed by a qualified biologist on a regular basis. This survey will include:

- Identification of any barren areas
- Identification of all plant species present on the cover

- Quantification of plant species present on the cover

Plant species will be identified according to their scientific names. Plant species will be quantified by determining the percent cover of each actively photosynthesizing species contained within a one-meter by one-meter survey quadrat. These quadrat survey locations will vary across the cover at the time of each inspection in order to best reflect plant cover across the MWL.

The mature, secondary plant community will be achieved when greater than 50% of the photosynthesizing foliar coverage is comprised of grass species native to the general TA-III area.

General Comments and Requirements for Soil-Gas Sampling

As the Permittees are aware, most site characterization data for the MWL (other than groundwater data) dates before the mid 1990's. Because the rupturing of containers and the leaking of their contents could have occurred since the mid 1990's, the NMED requires more current soil-gas data to help resolve this issue. The Permittees shall therefore collect and analyze active soil-gas samples taken at depths of 10 and 30 feet at a minimum of three locations within the landfill where previous sampling has detected the highest soil-gas concentrations in the past. The soil-gas samples shall be analyzed for volatile organic compounds, tritium, and radon. Pursuant to Section VI.A of the Order on Consent (April 29, 2004), the Permittees shall provide for approval to the NMED within 30 days of receipt of this letter a work plan to conduct the active soil-vapor sampling described above. The work plan shall be prepared in accordance with Section X.B of the Consent Order.

Response: A work plan has been developed which presents plans for sampling and analysis of soil gas at six locations within or adjacent to the MWL, and at two background locations. Soil gas samples will be collected at depths of 10 and 30 feet, and analyzed for VOCs. Soil samples will be collected from the same locations and depths, and analyzed for tritium in soil moisture. Samples for analysis of radon are difficult to obtain from soil gas samples; instead, radon sampling is proposed to be conducted along the MWL perimeter once the MWL cover has been completed.

The sampling and analysis plan for soil gas VOCs and tritium and radon is presented in Appendix A.

References

City of Albuquerque, 2006, “Albuquerque Development Process Manual”, October 2006 Revision, published by American Legal Publishing Corporation, 432 Walnut Street, Cincinnati, Ohio 45202.

Dick-Peddie, W.A. 1992, “New Mexico Vegetation Past, Present and Future.” University of New Mexico Press, Albuquerque, NM. 244 pp.

Sandia National Laboratories/New Mexico (SNL/NM), September, 1999, "Deployment of an Alternative Cover and Final Closure of the Mixed Waste Landfill, Sandia National Laboratories, New Mexico", prepared for US DOE by Sandia National Laboratories Environmental Restoration Project, Albuquerque, New Mexico, September 23, 1999.

Sandia National Laboratories/New Mexico (SNL/NM), November 2005. "Mixed Waste Landfill Corrective Measures Implementation Plan", prepared at Sandia National Laboratories by J. Peace, T. Goering, C. Ho and M. Miller for the U.S. Department of Energy, Albuquerque, NM.

Wolford, R.A., 1998, Preliminary unsaturated flow modeling and related work performed in support of the design of a closure cover for the Mixed Waste Landfill. Prepared by GRAM, Inc. for the Mixed Waste Landfill Cover Project, Environmental Restoration Program, Organization 6135. Sandia National Laboratories, Albuquerque, NM, November 10, 1998.

Attachment 1

Universal Soil Loss Calculations for the MWL Cover

Using the

Modified Universal Soil Loss Equation (MUSLE)

GRAM, Inc.

Calculation Sheet Sheet 1 of 15

By: M. McVey	Date: 8/19/99	Title: Potential Soil Loss from the MWL Cover by Overland Runoff
Chkd. By: J. Peace	Date: 8/20/99	

Purpose:

Determine the soil loss due to sheet and rill erosion for the Mixed Waste Landfill alternative cover. The soil loss will be calculated by the Modified Universal Soil Loss Equation (MUSLE). This calculation only presents potential loss.

References:

1. Geotechnology of Waste Management, 2nd Ed., Issa S. Oweis, Raj P. Khera, February, 1998.
2. AGRA, Mixed Waste Landfill Cover, Tabulation of Test Results, performed by AGRA Earth & Environmental on May 17, 1999.

Soil Loss Calculations

Modified Universal Soil Loss Equation (MUSLE):

$$A = RK(LS)(VM)$$

Where:

A = Average annual soil loss (Tons/Acre/yr.)

R = Rainfall factor

K = Soil erodibility factor

LS = Topographic factor

VM = Erosion control factor

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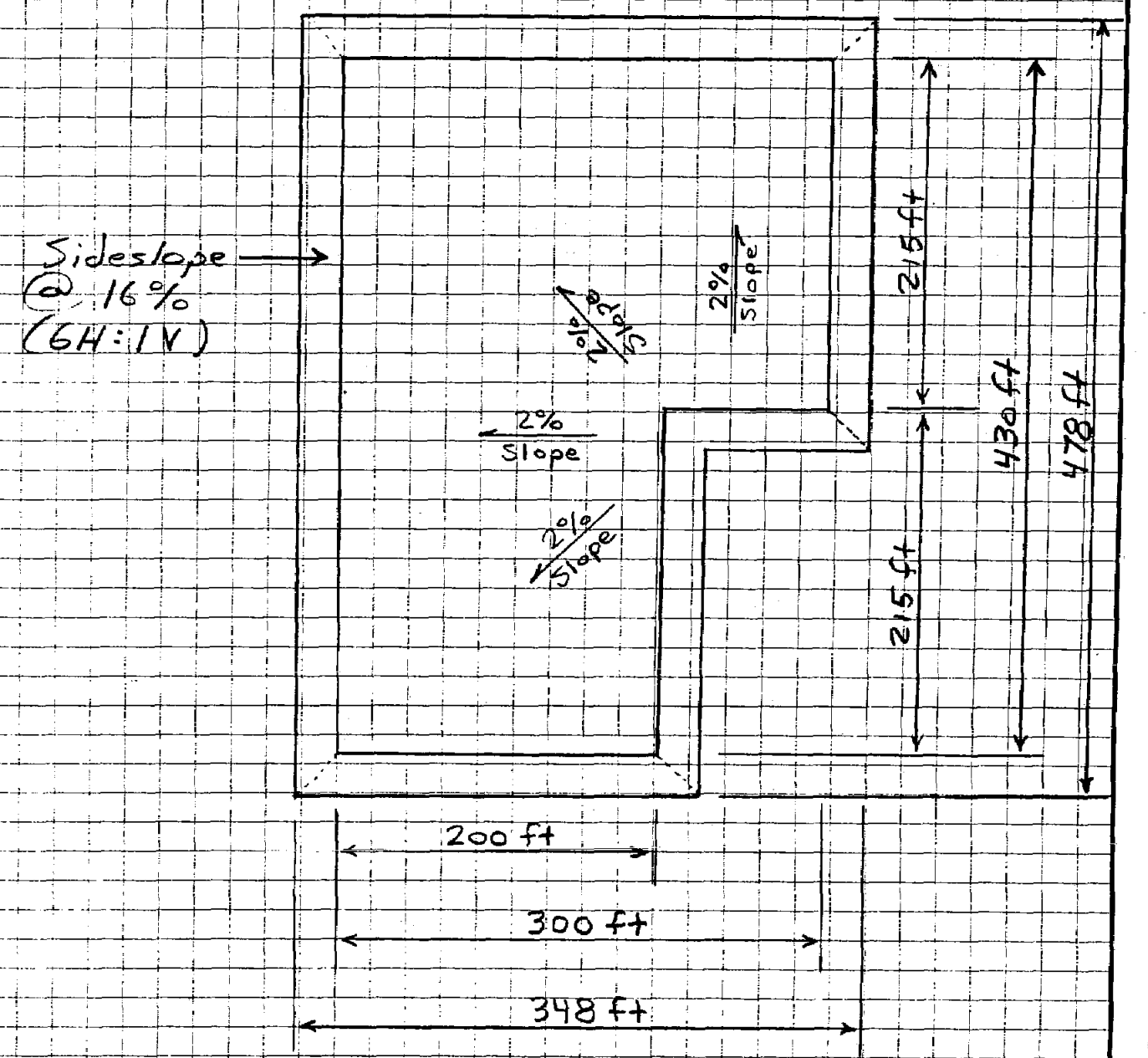
Calculation Sheet

By: M. McVey	Date: 8/19/99	Title: Potential Soil Loss from the MWL Cover by Overland Runoff
Chkd. By: J. Peace	Date: 8/20/99	

Plan View Cover



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Calculation Sheet Sheet 3 of 15

By: M. McVey	Date: 8/19/99	Title: Potential Soil Loss from the MWL Cover by Overland Runoff
Chkd. By: J. Peace	Date: 8/20/99	

Area of Cover

$A_C = (200\,ft \times 215\,ft) + (200\,ft \times 215\,ft) + (100\,ft \times 215\,ft)$

$= 107,500\,ft^2$

$= 107,500\,ft^2 / 43,560\,ft^2/Acre$

$= \underline{2.47\ Acres}$

Area of Sideslopes

$A_{SS} = (24\,ft \times 478\,ft) + (24\,ft \times 200\,ft) + (24\,ft \times 239\,ft) + (24\,ft \times 100\,ft) + (24\,ft \times 215\,ft) + (24\,ft \times 324\,ft)$

$= 37,344\,ft^2 / 43,560\,ft^2/Acre$

$= \underline{0.86\ Acres}$

Total Area of Cover and Sideslopes

$A_{TOT} = A_C + A_{SS}$

$= 2.47\ Acres + 0.86\ Acres$

$= \underline{3.33\ Acres}$

By: M. McVey	Date: 8/19/99	Title: Potential Soil Loss from the MWL Cover by Overland Runoff
Chkd. By: J. Peace	Date: 8/20/99	

1) Determine rainfall factor, R:
From Figure 1 (Sheet 9)
$\Rightarrow R = 35$

2) Determine soil erodibility factor, K:
- From Tabulation of AGRA Test Results, Table 1 (Sheet 10), USCS Classification = SM
- USDA classification for SM with sand fraction > 70% is loamy sand, Figure 2 (Sheet 11).
- Percent passing #170 sieve indicates that sand fraction is predominantly fine to very fine.

$\Rightarrow$ Loamy very fine sand

From Table 2 (Sheet 12), K for a loamy very fine sand with organic content < 0.5%
= 0.44

$K = 0.44$

By: M. McVey	Date: 8/19/99	Title: Potential Soil Loss from the MWL Cover by Overland Runoff
Chkd. By: J. Peace	Date: 8/20/99	

3) Determine topographic factor, LS:

$$LS = \frac{(L/72.6)^m (65s^2 + 450s + 650)}{(s^2 + 10{,}000)}$$

where:

L = Slope length (See sheet 13)

S = Slope steepness (%)

m = exponent

0.20 for $S < 1$

0.30 for $1 \leq S < 3$

0.40 for $3 \leq S < 5$

0.50 for $5 \leq S < 10$

0.60 for $S \geq 10$

$$LS_{(2\%)\ \text{Cover}} = \frac{(327/72.6)^{0.3} (65(2)^2 + 450(2) + 650)}{(2)^2 + 10{,}000}$$

$$= \underline{\underline{0.28}}$$

for:

L = 327 ft

S = 2%

m = 0.30

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Calculation Sheet Sheet 6 of 15

By: M. McVey	Date: 8/19/99	Title: Potential Soil Loss from the MWL Cover by Overland Runoff
Chkd. By: J. Peace	Date: 8/20/99	

$$LS_{(16.7\%\ \text{Sideslopes})} = \frac{(24/72.6)^{0.6}\left(65(16.7)^2 + 450(16.7) + 650\right)}{(16.7)^2 + 10{,}000}$$

$$= 1.32$$

for:

$L = 24$ ft (See sheet 13)

$S = 16.7\%$

$m = 0.60$

MUSLE:

$$A = RK(LS)(VM)$$

$$A_{(2\%\ \text{Cover})} = 35(0.44)(0.28)(VM)$$

$$= 4.31(VM)$$

$$A_{(16.7\%\ \text{Sideslopes})} = 35(0.44)(1.32)(VM)$$

$$= 20.33(VM)$$

GRAM, Inc. Calculation Sheet Sheet 7 of 15

By: M. McVey	Date: 8/19/99	Title: Potential Soil Loss from the MWL Cover by Overland Runoff
Chkd. By: J. Peace	Date: 8/20/99	

4) Determine erosion control factor, VM:

Case 1 : No vegetation yet established, straw mulch applied to cover and sideslopes at 2 tons/acre, crimpted into soils with disk.

From Table 3 (Sheet 14)

$\Rightarrow VM_{(2\%\ Cover)} = 0.06$

$\Rightarrow VM_{(16.7\%\ Sideslopes)} = 0.11$

For 2% Cover Slope

$A = 4.31(0.06) = 0.26$ Tons/acre/yr.

For 16.7% Sideslopes

$A = 20.33(0.11) = 2.24$ Tons/acre/yr.

$$\text{Total Soil Loss} = \frac{(0.26\ Tn/Ac/Yr)(2.47\ Ac) + (2.24\ Tn/Ac/Yr)(0.86\ Ac)}{2.47\ Ac + 0.86\ Ac}$$

$= 0.77$ Tons/Acre/yr. < 2 Tons/Acre/yr.

OK

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Calculation Sheet Sheet 8 of 15

By: M. McVey	Date: 8/19/99	Title: Potential Soil Loss from the MWL Cover by Overland Runoff
Chkd. By: J. Peace	Date: 8/20/99	

Case 2: Vegetation is established over cover and sideslopes 12 months after seeding; 1/2 straw mulch remains.

From Table 4 (Sheet 15)

$\Rightarrow VM = 0.01$

For 2% Cover Slope

$A = 4.31(0.01) = 0.04$ Tons/Acre/yr.

For 16.7% Sideslopes

$A = 20.33(0.01) = 0.2$ Tons/Acre/yr.

$$\text{Total Soil Loss} = \frac{(0.04 \text{ Tn/Ac/yr.})(2.47 \text{ Ac}) + (0.2 \text{ Tn/Ac/yr.})(0.86 \text{ Ac})}{2.47 \text{ Ac} + 0.86 \text{ Ac}}$$

$= 0.08$ Tons/Acre/yr. < 2 Tons/Acre/yr.

OK

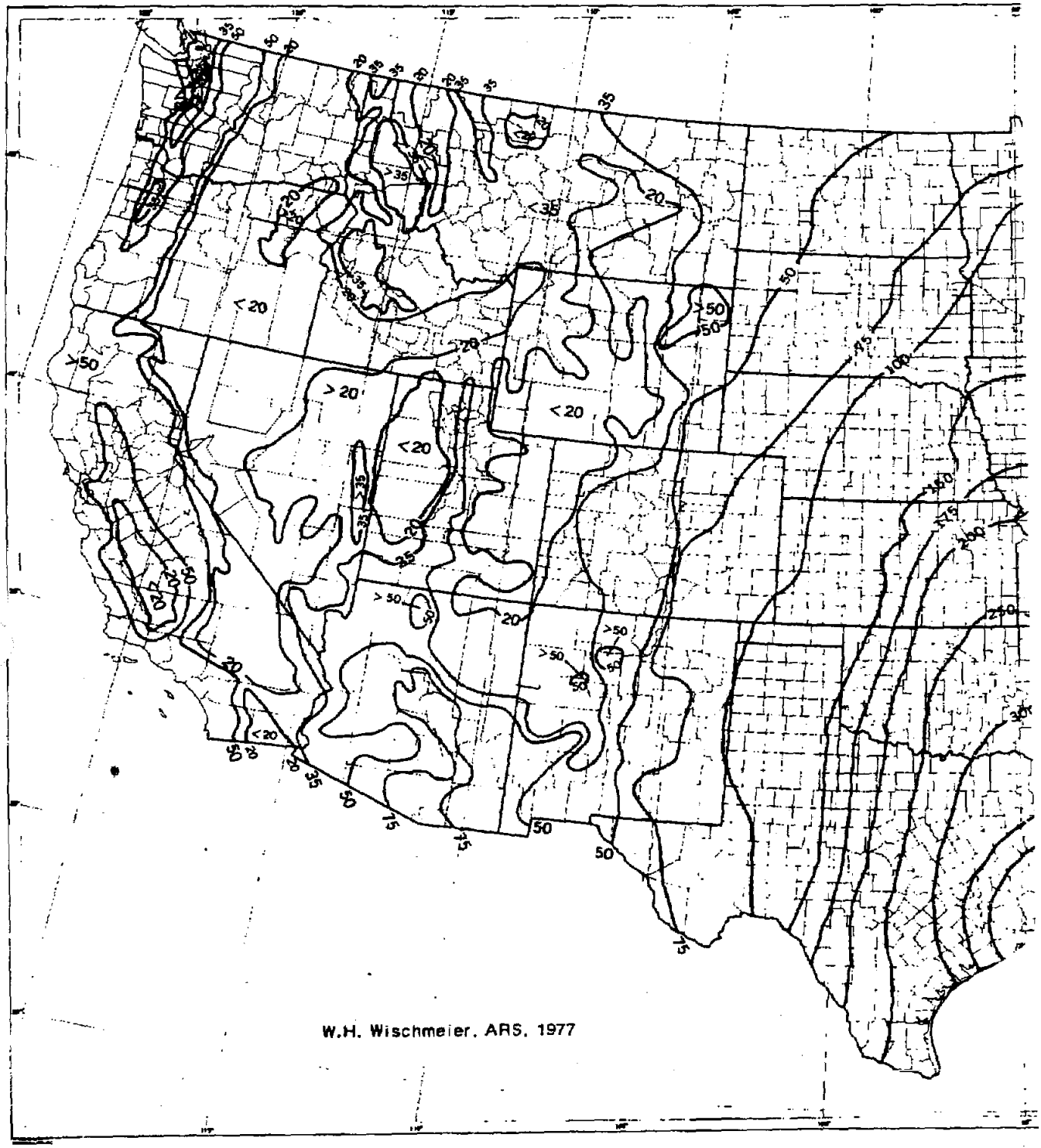


Figure 1 —Iso-erodent map illustrating average annual values of the rainfall factor, R.

Table 1.

TABULATION OF TEST RESULTS

JOB NO. 9-519-001154

PROJECT: Mixed Waste Landfill Cover

DATE: 05/17/09

SOURCE: SNI

LOCATION	DEPTH (ft.)	UNIFIED CLASS	LL	PI	SIEVE ANALYSIS - ACCUM. % PASSING 200	170	100	80	70	40	10	4	3/8	1/2	3/4	MOIST.	LAB NO.
Composite MWL-A1	0'-2'	ML	NV	NP	58	64	82	85	87	89	95	98	99	100		4.5	4557
Composite MWL-1B	2'	SM	NV	NP	25	35	56	73	79	87	95	99	100			4.3	4560
Native Soil	1 of 3	SM	NV	NP	24	35	68	74	78	83	90	94	97	100		4.8	4565
Native Soil	2 of 3	SM-SC	22	6	31	42	70	75	78	84	91	96	98	100		6.2	4566
Native Soil	3 of 3	SM	NV	NP	28	38	60	66	70	77	87	92	97	100		6.5	4567
Subgrade Soil	1 of 3	SM	NV	NP	29	40	69	75	78	82	91	96	99	100		8.4	4568
Subgrade Soil	2 of 3	SM	NV	NP	25	36	67	73	76	81	91	96	99	100		6.6	4569
Subgrade Soil	3 of 3	SM	NV	NP	27	38	69	75	78	83	91	95	100			7.3	4570
P2A	0.6'	SM	NV	NP	43	43	73	82	88	96	99	100				13.1	4571
P2A	1.5'	SM	NV	NP	28	36	63	73	81	92	96	99	100			7.1	4572
P2A	1.7'	SM	NV	NP	25	33	61	72	82	94	98	100				7.3	4573
P2D	0.6'	SM-SC	23	7	37	45	70	80	88	97	100					12.0	4574
P2E	1.0'	ML	NV	NP	62	67	83	88	92	97	99	100				5.9	4575

SM ⇒ Silty Sand (USCS)

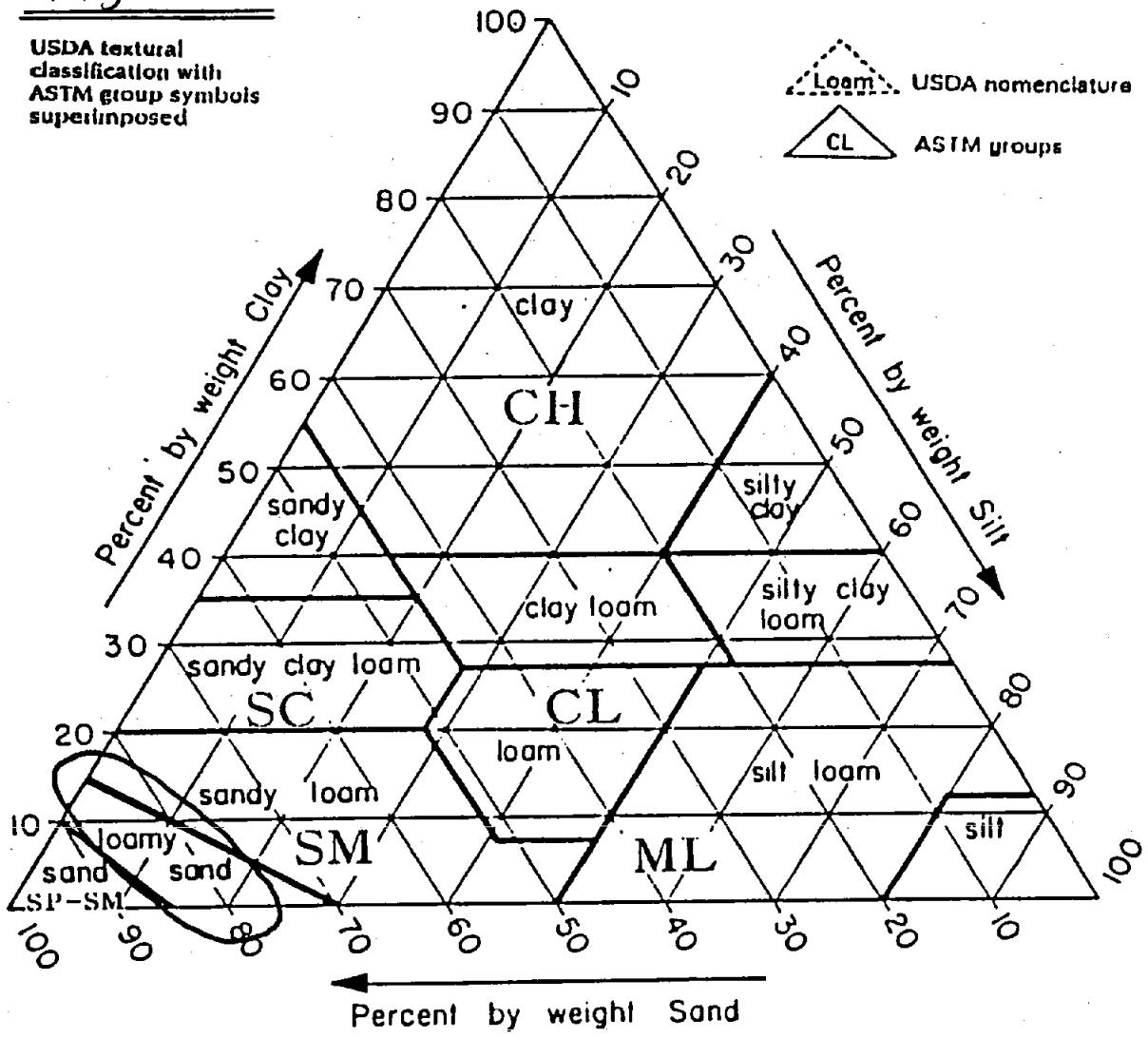
Loamy Very Fine Sand (USDA)

Table 2.6
Soil symbols used in USDA

USDA soil type or state	USDA symbol
Gravel	G
Sand	S
Silt	Si
Clay	C
Loam (sand, silt, clay, and humus mixture)	L
Coarse	Co
Fine	F

Figure 2.

USDA textural classification with ASTM group symbols superimposed



Sheet 12 of 15

Example 12.3

A landfill in south New Jersey is designed to have a cover with a slope of 5% of a top plateau extending from a central ridge (high point) for a distance of 300 ft. Beyond this distance, the cover slopes down to the toe at a grade of $1V$ on $4H$. The upper cover component is loamy sand with 2% organic content. Grass is the only means of erosion control. Determine the expected soil loss from sheet flow.

Solution: From Figure 12.7, $R = 200$. From Table 12.9, $K = 0.1$. From Eq. 12.21:

LS (top plateau), $m = 0.4$

$LS = (300/72.6)^{0.4}(65 \times 25 + 450 \times 5 + 650)/(25 + 10{,}000) = 0.794$

LS (side slope), $m = 0.6$

$LS = (500/72.6)^{0.6}(65 \times 625 + 450 \times 25 + 650)/(625 + 10{,}000) = 15.73$

To determine the soil loss, we begin by using Eq. 12.20 for the top plateau:

$$A = 200(0.1)(0.79)(VM) = 15.8(VM)$$

From Table 12.8, the VM factors are 0.4, for grass seedings less than 2 months old, 0.05 for those 2 to 12 months old, and 0.01 for those over 12

Table 2.

Approximate values of factor K for USDA textural classification

Texture class	ORGANIC MATTER CONTENT <0.5% K	2% K	4% K
Sand	0.05	0.03	0.02
Fine sand	0.16	0.14	0.10
Very fine sand	0.42	0.36	0.28
Loamy sand	0.12	0.10	0.08
Loamy fine sand	0.24	0.20	0.16
Loamy very fine sand	0.44	0.38	0.30
Sandy loam	0.27	0.24	0.19
Fine sandy loam	0.35	0.30	0.24
Very fine sandy loam	0.47	0.41	0.33
Loam	0.38	0.34	0.29
Silt loam	0.48	0.42	0.33
Silt	0.60	0.52	0.42
Sandy clay loam	0.27	0.25	0.21
Clay loam	0.28	0.25	0.21
Silty clay loam	0.37	0.32	0.26
Sandy clay	0.14	0.13	0.12
Silty clay	0.25	0.23	0.19
Clay		0.13–0.29	

The values shown are estimated averages of broad ranges of specific-soil values. When a texture is near the borderline of two texture classes, use the average of the two K values.

Source: Lutten et al., 1979

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Calculation Sheet

Sheet 13 of 15

By: M. McVey	Date: 8/19/99	Title: Potential Soil Loss from the MWL Cover by Overland Runoff
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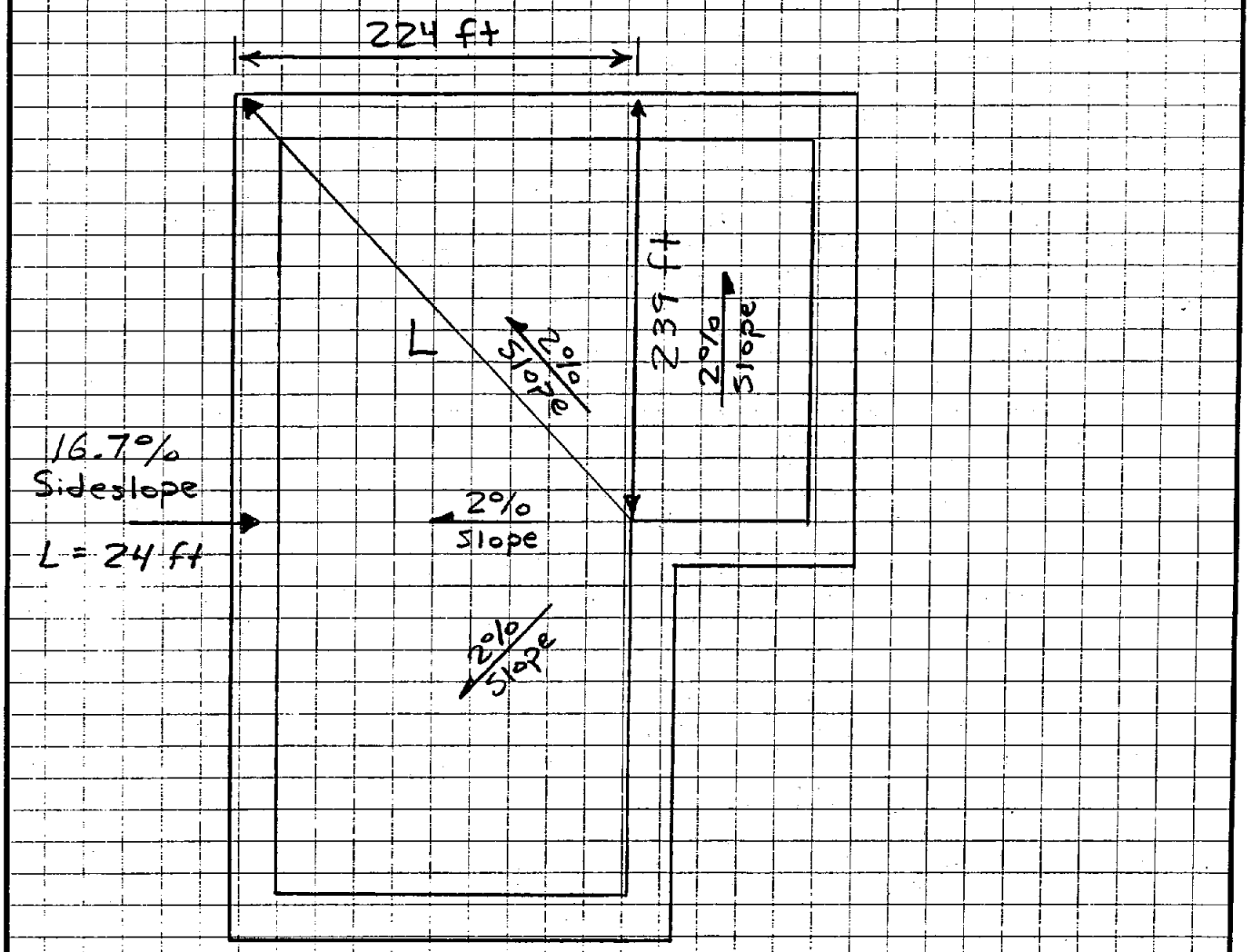

For 2% Cover Slope

L = 327 ft

For 16.7% Sideslopes

L = 24 ft

Table 3.

Straw or hay mulches applied to steep construction slopes and not tied to the soil by anchoring and tacking equipment may be less effective than equivalent mulch rates on cropland. In Indiana, tests on a 20% slope of scalped subsoil, a 2.3-t rate of unanchored straw mulch allowed soil losses of 12 t/A when 5 in. of simulated rain was applied at 2.5 in./hr on a 35-ft plot (Wischmeier and Meyer, 1973). There was evidence of erosion from flow beneath the straw. Mulches of crushed stone at 135 or more t/A, or wood chips at 7 or more t/A, were more effective.

Table IV presents approximate C values for straw, crushed stone, and woodchip mulches on construction slopes where no canopy cover exists, and also shows the maximum slope lengths on which these values may be assumed to be applicable.

Soil loss ratios for many conditions on SLB construction, and developmental areas can be obtained from Table IV if good judgment is exercised in comparing the surface conditions with those of specified agricultural conditions. Time intervals analogous to cropstage periods will be defined to begin and end with successive construction or management activities that appreciably change the surface conditions.

The observed soil loss ratios for given conditions often varied substantially from year to year because of influence of unpredictable random variables and experimental error. The percentages listed for Table V are the best available averages for a wide variety of specified agricultural conditions, only a few of which might be applicable to SLB systems. To make the table inclusive enough for general field use, expected ratios had to be computed for cover, residue, and management combinations that were not directly represented in the plot data. This was done by using empirical relationships of soil losses to the subfactors and interactions discussed in the preceding subsection. The user should recognize that the tabulated percentages are subject to appreciable experimental error and could be improved through additional research. However, because of the large volume of data considered in developing the table, the listed values should be near enough to the true averages to provide highly valuable planning and monitoring guidelines. A ratio derived locally from 1-year rainfall simulator tests on a few plots would not necessarily more accurately represent the true average for that locality. Small samples are more subject to bias by random variables and experimental error than are larger samples.

MULCH FACTORS AND LENGTH LIMIT FOR CONSTRUCTION SLOPES

Type of Mulch	Mulch Rate (Tons/Acre)	Land Slope (%)	Factor C	L (ft)
None	0	all	1.0	
Straw or hay, tied down by anchoring and tacking equipment[a]	1.0	1-5	0.20	2
	1.0	6-10	0.20	1
	1.5	1-5	0.12	3
	1.5	6-10	0.12	1
2% Cover → Slope	2.0	1-5	0.06	4
	2.0	6-10	0.06	2
	2.0	11-15	0.07	1
16.7% → Sideslopes	2.0	16-20	0.11	1
	2.0	21-25	0.14	
	2.0	26-33	0.17	
	2.0	34-50	0.20	
Crushed stone, ¾ to 1½ in	135	<16	0.05	2
	135	16-20	0.05	
	135	21-33	0.05	
	135	34-50	0.05	
	240	<21	0.02	3
	240	21-33	0.02	2
	240	34-50	0.02	1
Wood chips	7	<16	0.08	
	7	16-20	0.08	
	12	<16	0.05	1
	12	16-20	0.05	1
	12	21-33	0.05	
	25	<16	0.02	2
	25	16-20	0.02	1
	25	21-33	0.02	1
	25	34-50	0.02	

[a] From Meyer and Porta (1976). Developed by an ins agency workshop group on the basis of field experience a limited research data.

[b] Maximum slope length for which the specified mulch r is considered effective. When this limit is exceeded, either higher application rate or mechanical shortening of t effective slope length is required.

[c] When the straw or hay mulch is not anchored to the soil, values on moderate or steep slopes of soils having K valu greater than 0.30 should be taken at double the values giv in this table.

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Table 12.8
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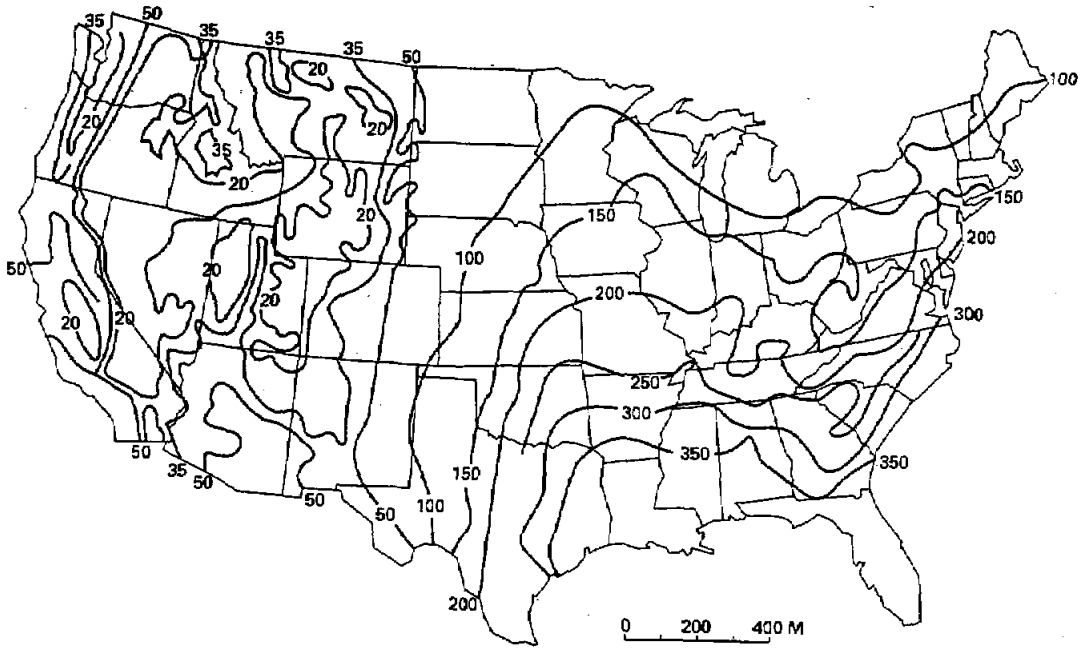


Figure 12.7 Average annual rainfall—erosivity factor *R*

Table 4.

Typical *VM* factor values

Condition	*VM* factor
Bare soil condition	
Freshly disked, 6–8 in.	1.0
After one rain	0.89
Loose, 12 in. thick	
Smooth	0.9
Rough	0.8
Compacted bulldozer scraped up and down	1.3
Same except roots raked	1.2
Compacted bulldozer scraped across slope	1.2
Rough irregular tracked in all directions	0.9
Seed and fertilize fresh	0.9
Same after 6 months	0.54
Compacted fill	1.24–1.71
Saw dust, 2 in. deep disked in	0.61
Dust binder	
605 gal/acre	1.05
1210 gal/acre	0.29–0.78
Hydromulch (wood fiber slurry), fresh	
1000 lb/acre	0.05
1400 lb/acre	0.01–0.02
Seedings	
Temporary, 0–60 days	0.4
After 60 days	0.05
Permanent, 0–60 days	0.4
2–12 months	0.05
After 12 months	0.01
Excelsior blanket with plastic net	0.04–0.1

Attachment 2

Potential Soil Loss

From the MWL Cover

By Wind Erosion

GRAM, Inc.

Calculation Sheet

By: M. McVey	Date: 8/24/99	Title: Potential Soil Loss from the MWL Cover by Wind Erosion
Chkd. By: J. Peace	Date: 8/25/99	

Purpose:

Determine the soil loss due to wind erosion for the Mixed Waste Landfill alternative cover. The soil loss will be calculated by the Wind Erosion Equation (WEQ). This calculation only presents potential loss.

References:

Natural Resources Conservation Service (NRCS) National Agronomy Manual, 190-V-NAM, 2nd Ed., Part 502, March 1988.

N.P. Woodruff and F.H. Siddaway, 1965. "A Wind Erosion Equation," Soil Science Society of America Proceedings, Vol. 29, No. 5, pages 602-608.

Method of Analysis:

Standard engineering hand calculations using the Wind Erosion Equation (WEQ).

$$E = f[(IKC)LV]$$

where:

E = estimated average annual soil loss (Tons/Acre/yr.)

I = soil erodibility index

K = ridge roughness factor

C = climatic factor

L = unsheltered distance

V = vegetative factor

By: M. McVey	Date: 8/24/99	Title: Potential Soil Loss from the MWL Cover by Wind Erosion
Chkd. By: J Peace	Date: 8/25/99	

1) Determine soil erodibility index, I:

- From Tabulation of AGRA Test Results, Table 1 (Sheet 9), USCS classification is SM.
- USDA classification for SM with sand fraction > 70% is loamy sand (Sheet 10).
- Percent passing #170 sieve indicates that the sand fraction is predominantly fine to very fine.

Soil classification ⟹ Loamy very fine sand

From Table 2 (Sheet 11) for a loamy very fine sand ⟹ I = 134 Tons/Acre/yr.

For 2% Cover Slope

I = 134 Tons/Acre/yr.

- Knoll erodibility adjustment: Adjustments of the "I" factor for knolls is used where windward facing slopes are less than 500 ft long and the increase in slope gradient from the adjacent upwind landscape is 3% or greater.

Since the windward facing slopes are > 500 ft long and < 3%, no adjustment to the soil erodibility index, I, is warranted for the 2% cover slope.

I = 134 Tons/Acre/yr.

By: M. McVey	Date: 8/24/99	Title: Potential Soil Loss from the MWL Cover by Wind Erosion
Chkd. By: J. Peace	Date: 8/25/99	

For the 16.7% Sideslopes

I = 134 Tons/Acre/yr.

Knoll erodibility adjustment: Since the 6:1 (16.7%) sideslopes are < 500 ft long and the windward facing slopes are > 3%, the knoll erodibility adjustment is warranted.

Max slope change = 16.7% (6:1)

From Table 3 (Sheet 12):

Adjustment to I = 1.4 multiplier

Therefore: I = 134(1.4) = 188

I = 188 Tons/Acre/yr.

2) Determine the total surface roughness, K:

$K = K_{rd}$ (ridge roughness) x K_{rr} (random roughness)

K_{rd}

Because the cover is man-made, it is assumed that the cover and sideslopes will be smooth and without ridges.

From Figure 2 (Sheet 13): $K_r = 0$

Since $K_r = 0 \Rightarrow K_{rd} = 1.0$

By: M. McVey	Date: 8/24/99	Title: Potential Soil Loss from the MWL Cover by Wind Erosion
Chkd. By: J. Peace	Date: 8/25/99	

K_{rr}

Random roughness (rr) is the non-oriented surface roughness that is sometimes referred to as clodiness. Clodiness is usually created by the action of tillage implements.

From Table 4 (Sheet 14):

For drill, double disk $\Rightarrow$ rr = 0.4 inches

For 2% Cover Slope

rr = 0.4 inches

I = 134

From Figure 3 (Sheet 14) $\Rightarrow$ $K_{rr} = 1.0$

For 16.7% Sideslopes

rr = 0.4 inches

I = 188

From Figure 3 (Sheet 14) $\Rightarrow$ $K_{rr} = 1.0$

Total Surface Roughness for the 2% Cover Slope and the 16.7% Sideslopes

$$K = K_{rd} \times K_{rr} = (1.0)(1.0)$$

$$K = 1.0$$

By: M. McVey	Date: 8/24/99	Title: Potential Soil Loss from the MWL Cover by Wind Erosion
Chkd. By: J. Peace	Date: 8/25/99	

3) Determine the climatic factor, C:

The climatic factor is an index of the relative erosivity by geographic location.

From Figure 4 (Sheet 15) $\Rightarrow$ C = 120

4) Determine the unsheltered distance, L:

The unsheltered distance is the field length along the prevailing wind direction.

For 2% Cover Slope

From Figure 5 (Sheet 16) $\Rightarrow$ L = 524 ft

For 16.7% Sideslopes

From Figure 6 (Sheet 17) $\Rightarrow$ L = 25 ft

5) Determine the vegetative cover factor, V:

The effect of vegetative cover in the WEQ is expressed by relating the kind, amount, and orientation of vegetative material to its equivalent in pounds per acre of small grain residue in reference condition (small grain equivalent - sge).

Case 1: No vegetation yet established, straw mulch applied to cover and sideslopes at 2 tons/acre, crimped into soil with disk.

By: M. McVey	Date: 8/24/99	Title: Potential Soil Loss from the MWL Cover by Wind Erosion
Chkd. By: J. Peace	Date: 8/25/99	

2 Tons/Acre (straw mulch) = 4,000 lbs/Acre (small grain residue)

From Figure 7, using the flat winter wheat residue 10" long randomly distributed reference line (because straw mulch will be lying flat on landfill cover surface)

$\Longrightarrow$ V = 4,500 Sge (small grain equivalent)

Case 2: Vegetation is established over cover and sideslopes 12 months after seeding; 1/2 straw mulch remains.

1 Ton/Acre (1/2 straw mulch remains) = 2,000 lbs/Acre (Small grain residue)

From Figure 7: 2,000 lbs/Acre small grain residue

$\Longrightarrow$ V = 2,800 Sge (small grain equivalent)

12 months after seeding, 400 Sge* of native grass is established on the cover and sideslopes.

* 400 Sge is a conservative estimate from New Mexico state Agronomist, Mike Sporcic. The estimate is based upon a two year decomposition routine contained in a revised USLE equation for grain straw decomposition in contact with soil.

$\Longrightarrow$ V = 2,800 Sge + 400 Sge = 3,200 Sge

By: M. McVey	Date: 8/24/99	Title: Potential Soil Loss from the MWL Cover by Wind Erosion
Chkd. By: J. Peace	Date: 8/25/99	

6) Determine the average annual soil loss, E:

For 2% Cover Slope

From Table 5 (Sheet 19)

for: C = 120

I = 134

K = 1.0

L = 524 ft

Case 1:

V = 4,500 Sge

$\Rightarrow$ E = 0 Tons/Acre/yr.

Case 2:

V = 3,200 Sge

$\Rightarrow$ E = 0 Tons/Acre/yr.

GRAM, Inc.

Calculation Sheet

By: M. McVey	Date: 8/24/99	Title: Potential Soil Loss from the MWL Cover by Wind Erosion
Chkd. By: J. Peace	Date: 8/25/99	

For 16.7% Sideslopes

From Table 6 (Sheet 20)

for: C = 120

I = 188

K = 1.0

L = 25 ft

Case 1:

V = 4,500 Sge

$\Rightarrow$ E = 0 Tons/Acre/yr.

Case 2:

V = 3,200 Sge

$\Rightarrow$ E = 0 Tons/Acre/yr.

Table 1.

TABULATION OF TEST RESULTS

JOB NO. 9-519-001154

PROJECT: Mixed Waste Landfill Cover

DATE: 05/17/99

SOURCE: SNL

LOCATION	DEPTH (ft.)	UNIFIED CLASS	LL	PI	SIEVE ANALYSIS - ACCUM. % PASSING 200	170	100	80	70	40	10	4	3/8	1/2	3/4	MOIST.	LAB NO.
Composite MWL-A1	0'-2'	ML	NV	NP	58	64	82	85	87	89	95	98	99	100		4.5	4557
Composite MWL-1B	2'	SM	NV	NP	25	35	56	73	79	87	95	99	100			4.3	4560
Native Soil	1 of 3	SM	NV	NP	24	35	68	74	78	83	90	94	97	100		4.8	4565
Native Soil	2 of 3	SM-SC	22	6	31	42	70	75	78	84	91	96	98	100		6.2	4566
Native Soil	3 of 3	SM	NV	NP	28	38	60	66	70	77	87	92	97	100		6.5	4567
Subgrade Soil	1 of 3	SM	NV	NP	29	40	69	75	78	82	91	96	99	100		8.4	4568
Subgrade Soil	2 of 3	SM	NV	NP	25	36	67	73	76	81	91	96	99	100		6.6	4569
Subgrade Soil	3 of 3	SM	NV	NP	27	38	69	75	78	83	91	95	100			7.3	4570
P2A	0.6'	SM	NV	NP	43	43	73	82	88	96	99	100				13.1	4571
P2A	1.5'	SM	NV	NP	28	36	63	73	81	92	96	99	100			7.1	4572
P2A	1.7'	SM	NV	NP	25	33	61	72	82	94	98	100				7.3	4573
P2D	0.6'	SM-SC	23	7	37	45	70	80	88	97	100					12.0	4574
P2E	1.0'	ML	NV	NP	62	67	83	88	92	97	99	100				5.9	4575

SM => Silty Sand (USCS)

Loamy Very Fine Sand (USDA)

Table 2.6
Soil symbols used in USDA

USDA soil type or state	USDA symbol
Gravel	G
Sand	S
Silt	Si
Clay	C
Loam (sand, silt, clay, and humus mixture)	L
Coarse	Co
Fine	F

Figure 1.

USDA textural classification with ASTM group symbols superimposed

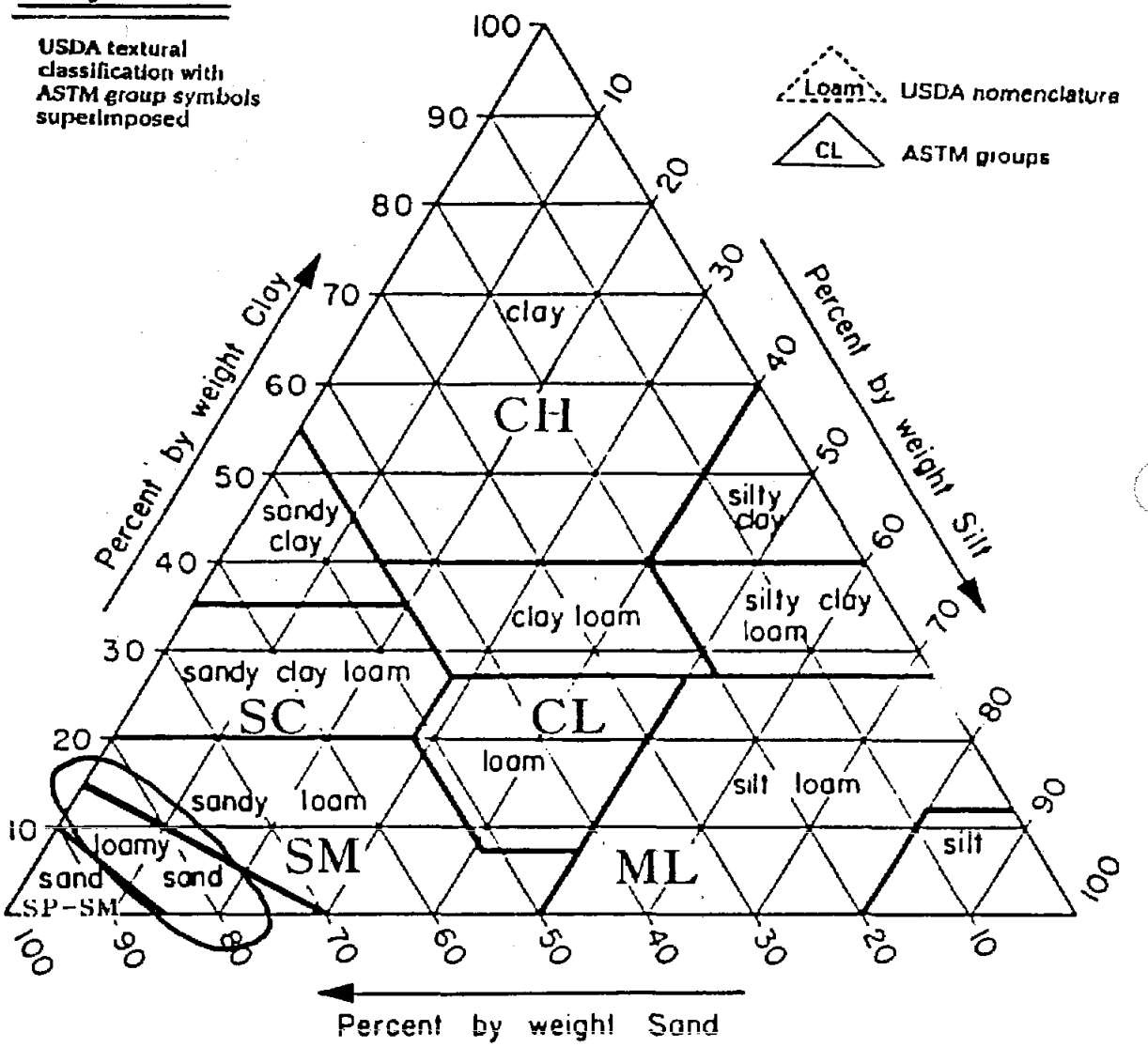


TABLE 2.

WIND ERODIBILITY GROUPS
and SOIL ERODIBILITY INDEX

Predominant Soil Texture Class of Surface Layer	Wind Erodibility Group (WEG)	Soil Erodibility Index (I) (Tons/Acre/Year)[1]
Very fine sand, fine sand, sand, or coarse sand	1	310[2] 250 220 180 160
Loamy very fine sand, loamy fine sand, loamy sand, loamy coarse sand, or sapric organic soil materials	2	134
Very fine sandy loam, fine sandy loam, sandy loam, or coarse sandy loam	3	86
Clay, silty clay, noncalcareaous clay loam, or silty clay loam with more than 35 % clay	4	86
Calcareous loam and silt loam, or calcareous clay loam and silty clay loam	4L	86
Noncalcareous loam and silt loam with less than 20% clay, or sandy clay loam, sandy clay, and hemic organic soil materials	5	56
Noncalcareous loam and silt loam with more than 20% clay, or non-calcareous clay loam with less than 35% clay	6	48
Silt, non-calcareous silty clay loam with less than 35% clay, and fibric organic soil material	7	38
Soils not susceptible to wind erosion due to coarse surface fragments or wetness	8	---

[1] The soil erodibility index is based on the relationship of dry soil aggregates greater then .84 mm to potential soil erosion.

[2] The "I" factors for WEG 1 vary from 160 for coarse sands to 310 for very fine sands. Use an I of 220 as an average figure. For coarse sand with gravel, use a low figure. For no gravel and very fine sand, use a higher figure.

TABLE 3. KNOLL ERODIBILITY ADJUSTMENT FACTOR FOR I

Slope Change in Prevailing Wind Erosion Direction	A Knoll Adjustment to I	B Increase at Crest Area Where Erosion Is Most Severe
3	1.3	1.5
4	1.6	1.9
5	1.9	2.5
6	2.3	3.2
8	3.0	4.8
10	3.6	6.8
10 - 15*	2.0	–
16.7% * 15 - 20	1.4	–
20 +	1.0	–

*Factors above 10% slope change based on NRCS judgment. No research data available.

To adjust the "I" factor for knoll erodibility the "I" factor for the soil on the windward facing part of the knoll is multiplied by the factor shown in Column A of Table 3. Column B in the same table shows the increased erodibility near the crest (upper 1/3 of the slope), where the effect is most severe. This adjustment applies only to that portion of the knoll exposed to the prevailing wind erosion direction.

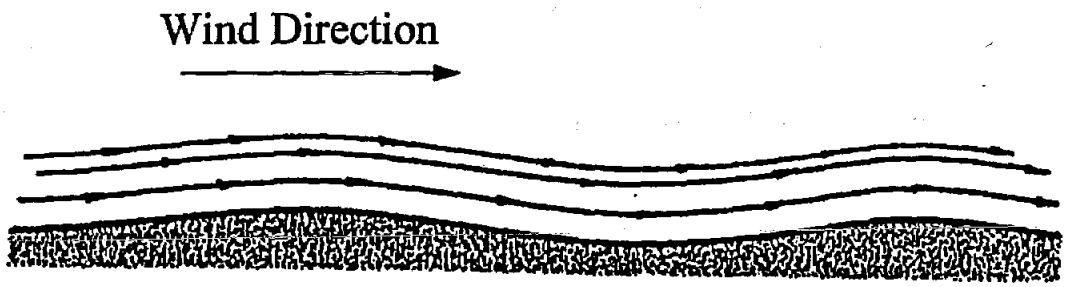
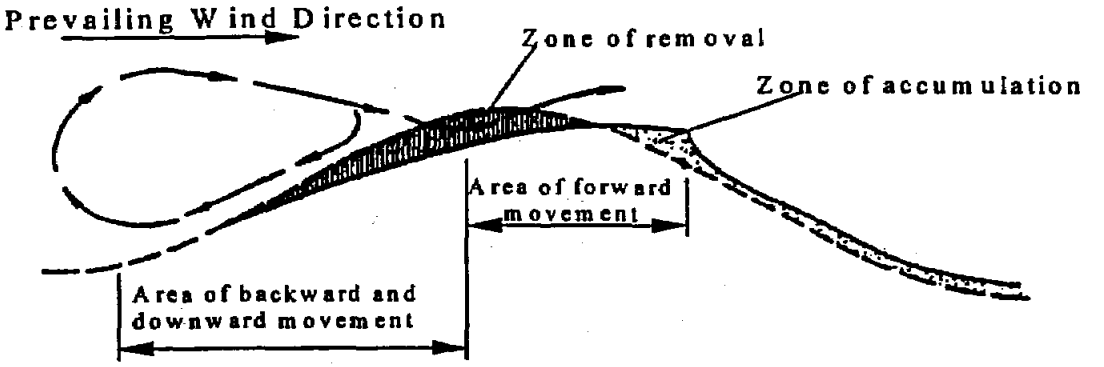


Figure 4. Wind Flow Pattern over Level to Rolling Terrain

On level fields or on rolling terrain where slopes are longer and slope changes are less than those used to describe a knoll, the wind flow pattern tends to conform to the surface and do not exhibit the flow constriction typical of knolls, as illustrated in Figure 4.



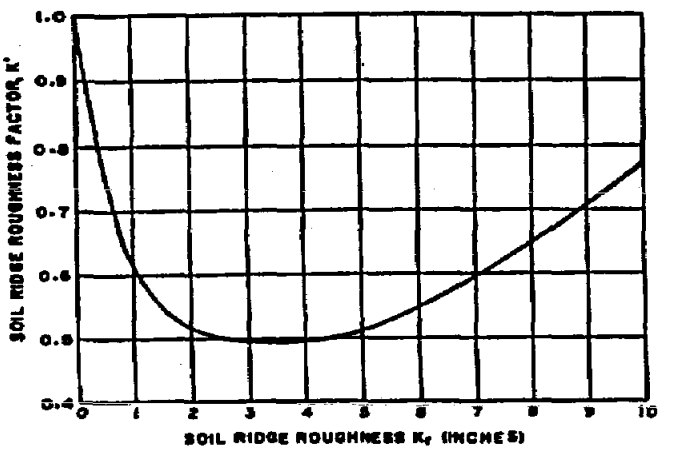
Soil Movement on Ridges

Information Needed to Determine the "K" Factor for Ridge Roughness

- Angle of Deviation
  - Prevailing wind erosion direction
  - Ridge-furrow direction
- Ridge Height
- Ridge Spacing

The "K" factor is based on a standard ridge height to ridge spacing ratio of 1:4. Calibrations of wind tunnel studies led to the development of this curve that relates ridge-furrow roughness to the "K" factor.

This curve is the basis for the "K" factor tables found in Exhibit 502.62 in the National Agronomy Manual and in the Field Office Technical Guide.



$$K_r = \frac{4h^2}{s}$$

where:
h = ridge height in inches
s = ridge spacing (inches) measured in the wind erosion direction

Figure 2. Graph to determine soil ridge roughness factor K from soil ridge roughness Kr.

Table 4. Random Roughness Values for "Core" Field Operations[1]

Field Operations	Random Roughness (in)	Field Operations	Random Roughness (in)
Chisel, sweeps	1.2[2]	Fertilizer applicator, anhydrous knife	0.6
Chisel, straight points	1.5	Harrow, spike	0.4
Chisel, twisted shovels	1.9	Harrow, tine	0.4
Cultivator, field	0.7	Lister	0.8
Cultivator, row	0.7	Manure injector	1.5
Cultivator, ridge till	0.7	Moldboard plow	1.9
Disk, one way	1.2	Mulch treader	0.4
Disk, heavy plowing	1.9	Planter, no-till	0.4
Disk, tandem	0.8	Planter, row	0.4
Drill, double disk	0.4	Rodweeder	0.4
Drill, deep furrow	0.5	Rotary hoe	0.4
Drill, no-till	0.4	Vee ripper	1.2
Drill, no-till into sod	0.3		

[1] These values are typical and representative for operations in medium textured soils tilled at optimum moisture conditions. Many of the machines may vary by cropping region, farming practice, soil texture, or other conditions.

[2] These values may be used in WEQ for random roughness. However, the use of the random roughness photos in Agriculture Handbook 703 is preferable.

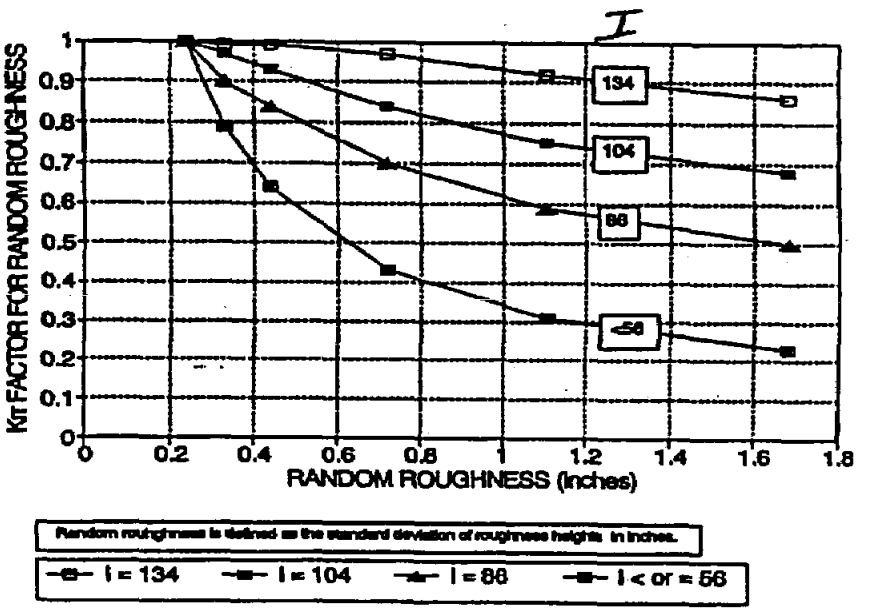


Figure 3. Graph to Determine K_{rr} from Random Roughness and "I" Factor Values

Annual "C" Values
Of The Wind Erosion Equation
New Mexico

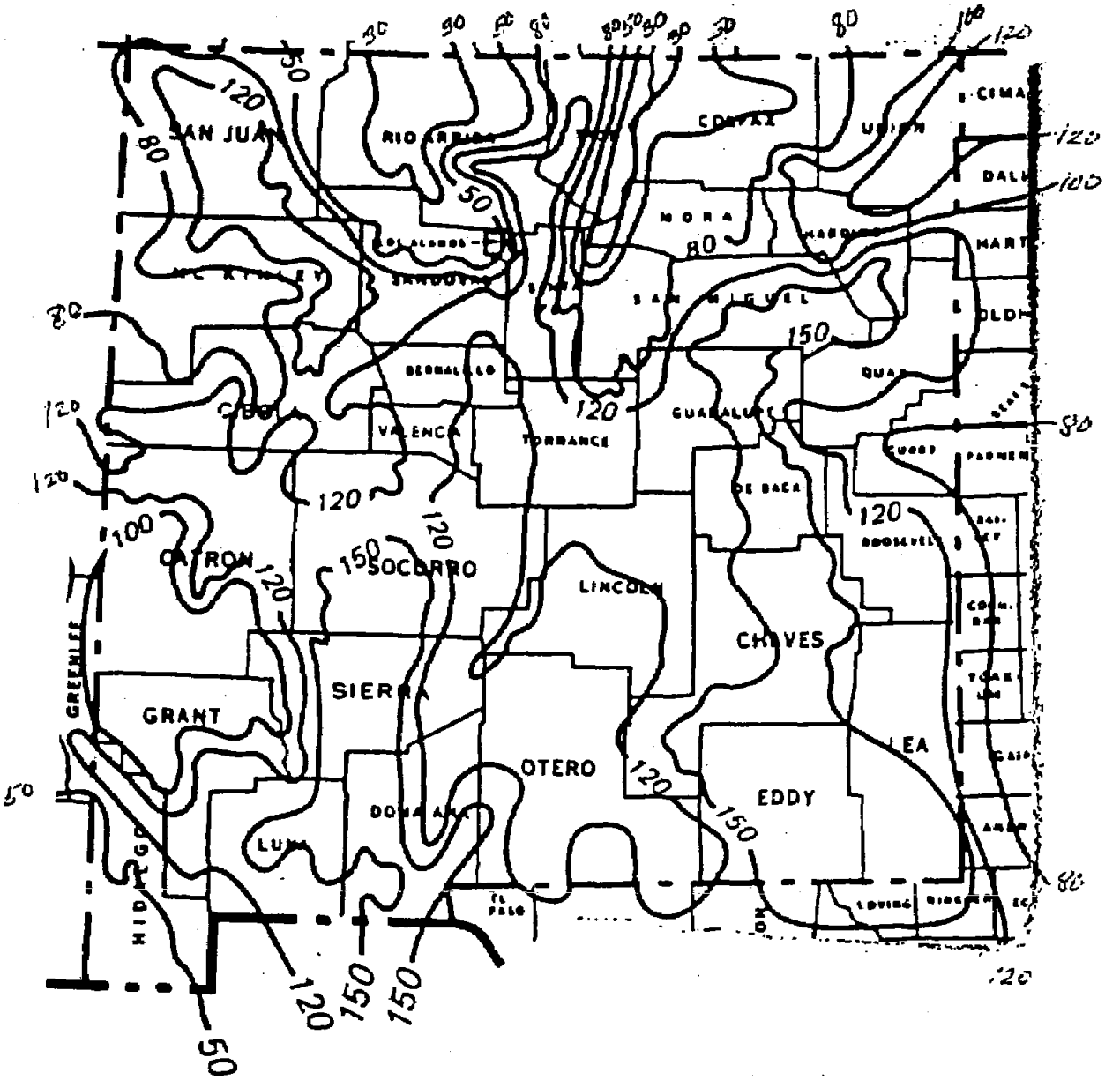


Figure 4.

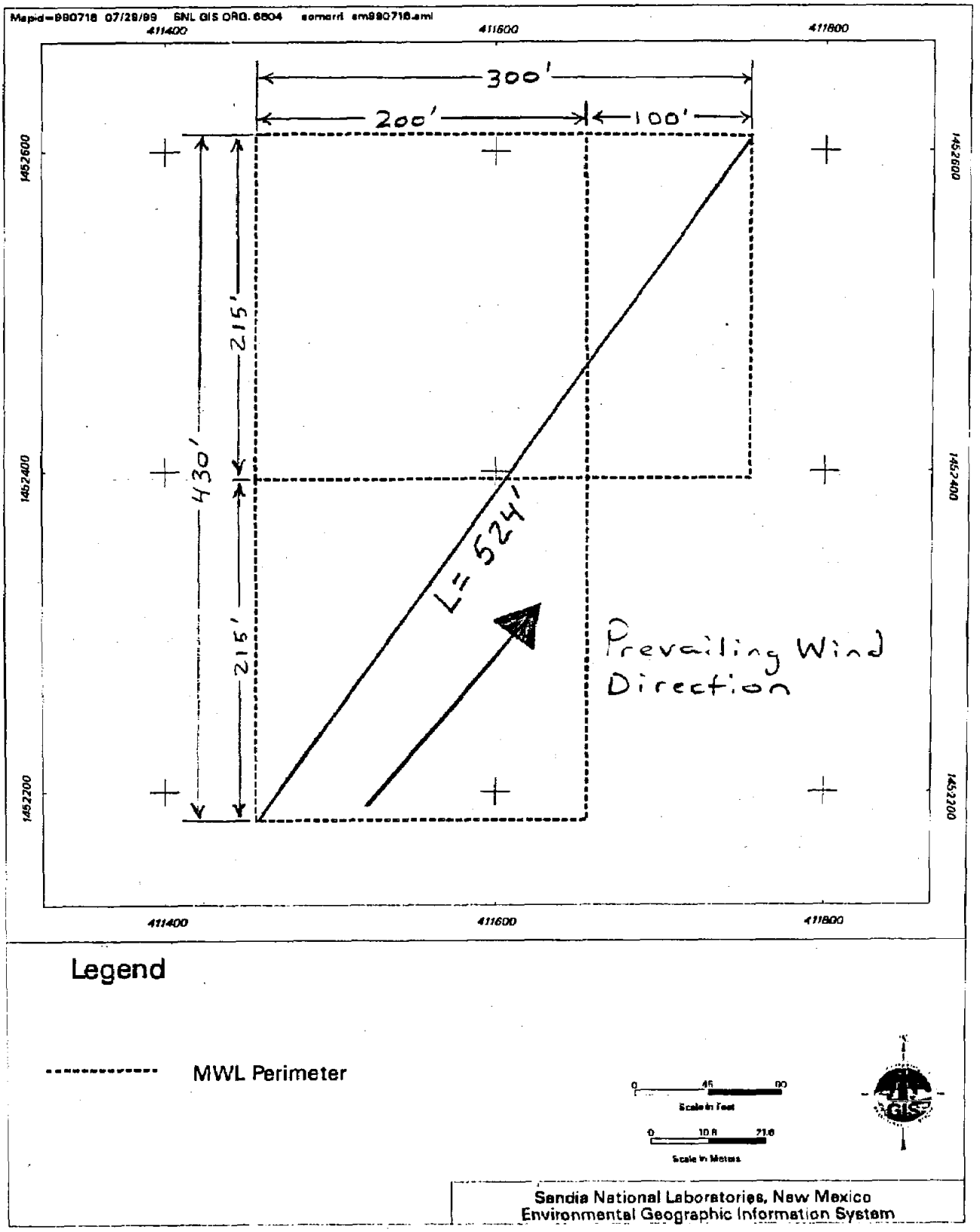


Figure 5. Unsheltered distance, L, for the 2% Cover Slope

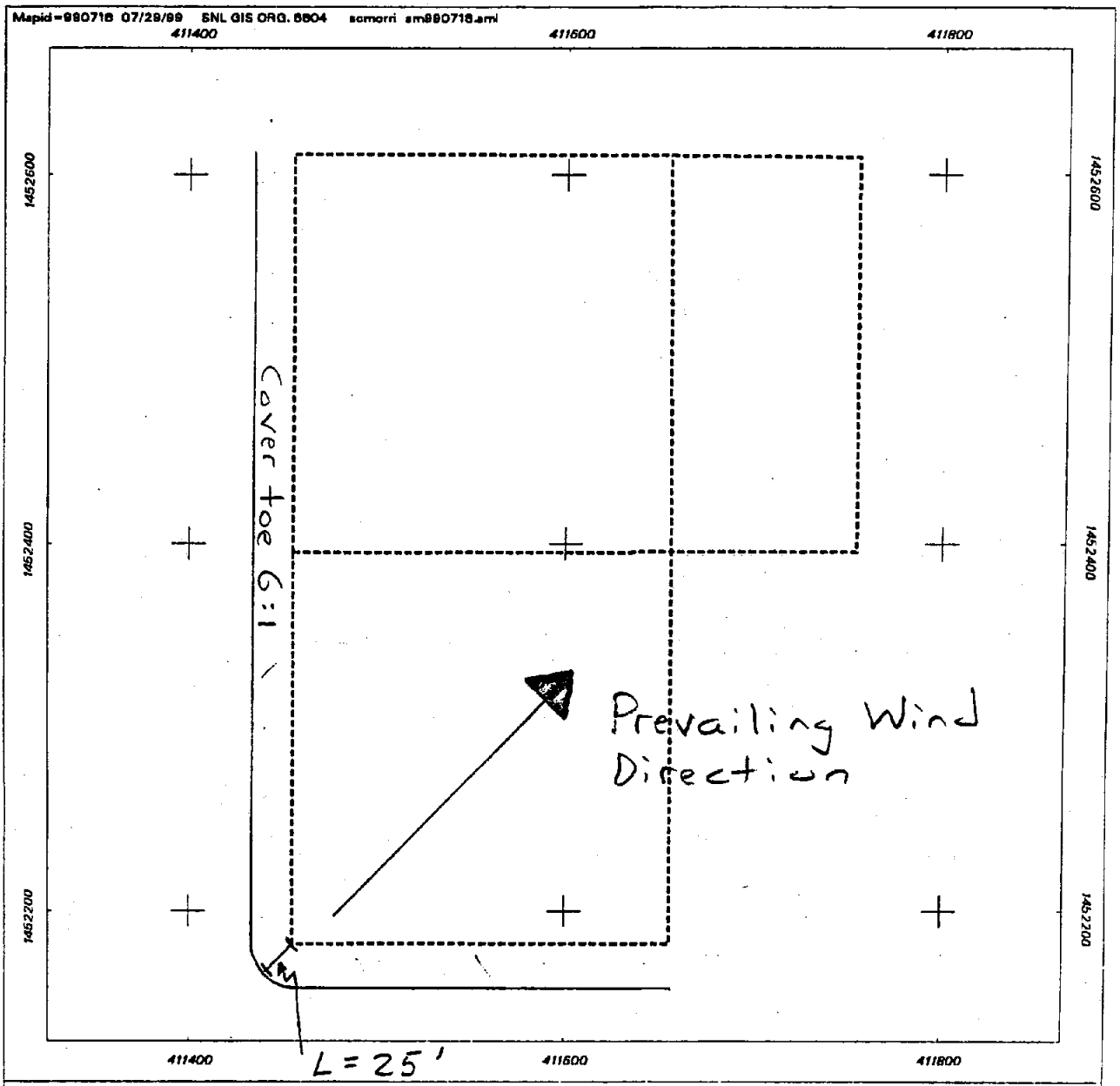


Figure 6. Unsheltered distance, L, for the 16.7% Sideslopes

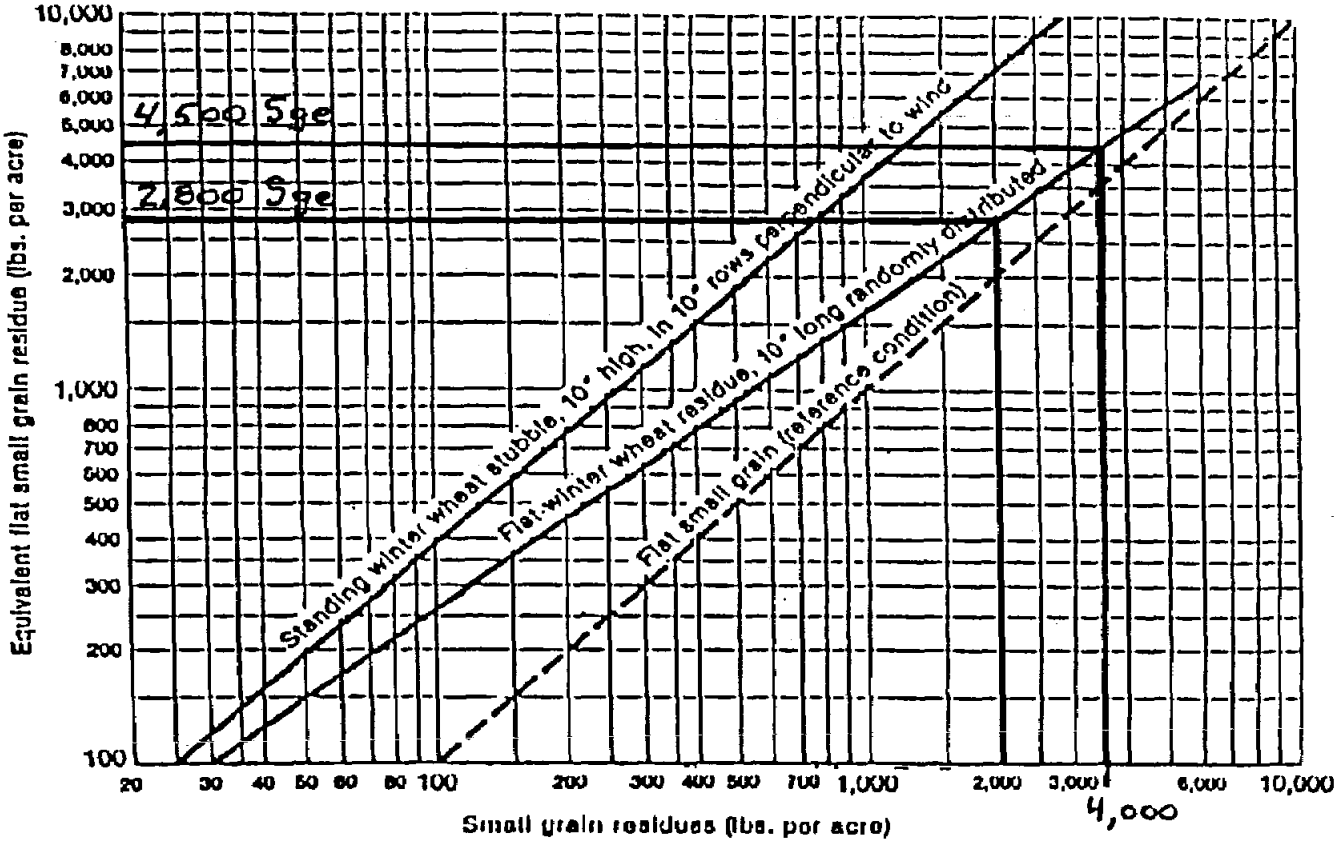
GETATIVE COVER "V"

ıd Erosion Equation E = f[(IKC)LV]

;etative Cover Factor "V"

: effect of vegetative cover in the Wind Erosion Equation is expressed by relating the . l, amount, and orientation of vegetative material to its equivalent in pounds per acre of ll grain residue in reference condition (SGe).

Flat Small Grain Equivalents of Small Grain Residues
(Use for wheat, barley, rye and oats)



(reference condition - dry small grain stalks 10" long, lying flat on the soil surface in 10" rows, rows perpendicular to wind direction, stalks oriented to wind direction.
Source: Lyles and Allison—Trans. ASAE 1981, 24 (2): 405-406.
Residues are wasted, air dried, and placed as described for wind tunnel tests.

Figure 7.

e Reference Condition

: term Flat Small Grain Equivalent (SGe) is based on a reference condition (dotted line Figure 6) developed from wind tunnel research. It is defined as:

10-inch stalks of small grain lying parallel to the wind arranged in rows

Table 5. C=120, I=134, k=1.0

WIND EROSION EQUATION "C" FACTORS

NEW MEXICO

(E)* SOIL LOSS FROM WIND EROSION IN TONS PER ACRE PER YEAR — JANUARY, 1998
C = 120
I = 134

SURFACE - K =1.00

(V)** - FLAT SMALL GRAIN RESIDUE IN POUNDS PER ACRE

(L) UNSHELTERED DISTANCE IN FEET	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
10000	160.8	144.5	122.7	101.4	70.1	49.4	30.1	19.0	12.2	6.6	3.7	0.8	0.4
8000	160.8	144.5	122.7	101.4	70.1	49.4	30.1	19.0	12.2	6.6	3.7	0.8	0.4
6000	160.8	144.5	122.7	101.4	70.1	49.4	30.1	19.0	12.2	6.6	3.7	0.8	0.4
4000	160.8	144.5	122.7	101.4	70.1	49.4	30.1	19.0	12.2	6.6	3.7	0.8	0.4
3000	160.8	144.5	122.7	101.4	70.1	49.4	30.1	19.0	12.2	6.6	3.7	0.8	0.4
2000	160.8	144.5	122.7	101.4	70.1	49.4	30.1	19.0	12.2	6.6	3.7	0.8	0.4
1000	153.2	137.4	116.2	95.5	65.4	45.4	27.4	17.1	10.8	5.8	3.2	0.7	0.4
800	151.0	135.3	114.3	93.7	64.0	44.3	26.6	16.5	10.5	5.5	3.0	0.6	0.3
524' > 600	144.7	129.5	109.0	88.9	60.2	41.2	24.5	15.0	9.4	4.9	2.6	0.2	0.0
400	137.4	122.7	102.8	83.3	55.9	37.6	22.1	13.3	8.3	4.2	2.2	0.2	
300	131.6	117.2	97.9	78.9	52.5	34.9	20.3	12.1	7.4	3.7	1.9	0.2	
200	120.2	106.7	88.5	70.5	46.1	29.9	17.0	9.8	5.9	2.8	1.4	0.1	
150	111.5	98.7	81.3	64.2	41.4	26.3	14.6	8.3	4.9	2.3	1.1	0.1	
100	104.4	92.1	75.5	59.1	37.6	23.4	12.8	7.1	4.1	1.9	0.9	0.1	
80	98.5	86.7	70.7	54.9	34.6	21.2	11.4	6.3	3.6	1.6	0.7	0.1	
60	88.7	77.7	62.8	48.2	29.7	17.7	9.3	4.9	2.8	1.2	0.4	0.0	
50	82.8	72.4	58.2	44.2	26.9	15.7	8.1	4.2	2.3	1.0	0.3		
40	77.5	67.5	54.0	40.7	24.5	14.0	7.1	3.6	2.0	0.7	0.0		
30	69.3	60.1	47.7	35.4	20.9	11.6	5.7	2.8	1.5	0.5			
20	57.9	49.8	38.9	28.3	16.1	8.5	4.0	1.9	0.9	0.0			
10	43.2	36.8	28.1	19.7	10.6	5.1	2.3	1.0	0.3				

(E)* SOIL LOSS FROM WIND EROSION IN TONS PER ACRE PER YEAR — JANUARY, 1998
C = 120
I = 134

SURFACE - K =0.90

(V)** - FLAT SMALL GRAIN RESIDUE IN POUNDS PER ACRE

(L) UNSHELTERED DISTANCE IN FEET	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
10000	144.7	129.5	109.0	88.9	60.2	41.2	24.5	15.0	9.4	4.9	2.6	0.2	
8000	144.7	129.5	109.0	88.9	60.2	41.2	24.5	15.0	9.4	4.9	2.6	0.2	
6000	144.7	129.5	109.0	88.9	60.2	41.2	24.5	15.0	9.4	4.9	2.6	0.2	
4000	144.7	129.5	109.0	88.9	60.2	41.2	24.5	15.0	9.4	4.9	2.6	0.2	
3000	144.7	129.5	109.0	88.9	60.2	41.2	24.5	15.0	9.4	4.9	2.6	0.2	
2000	143.2	128.0	107.6	87.7	59.3	40.4	23.9	14.6	9.1	4.7	2.5	0.2	
1000	137.3	122.6	102.7	83.3	55.8	37.6	22.1	13.3	8.2	4.2	2.2	0.2	
800	132.5	118.1	98.7	79.7	53.1	35.4	20.6	12.3	7.5	3.8	2.0	0.2	
600	126.6	112.7	93.8	75.2	49.7	32.7	18.8	11.1	6.7	3.3	1.7	0.1	
400	118.1	104.8	86.7	69.0	44.9	29.0	16.4	9.5	5.6	2.7	1.3	0.1	
300	112.0	99.1	81.7	64.5	41.6	26.4	14.8	8.4	4.9	2.3	1.1	0.1	
200	104.1	91.9	75.3	58.9	37.5	23.3	12.8	7.1	4.1	1.9	0.9	0.1	
150	96.6	85.0	69.2	53.7	33.6	20.5	11.0	6.0	3.4	1.5	0.7	0.1	
100	88.7	77.8	62.9	48.2	29.7	17.7	9.3	4.9	2.8	1.2	0.4		
80	83.1	72.6	58.4	44.4	27.1	15.8	8.2	4.3	2.3	1.0	0.3		
60	74.3	64.7	51.6	38.7	23.1	13.0	6.6	3.3	1.8	0.7			
50	69.8	60.6	48.0	35.7	21.1	11.7	5.8	2.9	1.5	0.6			
40	64.8	56.1	44.2	32.6	18.9	10.3	5.0	2.4	1.3				
30	57.2	49.3	38.4	27.9	15.8	8.3	3.9	1.8	0.9				
20	48.8	41.8	32.1	22.9	12.6	6.3	2.9	1.3	0.4				
10	35.4	29.9	22.4	15.3	8.0	3.6	1.5	0.5					

* NOTE: SOIL LOSS FOR VALUES WHERE 'E' IS LESS THAN 0.1 OR GREATER THAN 440.0 ARE NOT SHOWN; OTHER VALUES NOT SHOWN ARE INVALID

** NOTE: VALUES SHOWN ARE FLAT SMALL GRAIN EQUIVALENT, NOT 'V'

Sheet 19 of 20

Table 6. C = 120, I = 100, K = 1.0

WIND EROSION EQUATION "C" FACTORS

NEW MEXICO

(E)* SOIL LOSS FROM WIND EROSION IN TONS PER ACRE PER YEAR — JANUARY, 1998
C = 120
SURFACE - K =1.00 — I = 180
(V)** - FLAT SMALL GRAIN RESIDUE IN POUNDS PER ACRE

(L) UNSHELTERED DISTANCE IN FEET	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
10000	216.0	196.6	171.0	146.7	107.5	82.3	54.0	37.2	25.7	15.7	9.8	2.4	1.6
8000	216.0	196.6	171.0	146.7	107.5	82.3	54.0	37.2	25.7	15.7	9.8	2.4	1.6
6000	216.0	196.6	171.0	146.7	107.5	82.3	54.0	37.2	25.7	15.7	9.8	2.4	1.6
4000	216.0	196.6	171.0	146.7	107.5	82.3	54.0	37.2	25.7	15.7	9.8	2.4	1.6
3000	216.0	196.6	171.0	146.7	107.5	82.3	54.0	37.2	25.7	15.7	9.8	2.4	1.6
2000	216.0	196.6	171.0	146.7	107.5	82.3	54.0	37.2	25.7	15.7	9.8	2.4	1.6
1000	214.0	194.7	169.2	145.0	106.1	81.0	53.0	36.5	25.1	15.3	9.5	2.4	1.6
800	211.0	191.8	166.5	142.5	103.9	79.1	51.5	35.3	24.2	14.7	9.1	2.2	1.5
600	206.0	187.1	162.1	138.2	100.4	75.8	49.1	33.4	22.8	13.7	8.4	2.0	1.3
400	196.7	178.3	153.8	130.5	93.9	70.0	44.8	30.1	20.3	12.0	7.2	1.7	1.1
300	190.0	172.0	148.0	124.9	89.3	65.9	41.9	27.8	18.6	10.8	6.4	1.5	1.0
200	179.0	161.6	138.4	116.0	81.9	59.5	37.3	24.3	16.0	9.1	5.3	1.2	0.6
150	167.2	150.5	128.2	106.5	74.2	52.8	32.5	20.8	13.5	7.4	4.2	0.9	0.5
100	156.0	140.0	118.6	97.6	67.1	46.9	28.4	17.8	11.4	6.1	3.4	0.7	0.4
80	147.3	131.9	111.2	90.9	61.8	42.5	25.4	15.6	9.8	5.1	2.8	0.6	0.0
60	135.7	121.1	101.4	82.0	54.9	36.8	21.6	13.0	8.0	4.0	2.1	0.2	
50	127.8	113.7	94.7	76.1	50.3	33.2	19.1	11.3	6.9	3.4	1.7	0.1	
40	119.7	106.2	88.0	70.1	45.8	29.6	16.8	9.7	5.8	2.8	1.4	0.1	
30	109.5	96.8	79.6	62.7	40.3	25.4	14.1	8.0	4.7	2.2	1.0	0.1	
20	94.6	83.1	67.6	52.2	32.6	19.7	10.6	5.7	3.2	1.4	0.4	0.0	
10	72.7	63.2	50.3	37.6	22.4	12.6	6.3	3.2	1.7	0.6	0.0		

25' >

(E)* SOIL LOSS FROM WIND EROSION IN TONS PER ACRE PER YEAR — JANUARY, 1998
C = 120
SURFACE - K =0.90 — I = 180
(V)** - FLAT SMALL GRAIN RESIDUE IN POUNDS PER ACRE

(L) UNSHELTERED DISTANCE IN FEET	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
10000	194.4	176.1	151.9	128.6	92.3	68.6	43.8	29.3	19.7	11.6	6.9	1.6	1.1
8000	194.4	176.1	151.9	128.6	92.3	68.6	43.8	29.3	19.7	11.6	6.9	1.6	1.1
6000	194.4	176.1	151.9	128.6	92.3	68.6	43.8	29.3	19.7	11.6	6.9	1.6	1.1
4000	194.4	176.1	151.9	128.6	92.3	68.6	43.8	29.3	19.7	11.6	6.9	1.6	1.1
3000	194.4	176.1	151.9	128.6	92.3	68.6	43.8	29.3	19.7	11.6	6.9	1.6	1.1
2000	194.4	176.1	151.9	128.6	92.3	68.6	43.8	29.3	19.7	11.6	6.9	1.6	1.1
1000	189.6	171.6	147.6	124.6	89.0	65.7	41.7	27.7	18.5	10.7	6.4	1.5	1.0
800	186.4	168.5	144.8	122.0	86.8	63.8	40.3	26.6	17.7	10.2	6.0	1.4	0.7
600	182.7	165.1	141.6	119.0	84.4	61.6	38.8	25.5	16.9	9.6	5.7	1.3	0.7
400	174.1	156.9	134.1	112.0	78.7	56.6	35.2	22.8	14.9	8.4	4.8	1.1	0.6
300	167.3	150.6	128.3	106.6	74.3	52.9	32.6	20.8	13.5	7.5	4.2	0.9	0.5
200	153.1	137.3	116.1	95.4	65.3	45.3	27.3	17.0	10.8	5.7	3.2	0.7	0.4
150	143.3	128.1	107.7	87.8	59.4	40.5	24.0	14.7	9.2	4.7	2.5	0.2	
100	134.1	119.6	100.0	80.8	54.0	36.1	21.1	12.6	7.8	3.9	2.0	0.2	
80	126.3	112.3	93.5	75.0	49.5	32.5	18.7	11.0	6.7	3.3	1.7	0.1	
60	114.9	101.8	84.1	66.6	43.2	27.6	15.5	8.9	5.3	2.5	1.2	0.1	
50	108.3	95.8	78.7	61.9	39.7	25.0	13.8	7.8	4.5	2.1	1.0	0.1	
40	102.8	90.7	74.2	58.0	36.8	22.8	12.5	6.9	4.0	1.8	0.9	0.1	
30	94.5	83.1	67.5	52.2	32.6	19.7	10.6	5.7	3.2	1.4	0.4		
20	79.5	69.4	55.6	42.1	25.4	14.6	7.5	3.9	2.1	0.8			
10	60.1	51.8	40.6	29.7	17.0	9.0	4.3	2.0	1.0				

* NOTE: SOIL LOSS FOR VALUES WHERE 'E' IS LESS THAN 0.1 OR GREATER THAN 440.0 ARE NOT SHOWN; OTHER VALUES NOT SHOWN ARE INVALID

** NOTE: VALUES SHOWN ARE FLAT SMALL GRAIN EQUIVALENT, NOT 'V'

Sheet 20 of 20

Attachment 3

Calculations

Regarding

Run-Off and Run-On Controls

For the MWL Cover

NMED (NOD) COMMENT: "Demonstrate with calculations and other information whether run-off and run-on controls have been adequately designed to handle peak precipitation events. Evaluate and discuss whether additional fun-on controls should be constructed at locations further away from the landfill (e.g. at distances of 25 to 50 meters) to provide more protection for the cover from heavy rainfall events."

Response to NMED (NOD) Comment;

The site will be graded such that runoff from the site flows north, west and east. There is a high point on the north side of the site that prevents flow from running onto the site. Two swales will be provided to carry the flow to the north or the south. This may be seen in Exhibit 1: Mixed Waste Landfill Final Cover Grading Plan" attached.

The watershed basin draining onto the site has been delineated and is shown on Exhibit 2. It is divided in to a north basin and a south basin that drain to the north and south swales respectively.

Runoff was calculated using the City of Albuquerque DPM criteria for the 100 year –6 hour storm. Reference: DPM Criteria Attached. The north basin generates 24 cfs and the north swale has the capacity for 79 cfs. The south basin generates 6.5 cfs and the capacity of the south swale is 58 cfs.

The swales are therefore sized with abundant capacity to prevent flow from entering the site and to carry the runoff around the site.

The general drainage pattern in this area is a gentle slope to the west. So after the flow is discharged from the site, they drain westward and no additional controls are needed. Exhibit 2 shows the topography up to a minimum of 200 feet beyond the site to illustrate this.

URS

Page 1 of ____

Job Mixed Waste Landfill Project Project No. ____ Sheet ____ of ____

Description Response to NAED Comment No. 16, Computed by [signature] Date 11 Dec. 06

Checked by HB PE Date 11 Dec. 06

Reference

USE CITY of ALB. DRAINAGE METHOD

BASIN AREA

NORTH 297636 ☐

SOUTH 81997.54 ☐

) TOTAL = 379633.54 SF ✓

Time of Concentration

Longest flow path

N = 964' SLOPE sheet flow $\frac{92.2-91.7}{400} = .01375$ ft/ft

S = 616' other $\frac{5391.7-5380}{564} = .02074$ ft/ft

Slope = $\frac{5388-5382}{616} = 0.0097$ ft/ft

Zone 3

LAND TREATMENT

⇒ SAY type C possibly some type A is there but much of the area has been impacted by human activity

this is conservative

Time of Concentration

NORTH $t_c = L/V_1 + L/V_2 \ldots$

$V = K\sqrt{S * 1000}$

$V_1 = .7\sqrt{.01375(100)} = 0.82$ ✓

$V_2 = 2\sqrt{.02074(100)} = 2.88$ ✓

$T_c = \left(400'/0.82\ \frac{ft}{sec} + 564'/2.88\ ft/sec\right) / (3600\ sec/hour) = 0.1899$ hrs ✓

$= 11$ min

URS

Page 2 of ____

Job Mixed Waste Landfill Project Project No. ____ Sheet ____ of ____

Description Response to NMED Comment Computed by SJ Date 11 Dec. 06

Nov. 06 Checked by HB PE Date 11 Dec. 06

Reference

SOUTH use K = 2

$V = 2\sqrt{.0097(100)} = 1.97$ ✓

$T_c = \frac{616 \text{ ft}}{1.97 \frac{\text{ft}}{\text{sec}}} = 312.7 \text{ sec} = 5 \text{ min}$ ✓

NORTH + SOUTH - Both < 12 min ✓

Use TABLE A-9 for Q_{peak} - 100

Zone 3 / L.T. C

NORTH 297636 ☐ = 6.833 Ac ✓

SOUTH 81997.54 ☐ = 1.882 Ac ✓

$Q_{peak\ NORTH} = 6.833 \text{Ac} \left(3.45 \frac{\text{cfs}}{\text{Acre}}\right) = 23.6 \text{cfs}$ ✓

$Q_{peak\ SOUTH} = 1.882 \text{Ac} \left(3.45 \frac{\text{cfs}}{\text{Ac}}\right) = 6.5 \text{cfs}$ ✓

NORTH SWALE - Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02000	ft/ft
Discharge	23.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
1+00	5388.00
1+40	5382.00
1+56	5381.00
1+86	5382.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(1+00, 5388.00)	(1+86, 5382.50)	0.030

Results

Normal Depth		0.63	ft
Elevation Range	5381.00 to 5388.00 ft		
Flow Area		7.25	ft²
Wetted Perimeter		22.88	ft
Top Width		22.84	ft
Normal Depth		0.63	ft
Critical Depth		0.64	ft
Critical Slope		0.01922	ft/ft
Velocity		3.26	ft/s
Velocity Head		0.16	ft
Specific Energy		0.80	ft
Froude Number		1.02	
Flow Type	Supercritical		

NORTH SWALE - Q100

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.63	ft
Critical Depth	0.64	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.01922	ft/ft

NORTH SWALE - CAPACITY

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.02000	ft/ft
Normal Depth	1.00	ft

Section Definitions

Station (ft)	Elevation (ft)
1+00	5388.00
1+40	5382.00
1+56	5381.00
1+86	5382.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(1+00, 5388.00)	(1+86, 5382.50)	0.030

Results

Discharge		79.35	ft^3/s
Elevation Range	5381.00 to 5388.00 ft		
Flow Area		18.00	ft^2
Wetted Perimeter		36.06	ft
Top Width		36.00	ft
Normal Depth		1.00	ft
Critical Depth		1.04	ft
Critical Slope		0.01631	ft/ft
Velocity		4.41	ft/s
Velocity Head		0.30	ft
Specific Energy		1.30	ft
Froude Number		1.10	
Flow Type	Supercritical		

NORTH SWALE - CAPACITY

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	1.04	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.01631	ft/ft

SOUTH SWALE - CAPACITY

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00900	ft/ft
Normal Depth	1.10	ft

Section Definitions

Station (ft)	Elevation (ft)
1+00	5388.00
1+24	5384.00
1+32	5383.90
1+39	5385.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(1+00, 5388.00)	(1+39, 5385.00)	0.030

Results

Discharge		57.58	ft^3/s
Elevation Range	5383.90 to 5388.00 ft		
Flow Area		15.25	ft^2
Wetted Perimeter		21.17	ft
Top Width		21.00	ft
Normal Depth		1.10	ft
Critical Depth		0.97	ft
Critical Slope		0.01529	ft/ft
Velocity		3.78	ft/s
Velocity Head		0.22	ft
Specific Energy		1.32	ft
Froude Number		0.78	
Flow Type	Subcritical		

SOUTH SWALE - CAPACITY

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.10	ft
Critical Depth	0.97	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.01529	ft/ft

SOUTH SWALE - Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00900	ft/ft
Discharge	6.50	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
1+00	5388.00
1+24	5384.00
1+32	5383.90
1+39	5385.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(1+00, 5388.00)	(1+39, 5385.00)	0.030

Results

Normal Depth		0.38	ft
Elevation Range	5383.90 to 5388.00 ft		
Flow Area		3.29	ft^2
Wetted Perimeter		12.11	ft
Top Width		12.05	ft
Normal Depth		0.38	ft
Critical Depth		0.30	ft
Critical Slope		0.02186	ft/ft
Velocity		1.97	ft/s
Velocity Head		0.06	ft
Specific Energy		0.44	ft
Froude Number		0.67	
Flow Type	Subcritical		

SOUTH SWALE - Q100

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.38	ft
Critical Depth	0.30	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.02186	ft/ft

TABLE 22.3 B-1

VALUES OF MANNING'S n

	n
Reinforced Concrete Pipe	.013
Poured Concrete	.013
No-joint cast in place concrete pipe	.014
Reinforced Concrete Box	.015
Reinforced Concrete Arch	.015
Streets	.017
Flush Grouted Rip-Rap	.020
Corrugated Metal Pipe	.025
Grass Lined Channels (sodded & irrigated)	.025
Earth Lined Channels (smooth)	.030
Arroyo Channels	.030
Wire Tied Rip-Rap	.040
Medium Weight Dumped Riprap	.045
Grouted Rip-Rap (exposed rock)	.045
Arroyo Overbank	.045
Jetty Type Rip-Rap (D_{50} > 24")	.050

Following incorporation of review comments, the August, 1991 version of Section 22.2, Hydrology was released for use by the Drainage Design Criteria Committee. This version included the placement of the rainfall peak in this second hour of the design storm. Modifications to the Probable Maximum Flood procedures incorporated a "local storm" and a "general storm." A "Notice of Second Review" was published in the Albuquerque Journal and Tribune on August 31, 1991. The August, 1991 version has been accepted by the City, County and AMAFCA as an allowable procedure for hydrologic analysis and design of flood control structures.

The January, 1993 version of Section 22.2, Hydrology incorporates comments received since August, 1991. The version includes a procedure to evaluate basin hydrology for steep natural slopes, and some text revisions suggested by the USDA Soil Conservation Service. For most applications, there will be no computational differences between the January, 1993 version and the August, 1991 version. The text has been reformatted into seven (7) separately numbered parts, to simplify future revision of the document.

The pages which follow replaced all previous pages in the Hydrology Section of the DPM (Section 22.2, pages 2 through 21). Following a public review and comment period, the revised Section 22.2, Hydrology was approved by the City Engineer and the Mayor. In the City of Albuquerque, the revision became effective on April 7, 1993. Bernalillo County also adopted the revision as the standard for design of flood and drainage control, effective April 7, 1993. The revised Section 22.2, Hydrology is to be regarded as the principal reference for hydrologic design in the City of Albuquerque and Bernalillo County.

The Drainage Design Criteria Committee wish to acknowledge the assistance of the many individuals who reviewed the document. In particular we wish to thank Richard Leonard, Brian Burnett and Dwayne Sheppard for their work on the Committee.

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P. 12

INTRODUCTION

There have been many methods used in Albuquerque and Bernalillo County to compute runoff volumes, peak flow rates and runoff hydrographs from drainage basins. Any methodology used should be based on measurable conditions, be as simple as possible and produce accurate reproducible results. The methods, graphs, and tables which follow will be used by the City of Albuquerque, Bernalillo County and AMAFCA staff in the review and evaluation of development plans and drainage management plans.

Two basic methods of analysis are presented herein:

a) **PART A** - describes a simplified procedure for smaller watersheds based on the Rational Method and initial abstraction/uniform infiltration precipitation losses. The procedure is applicable to watersheds up to 40 acres in size, but the procedure may be extended to include larger watersheds with some limitations.

b) **PART C** - describes a unit hydrograph procedure which uses a version of the U.S.D.A. Agricultural Research Service HYMO computer program, modified to utilize initial abstraction/uniform infiltration precipitation losses. The AHYMO computer program developed by the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA), and the simplified input procedures available with this program, are also described. This procedure is applicable for small and large watersheds.

In addition to these procedures, **PART D** describes a modification of the **PART C** procedures to compute a Probable Maximum Flood. This has special application to the design of dams.

PART B describes the computation of time of concentration and time to peak which are used in PART A, PART C and PART D.

There may be conditions in which the procedures and analysis tools described in PART A, PART C or PART D are not applicable or optimal for design. **PART E** describes some additional analysis procedures and some criteria under which alternate procedures will be evaluated.

PART F contains a tabulated list of definitions of symbols used in this Section of the D.P.M. and a bibliography.

PART G contains the input and output files from the examples in PARTS C and D which utilize the HYMO computer program.

PART A - PROCEDURE FOR 40 ACRE AND SMALLER BASINS

A simplified procedure for projects with sub-basins smaller than 40 acres has been developed based on initial abstraction/uniform infiltration precipitation losses and Rational Method procedures. For this procedure, Bernalillo County has been divided into four (4) Precipitation Zones.

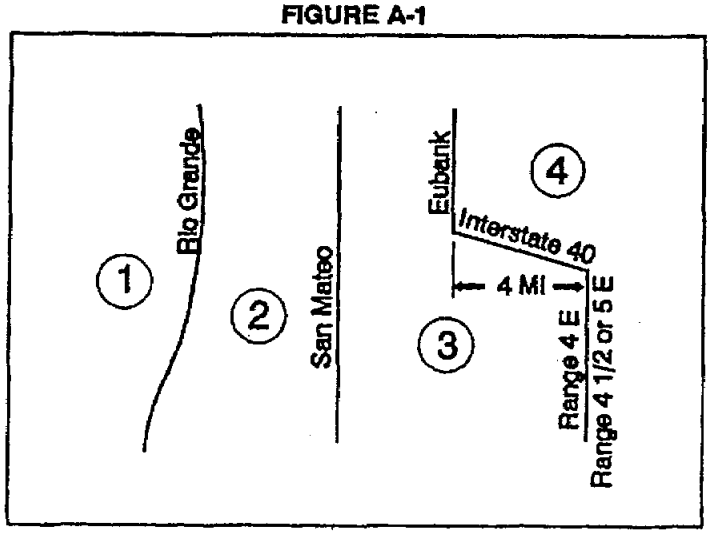
A.1 PRECIPITATION ZONES

Bernalillo County's four precipitation zones are indicated in TABLE A-1 and on FIGURE A-1.

TABLE A-1. PRECIPITATION ZONES

Zone	Location
1	West of the Rio Grande
2	Between the Rio Grande and San Mateo
3	Between San Mateo and Eubank, North of Interstate 40; and between San Mateo and the East boundary of Range 4 East, South of Interstate 40
4	East of Eubank, North of Interstate 40; and East of the East boundary of Range 4 East, South of Interstate 40

FIGURE A-1



Where a watershed extends across a zone boundary, use the zone which contains the largest portion of the watershed.

A.2 DESIGN STORM

The principal design storm is the 100-year 6-hour event defined by the NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Vol. IV - New Mexico. Assume an AMC II condition (a normally dry watershed). For design of retention or detention ponds, storms of 24-hour or longer duration many be required. The 24-hour event is defined by the NOAA Atlas 2. The 4-day and 10-day events can be obtained using the procedures in S.C.S. TSC Technical Note-Hydrology, PO-6 (Rev. 2) The 100-year 60-minute depth is computed by the following formula from Table 11 of NOAA Atlas 2:

$$P_{60} = 0.494 + 0.755 * (P_{360} * P_{360} / P_{1440}) \quad \text{(a-1)}$$

TABLE A-2. DEPTH (INCHES) AT 100-YEAR STORM

Zone	P_{60}	P_{360}	P_{1440}	P_{4days}	P_{10days}
1	1.87	2.20	2.66	3.12	3.67
2	2.01	2.35	2.75	3.30	3.95
3	2.14	2.60	3.10	3.95	4.90
4	2.23	2.90	3.65	4.70	5.95

The 2-year 60-minute depth is computed by the following formula from NOAA Atlas 2:

$$P_{60\text{-}2} = -0.011 + 0.942 * (P_{360\text{-}2} * P_{360\text{-}2} / P_{1440\text{-}2}) \quad \text{(a-2)}$$

Based on fitting a logarithmic curve to the values in Table 12 of NOAA Atlas 2, the 12-minute (0.2 hour) depth was computed to be 50.24 percent of the 60-minute depth:

$$P_{12} = 0.5024 * P_{60} \quad \text{(a-3)}$$

For certain applications (e.g., street drainage, low flow channels and sediment transport) storms of greater frequency than the 100-year storm must be considered. To estimate precipitation at return periods other than 100 years, multiply the 360-minute or 1440-minute 100-year precipitation amounts by the factors in TABLE A-3.

TABLE A-3. RETURN PERIOD FACTORS	
Return Period (years)	**Factor**
50	0.900
25	0.800
10	0.667
5	0.567
2	0.434

Example A-1
Find the 10-year, 6-hour storm depth for Zone 2.
$P_{360\text{-}10} = 2.35 * 0.667 = 1.57$ inches

Example A-2
Find the 2-year, 1-hour storm depth for Zone 3.
$P_{360\text{-}2} = 2.60 * 0.434 = 1.128$ inches
$P_{1440\text{-}2} = 3.10 * 0.434 = 1.345$ inches
$P_{60\text{-}2} = -0.011 + 0.942 * (P_{360\text{-}2} * P_{360\text{-}2} / P_{1440\text{-}2})$ $= -0.011 + 0.942 * (1.128 * 1.128 / 1.345)$ $= 0.880$ inches

A.3 LAND TREATMENTS

All land areas are described by one of four basic land treatments or by a combination of the four land treatments.

Land treatments are given in TABLE A-4.

TABLE A-4. LAND TREATMENTS	
Treatment	**Land Condition**
A	Soil uncompacted by human activity with 0 to 10 percent slopes. Native grasses, weeds and shrubs in typical densities with minimal disturbance to grading, groundcover and infiltration capacity.
B	Irrigated lawns, parks and golf courses with 0 to 10 percent slopes. Native grasses, weeds and shrubs, and soil uncompacted by human activity with slopes greater than 10 percent and less than 20 percent.
C	Soil compacted by human activity. Minimal vegetation. Unpaved parking, roads, trails. Most vacant lots. Gravel or rock on plastic (desert landscaping). Irrigated lawns and parks with slopes greater than 10 percent. Native grasses, weeds and shrubs, and soil uncompacted by human activity with slopes at 20 percent or greater. Native grass, weed and shrub areas with clay or clay loam soils and other soils of very low permeability as classified by SCS Hydrologic Soil Group D.
D	Impervious areas, pavement and roofs.
Most watersheds contain a mix of land treatments. To determine proportional treatments, measure respective subareas. In lieu of specific measurement for treatment D, the areal percentages in TABLE A-5 may be employed.	

TABLE A-5. PERCENT TREATMENT D (Impervious)	
Land Use	**Percent**
Commercial*	90
Single Family Residential N=units/acre, N≤6	$7*\sqrt{((N*N)+(5*N))}$ (a-4)
Multiple Unit Residential Detached* Attached*	 60 70
Industrial Light* Heavy*	 70 80
Parks, Cemeteries	7
Playgrounds	13
Schools	50
Collector & Arterial Streets	90
*Includes local streets	

TABLE A-5 does not provide areal percentages for land treatments A, B and C. Use of TABLE A-5 will require additional analysis to determine the appropriate areal percentages of these land treatments.

Backyard retention ponds, and other small on-site ponding, may have the effect of reducing runoff from impervious areas. Where it can be clearly demonstrated that backyard and small on-site retention ponding currently exist, impervious and/or pervious areas which drain to such ponds ~~may~~ can be given credit towards their determination of peak rates of runoff and runoff volumes from the development. ~~considered to be in land treatment A. Application of backyard ponding is not normally applicable to more than 35 percent of the area in land treatment D (impervious). Allowance for backyard ponding will not be considered for new developments and future development.~~

A.4 ABSTRACTIONS

Initial abstraction is the precipitation depth which must be exceeded before direct runoff begins. Initial abstraction may be intercepted by vegetation, retained in surface depressions, or absorbed on the watershed surface. Initial abstractions are shown in TABLE A-6.

TABLE A-6. INITIAL ABSTRACTION (IA)	
Treatment	**Initial Abstraction (inches)**
A	0.65
B	0.50
C	0.35
D	0.10

Infiltration is the only significant abstraction after the initial abstraction. After initial abstraction is satisfied, treat infiltration as a constant loss rate as specified in TABLE A-7.

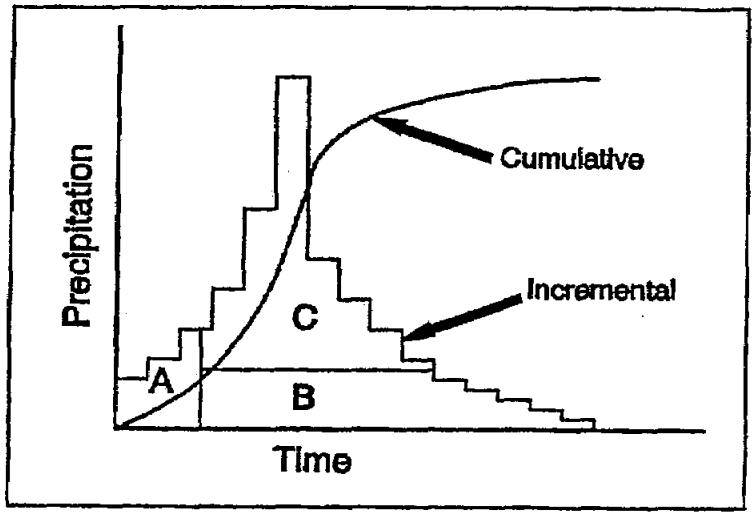
TABLE A-7. INFILTRATION (INF)	
Treatment	**Loss Rate (inches/hour)**
A	1.67
B	1.25
C	0.83
D	0.04*
* Treatment D infiltration rate is applicable from 0 to 3 hours; use uniform reduction from 3 to 6 hours, with no infiltration after 6 hours.	

Runoff from a previous event can saturate a channel bed, rendering it minimally pervious for several days. Do not anticipate additional bed losses for design purposes.

A.5 EXCESS PRECIPITATION & VOLUMETRIC RUNOFF

Excess precipitation, E, is the depth of precipitation remaining after abstractions are removed. Excess precipitation does not depend on watershed area. Excess precipitation is determined by subtracting the initial abstraction and infiltration from the design storm hydrograph. FIGURE A-2 illustrates the development of excess precipitation. The curved line plots cumulative precipitation. Precipitation intensities (in/hr) are shown as a histogram. Initial abstraction is area A. The horizontal line is at a height corresponding to the infiltration rate. Infiltration loss is area B. The remaining histogram, area C, is excess precipitation.

FIGURE A-2



Excess precipitation, E, by zone and treatment is summarized in TABLE A-8.

(NOTE: In this table and several tables which follow, corresponding values for 2- and 10- year storms are shown in brackets below each 100-year value)

TABLE A-8. EXCESS PRECIPITATION, E (INCHES) - 6 HOUR STORM

Zone	Treatment 100-YR [2-YR, 10-YR]			
	A	B	C	D
1	0.44 [0.00, 0.08]	0.67 [0.01, 0.22]	0.99 [0.12, 0.44]	1.97 [0.72, 1.24]
2	0.53 [0.00, 0.13]	0.78 [0.02, 0.28]	1.13 [0.15, 0.52]	2.12 [0.79, 1.34]
3	0.66 [0.00, 0.19]	0.92 [0.06, 0.36]	1.29 [0.20, 0.62]	2.36 [0.89, 1.50]

4	0.80 [0.02, 0.28]	1.08 [0.11, 0.46]	1.46 [0.27, 0.73]	2.64 [1.01, 1.69]

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To determine the volume of runoff,

1) Determine the area in each treatment, A_A, A_B, A_C, A_D

2) Compute the weighted excess precipitation, E

$$\text{Weighted } E = \frac{E_A A_A + E_B A_B + E_C A_C + E_D A_D}{A_A + A_B + A_C + A_D} \qquad \text{(a-5)}$$

3) Multiply the weighted E by the watershed area.

$$V_{360} \text{ (as volume)} = \text{weighted } E^* (A_A + A_B + A_C + A_D) \qquad \text{(a-6)}$$

EXAMPLE A-3
Find the 100-year V_{360} for 30 acres in zone 1. Eight acres are treatment A, 10 acres are treatment B, 5 acres are treatment C, and 7 acres are treatment D.
Weighted E = ((8 * 0.44) + (10 * 0.67) + (5 * 0.99) + (7 * 1.97)) / 30 = 0.965 inches
Volume = (0.965 * 30) / 12 = 2.41 acre-ft. = V_{360}

For ponds which hold water for longer than 6 hours, longer duration storms are required to establish runoff volumes. Since the additional precipitation is assumed to occur over a long period, the additional volume is based on the runoff from the impervious areas only.

For 24-hour storms:

$$V_{1440} = V_{360} + A_D * (P_{1440} - P_{360}) / 12 \text{ in/ft} \qquad \text{(a-7)}$$

For 4-day storms:

$$V_{4DAYS} = V_{360} + A_D * (P_{4DAYS} - P_{360}) / 12 \text{ in/ft} \qquad \text{(a-8)}$$

For 10-day storms:

$$V_{10DAYS} = V_{360} + A_D * (P_{10DAYS} - P_{360}) / 12 \text{ in/ft} \qquad \text{(a-9)}$$

EXAMPLE A-4
Find the 100-year 24-hour and 4-day runoff volume, V_{1440} and V_{4days}, for the area in Example A-3.
V_{360} = 2.41 acre-feet
V_{1440} = 2.41 + 7 ac * (2.66 - 2.20) / 12 = 2.68 acre-feet
V_{4DAYS} = 2.41 + 7 ac * (3.12 - 2.20) / 12 = 2.95 acre-feet

A.6 PEAK DISCHARGE RATE FOR SMALL WATERSHEDS

Small watersheds are less than or equal to 40 acres.

Peak Discharge

Using a 0.2-hour (12-minute) time of concentration, peak discharge, Q_P, per acre is the volume of excess precipitation in the heaviest 12-minute portion of the storm, divided by the time increment 12 minutes, and multiplied by an attenuation factor. The attenuation factor (0.59 for treatment A, 0.67 for treatment B, 0.75 for treatment C and 0.93 for treatment D) describes the effect of routing. Determine the peak discharge using the values in TABLE A-9, which have been adjusted to consider the effects of initial abstraction.

TABLE A-9. PEAK DISCHARGE (CFS/ACRE)

Zone	Treatment 100-YR [2-YR, 10-YR]			
	A	B	C	D
1	1.29 [0.00, 0.24]	2.03 [0.03, 0.76]	2.87 [0.47, 1.49]	4.37 [1.69, 2.89]
2	1.56 [0.00, 0.38]	2.28 [0.08, 0.95]	3.14 [0.60, 1.71]	4.70 [1.86, 3.14]
3	1.87 [0.00, 0.58]	2.60 [0.21,1.19]	3.45 [0.78, 2.00]	5.02 [2.04, 3.39]
4	2.20 [0.05, 0.87]	2.92 [0.38, 1.45]	3.73 [1.00, 2.26]	5.25 [2.17, 3.57]

To determine the peak rate of discharge,

1) Determine the area in each treatment, A_A, A_B, A_C and A_D.

2) Multiply the peak rate for each treatment by the respective areas and sum to compute the total Q_P.

$$\text{Total } Q_P = Q_{PA}A_A + Q_{PB}A_B + Q_{PC}A_C + Q_{PD}A_D \qquad \text{(a-10)}$$

Example A-5
Find 100-year Q_P for 14 acres in zone 1. The four land treatments are: 3 acres in treatment A, 5 acres in treatment B, 2 acres in treatment C and 4 acres in treatment D. Total $Q_P = (1.29 * 3) + (2.03 * 5) + (2.87 * 2) + (4.37 * 4) = 37.24$ cfs

3) Approximately the same results can be achieved by a Rational Method solution. The 0.2-hour (12-minute) peak intensities, I, are given in TABLE A-10 and Rational Method coefficients, C, are given in TABLE A-11.

$$\text{Total } Q_P = (C_A * I * A_A) + (C_B * I * A_B) + (C_C * I * A_C) + (C_D * I * A_D) \qquad \text{(a-11)}$$

TABLE A-10. PEAK INTENSITY (IN/HR at t_c = 0.2 hour)

Zone	Intensity 100-YR [2-YR, 10-YR]
1	4.70 [1.84, 3.14]
2	5.05 [2.04, 3.41]
3	5.38 [2.21, 3.65]
4	5.61 [2.34, 3.83]

TABLE A-11. RATIONAL METHOD COEFFICIENT, C				
Zone	Treatment			100-YR [2-YR, 10-YR]
	A	B	C	D
1	0.27 [0.00, 0.08]	0.43 [0.02, 0.24]	0.61 [0.26, 0.47]	0.93 [0.92, 0.92]
2	0.31 [0.00, 0.11]	0.45 [0.04, 0.28]	0.62 [0.29, 0.50]	0.93 [0.91, 0.92]
3	0.35 [0.00, 0.16]	0.48 [0.10, 0.33]	0.64 [0.35, 0.55]	0.93 [0.92, 0.93]
4	0.39 [0.02, 0.23]	0.52 [0.16, 0.38]	0.66 [0.43, 0.59]	0.94 [0.93, 0.93]

(Note the quote from the ASCE Manual and Report on Engineering Practice No. 37 (1969): The commonly reported Rational C values "are applicable for storms to 5- to 10-yr frequencies. Less frequent, higher intensity storms will require the use of higher coefficients because infiltration and other losses have a proportionally smaller effect on runoff." Thus higher C's realized under heavy precipitation might be expected.)

Example A-6

Recompute Example A-5 using the Rational Method.

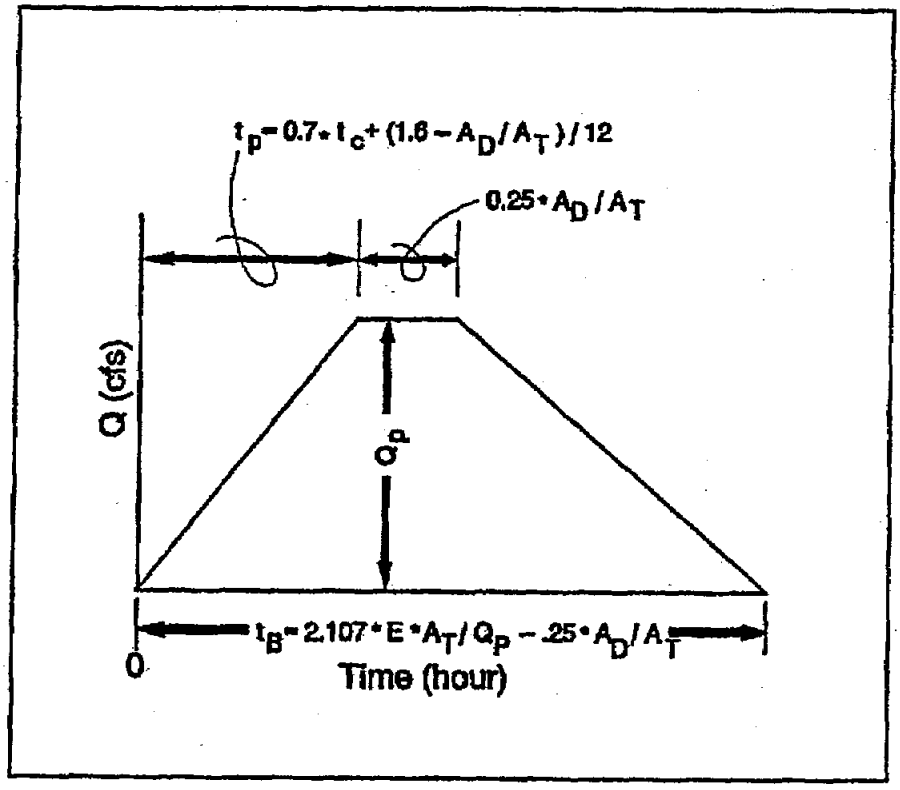
$Q = C I A$

$= (0.27 * 4.70 * 3) + (0.43 * 4.70 * 5) + (0.61 * 4.70 * 2) + (0.93 * 4.70 * 4)$

$= 37.13$ cfs

Continue the peak for 0.25 * A_D / A_T hours. When A_D is zero, the hydrograph will be triangular. When A_D is not zero, the hydrograph will be trapezoidal. FIGURE A-3 shows the hydrograph in graphic form.

FIGURE A-3



Example A-8
Determine the hydrograph for Example A-5.
A_T = 14.0 acres A_D = 4.0 acres t_C = 0.2 hour Q_P = 37.24 cfs
E = ((3 * .44) + (5 * .67) + (2 * .99) + (4 * 1.97)) / (3 + 5 + 2 + 4) = 1.038 inches
t_P = (0.7 * 0.2) + (1.6 - (4 / 14)) / 12) = 0.2495 hours
t_B = (2.017 * 1.038 * 14 / 37.24) - (0.25 * 4 / 14) = 0.7157 hours
Duration of peak = 0.25 * 4 / 14 = 0.0714 hours

PART B - TIME OF CONCENTRATION, LAG TIME, AND TIME TO PEAK

There is a delay, after a brief heavy rain over a watershed, before the runoff reaches its maximum. The length of time it takes for runoff from a watershed to reach an analysis point effects the peak runoff rate, with shorter times producing higher peak flow for a constant runoff volume. The velocity at which water can flow through a watershed and the length of flow path are used to determine the time factors. Time of concentration, lag time, and time to peak are three related watershed parameters that are used to determine peak rates of runoff.

B.1 DEFINITIONS

The three time parameters used are defined as follows:

time of concentration (t_c) = time it takes for runoff to travel from the hydraulically most distant part of the watershed basin to the basin outlet or point of analysis

Lag time (L_G) = time from the center of unit rainfall excess to the time that 50 percent of the volume of unit runoff from the drainage basin has passed the concentration point or point of analysis.

time to peak (t_p) = time from the beginning of unit rainfall excess to the time of the peak flow of the unit runoff hydrograph.

The three time parameters can be computed using the procedures identified in this section. The peak discharge rates and intensity factors identified in TABLES A-9 and A-10 (PART A) were computed using a time of concentration (t_c) of 0.2 hour. The procedures in Part C require the computation of time to peak (t_p) as specified herein.

B.2 COMPUTATION OF TIME OF CONCENTRATION

Three different equations are used to compute time of concentration (t_c) for larger watersheds. For subbasin reach lengths shorter than 4000 feet the SCS Upland Method is used; for subbasin reach lengths longer than 12000 feet the USDI Bureau of Reclamation lag time equation is used. A transition equation is used for subbasin reach lengths between 4000 and 12000 feet.

Consideration should be given to splitting large watersheds into smaller subbasins with reach lengths less than 4000 feet. Smaller subbasins will allow more accurate modeling of channels and basin topography, and should provide for greater modeling accuracy.

1). For subbasin reach lengths less than 4000 feet:

Compute time of concentration, t_c (hours), for the entire (pervious and impervious) watershed by the SCS Upland Method, the sum of the travel times in the subreaches comprising the longest flow path to the watershed outlet.

$$t_c = (L_1 / V_1 + L_2 / V_2 + ... + L_x / V_x) / 3600 \text{ sec/hour} \quad \text{(b-1)}$$

and, $(L_1 + L_2 + ... + L_x) < 4000$ feet

where L_x is the subreach length (feet) and v is the velocity (feet/sec) in that subreach, as determined by the following equation:

$$v = K * \sqrt{(s * 100)} = 10 * K * \sqrt{(s)} \quad \text{(b-2)}$$

where s is the slope in foot per foot, and K depends upon the conveyance condition, as shown in TABLE B-1. If t_C is computed to be less than 0.2 hours, use $t_C = 0.2$ hours.

TABLE B-1. CONVEYANCE FACTORS

K	Conveyance Condition
0.7	Turf, landscaped areas and undisturbed natural areas (sheet flow* only).
1	Bare or disturbed soil areas and paved areas (sheet flow* only).
2	Shallow concentrated flow (paved or unpaved).
3	Street flow, storm sewers and natural channels, and that portion of subbasins (without constructed channels) below the upper 2000 feet for subbasins longer than 2000 feet.
4	Constructed channels (for example: riprap, soil cement or concrete lined channels).

* Sheet flow is flow over plane surfaces, with flow depths up to 0.1 feet. Sheet flow applies only to the upper 400 feet (maximum) of a subbasin.

For composite reaches, where this basin slope is uniform, the composite basin conveyance condition, K, can be computed using the following equation:

$$K = L / (L_1 / K_1 + L_2 / K_2 + ... + L_X / K_X) \quad \text{(b-3)}$$

where $L = L_1 + L_2 + ... + L_X$

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For composite reaches where the basin slope is not uniform, the composite basin conveyance condition, K, can be computed using the following equation:

$$K = (L / \sqrt{s}) / (L_1 / (K_1 * \sqrt{s_1}) + L_2 / (K_2 * \sqrt{s_2}) + ... + L_x / (K_x * \sqrt{s_x})) \quad \text{(b-4)}$$

where: $L = L_1 + L_2 + ... + L_x$

and, $s = (L_1 * s_1 + L_2 * s_2 + ... + L_x * s_x) / L \quad \text{(b-5)}$

2.) For subbasin reach lengths between 4000 and 12000 feet:

Compute the time of concentration, t_C (hours), for the entire watershed using the following equation:

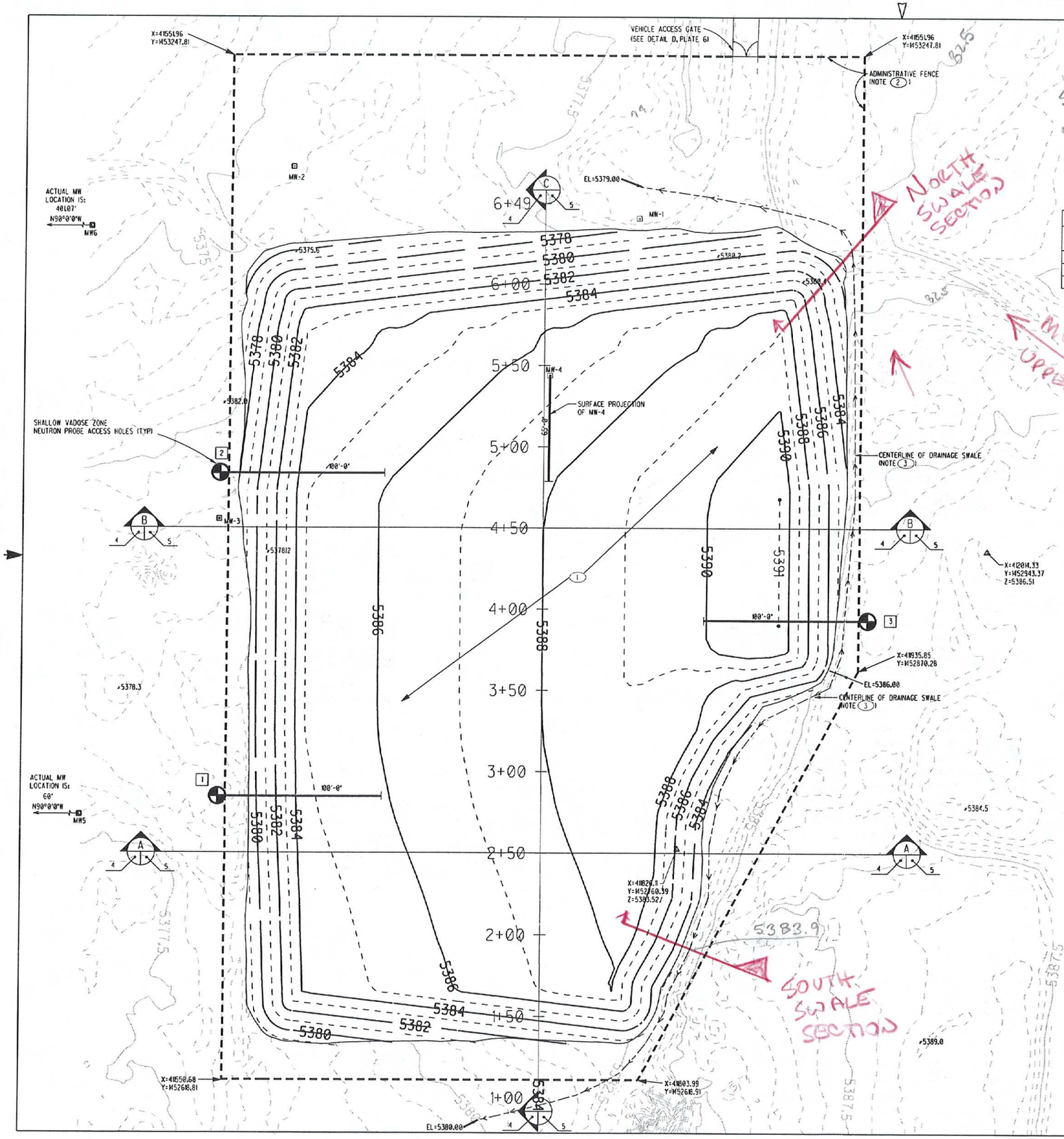
$$t_C = ((12000 - L) / (72000 * K * s^{0.5})) + ((L - 4000) * K_N * (L_{CA} / L)^{0.33} / (552.2 * s^{0.165})) \quad \text{(b-6)}$$

where:

- K = Conveyance factor from TABLE B-1. For composite reaches, K is computed using equation b-3 or b-4.
- L = distance of longest watercourse, in feet.
- L_{CA} = distance along L from point of concentration to a point opposite centroid of drainage basin, in feet.
- s = overall slope of L, in foot per foot. For composite reaches s is computed using equation b-5.
- K_N = a basin factor based on an estimate of the weighted, by stream length, average Manning's n value for the principal watercourses in the drainage basin. For the Albuquerque area, values of K_N may be estimated from TABLE B-2.

TABLE B-2. LAG EQUATION BASIN FACTORS

K_N	Basin Condition
0.042	Mountain Brush and Juniper
0.033	Desert Terrain (Desert Brush)
0.025	Low Density Urban (Minimum improvements to watershed channels)
0.021	Medium Density Urban (Flow in streets, storm sewers and improved channels)
0.016	High Density Urban (Concrete and rip-rap lined channels)



GENERAL NOTES

1. BORROW SITE FOR NATIVE SOIL LAYER FILL AND TOPSOIL LAYER IS APPROXIMATELY 1.5 MILES SOUTH OF THE PROJECT AREA.
2. NATIVE SOIL LAYER FILL SHALL BE OBTAINED FROM TA-3 BORROW PITS. APPROXIMATELY 13,200 CUBIC YARDS OF FILL SHALL BE REQUIRED FOR THE NATIVE SOIL LAYER. FILL SHALL BE PLACED IN MAXIMUM 8-INCH LOOSE LIFTS TO ATTAIN MAXIMUM 6-INCH COMPACTED LIFT THICKNESS. FILL SHALL BE COMPACTED TO NOT LESS THAN 90 PERCENT OF MAXIMUM DRY DENSITY AT -2 TO +2 PERCENT OF OPTIMUM MOISTURE CONTENT, AS DETERMINED BY ASTM D698 (STANDARD PROCTOR TESTING). ANY GRADE STAKES USED ON THE PROJECT SHALL BE REMOVED AND BACKFILLED WITH COVER MATERIAL TO MEET CONSTRUCTION SPECIFICATIONS.
3. THE TOPSOIL LAYER SHALL BE PLACED IN A MAXIMUM 8-INCH LOOSE LIFT. THE TOPSOIL LAYER SHALL BE MINIMALLY COMPACTED TO NOT LESS THAN 80 PERCENT AND NOT GREATER THAN 90 PERCENT OF MAXIMUM DRY DENSITY AT -2 TO +2 PERCENT OF OPTIMUM MOISTURE CONTENT, AS DETERMINED BY ASTM D698 (STANDARD PROCTOR TESTING). TOPSOIL SHALL BE ADMIXED 25 PERCENT BY VOLUME WITH 3/8-INCH CRUSHED GRAVEL (ASTM D448, SIZE #8). APPROXIMATELY 3,900 CY WILL BE REQUIRED FOR THE TOPSOIL LAYER.
4. BIOINTRUSION LAYER MATERIALS: THE BIOINTRUSION BARRIER MATERIAL SHALL BE CONSTRUCTED USING A GRADED ROCK RIPRAP. RIPRAP SIZE SHALL BE OF STONE SIZE SO THAT 50 PERCENT OF THE PIECES, BY WEIGHT, SHALL BE LARGER THAN THE D50 SIZE(4"). THE WELL GRADED MATERIAL SHALL BE A MIXTURE COMPOSED PRIMARILY OF LARGER STONE SIZES BUT WITH A SUFFICIENT MIXTURE OF OTHER SIZES TO FILL THE SMALLER VOIDS BETWEEN THE STONES. THE DIAMETER OF THE LARGEST STONE SIZE IN SUCH A MIXTURE SHALL BE 6" (1.5 TIMES THE D50 SIZE OF 4". THE THICKNESS OF THE BIOINTRUSION BARRIER MATERIAL LAYER SHALL BE A MINIMUM OF 1' AND A MAXIMUM OF 1.25'.

   THE BIOINTRUSION LAYER SHALL BE OBTAINED FROM A LOCAL SUPPLIER AND STOCKPILED SOUTH OF THE SITE BY THE OPERATOR FOR THE CONTRACTOR'S USE.

SHALLOW VADOSE ZONE NEUTRON PROBE ACCESS HOLES					
	SURFACE LOCATION		MEASURED		
HOLE	X	Y	DEPTH (FT)	ANGLE	AZIMUTH
1	41546.65	452792.603	200	30°	90°
2	41546.65	452991.693	200	30°	90°
3	41941.355	452981.054	200	30°	270°

KEYED NOTES

(1) THE FINAL COVER CONTOURS INDICATE TOP OF THE FINAL COVER.

(2) CONTRACTOR SHALL INSTALL AN ADMINISTRATIVE FENCE AROUND PERIMETER OF CONSTRUCTED LANDFILL COVER. ADMINISTRATIVE FENCE SHALL BE CONSTRUCTED ACCORDING TO DETAIL D, PLATE 6.

(3) CONTRACTOR SHALL CONSTRUCT A DRAINAGE SWALE IN ACCORDANCE WITH DETAIL C, PLATE 6. DRAINAGE SWALE SHALL BE CONSTRUCTED TO ENSURE POSITIVE DRAINAGE USING ELEVATIONS SHOWN ON THIS PLAN AS A GENERAL GUIDE.

SEEDING PLAN

1. SEEDING SHALL COMPLY WITH CONSTRUCTION SPECIFICATION 02930, RECLAMATION SEEDING AND MULCHING.
2. THE FOLLOWING SEED MIX SHALL BE USED FOR SEEDING OF THE FINAL GRADE, BORROW LOCATION, LAYDOWN AREAS, AND OTHER LOCATIONS IMPACTED BY CONSTRUCTION ACTIVITIES:

SEED SPECIES	SEEDING RATE PURE LIVE SEED (POUNDS PER ACRE)
BLACK GRAMA	6.0
GALLETA GRASS	8.0
RING MUHLY	3.0
SPIKE DROPSEED	3.0

ESTIMATED BORROW QUANTITES	
TOPSOIL LAYER	3900 CY
BIOINTRUSION LAYER	4900 CY
NATIVE SOIL LAYER	13,200 CY

LEGEND

- EXISTING INDEX CONTOUR
- EXISTING INTERMEDIATE CONTOUR
- FINAL ADMINISTRATIVE FENCE
- FINAL COVER INDEX CONTOUR
- FINAL COVER INTERMEDIATE CONTOUR
- MW-4 GROUNDWATER MONITORING WELL
- DRAINAGE SWALE CENTERLINE
- SHALLOW VADOSE ZONE NEUTRON PROBE ACCESS HOLES
- PROJECT BENCHMARKS

P.O. OR W.O. / PROJECT NO.	REV	DATE	DESCRIPTION	DWN	CKD	APP
	B	7/29/05	ISSUED FOR VOLUNTARY CORRECTIVE MEASURE	M.T.D.	G.A.W.	H.C.S.
	A	5/23/03	ISSUED FOR REGULATORY REVIEW	S.F.G.	R.A.W.	H.C.S.

U.S. DEPARTMENT OF ENERGY
KIRTLAND AREA OFFICE
ALBUQUERQUE, NEW MEXICO

SANDIA NATIONAL LABORATORIES
ALBUQUERQUE, NEW MEXICO

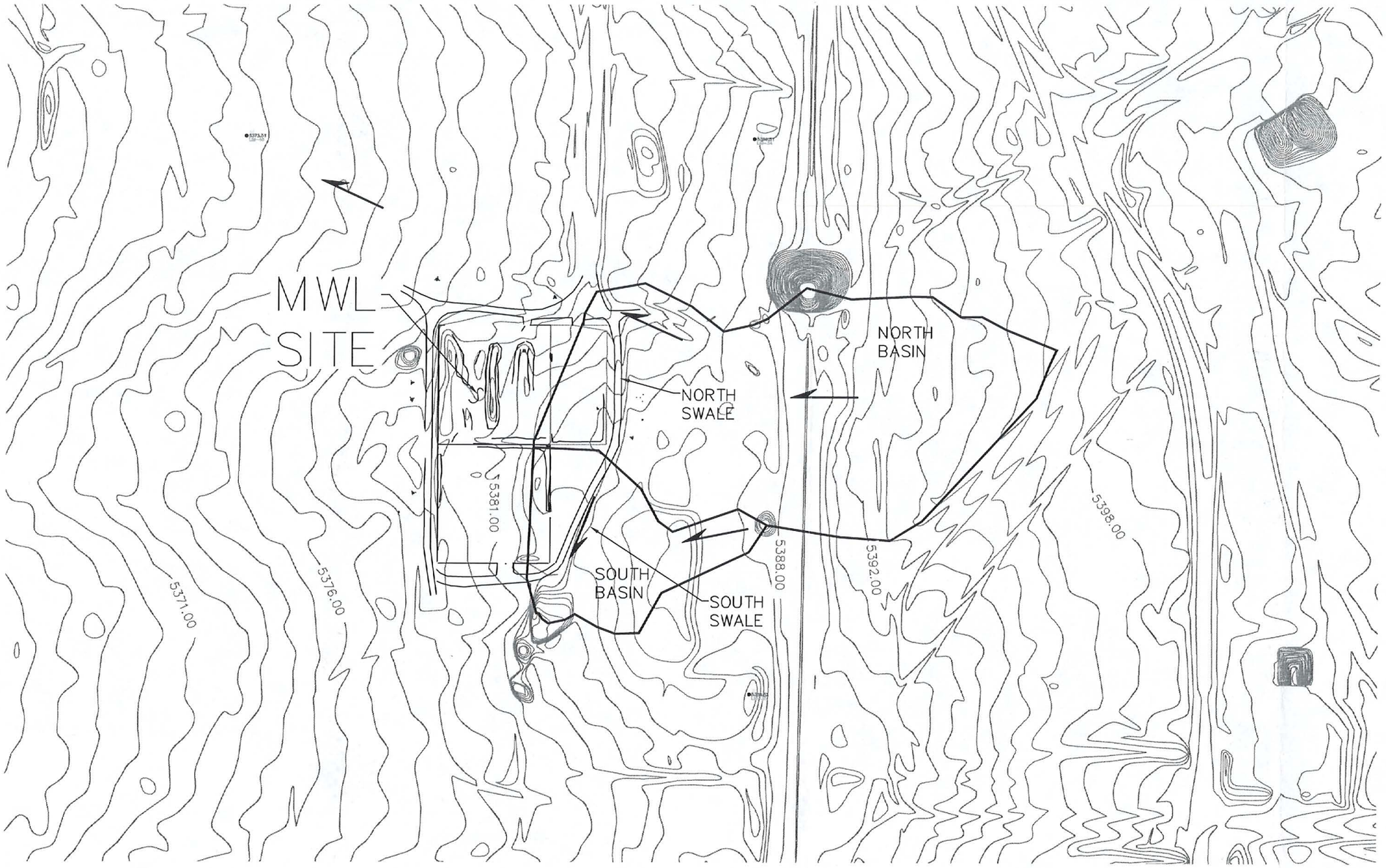
FINAL COVER

MIXED WASTE LANDFILL
FINAL COVER GRADING PLAN

P.O. OR W.O.	
PROJECT NO.	
DRAWN BY	M.T.D./S.F.G.
CHECKED BY	G.A.W.
APPROVED BY	H.C.S./xx
DATE	07.29.05
SIZE	D+
DRAWING NO./SHEET	999997/A6.91
PLATE	4

CAD DRAWING
COMPUTER SYSTEMS DEPT. 7901
SITE UTILITIES DEPT. 7829/7823
FILE NAME: 999997A6.91
REFERENCE FILES:

EXHIBIT 1



0 100 200

SCALE 1" = 200'

DIRECTION OF FLOW

BASIN BOUNDARY

URS

6501 AMERICAS PARKWAY N.E., SUITE 900
ALBUQUERQUE, NEW MEXICO 87110
(505) 855-7500 FAX: (505) 855-7555

TOPOGRAPHICAL MAP FOR MIXED WASTE EXHIBIT #2

MWL SITE
AS OF DECEMBER, 2006

Volume I

TAB 13

DOE/Sandia Responses to the NOD Part 2 Comments: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005

(Includes submittal of the 2nd Edition of Appendix E, SAND2007-0170)

From: SNL/Wagner
To: NMED/Bearzi

Back of Tab 13

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

JAN 19 2007

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road, East, Bldg. 1
Santa Fe, NM 87505

Dear Mr. Bearzi,

On behalf of the Department of Energy (DOE) and Sandia Corporation (Sandia), DOE is submitting the second response to the Notice of Disapproval (NOD): Mixed Waste Landfill Corrective Measures Implementation Work Plan, November 2005 and Requirements for Soil-Vapor Sampling and Analysis Plan, Sandia National Laboratories, EPA ID NM5890110518, HWB-SNL-05-025. In a letter dated December 21, 2006, we submitted responses to Part 1 comments and the required Soil Vapor Sampling and Analysis Plan.

Enclosed with this letter is an Errata sheet correcting a typographical error in the response to Part 1 Comment Number 15. In addition, the enclosure contains responses that address Part 2 comments.

As part of this response submittal, DOE and Sandia are presenting additional information on the monitoring trigger evaluation process. This information provides the basis for requirements to be established under the Long Term Monitoring and Maintenance Plan (LTMMP). Accordingly, this information is preliminary and will be finalized in the LTMMP which is required for submittal to the New Mexico Environment Department and subject to a public review and comment period.

If you have any questions regarding this submittal, please contact me at (505) 845-6036 or Joe Estrada of my staff at (505) 845-5326.

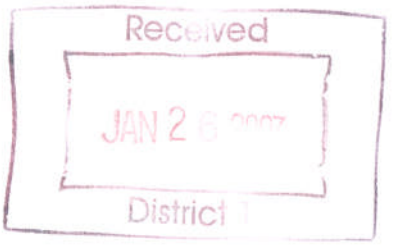
Sincerely,

Kimberly A Davis for

Patty Wagner
Manager

Enclosures (2)

JAN 1 9 2007



cc w/enclosures:
W. Moats, NMED (via Certified Mail)
J. Kieling, NMED, Santa Fe
L. King, USEPA, Region VI (via Certified Mail)
T. Skibitski, NMED-OB
T. Longo, NNSA/NA-56/HQ, GTN
UNM Zimmerman Library

cc w/o enclosure:
M. Reynolds, NNSA/SSO, MS-0184
J. Gould, NNSA/SSO, MS-0184
A. Blumberg, SNL/NM, Org. 11100, MS- 0141
P. Freshour, SNL/NM, Org. 6765, MS-1089
D. Miller, SNL/NM, Org. 6765, MS -0718
C. Ho, SNL/NM, Org. 6313, MS- 0735
T. Goering, SNL/NM, Org. 6765, MS -1089
S. Griffith, SNL/NM, Org. 6765, MS-1089
M. J. Davis, SNL/NM, Org. 6765, MS-1089
Records, Center, SNL/NM, Org. 6765, MS-1089

AOP 95-45, 06

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **DOE/Sandia Response to NMED's "Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Work Plan, November 2005" (Comment Set 2), January 2007**

Document authors: **Tim Goering, 6765 and Cliff Ho, 6313**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 1/15/07

Peter B. Davies
Director
Nuclear Energy & Global Security Technologies
Division 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

Date

and

Signature: _____ 1/19/07

Patty Wagner
Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

for

Date

ERRATA SHEET

Part 1, Comments on Landfill Construction Plans and Performance Modeling

Revised Response to Comment No. 15, Comment Set 1 (SNL December 2006):

15. Appendix B, Construction Quality Assurance Plan, Section 8.7 -- The Final Report must be submitted to the NMED as part of the CMI Report. The Final Report must include copies of all quality control data generated by the construction contractor as well as the quality assurance data generated by the CQA contractor.

Response: The Construction Quality Assurance **Report** will include all quality control data generated by the construction contractor as well as quality insurance data generated by the CQA contractor. The Construction Quality Assurance **Report** will be submitted to the NMED as part of the CMI Report.

Note: The original response incorrectly referred to the document as a Construction Quality Assurance Plan, rather than a Construction Quality Assurance Report.

Sandia Corporation
Albuquerque, New Mexico
January 15, 2007

DOE/Sandia Responses to NMED's "Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Work Plan, November 2005"

Comment Set 2

INTRODUCTION

This document responds to the second set of comments received in a letter from the New Mexico Environment Department (NMED) to the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia) on November 24th, 2006 regarding the Mixed Waste Landfill (MWL) Corrective Measures Implementation (CMI) Plan for Sandia National Laboratories (SNL). The letter is entitled "Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Work Plan, November 2005, and Requirement for Soil-Vapor Sampling and Analysis Plan, Sandia National Laboratories" [EPA ID NM5890110518, HWB-SNL-05-025].

The NMED letter contains two sets of comments, divided based on subject. The first set is entitled, "Part 1, Comments on Landfill Construction Plans and Performance Modeling". A response to the first set of comments was submitted by DOE/Sandia to NMED on December 21, 2006 (SNL December 2006). This document provides a correction for the response to Comment No. 15 in Comment Set 1 along with the DOE/Sandia response to the second set of comments, which are entitled, "Part 2, Comments on the MWL Fate and Transport Model (Appendix E)".

This document lists each NMED comment, and DOE/Sandia's response to that comment. The NMED comment is listed in boldface, followed by the DOE/Sandia response, written in normal font under "Response".

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.

Part 2. Comments on the MWL Fate and Transport Model (Appendix E)

1. Section 2.1.2.2 -- The last paragraph of Section 2.1.2.2 states, "Present conditions were simulated by modeling infiltration through various thicknesses of an engineered cover, while future conditions were simulated by modeling infiltration through various thicknesses of soil under natural conditions (i.e., the 'natural analog')." This description implies that present and future conditions are simulated using different designs (in the near term an engineered cover which in the future eventually degrades to the conditions of natural soil). Section 3.4.2 states that the engineered soil cover reverts to the natural soil conditions around the landfill. Provide clarification in Section 2.1.2.2 regarding the evolving soil conditions within the cover. Explain what soil conditions are expected to evolve, why and when they will evolve, and what will they will evolve to.

Response: Cover performance modeling was conducted in 2003 and 2004 using site-specific climate, hydrologic, and vegetation input parameters, and is discussed in depth the document entitled, "Calculation Set for Design and Optimization of Vegetative Soil Covers" (Peace and Goering 2005). This modeling effort simulated cover performance under present and future conditions using the same design, but slightly different soil hydraulic properties. A complete copy of this report is included on the CD as Attachment 1, under the subdirectory, "Supporting Documentation".

Soil hydraulic properties for modeling present conditions were determined by measuring soil hydraulic properties of an engineered cover test plot, while soil hydraulic properties for modeling future conditions were determined by measuring soil hydraulic properties of the natural analogue. Additional information on measurement of the soil hydraulic properties for both modeling scenarios is presented below.

Present Conditions – Engineered Cover Properties

Soil hydraulic properties for the engineered vegetative cover were determined by field and laboratory measurements conducted on an engineered cover test plot constructed at the IP Test Site west of the MWL. The engineered cover test plot was constructed to the same bulk density and initial moisture contents specified in the current MWL cover design. The test plot consisted of 6 feet of compacted native soil overlain by 9 inches of uncompacted native topsoil. The native soil layer was placed in 8-inch loose lifts to attain maximum 6-inch compacted lift thickness. The native soil was compacted to not less than 90% maximum dry density at -3 to +2 percentage points of optimum moisture content, as determined by ASTM D698 (Standard Proctor testing). A total of 13 lifts, excluding subgrade, were placed to complete construction of the engineered cover test plot. Additional details on the construction of the engineered cover test plot and the measurement of the soil hydraulic properties are presented in Section 4.2 of the document, "Calculation Set for Design and Optimization of Vegetative Soil Covers, Sandia National Laboratories, Albuquerque, New Mexico" (Peace and Goering 2005).

Field and laboratory tests were conducted on the soils of the engineered cover test plot to

measure the soil hydraulic and geotechnical properties used for performance modeling of the engineered cover. Because the engineered cover test plot was constructed to the same specifications as the proposed MWL cover using the same soil type, the soil hydraulic properties of the engineered test plot were considered representative of the proposed MWL cover. Thus, the modeling results from the engineered cover represent present conditions for the proposed MWL cover.

Future Conditions – Natural Analogue Properties

The soil hydraulic properties for the natural analogue were determined by field and laboratory measurements conducted on undisturbed soils near the IP test site west of the MWL. The soil hydraulic properties of the natural analogue are discussed in Section 6.5.3 of Peace and Goering (2005). The soil hydraulic properties of the natural analogue were considered representative of future conditions for reasons presented below.

Evolution of Soil Conditions within the Cover:

The MWL engineered cover will gradually evolve over time to a more natural system (i.e. the natural analogue) as vegetation is established, and natural processes gradually affect the properties of the cover. Pedogenic processes (i.e., soil evolution) will change soil physical and hydraulic properties that are fundamental to the performance of the engineered cover. Pedogenesis includes processes such as 1) hydraulic and mechanical redistribution of soil particles, affecting soil hydrologic properties (i.e. bulk density, porosity, and hydraulic conductivity); 2) formation of macropores for preferential flow associated with root growth, animal intrusion, and soil structural development; 3) secondary mineralization, deposition, and illuviation of fines, colloids, soluble salts, and oxides that can alter water storage and infiltration; and 4) soil mixing caused by freeze-thaw activity, animal burrows, and the shrink-swell action of expansive clays (Chadwick and Graham 2000).

Although vegetation will be established on the MWL cover within three to five years, the pedogenic processes discussed above will take many years for the engineered cover to evolve to, and perform like the natural analogue. Pedogenic processes are driven by climate, organisms, topographic relief, parent material, and time. Many interactions occur between water, air, temperature, microorganisms, plants, animals, and their residues, affecting the mineral material of the original soil and its position in the landscape. During its evolution, the soil profile slowly expands and deepens, developing characteristic discrete soil layers called horizons, while a steady-state balance is approached. One cannot predict when steady state (i.e. the natural analogue) is attained. For this reason, the soil properties of the natural analogue were considered, and used as modeling input parameters to assess the future performance of the MWL cover.

Cover Performance Modeling of Present Conditions versus Future Conditions

Cover performance modeling of both the engineered cover and the natural analogue was conducted using input parameters measured on the engineered cover and the natural

analogue, as described above. Present conditions were simulated by modeling cover performance assuming soil properties of the engineered cover. Future conditions were simulated by modeling cover performance assuming soil properties of the natural analogue. Table 1 presents the model input parameters for both the engineered cover and the natural analogue.

The modeling results confirm that under both current and future scenarios, the MWL cover will meet the EPA-prescribed technical equivalency criteria for RCRA landfills. These criteria are a net annual infiltration of 31.5 millimeter/yr, and an average infiltration rate of $1 \text{ X } 10^{-7}$ cm/s or less (Peace and Goering 2005).

Table 1. UNSAT-H Code Input Parameters

Parameter	Natural Analogue		Engineered Cover		Source
	Input value	Unit(s)	Input value	Unit(s)	
Initial Head	17,200	cm	5620	cm	RETC Code
θ_s	0.39	Percent	0.35	Percent	RETC Code
θ_r	0.001	Percent	0.001	Percent	RETC Code
α	0.0309	cm^{-1}	0.022	cm^{-1}	RETC Code
n	1.19	(-)	1.26	(-)	RETC Code
ℓ	0.5	(-)	0.5	(-)	[a]
K_s	4.05×10^{-4}	cm/s	3.46×10^{-4}	cm/s	Field
Root Depth	80	cm	80	cm	Field
LAI Historical Precipitation	0.8 max	(-)	0.8 max	(-)	[b, c, d]
LAI Maximum Precipitation	1.2 max		1.2 max		
Growing Season	2–364	Julian Day	2–364	Julian Day	[b, c, d]
Percent Bare Area	81	Percent	81	Percent	Field
RLD coefficient *a*	0.5090	(-)	0.5090	(-)	Field
RLD coefficient *b*	-0.0630	(-)	-0.0630	(-)	Field
RLD coefficient *c*	0.0262	(-)	0.0262	(-)	Field
Ψ_w	30,000	cm	30,000	cm	[e, f, g]
Ψ_d	3000	cm	3000	cm	[h, i]
Ψ_n	30	cm	30	cm	[h, i]
PET coefficient *a*	0	(-)	0	(-)	[j]
PET coefficient *b*	0.52	(-)	0.52	(-)	[j]
PET coefficient *c*	0.5	(-)	0.5	(-)	[j]
PET lower limit *d*	0.0	(-)	0.0	(-)	[j]
PET upper limit *e*	3.7	(-)	3.7	(-)	[j]

[a] Maulem (1976)
[b] NMED (1998)
[c] Scurlock et al. (2001)
[d] Munk (2004)
[e] HDR Engineering (2000)
[f] ITRC (2003)
[g] Hillel (1998)
[h] Fayer (2000)
[i] Feddes et al. (1978)
[j] Ritchie and Burnett (1971)

α Air entry parameter
θ_r Residual moisture content
θ_s Saturated moisture content
Ψ_w Wilting point
Ψ_d Limiting point
Ψ_n Anaerobic
cm Centimeter(s)
K_s Saturated hydraulic conductivity
ℓ Mualem numerical parameter
LAI Leaf area index
max Maximum
n van Genuchten curve-fitting parameter
PET Potential evapotranspiration
RDL Root length density

2. The first paragraph of Section 3.2.1 states that lead, cadmium, and radionuclides (except radon) were modeled using the Framework for Risk Analysis in Multimedia Environmental Systems (FRAMES) and Multimedia Environmental Pollutant Assessment System (MEPAS) simulation tools. Section 3.2.2 states, "A separate model was used to model the transient transport of tritium at the MWL". The reader, however, does not learn until Section 3.7.1 that tritium was also modeled using FRAMES and MEPAS. Revise the text of Section 3.2.1 to indicate tritium was modeled using FRAMES and MEPAS, as well as the separate transient transport model.

The second paragraph of Section 3.2.1 indicates MEPAS is capable of computing contaminant fluxes for multiple routes, including radioactive decay and contaminant degradation. The paragraph states further that MEPAS was used only for the source-term and vadose-zone models, suggesting MEPAS was not used to model radioactive decay. In contrast, Section 3.2.2 indicates that the transient model for tritium and perchloroethene (PCE) accounts for contaminant decay. Clarify whether the modeling of radionuclide transport through the vadose zone at the MWL accounts for contaminant decay.

Response: The text in Sections 3.2.1 and 3.2.2 has been clarified to indicate that FRAMES/MEPAS can only simulate liquid-phase transport of constituents such as tritium. A separate analytical model was used to simulate the gas and liquid-phase transport of tritium.

The use of source-term and vadose-zone models in MEPAS does not preclude radioactive decay. Constituent decay can occur in both the source-term and vadose-zone transport models. Text has been added to Section 3.2.1 to clarify this. The revised Probabilistic Performance Assessment Modeling Report is included in Appendix A.

3. The first paragraph of Section 3.3 references Table E-2, which provides a summary of input parameters and distributions of constituents used in the modeling. Footnotes "b" and "d' reference an EPA fact sheet for tetrachloroethene; the fact sheet was reportedly accessed on the U.S. EPA website at www.epa./WGWDW/dwh/t-voc/tetrachl.html, but it is not referenced in Section 6, References, of the report. The fact sheet was not available at the web address provided, so the input parameters could not be verified. Provide the fact sheet as an attachment to the report and update the website address, if available, for the fact sheet. Also, revise Section 6 to include this fact sheet among the references. In addition, provide all other internet-referenced data as attachments to the report and cite these sources in Section 6.

Response: There was a typo in the URL address for the PCE fact sheet. This has been corrected and all online references have been added to Section 6. PDF versions of these web pages are included in the attached CD (Attachment 1). The online references are listed in Section 6 as follows:

- U.S. EPA, Tetrachloroethylene (PCE) Online Fact Sheet: www.epa.gov/OGWDW/dwh/t-voc/tetrachl.html

- U.S. EPA, Cadmium Online Fact Sheet:
  www.epa.gov/safewater/dwh/t-ioc/cadmium.html

- U.S. EPA, Lead Online Fact Sheet:
  www.epa.gov/safewater/dwh/t-ioc/lead.html

- U.S. EPA, Henry's Constant Online Calculator:
  www.epa.gov/athens/learn2model/part-two/onsite/esthenry.htm)

4. Section 3.4.2, page E-35, 2nd paragraph -- Explain why future infiltration rates would be less than current rates.

Response: The cover performance modeling predicted the average infiltration rate through the engineered cover (representing present conditions) to be 1.18 X 10^{-9} cm/s for historical precipitation, and 5.34 X 10^{-9} cm/s for the maximum precipitation scenario (Peace and Goering 2005). The modeling predicted the average infiltration rate for the natural analogue (representing future conditions) to be 2.44 X 10^{-10} cm/s for the historical precipitation scenario, and 1.04 X 10^{-9} cm/s for the maximum precipitation scenario.

The difference in modeling results between the engineered cover (representing present conditions) and the natural analogue (representing future conditions) reflect variations in soil properties between the engineered cover and the natural analogue, as shown in Table 1. These include minor differences in saturated hydraulic conductivity (4.05 X 10^{-4} cm/s for the natural analogue, versus 3.46 X 10^{-4} cm/s for the engineered cover) and porosity, as indicated by the saturated moisture content (θ_s) of 0.39 for the natural analogue versus 0.35 for the engineered cover. These variations in soil properties are a result of the pedogenic processes discussed above (see Response to Comment No. 1), and result in a net increase in porosity and hydraulic conductivity. The increased porosity and hydraulic conductivity of the natural analogue facilitate evapotranspiration, resulting in a net decrease in infiltration rate for the natural analogue (i.e. future conditions).

5. **Section 3.6, Fate and Transport of Radon -- Radon was modeled as originating from radium-226 sources. Explain why radon originating from the decay of depleted uranium was not incorporated into the radon fate and transport model.**

Response: Radon was included as a daughter product of uranium-238 in the FRAMES/MEPAS simulations, as discussed in Section 3.6.2.2 and 3.7.2.2. However, U-238 was not included as a source of radon for the gas-transport model detailed in Section 3.6.2.2 because the activity of Ra-226 (parent of Rn-222) resulting from the decay of uranium-238 is negligible (15 microCuries after the first 1,000 years) relative to the activity of Ra-226 assumed in the model (6-12 Curies). This has been clarified in the text.

6. Section 4, Pages E-59 and E-59a -- Revise the trigger evaluation process to follow the corrective action process described in the Consent Order (April 29, 2004) if a trigger level is exceeded (step 3A), provided the Consent Order is still in force at the time the trigger level is exceeded. If the Consent Order has terminated, the trigger evaluation process

should follow the standard RCRA corrective action process.

Response: To be consistent with the Compliance Order on Consent (NMED April 2004) between the NMED, the DOE, and Sandia Corporation, hereinafter referred to as the Consent Order, several minor modifications were made to the trigger evaluation process figure on Pages E-59 and E-59a. The Consent Order requires notification of the NMED in writing within 15 days after the discovery of any previously unknown release of a Contaminant from a SWMU or Area of Concern. For consistency with the Consent Order, Step 3B on Figure E-25 has been revised to state, "If verified, notify NMED ***in writing within 15 days*** and increase sampling frequency as negotiated with NMED".

In addition, the following line was added to Item 5 on Page E-59a, which explains the trigger evaluation process, ***"If the NMED determines that further investigation of the trigger exceedance is needed, NMED may require corrective action based on a finding that releases of contaminants have occurred, are occurring, or are likely to occur."***

The revised Trigger Evaluation Process is shown in Figure 1 below. All proposed monitoring triggers are considered preliminary at this point, and provide the basis for requirements to be established under the Long Term Monitoring and Maintenance Plan (LTMMP). Accordingly, this information is preliminary and will be finalized in the LTMMP which is required for submittal to NMED and subject to a public review and comment period.

7. Section 3.3 -- The fourth paragraph of Section 3.3 discusses the dose via inhalation and dermal adsorption for gas-phase tritium, but a similar discussion is not presented for radon gas or gas-phase PCE. Clarify whether this dose discussion is applicable to all gas-phase constituents considered in the Report. If the dose discussion is only applicable to gas-phase tritium, then explain why this is the case. Alternatively, discuss inhalation and dermal adsorption doses for radon gas and gas-phase PCE.

Response: Inhalation and dermal adsorption of gas-phase radon and PCE were not used as performance metrics in this analysis. Table 1 in Section 3.1 of the Performance Assessment Modeling Report summarizes the performance metrics that were used for these constituents. Text has been added to clarify this in the report. The inhalation dose is only applicable to gas-phase tritium because the enforceable regulatory metrics pertaining to radon and PCE do not use dose (surface flux is used for radon and groundwater concentration is used for PCE).

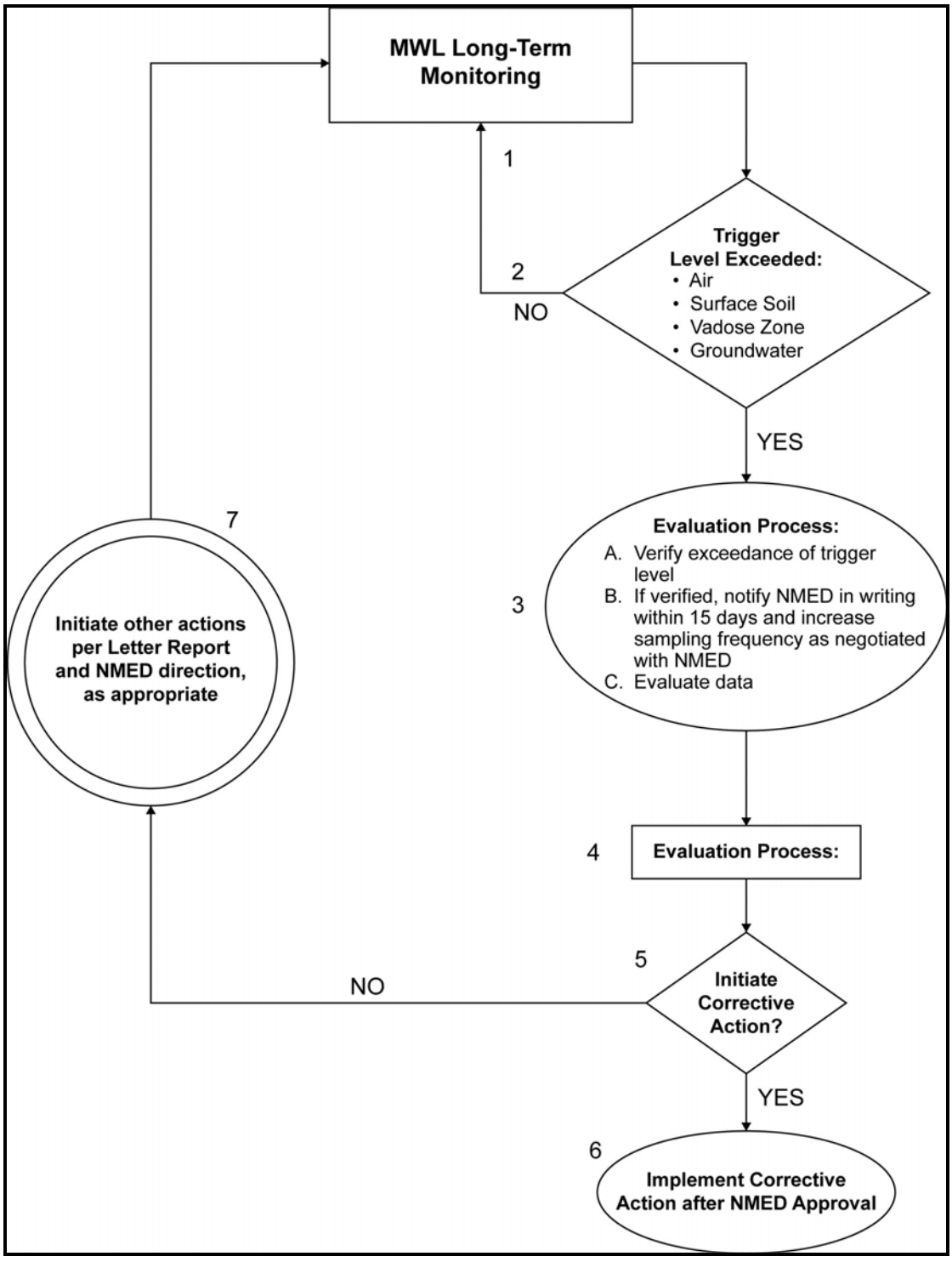


Figure 1. Trigger evaluation process for the Mixed Waste Landfill (revised)

8. Section 3.4.1 --The first paragraph of Section 3.4.1 states the modeling study of water infiltration through the cover was "discretized by placing computational nodes at predetermined vertical spacing in a conceptual soil profile to evaluate the performance of a cover 3 ft in thickness." The model evaluated a soil profile that was actually 6 feet thick in order to avoid impacts due to boundary conditions, but these impacts and boundary conditions are not discussed. Thirty nodes were located within this 6-foot-thick soil profile. However, the discussion does not describe how or why the 30 node locations were predetermined within this soil profile. Explain the specific impacts caused by boundary conditions. Clarify how and why the computational node locations were predetermined.

The conceptual soil profile for the infiltration model, as discussed in Section 3.4.1, is presented side-by-side in Figure E-3 with nodal discretization used in the UNSAT-H model. As illustrated, the conceptual soil profile does not correspond to the components of the MWL soil cover cross-section. The soil profile illustration is dimensionless; i.e., it is not clear whether the soil profile is 6 feet thick. Also, only 23 of the 30 computational nodes within the cross-section are shown. In addition, the nodal depth locations cannot be determined from the illustration. Revise the Figure E-3 conceptual model to clearly indicate the components of the MWL soil cover (i.e., subgrade layer, biointrusion barrier, native soil layer, topsoil layer, and vegetation) and their location relative to the MWL waste zone. Revise Figure E-3 to include a vertical scale for depth (i.e., inches or feet below the cover surface) and the locations of all 30 computational nodes. Clarify the soil type specified for each component of the soil cover.

Response: Section 3.4.1 presents only a conceptualization of the model used to predict water percolation through the cover. A detailed description of the model and extensive discussion of the input parameters, boundary conditions, and results are discussed in the document, "Calculation Set for Design and Optimization of Vegetative Soil Covers, Sandia National Laboratories, Albuquerque, New Mexico" (Peace and Goering, 2005). Additional information from this report is included below.

Node Locations:

The 30 node locations within this soil profile were carefully selected to minimize modeling computational requirements, yet yield accurate numerical results. Node spacing is very fine near the ground surface and becomes progressively larger with increased depth through the soil profile. The fine node spacing near the surface is necessary for an accurate numerical solution because very large and rapid changes in suction head occur as the surface dries and wets in response to evaporation and precipitation. Deeper in the soil profile, suction head changes are less dramatic and node spacing is increased. This spacing was selected to minimize numerical errors while maintaining reasonable execution times.

By code convention, nodal depths in the soil profile were assigned metric values. The node locations were "predetermined" within the soil profile to facilitate interpretation of modeling results. Node numbers 10, 14, 19, 22, and 26 were assigned depths of 30, 61, 91, 122 and 152 cm, respectively, to represent the lower boundary of covers 1,2,3,4 and 5 ft in thickness. Model output included flux across each nodal boundary; hence, the results could be used to optimize cover thickness for the remedy design.

Boundary Conditions:

Boundary conditions were selected to be conservative with regards to prediction of net percolation through the cover. Hence, predicted percolation values may be higher than actual percolation values. The water flow for the upper boundary (i.e., through the surface of the soil profile), is specified as an evaporation flux boundary and an infiltration boundary equivalent to hourly precipitation over a 24-hr period. The water flow for the lower boundary or the base of the soil profile at 6 ft is specified as a unit downward gradient —flow is always directed downward. A lower boundary specified as a unit gradient is conservative because in nature, movement of water is either upward or downward as the soil profile responds to precipitation, evaporation, and transpiration. Since hourly precipitation is designated and the model regards daily precipitation as occurring over a 24-hr period, all flow is directed downward through the soil profile.

Nodal Discretization versus Conceptual Soil Profile (Figure E-3):

The MWL cover was modeled as a lithologic monolayer to be conservative. A soil profile with uniform soil and hydrologic properties translates into a significant conservative estimate of liquid water flow, i.e. water flow is increased. If multiple layers are simulated, the water potential in the underlying layer must equal the water potential in the overlying layer before flow into the lower layer occurs. Multiple layering in performance modeling as well as multiple layers in nature attenuate the downward flow of liquid water (e.g., yielding multiple capillary barriers that slow water flow).

Figure E-3 does not show the actual components of the MWL soil cover (i.e., subgrade layer, biointrusion barrier, native soil layer, topsoil layer, and vegetation), because the model did not model each of these as individual components of the cover. Figure E-3 represents a conservative 3-ft thick, monolithic cover (i.e., the native soil layer, the topsoil layer, and the vegetation). The subgrade layer adds additional thickness to the lithologic monolayer represented by the modeled thicknesses of 4 and 5 ft. Although the biointrusion barrier was not modeled, its inclusion in the design does not adversely affect cover performance. In fact, the biointrusion barrier serves as a capillary break, further reducing the downward flow of water and adding additional conservatism to the estimate of net percolation by the model.

The figure has been revised to include a vertical scale for depth (i.e., feet below the cover surface) and the locations of all 30 computational nodes. However, to be true to the infiltration model, the biointrusion barrier, subgrade layer, and underlying wastes are not shown on the revised figure. The revised figure is shown below.

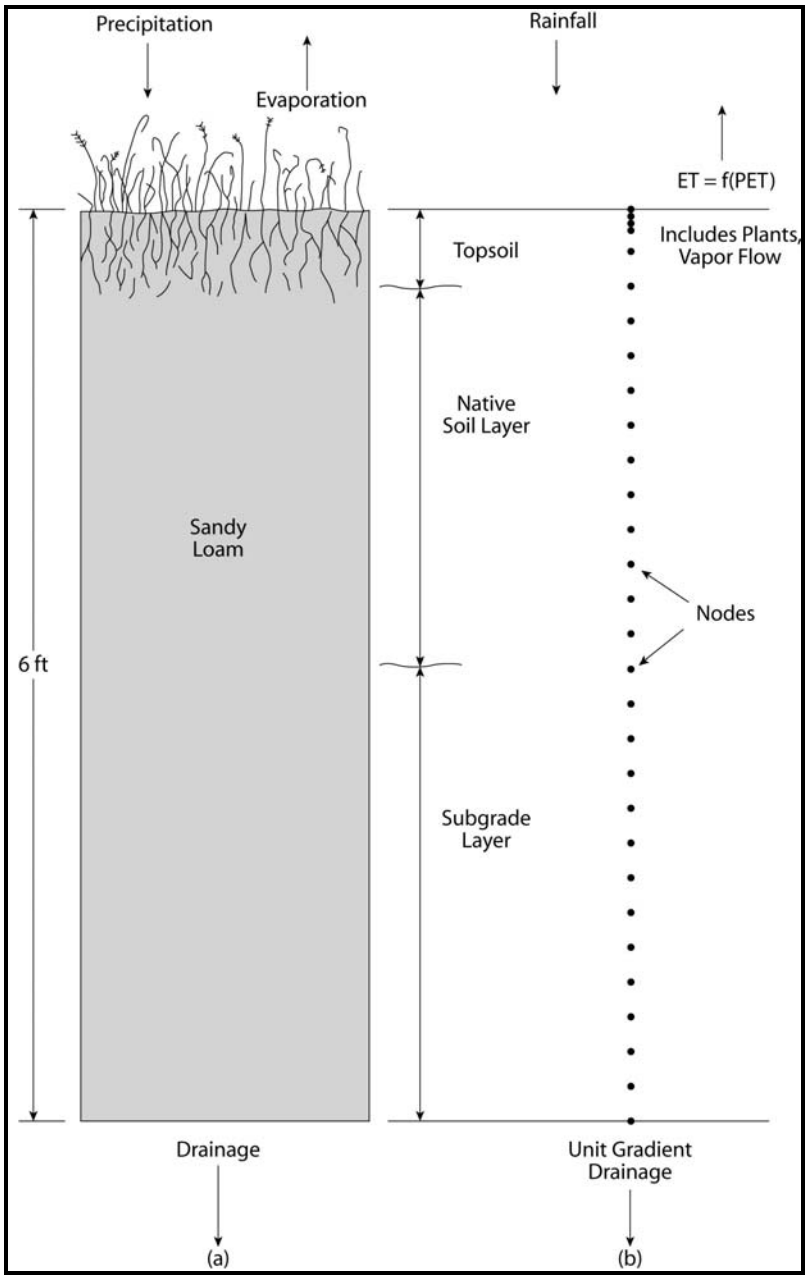


Figure 2. (a) Conceptual model for infiltration model. (b) Nodal discretization in UNSAT-H.

Soil Type Modeled:

The soil type modeled for the cover is a sandy loam.

9. Section 4.2.2 -- Section 4.2.2 discusses the proposed neutron probe system for monitoring moisture content beneath the MWL. However, for the neutron probes to detect percolation through the soil cover, water will have to move through the bio-

intrusion barrier, the waste zone, and a portion of the vadose zone prior to detection, which would be expected to require a considerable amount of time. The neutron probe system is thus more reliably a vadose-zone monitoring system rather than a tool to determine loss of integrity of the soil cover. If the Permittees want to monitor the cover for performance, the neutron probes should be placed just below the cover in the subgrade.

Response: Neutron probes installed immediately below the cover in the subgrade could be used to detect changes in moisture content as a result of infiltration through the cover. However, installation of horizontal neutron access tubes beneath the MWL to monitor moisture would yield limited additional monitoring benefits. The behavior of the cover design was evaluated at the engineered cover test plot constructed at the IP Test Site west of the MWL and is well understood. It is of more interest to monitor the vadose zone beneath the landfill to monitor potential migration of contaminants from the landfill. The proposed neutron probe system is suggested as part of the vadose zone monitoring system to be utilized for long-term monitoring of the landfill.

Installation of vertical neutron probe access holes through the MWL cover to monitor the subgrade is also not recommended. Access holes installed directly through the cover would increase the potential for preferential flow down the boreholes, and into the underlying wastes. In addition, increased vehicular traffic on the cover during monitoring activities could damage the vegetation growing on the cover, and would negatively affect bulk density and porosity of the cover. Increased traffic on the cover may also cause rutting and potential erosion of the cover itself.

The current neutron moisture monitoring system, consisting of three boreholes angled 30 degrees from vertical beneath the MWL, will be used to monitor the vadose zone beneath the landfill, and to indirectly monitor the cover performance. If infiltration through the cover were to significantly increase, the resulting percolation through the disposal cell would be detected by neutron moisture logging in the underlying vadose zone. The angled boreholes extend well beneath the lateral extent of the cover with depth, as shown in Plate 4 of the MWL CMI Plan, and will intercept any increased percolation through the cover. Additional details on use of the current neutron moisture monitoring system to monitor cover performance are included in the response to Comment No. 16, below.

10. Figures -- Figures E-13, E-15, E-19, and E-24 present a graphical illustration of the sensitivity analyses performed for some of the constituents. The figures present histograms to compare ΔR^2 for constituent concentration and dose. Clarify why actual concentrations and doses were not presented in the sensitivity analyses.

Response: Section 2.2.1 describes the stepwise linear rank-regression sensitivity analysis that was used in this study. In this approach, the actual concentrations and doses *are* used as performance metrics in the sensitivity analyses. The impact of the uncertainty of the input parameters on the simulated performance metrics (e.g., concentration, dose) is evaluated, and the relative impact is presented as ΔR^2 in Figures E-13, E-15, E-19, and E-24 Those

parameters with a large ΔR^2 have a greater correlation to the simulated performance metric; in other words, the simulated performance metric (e.g., concentration, dose) has a greater sensitivity to those parameters. Additional text has been added to Section 3.5.2.3 to clarify this.

11. General Comment on the Fate and Transport Model -- Compared to typical reports for modeling studies, the report as presented is brief, particularly when considering the complexity of using a Monte Carlo approach with multiple models, scenarios, and constituents of concern. In general, the report provides a narrative of a probabilistic model that is presented as a "black box." The report discusses the input parameters and selectively presents output results, but there is not adequate information to assess whether the "black box" is operating satisfactorily. The report does not present a discussion regarding software quality assurance -- it is not known how well the various models work separately or together. Also, the report does not provide a critique of the modeling runs, except for an occasional qualitative statement In contrast, a typical modeling report is a detailed and exhaustive presentation that addresses the conceptual development and construction of the model (e.g., the data quality objectives, the software code), the software quality assurance performed (including software validation and verification) to assess model performance both separately and when working together, the details regarding specific inputs and outputs for all runs of every scenario, and a quantitative analysis of the sensitivities of the input parameters, including an assessment of the bias of the model toward specific outputs. The report, however, does not provide this level of information. The Permittees must provide additional information to address the deficiencies mentioned above.

Response: The software and models that are used in this report are taken from widely used packages (e.g., FRAMES/MEPAS) or peer-reviewed journal articles. The report provides references for each model and software that is used (the gas-phase radon-transport model is derived in an appendix). These references contain the full description of each mathematical model and associated validation studies, and the report qualitatively summarizes the relevant features and processes that are utilized in the analysis. We felt that this was the best approach for this report; inclusion of this material in the report would have made the report extremely large and cumbersome to read.

We agree, however, that additional work and materials are needed to provide quality assurance for the models and software used in this particular study. With regard to model and software validation and verification, we have added additional documentation of tests that demonstrate the models and software were working properly and as intended (see "Model_Supplement_12-7-06.doc," included on the CD in Attachment 1). This supplement includes additional details regarding each of the models and software that were used in the analyses, and tests are performed to demonstrate the performance of each model. Links are provided to the Mathcad models (written in plain English and symbolic text) for the radon, tritium, and PCE transport models. In addition, all of the model input and output files have been made available on the CD.

With regard to "details regarding specific inputs and outputs for all runs of every scenario," the CD contains Excel files that contain the inputs and outputs for every realization that was simulated for each constituent. This information is summarized in the cumulative distribution

functions and plots presented in the report. We believe that presenting the input and output data for every realization in the report would be excessive, so we have included it on the CD instead.

Finally, with regard to "a quantitative analysis of the sensitivities of the input parameters," this has been done and is described in the sensitivity-analysis sections throughout the report for each constituent (see Sections 3.5.2.3, 3.6.2.3, 3.7.2.3, and 3.9.2.3).

12. Provide information evaluating the risk to ecological receptors for tritium, radon, and radon daughter products, which are expected to be released to surface soil and the atmosphere.

Response: Risk to ecological receptors from tritium, radon, and radon daughter products that would be expected to be released to surface soil and the atmosphere is anticipated to be negligible, and is typically not evaluated for ecological risk. The primary components of ecological risk from these radionuclides are due to ingestion and external exposure.

SNL current ecological risk assessment methodology, as agreed upon by NMED, does not account for inhalation as a primary pathway. Within the current SNL ecological risk assessment methodology, the inhalation pathway is considered to be a minor pathway in the overall contribution to ecological risk. Furthermore, ecological risks due to radiological contaminants have been minimal at other SNL sites when compared to human health radiological risk assessment concerns (i.e., the allowable dose is significantly higher for ecological receptors when compared to human receptors), and are anticipated to be negligible at the MWL as well. For this reason, evaluation of risk to ecological receptors was not included in the report.

13. Provide information evaluating the risk to human receptors for tritium, radon, and radon daughter products that would be expected to be released to surface soil and the atmosphere. Include external exposures.

Response: For tritium, calculation of risk to human receptors can be estimated from dose which was calculated in the fate and transport (F&T) modeling report. The maximum dose from tritium calculated in the F&T realizations was 18 mrem/year, while the average dose was 1.7 mrem/year. The risk from these tritium doses ranges from 1E-5 to 1E-6.

Regulatory-based metrics (e.g., dose, groundwater concentrations, and surface flux rate for radon) provide a more rigorous basis for performance-assessment calculations than risk. For this reason, risk from tritium to human receptors was not calculated in the F&T report.

Risk from radon and radon daughter products is implicit in the airborne concentrations provided in the EPA guidelines. Dose/risk from radon and radon daughter products are considered as one. The majority of dose/risk from exposure to radon and its daughter products comes from the daughter products, which are solids that may be deposited in lung tissue.

The estimate of risk from radon is subject to considerable uncertainty, and depends on a

myriad of variables affecting dose for a given exposure scenario. For example, risk from radon (and its daughter products) is a function of age, gender and whether or not one currently smokes, has smoked in the past, or has never smoked. Additional information on the risk to human receptors from radon (and radon daughter products) is presented in the document, "EPA Assessment of Risks from Radon in Homes", US EPA 2003 (*http://www.epa.gov/radon/images/402-r-03-003.pdf*). A copy of this document is included on the attached CD (Attachment 1) under the subdirectory, "Supporting Documentation".

14. The NMED expects surface soil surrounding animal borrows (including ant nests) to be monitored for radionuclides and metals. Develop triggers that are protective of both human health and the environment for radionuclides and metals in soil.

Response: Surface soil surrounding select animal burrows and ant nests was sampled prior to clearing and grubbing the site in order to obtain baseline environmental monitoring data. The data are being evaluated, and will be presented in a report to NMED on baseline environmental monitoring data for the MWL that is currently being drafted.

During long-term monitoring at the MWL, DOE/Sandia will monitor animal burrows and ant nests (ant hills). Current plans are to survey locations of animal burrows and ant hills by GPS on an annual basis, and to collect surface soil samples from animal burrows and ant hills every five years to ensure that contaminants have not been mobilized by biota. The soil samples will be analyzed for RCRA metals, gamma-emitting radionuclides, and gross alpha and gross beta activity.

Triggers proposed for RCRA metals concentrations in the surface soil samples are the NMED Industrial/Occupational Soil Screening Levels (NMED 2006). Triggers proposed for gamma-emitting radionuclides are the NMED-HWB Approved Background Values (Dinwiddie 1997).

A table summarizing all proposed monitoring triggers is included in the DOE/Sandia response to Comment No. 20, below.

Please note that the Consent Order includes the corrective action requirements for the MWL but contains no requirements for radionuclides or the radioactive portion of mixed waste. Thus, any triggers proposed for radionuclides are provided voluntarily, pursuant to the Consent Order. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements of the Consent Order. Additional information on radionuclides and the scope of the Consent Order is available in Section III.A of the Consent Order. Throughout the remainder of this submittal, this paragraph will be referred to as the Consent Order note.

15. Develop triggers for tritium, radon, PCE and total VOCs as soil vapor. The NMED expects soil-gas in the vadose zone to be monitored for these constituents.

Response: In order to monitor soil vapor for contaminants, DOE/Sandia is proposing

installation of a robust monitoring system for sampling soil gas within the vadose zone at the MWL. The proposed vadose zone monitoring system would serve as an early warning system to protect groundwater, and would allow early detection of contaminants migrating through the vadose zone, before they impact groundwater quality. Soil gas samples would be analyzed for VOCs, but not for tritium or radon for reasons described below.

During the Phase 2 RCRA Facility Investigation (RFI) in the mid 1990s, extensive soil gas data were collected to determine the nature and extent of VOC contamination in near-surface soils at the site (SNL/NM 1996) with most of the samples collected from depths of 10 ft and 30 ft below ground surface. Although low concentrations of VOCs are present in the vadose zone at the MWL, they have not impacted groundwater quality based on sixteen years of groundwater monitoring data collected since 1990.

The proposed vadose zone monitoring system will provide updated data regarding VOC profiles with depth, and is proposed to consist of three Flexible Liner Underground Technologies (FLUTe™) sampling wells. The FLUTes™ are proposed to be constructed in vertical boreholes located immediately outside the perimeter of the MWL cover with the locations selected near areas where the highest concentrations of VOCs were detected during earlier studies at the MWL. Actual locations of the FLUTe™ boreholes will be selected in conjunction with NMED. Soil gas sampling ports are proposed to be installed in each FLUTe™ at depths of 50 ft, 100 ft, 200 ft, 300 ft, and 400 ft below ground surface.

Soil gas data collected from the FLUTes™ will be used to assess current VOC distributions with depth, and to monitor VOC concentrations over time, allowing early identification of any potential threats to groundwater. The VOC data from the FLUTes™ will also be used to update the MWL fate and transport model every five years, as required in the NMED Final Order (NMED 2005).

Triggers for Tritium and Radon

Analysis of FLUTe™ soil gas samples for tritium and radon is not recommended, as these are not routine analyses, and would yield data of limited value. Tritium and radon can be more directly monitored at ground surface, as described in Section 4.2.1 of the Performance Assessment Modeling Report. Because of tritium's high mobility, any significant releases of tritium would be readily detected in surface soils adjacent to the landfill, eliminating the need to sample tritium in soil gas. As discussed in the Performance Assessment Modeling Report, the proposed trigger for tritium in surface soils along the MWL perimeter is 20,000 pCi/L in soil moisture. Tritium concentrations measured in soil samples collected with depth during the Phase 2 RFI were relatively low below depths of 26 feet, pose minimal risk to human health, and have not impacted groundwater quality.

Radon will be monitored above ground surface along the MWL perimeter using track etch monitors (Section 4.2.1), with a proposed trigger value of 4 pCi/L in air. This technique is superior for analysis of radon flux over time, and will provide more useful information than time-discrete samples collected from the FLUTes™. Radon has not been detected above background levels in soils at the MWL, and any significant releases of radon in the near future are unlikely, due to the nature of the sealed sources containing radium-226, from which the

radon would emanate.

Please see Consent Order note provided in response to Comment No. 14.

Triggers for VOCs in the Vadose Zone

Triggers are proposed for PCE, TCE, and total VOCs in soil gas at the MWL. TCE has been detected in groundwater at other locations across SNL and Kirtland Air Force Base, and for this reason, a trigger is proposed for TCE, as well as PCE.

There are no regulatory limits for individual concentrations of volatile organic compounds in the vadose zone. DOE/Sandia propose trigger levels for TCE and PCE in soil gas based on a similar trigger proposed for the Chemical Waste Landfill (CWL). In the Post-Closure Care Plan for the CWL, a trigger of 20 ppmv was proposed for TCE in soil vapor samples collected from the deepest sampling ports (SNL September 2005). The CWL is located only 1.3 miles to the southeast of the MWL, and overlies similar hydrogeologic conditions, with similar depths to groundwater. Triggers protective of groundwater at the CWL should also be protective of groundwater at the MWL because of the similar hydrogeologic conditions at both sites.

DOE/Sandia propose triggers of 20 parts per million by volume (ppmv) for TCE and 20 ppmv for PCE for soil gas samples at the MWL. In addition, DOE/Sandia propose a trigger of 25 ppmv for total VOCs in soil gas samples at the MWL. These triggers, although not based on risk or regulatory limits, are sufficiently low to protect groundwater quality of the aquifer. All triggers would apply to samples collected from the deepest sampling port in each FLUTe™. Triggers would not apply to samples collected from shallower ports.

16. Table E-6 -- The proposed trigger value for "infiltration" is *25%* by volume. Specify whether "infiltration" means moisture content. Also, the proposed trigger is too high, as it likely represents conditions whereby there is near complete saturation of the soil.

Response: The trigger parameter actually applies to “moisture content” rather than “infiltration”. The moisture content of the subsurface soil provides an indirect indication of the infiltration through the cover. The EPA-prescribed technical equivalence criteria for RCRA landfills is an average infiltration rate of 10^{-7} cm/s through the landfill cover, equivalent to a net annual infiltration of 31.5 mm of water per year through the cover. Assuming an average vertical hydraulic gradient of unity, an infiltration rate of 10^{-7} cm/s would result in an underlying moisture content of the soils to be approximately 23 percent by volume. A 23 percent volumetric moisture content is equal to 59 percent saturation, assuming an average soil porosity of 39 percent.

Figure 3 shows the relationship between unsaturated hydraulic conductivity and volumetric moisture content for 18 subsurface soil samples collected from the IP Test Site, located 500 ft west of the MWL. Assuming a vertical hydraulic gradient of unity, the infiltration rate through soil at a given moisture content is equal to the unsaturated hydraulic conductivity at that moisture content. Thus, by drawing a horizontal line across the graph at the EPA-prescribed infiltration rate of 10^{-7} cm/s through the cover, one can estimate the volumetric moisture content of the underlying soils, based on their soil moisture characteristic curves. This

moisture content is equivalent to the extrapolated moisture content at the x-intercept along the graph where the horizontal line meets the soil moisture characteristic curve.

Based on soil moisture characteristic data for MWL soils shown in Figure 3, moisture contents in underlying soils would range from approximately 18 percent by volume up to 28 percent by volume, and would average approximately 23 percent by volume, if infiltration through the MWL cover averaged the EPA-prescribed equivalence criterion of 10^{-7} cm/s.

For this reason, DOE/Sandia recommend using the average 23 percent volumetric moisture content of underlying soils as the trigger to indicate that the MWL cover is meeting the EPA-prescribed technical equivalency criteria for RCRA landfills. This 23 percent volumetric moisture content has a regulatory basis, and is considered a reasonable value for a trigger to indicate cover performance. Because the accuracy of the neutron logging tool is ± 2 percent volumetric moisture content, a 2 percent delta was originally added to the 23 percent value to ensure that readings at this level are not false positive interpretations, and the trigger was initially proposed at 25 percent by volume in the original Performance Assessment Modeling Report (Appendix E in SNL November 2005). However, because NMED considers the initially-proposed 25 percent moisture content value to be too high, DOE/Sandia suggest eliminating the 2 percent delta, with the final moisture content trigger set at 23 percent by volume. The proposed trigger of 23 percent by volume would apply to linear depths of 10 ft to 100 ft (vertical depths of 8.7 ft to 86.6 ft) along the neutron probe access holes in the vadose zone beneath the MWL. This interval is proposed as the "regulated interval" because it lies beneath the root zone, and yet is shallow enough that a response would be readily detected if there is a significant increase in infiltration through the cover.

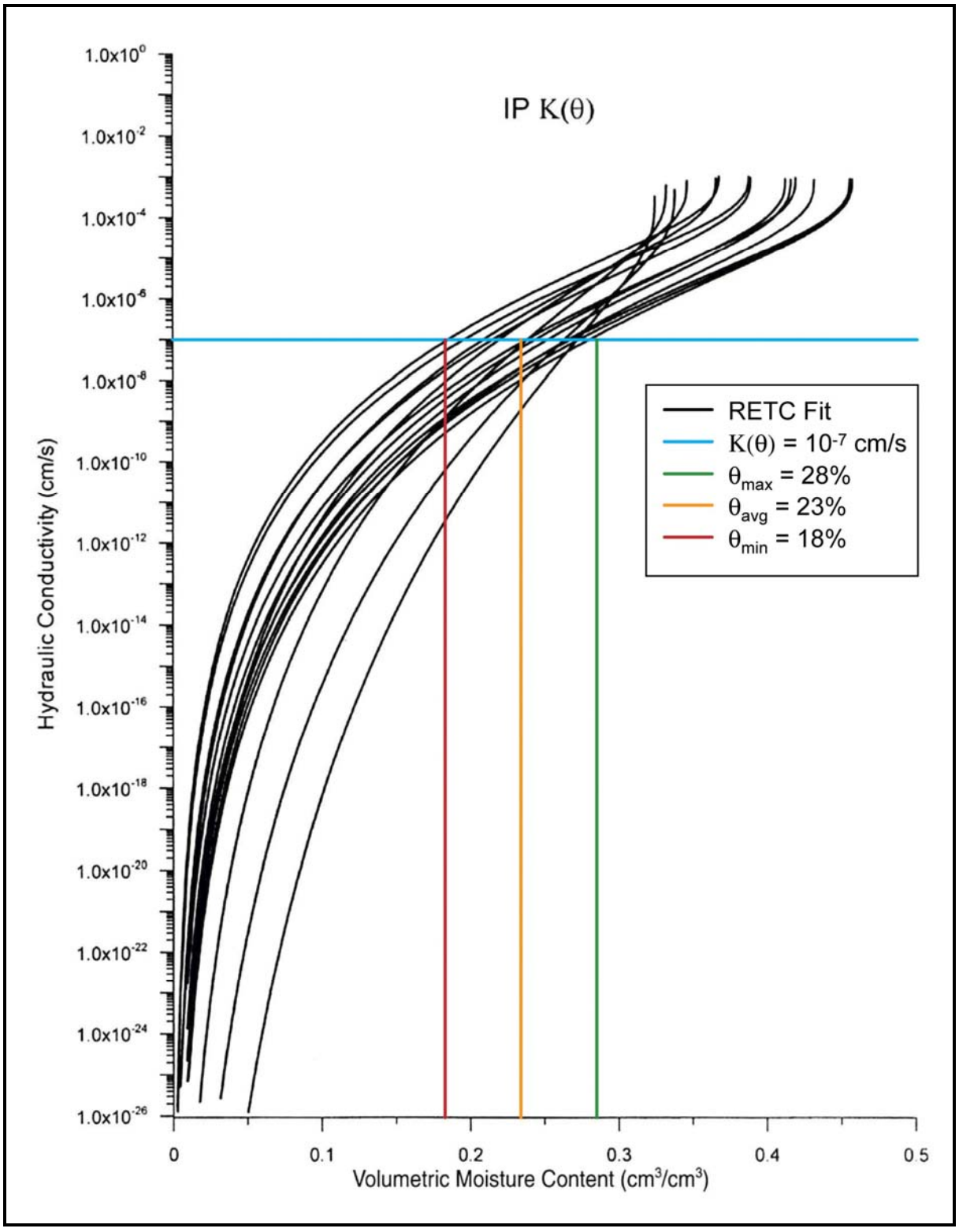


Figure 3. Relationship between unsaturated hydraulic conductivity and volumetric moisture content for 18 subsurface soil samples collected from the IP Test Site

17. Provide NMED a copy of the reference: Johnson et al (1995), *A Human Health Risk Assessment for the Mixed Waste Landfill, Sandia National Laboratories, Albuquerque, New Mexico,* Argonne National Laboratories, Argonne, IL.

Response: This document is actually entitled, "A Preliminary Human Health Risk Assessment for the Mixed Waste Landfill, Sandia National Laboratories, Albuquerque, New Mexico" by Johnson et al., 1995. A copy of this report is included on the attached CD, under the subdirectory "Preliminary Risk Assessment by Johnson et al".

18. Table E-6, the proposed trigger levels for 1,1,1-TCA, ethylbenzene, styrene, toluene, and total xylenes in groundwater are set too high. For these unnatural constituents, the levels of detection normally achieved by laboratories are much lower than groundwater standards set by the New Mexico Water Quality Control Commission (WQCC). The trigger levels can be set to much lower levels, and still allow for a given trigger level to be sufficiently above the limit of detection such that the constituent can be readily quantified with a high degree of confidence. Additionally, trigger levels should be set well below WQCC standards or below U. S. Environmental Protection Agency Maximum Contaminant Levels so that there will be time to react to prevent unacceptable levels of contamination should any trigger levels be exceeded.

Response: The proposed trigger levels for 1,1,1-TCA, ethylbenzene, styrene, toluene, and total xylenes in groundwater are regulatory-based, and are set at a value of one-half the EPA Primary Drinking Water Standard (MCL) (EPA 2003a) for each constituent. There is no technical or regulatory basis for further reducing these trigger levels (with respect to risk and human health), and DOE/Sandia are concerned that reductions in these triggers to even lower concentrations will result in more false positive detections for these constituents. There are often analytical difficulties with measuring extremely low concentrations of VOCs in groundwater.

Rather than lowering the trigger levels for VOCs in groundwater and increasing the risk of false positive detections, DOE/Sandia recommend installation of a robust vadose-zone monitoring system to allow early detection of any potential migration of VOCs through the vadose zone, well before they reach groundwater (see response to Comment No. 16). DOE/Sandia recommend keeping trigger levels for VOCs in groundwater at one-half the EPA Primary Drinking Water Standard, as proposed originally in Table E-6. DOE/Sandia also recommend expanding the list of triggers for VOC in groundwater to include triggers for all Target Compound List (TCL) VOCs analyzed using EPA Method 8260. See response to Comment No. 20, below.

19. Propose some additional monitoring to be conducted at locations within the landfill where contaminants were detected at their highest levels during the RFI. These locations should be subject to the same triggers as those proposed as points of compliance in Table E-6.

Response: Additional monitoring at locations within the landfill using intrusive techniques is not recommended, and could compromise the integrity of the cover. However, Appendix A to the first NOD Comment Set (SNL December 2006) presented a sampling and analysis plan

(SAP) for soil-gas volatile organic compounds, tritium, and radon at the Mixed Waste Landfill. Sampling locations were selected based on maximum concentrations of VOC contaminants detected during the Phase 2 RFI in the mid 1990s (SNL 1996). VOC concentrations will be measured at depths of 10 ft and 30 ft in a total of six boreholes in and around the MWL, and two background boreholes. The boreholes will be advanced using a GeoProbe in the same manner as was done during the Phase 2 RFI. Soil samples will also be collected at depths of 10 ft and 30 ft in each borehole for analysis of tritium concentrations in soil moisture. All sampling will be conducted prior to construction of the MWL cover.

If the upcoming sampling program within the MWL shows concentrations of VOC contaminants significantly elevated above concentrations detected during the Phase 2 RFI study, DOE/Sandia will open discussions with NMED on the potential need for additional intrusive monitoring activities within the landfill. However, at this time, DOE/Sandia suggest approaching this issue in a phased manner; if the data show no significant increases in contaminant concentrations, additional intrusive monitoring within the landfill is not recommended.

Additional monitoring for VOCs in soil gas is proposed using FLUTes™ installed around the perimeter of the MWL. The FLUTes™ are proposed to be located near areas of the landfill where contaminants were detected at their highest levels during the Phase 2 RFI. In order to protect the integrity of the cover and to minimize the potential for preferential flow down boreholes, the FLUTes™ are not planned to be installed directly through the cover of the landfill.

Monitoring of animal burrows and ant nests is also proposed for the MWL cover (see response to Comment No. 14). Samples of soil from the vicinity of animal burrows and ant nests on the MWL cover will be collected on a five-year basis and analyzed for RCRA metals, gross alpha and beta activity, and gamma-emitting radionuclides. Additional details on future monitoring activities will be included in the MWL Long Term Monitoring and Maintenance Plan.

20. Expand the proposed monitoring triggers in Table E-6, giving consideration of the following table:

Environmental Medium	Monitoring Parameters	Main Potential Receptors	Sampling Points
Air	**radon, tritium**	**humans**	**landfill perimeter and interior stations**
Surface Soil	**radon, tritium, other radionuclides, metals**	**humans and ecological receptors**	**landfill perimeter, interior stations, and animal burrows located on cover**
Subsurface Soil	**moisture**	**humans via groundwater**	**neutron probe monitoring wells**
Subsurface Soil Gas	**radon, tritium, VOCs**	**humans via groundwater**	**beneath landfill**
Groundwater	**tritium, radon, isotopic uranium, VOCs**	**humans**	**down gradient groundwater monitoring wells**

Radionuclides (other than radon and tritium) and metals should be the same as those listed in Table E-2. VOCs should include PCE, all organic constituents listed in Table E-6, and all other organic constituents normally detected by method 8260. NMED reserves the right to require additional monitoring pending review of the long-term monitoring and maintenance plan to be submitted later by the Permittees and pending receipt and review of public input of this latter mentioned plan.

Response: The proposed monitoring triggers in Table E-6 have been revised, based on NMED's requests presented in Comments No. 14, 15, 16, 18, and 20. The updated monitoring triggers are shown in Table 2. Based on NMED's recommendations, modifications to the proposed monitoring discussed in Appendix E (SNL November 2005) include the addition of the following:

- Collection of surface soil samples near animal burrows and ant nests, and analysis for RCRA metals, gamma-emitting radionuclides, gross alpha activity, and gross beta activity. Additional triggers are proposed for RCRA metals and gamma-emitting radionuclides. Please see Consent Order note provided response to Comment No. 14.

- Installation of a robust multi-level vadose zone sampling system for VOCs using FLUTe™ technology. This system will be used as an early-warning system to protect groundwater.

- Monitoring of the vadose zone to assess VOC profiles with depth. Triggers are proposed for TCE, PCE, and Total VOCs in soil vapor.

- Additional triggers are proposed for VOCs in groundwater. Triggers are proposed for all Target Compound List (EPA Method 8260) VOCs.

Table 2. Proposed Monitoring Triggers for the Mixed Waste Landfill.

Environmental Medium	Monitoring Parameter	Main Potential Receptors	Proposed Trigger Value	Sampling Points	Performance Objective	Applicable Guideline or Regulation
Air	Radon	Humans	4 pCi/L (measured by Track-Etch radon detectors)	MWL Perimeter	Average flux of radon-222 gas shall be less than 20 pCi/m^2/s at the landfill surface (design standard)	EPA Action Threshold for radon in air (U.S. EPA 2005)
Surface Soil	Tritium	Humans and ecological receptors	20,000 pCi/L tritium in soil moisture	MWL Perimeter	Dose to the public via the air pathway shall be less than 10 mrem/yr	DOE Order 5400.5, 10 CFR 61 Subpart H, 40 CFR 141.66
Surface Soil	Cs-137	Humans and ecological receptors	0.664 pCi/g	Animal burrows & ant nests on the cover	Radionuclide concentrations in soil shall not exceed NMED-Approved Maximum Background Concentrations	NMED-Approved Maximum Background Concentrations (Dinwiddie 1997)
Surface Soil	Ra-226	Humans and ecological receptors	2.30 pCi/g	Animal burrows & ant nests on the cover	Radionuclide concentrations in soil shall not exceed NMED-Approved Maximum Background Concentrations	NMED-Approved Maximum Background Concentrations (Dinwiddie 1997)
Surface Soil	Th-232	Humans and ecological receptors	1.01 pCi/g	Animal burrows & ant nests on the cover	Radionuclide concentrations in soil shall not exceed NMED-Approved Maximum Background Concentrations	NMED-Approved Maximum Background Concentrations (Dinwiddie 1997)
Surface Soil	U-235	Humans and ecological receptors	0.16 pCi/g	Animal burrows & ant nests on the cover	Radionuclide concentrations in soil shall not exceed NMED-Approved Maximum Background Concentrations	NMED-Approved Maximum Background Concentrations (Dinwiddie 1997)
Surface Soil	U-238	Humans and ecological receptors	1.4 pCi/g	Animal burrows & ant nests on the cover	Radionuclide concentrations in soil shall not exceed NMED-Approved Maximum Background Concentrations	NMED-Approved Maximum Background Concentrations (Dinwiddie 1997)

Table 2 (continued)

Environmental Medium	Monitoring Parameter	Main Potential Receptors	Proposed Trigger Value	Sampling Points	Performance Objective	Applicable Guideline or Regulation
Surface Soil	Arsenic	Humans and ecological receptors	17.7 mg/kg	Animal burrows & ant nests on the cover	RCRA metal concentrations in soil shall not exceed NMED Industrial/Occupational Soil Screening Levels	NMED Industrial/Occupational Soil Screening Levels (NMED 2006)
Surface Soil	Barium	Humans and ecological receptors	100,000 mg/kg	Animal burrows & ant nests on the cover	RCRA metal concentrations in soil shall not exceed NMED Industrial/Occupational Soil Screening Levels	NMED Industrial/Occupational Soil Screening Levels (NMED 2006)
Surface Soil	Cadmium	Humans and ecological receptors	56.4	Animal burrows & ant nests on the cover	RCRA metal concentrations in soil shall not exceed NMED Industrial/Occupational Soil Screening Levels	NMED Industrial/Occupational Soil Screening Levels (NMED 2006)
Surface Soil	Chromium	Humans and ecological receptors	3400 mg/kg	Animal burrows & ant nests on the cover	RCRA metal concentrations in soil shall not exceed NMED Industrial/Occupational Soil Screening Levels	NMED Industrial/Occupational Soil Screening Levels (NMED 2006)
Surface Soil	Lead	Humans and ecological receptors	800 mg/kg	Animal burrows & ant nests on the cover	RCRA metal concentrations in soil shall not exceed NMED Industrial/Occupational Soil Screening Levels	NMED Industrial/Occupational Soil Screening Levels (NMED 2006)
Surface Soil	Mercury	Humans and ecological receptors	100,000 mg/kg	Animal burrows & ant nests on the cover	RCRA metal concentrations in soil shall not exceed NMED Industrial/Occupational Soil Screening Levels	NMED Industrial/Occupational Soil Screening Levels (NMED 2006)
Surface Soil	Selenium	Humans and ecological receptors	5680 mg/kg	Animal burrows & ant nests on the cover	RCRA metal concentrations in soil shall not exceed NMED Industrial/Occupational Soil Screening Levels	NMED Industrial/Occupational Soil Screening Levels (NMED 2006)

Table 2 (continued)

Environmental Medium	Monitoring Parameter	Main Potential Receptors	Proposed Trigger Value	Sampling Points	Performance Objective	Applicable Guideline or Regulation
Surface Soil	Silver	Humans and ecological receptors	5680 mg/kg	Animal burrows & ant nests on the cover	RCRA metal concentrations in soil shall not exceed NMED Industrial/Occupational Soil Screening Levels	NMED Industrial/Occupational Soil Screening Levels (NMED 2006)
Subsurface Soil	Moisture Content	Humans via groundwater	23 percent by volume	Linear depths of 10 ft to 100 ft along neutron probe access holes beneath the MWL	Infiltration through the cover shall be less than the EPA-prescribed technical equivalence criterion of 31.5 mm/yr [10E-7 cm/s]	RCRA 40 CFR Part 264.301
Subsurface Soil Gas	PCE	Humans via groundwater	20 ppmv	Deepest FLUTe Sampling Port	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Subsurface Soil Gas	TCE	Humans via groundwater	20 ppmv	Deepest FLUTe Sampling Port	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Subsurface Soil Gas	Total Volatile Organic Compounds	Humans via groundwater	25 ppmv	Deepest FLUTe Sampling Port	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Uranium	Humans via groundwater	15 µg/L	Downgradient monitoring well locations	Uranium concentrations in groundwater shall not exceed the EPA MCL of 30 µg/L	EPA Primary Drinking Water Standard
Groundwater	1,1,1-Trichloroethane (1,1,1-TCA)	Humans via groundwater	100 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	1,1,2-Trichloroethane	Humans via groundwater	2.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	1,1-Dichloroethene	Humans via groundwater	3.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard

Table 2 (continued)

Environmental Medium	Monitoring Parameter	Main Potential Receptors	Proposed Trigger Value	Sampling Points	Performance Objective	Applicable Guideline or Regulation
Groundwater	1,2-Dichloroethane	Humans via groundwater	2.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	1,2-Dichloropropane	Humans via groundwater	2.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Benzene	Humans via groundwater	2.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Carbon tetrachloride	Humans via groundwater	2.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Chlorobenzene	Humans via groundwater	50 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Ethyl benzene	Humans via groundwater	350 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Methylene chloride	Humans via groundwater	2.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Styrene	Humans via groundwater	50 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Tetrachloroethene (PCE)	Humans via groundwater	2.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Toluene	Humans via groundwater	500 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Trichloroethene (TCE)	Humans via groundwater	2.5 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard

Table 2 (continued)

Environmental Medium	Monitoring Parameter	Main Potential Receptors	Proposed Trigger Value	Sampling Points	Performance Objective	Applicable Guideline or Regulation
Groundwater	Vinyl Chloride	Humans via groundwater	1.0 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Xylenes (Total)	Humans via groundwater	5,000 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	cis-1,2-Dichloroethene	Humans via groundwater	35 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Trans-1,2-Dichloroethene	Humans via groundwater	50 µg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA Primary Drinking Water Standard
Groundwater	Method 8260 VOCs with no MCLs	Humans via groundwater	EPA Region 6 Human Health Medium-Specific Screening Levels	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA Region 6 Human Health Medium-Specific Screening Levels	EPA Region 6 Human Health Medium-Specific Screening Levels

CFR = Code of Federal Regulations.
cm = Centimeter(s).
DOE = U.S. Department of Energy.
EPA = U.S. Environmental Protection Agency.
ft = Foot (feet).
L = Liter(s).
m = Meter(s).
m^2 = Square meter(s).
µg = Microgram(s).
MCL = Maximum contaminant level.
mm = Millimeter(s).
mrem = Millirem.
MWL = Mixed Waste Landfill.
pCi = Picocurie(s).
RCRA = Resource Conservation and Recovery Act.
s = Second(s).
TCA = Trichloroethane.
VOC = Volatile organic compound.
yr = Year(s).

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TAB 14

Second NOD: Mixed Waste Landfill Corrective Measures

Implementation Plan, November 2005

From: NMED/Bearzi
To: SNL/Wagner

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BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

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Santa Fe, New Mexico 87505-6303
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RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

October 10, 2008

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400 MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Securities Technologies
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RE: NOTICE OF DISAPPROVAL: MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION PLAN, NOVEMBER 2005
SANDIA NATIONAL LABORATORIES, NM5890110518
SNL-05-025

Dear Ms. Wagner and Mr. Nimick:

The New Mexico Environment Department (NMED) has reviewed the U.S. Department of Energy/Sandia Corporation's (Permittees) responses to the NMED's Notice of Disapproval (NOD) issued on November 20, 2006 for the Sandia National Laboratories Mixed Waste Landfill (MWL) Corrective Measures Implementation (CMI) Plan. The Permittees responses were submitted in two parts, dated December 15, 2006, and January 19, 2007. Based on our review of these responses, NMED has identified several deficiencies that require additional information or resolution. The deficiencies are described in the comments below.

Part 1 Comments

1. In response to NOD Comment 17, Permittees state that "[t]he mature, secondary plant community will be achieved when greater than 50% of the photosynthesizing foliar coverage is comprised of grass species native to the general TA-III area". Russian thistle (tumbleweed) should not be allowed to be a part of the foliage on the cover and should not count as part of the foliar coverage used as a measure for acceptable establishment of

vegetation. NMED expects any tumbleweed that grows on the cover to be removed periodically as part of long-term maintenance.

2. Also in response to NOD Comment 17, the Permittees did not indicate the extent of foliar coverage that would represent acceptable establishment of vegetation on the final landfill cover. Propose a percentage of foliar cover relative to the total surface area of the landfill cover that will be considered as representative of acceptable establishment of foliage. Indicate also the size (in square feet) of any barren areas that would be considered unacceptable and would thus require re-seeding and/or other corrective measures to improve the foliar coverage of the barren areas.

Part 2 Comments

1. In response to NOD Comment 4, the Permittees state that future infiltration rates through the MWL cover (based on the natural analogue) would be less than the current infiltration rates (based on the engineered cover). This reduction in future infiltration rates presumably is due to increased evapotranspiration caused by increasing porosity and hydraulic conductivity of the landfill cap as it reverts to natural soil conditions. While this process may occur, it is not clear how this conclusion was reached. Clarify if the anticipated increase in evapotranspiration is based on empirical data (i.e., actual infiltration and/or groundwater recharge data from areas with natural soil), modeling simulations, or another method.

2. In response to NOD Comment 6, Section 4, Pages E-59 and E-59a, the Permittees indicate that monitoring triggers are considered preliminary and are to be finalized in the Long-Term Monitoring and Maintenance Plan (LTMMP). This is not an acceptable approach, as the NMED Secretary's Final Order issued on May 25, 2006 requires that the triggers be developed as part of the CMI Plan. The relevant part of the Final Order states: "As part of the Corrective Measures Implementation Plan that incorporates the remedy (described in the draft permit modification in Paragraph V.3), Sandia shall additionally include the following: ..., b) triggers for future action, that identify and detail specific monitoring results that will require additional testing or the implementation of an additional or different remedy."

   Although the trigger levels and the environmental media that they apply to must be established as part of the CMI Plan, the specific methods, locations, and frequencies of monitoring, and other related details can be established through approval of the LTMMP. Trigger levels, once accepted by the NMED through its review and approval of the CMI Plan, must be incorporated into the proposed LTMMP.

   Additionally, the trigger evaluation process described in Section 4 and in Figure E-25 (of pages E-59 and E-59a), and as revised by the Permittees' response, is not an acceptable approach. In NOD Comment 6, and again through this Notice of Disapproval, the Permittees are instructed to revise the trigger evaluation process to follow the corrective

action process described in the Consent Order (April 29, 2004) if a trigger level is exceeded, provided the Consent Order is still in force at the time. If the Consent Order has terminated, the trigger evaluation process should follow the corrective action process described in the Facility Permit. The Permittees should repeat sampling to confirm if a trigger level has been exceeded. Repeat sampling should be the primary means to avoid implementation of corrective action based on false positives.

3. In NOD Comment 9, the NMED concluded that the neutron probes will only be able to evaluate soil moisture at depths in the vadose-zone that are considerably deeper than the base of the soil cover. Because it would take substantial time for moisture to move through the vadose zone to the depths of the neutron probe access tubes, and because the current design does not monitor for breakthrough of moisture from the cover to the waste, NMED does not agree that such moisture monitoring offers the best possible design for an early warning system. Thus, NMED will place more emphasis on other types of monitoring in the LTMMP. No response is required by the Permittees for this comment.

4. In NOD Comment 14, the Permittees indicate that soil samples from animal burrows and ant hills will be collected every five years. NMED believes that every five years is too long of an interval between sampling events given that the MWL remedy and fate and transport model are to be re-evaluated every five years in accordance with the Final Order. The Permittees' current proposal involves only one round of sampling results to be available for each five year re-evaluation. The Permittees must propose a sampling frequency with a shorter interval between sampling events.

5. In NOD Comment 15, NMED indicated that soil gas in the vadose zone was to be monitored for tritium, radon, PCE, and total VOCs. The Permittees plan to install a FLUTe™ vadose zone soil-gas monitoring system around the MWL for VOCs, and propose trigger levels of 20 parts per million by volume (ppmv) for trichloroethylene (TCE) and tetrachloroethylene (PCE), and 25 ppmv for total VOCs to ensure protection of groundwater. However, the Permittees did not agree to monitor for tritium or radon in soil gas on the basis that the data would be of limited value, and that NMED did not have the authority to require monitoring of these radioactive constituents. Note that the U. S. Environmental Protection Agency (EPA) and NMED regulates gross beta in groundwater through drinking water standards. Tritium and some isotopes of radon are beta emitters. Furthermore, NMED disagrees that the data would be of limited value, as NMED believes that concentration trends are useful indicators of contaminant migration. Thus, NMED expects the Permittees to monitor for tritium and radon in soil gas in the vadose zone. The Permittees must specify trigger levels for radon and tritium for soil gas in the vadose zone.

6. In NOD Comment 19, NMED asked that the Permittees propose additional monitoring points at locations (surface and subsurface) within the landfill where contaminants were detected at their highest levels during the RCRA Facility Investigation of the MWL. No additional sampling was proposed by the Permittees, chiefly on the basis that intrusive

monitoring techniques could possibly compromise cover integrity. However, NMED believes that additional monitoring points can be located within the landfill, and that such monitoring can be conducted without necessarily driving heavy vehicles over the landfill surface. The Permittees shall propose additional monitoring points at locations within the landfill where radon, tritium, and VOCs were detected at their highest levels during the RCRA Facility Investigation. These monitoring locations should consider air, surface soil, and subsurface soil as media to be monitored.

7. In NOD Comment 18, and in Table 2 of the Permittees' January 19, 2007, responses to the NOD for Comment 20, Permittees did not agree to lower the trigger levels for the VOCs 1,1,1-TCA, ethylbenzene, styrene, toluene, and total xylenes (in groundwater). The Permittees continue to propose trigger levels based on one-half of the value of EPA Primary Drinking Water Standards, and state that there are no regulatory or technical reasons for further reducing the trigger levels for these VOCs. The Permittees also argue that there are analytical difficulties with measuring low concentrations of VOCs in groundwater which could lead to false detections of contaminants.

   NMED finds that some of the proposed trigger levels are unacceptable because they fall within three general categories: a) they fail to take into account Consent Order (April 29, 2004) requirements for groundwater cleanup levels; b) they are erroneous; or c) they do not address all constituents of concern for the MWL. These deficiencies are discussed more specifically below. NMED also proposes alternative trigger levels for those considered to be unacceptable in the tables provided below.

   A. Consent Order Requirements for Cleanup Levels

   The Permittees assert that regulations do not require the cleanup of groundwater to concentrations that are below water quality standards; hence, setting trigger levels at one-half the water quality standard is adequate to protect groundwater. However, NMED may require corrective action at any solid waste management unit (SWMU) as necessary to protect human health and the environment from releases (20.4.1.500 NMAC incorporating 40 CFR 264.101). This is true even in cases where groundwater is known to be contaminated at levels below water quality standards. Additionally detection and prevention of the contamination of groundwater at any concentration should be the main goal of long-term monitoring at the MWL.

   Any given trigger level applicable to groundwater beneath the MWL should be based on the appropriate water quality standard, which in general will be the most stringent of a state or federal standard for the constituent of interest. Section VI.K.1.a of the Consent Order states that "[g]roundwater cleanup levels are based on the WQCC standards and the EPA MCLs for drinking water Contaminants. If both a WQCC standard and a MCL have been established for an individual substance, then the most stringent of the two levels shall be considered the cleanup level for that substance…If a WQCC standard or MCL has not been established for a specific substance, the EPA Region VI Human

Health Medium Specific Screening Level for tap water shall be used as the screening level".

The purpose of establishing trigger levels is to provide for early warning of any unexpected releases so that action can be taken to prevent groundwater contamination, and especially to prevent contamination from exceeding a water quality standard. Groundwater investigations can take considerable time to complete; often such investigations may take many years. Thus, to be useful as part of an early warning system, trigger levels are generally set much lower than their corresponding standards, and especially in cases where standards are much higher than laboratory analytical detection limits.

For these reasons, NMED believes one-half of a water quality standard is too high for a trigger level for a given groundwater constituent where the standard is greater than about 0.040 mg/L. In cases where the standard is greater than 0.040 mg/L, NMED proposes that the trigger level for a groundwater constituent should be set at one-quarter (25%) of the standard, which should be sufficiently higher than most detection limits such that false positives should be uncommon. However, in the case of naturally occurring constituents, it may be necessary to set the trigger level to corresponding background levels whenever 25% of the standard falls below the approved maximum background concentration for the area.

The trigger levels for 1,1,1-TCA; 1,1-dichloroethene, toluene, vinyl chloride, total xylenes, chlorobenzene, ethylbenzene, styrene; cis 1,2 – dichloroethene; trans 1,2-dichloroethene, and method 8260 VOCs in groundwater are not acceptable as they are not based on the lowest concentration of the applicable EPA MCL, WQCC standard, or if an applicable MCL or WQCC standard does not exist, the applicable EPA Region 6 Human Health Medium Specific Screening Level for tap (residential) water. NMED proposes alternate trigger levels for these constituents in the table below. The NMED's proposed alternate trigger levels should be incorporated into Table E-6 of Appendix E of the CMI Plan.

Environmental Medium	**Parameter**	**NMED proposed trigger level**	**Comments**
Groundwater	1,1,1-TCA	0.015 mg/L	25% of WQCC standard (0.060 mg/L)
Groundwater	1,1-dichloroethene	0.0025 mg/L	50% of WQCC standard (0.005 mg/L)
Groundwater	toluene	0.1875 mg/L	25% of WQCC standard (0.750 mg/L)
Groundwater	vinyl chloride	0.0005 mg/L	50% of WQCC standard (0.001 mg/L)
Groundwater	total xylenes	0.155 mg/L	25% of WQCC standard (0.620 mg/L)

Groundwater	chlorobenzene	0.025 mg/L	25% of EPA MCL
Groundwater	ethylbenzene	0.175 mg/L	25% of EPA MCL
Groundwater	styrene	0.025 mg/L	25% of EPA MCL
Groundwater	cis 1,2 - dichloroethene	0.0175 mg/L	25% of EPA MCL
Groundwater	trans 1,2-dichloroethene	0.025 mg/L	25% of EPA MCL
Groundwater	method 8260 VOCs	50% of the most stringent of EPA MCL, WQCC standard, or EPA Region 6 Human Health Medium Specific Screening Level for tap water, as applicable. Trigger level to be set at 25% of standard if the standard is greater than 0.040 mg/L.	As explained in the column to the left.

B. Erroneous Trigger Levels

The trigger levels for cadmium and mercury in surface soil are not acceptable for the reasons indicated in the column for "Comments" in the following table. NMED also proposes alternate trigger levels for these constituents in the following table. The alternate trigger levels are based on NMED industrial/occupational soil screening levels. The NMED's proposed alternate trigger levels should be incorporated into Table E-6 of Appendix E of the CMI Plan.

Environmental Medium	**Parameter**	**NMED proposed trigger level**	**Comments**
Surface soil	cadmium	564 mg/kg	Screening value was listed incorrectly in Table 2.
Surface soil	mercury	6.84 mg/kg	Screening value for methyl mercury is more conservative. Use of elemental mercury not supported

			by waste inventory.

C. Additional Metals of Concern at the MWL

For each given medium listed in the left-most column of the table below, add the following additional constituents and their corresponding trigger levels to Table E-6 of Appendix E of the CMI Plan. The trigger levels for soil are based on NMED industrial/occupational soil screening levels. The NMED's proposed additional trigger levels should be incorporated into Table E-6 of Appendix E of the CMI Plan.

Environmental Medium	**Parameter**	**NMED proposed trigger level**
Surface soil	Copper	45,400 mg/kg
Surface soil	Nickel	22,700 mg/kg
Surface soil	Vanadium	1,140 mg/kg
Surface soil	Zinc	100,000 mg/kg
Surface soil	Cobalt	20,500 mg/kg
Surface soil	Beryllium	2,250 mg/kg
Groundwater	Chromium (total)	0.043 mg/L (background)
Groundwater	Cadmium	0.0025 mg/L (50% of EPA MCL)
Groundwater	Nickel	0.050 mg/L (25% of WQCC standard of 0.2 mg/L)
Groundwater	Dichlorodifluoromethane	0.0975 mg/L (25% EPA Region 6 screening level for compound)
Groundwater	tritium	4 mrem/year (EPA MCL)
Groundwater	radon	300 pCi/L (proposed EPA MCL)

The Permittees are required to address these comments within 60 days of receipt of this letter. Please contact William Moats of my staff at (505) 222-9551 if you have any questions.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED, HWB

W. Moats, NMED, HWB
L. King, EPA-Region 6 (6PD-N)
J. Gould, DOE/NNSA/SSO, MS 0184
J. Cochran, SNL, MS 0719
File: Reading and SNL, 2008

Volume I

TAB 15

DOE/Sandia Responses to Second NOD: Mixed Waste Landfill

Corrective Measures Implementation Plan, November 2005

From: SNL/Davis
To: NMED/Bearzi

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ENTERED

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

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DEC 2008
NMED Hazardous Waste Bureau

James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Bldg. 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

On behalf of the Department of Energy/National Nuclear Security Administration (DOE/NNSA), and Sandia Corporation (Sandia), DOE/NNSA is submitting responses to comments received in a letter from the New Mexico Environment Department (NMED) to the U.S. Department of Energy and Sandia Corporation, dated October 10, 2008, regarding the Corrective Measures Implementation (CMI) Plan for the Mixed Waste Landfill (MWL) at Sandia National Laboratories/New Mexico. The letter is entitled "Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005, Sandia National Laboratories, NM5890110518 SNL-05-025". This Notice of Disapproval (NOD) is a result of the NMED review of an earlier DOE/Sandia response to an NOD (dated November 20, 2006). The earlier response by the DOE/Sandia was submitted in two-parts dated December 15, 2006, and January 19, 2007. The NMED identified several deficiencies that required additional information or resolution.

Should you have any questions regarding our responses to the NOD, contact me at (505) 845-6036, or Joe Estrada of my staff at (505) 845-5326.

Sincerely,

Kimberly A. Davis
Acting Manager

Enclosure

cc w/enclosure:
W. Moats, NMED (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB (2 copies)
C. Wimberly, SSO
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cc w/o enclosure:
T. Longo, NA-56, HQ/GTN
A. Blumberg, SNL/NM, Org. 11100, MS-0141
F. Nimick, SNL, Org. 6790, MS-0701
D. Miller, SNL/NM, Org 6765, MS-0718
J. Cochran, SNL/NM, Org. 6765, MS-0719
S. Griffith, SNL/NM, Org. 6765, MS-1089
B. Langkopf, SNL/NM, Org. 6765, MS-1089
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S. Lacy, SSO
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AOP 95-45, 06

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Responses to the "Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005 Sandia National Laboratories, NM5890110518 SNL-05-025"**

Document author: **Stacy Griffith, Department 06765**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 11/20/08
Date

Francis B. Nimick
Deputy Director to the
Nuclear Energy & Global Security Technologies
Division 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ 11/26/08
Date

Kimberly Davis
Acting Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Sandia National Laboratories
Albuquerque, New Mexico
December 10, 2008

DOE/Sandia Responses to NMED "Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005 Sandia National Laboratories, NM5890110518 SNL-05-025"

INTRODUCTION

This document responds to comments received in a letter from the New Mexico Environment Department (NMED) to the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia) dated October 10, 2008 regarding the Corrective Measures Implementation (CMI) Plan for the Mixed Waste Landfill (MWL) at Sandia National Laboratories/New Mexico (SNL/NM). The letter is entitled "Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005 Sandia National Laboratories, NM5890110518 SNL-05-025". This Notice of Disapproval (NOD) is a result of the NMED review of an earlier DOE/Sandia response to an NOD (dated November 20, 2006). The earlier response by the DOE/Sandia was submitted in two parts dated December 15, 2006, and January 19, 2007. The NMED has identified several deficiencies that required additional information or resolution. The deficiencies are listed in two parts.

This document lists each NMED comment, and the DOE/Sandia response to that comment. The NMED comment is listed in boldface, followed by the DOE/Sandia response, written in normal font under "Response".

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.

Part 1 Comments

Comment 1: In response to NOD Comment 17, Permittees state that "[t]he mature, secondary plant community will be achieved when greater than 50% of the photosynthesizing foliar coverage is comprised of grass species native to the general TA-III area". Russian thistle (tumbleweed) should not be allowed to be part of the foliage on the cover and should not count as part foliar coverage used as a measure for acceptable establishment of vegetation. NMED expects any tumbleweed that grows on the cover to be removed periodically as part of the long-term maintenance.

Response 1: DOE/Sandia offer a counterproposal that Russian-thistle, *Salsola tragus* (scientific name change from *Salsolsa kali*) be allowed as part of the foliage on the cover during the establishment of the mature, secondary plant community. Russian-thistle is a nonnative transitory species, but can be beneficial when rehabilitating disturbed sites. It is frequently an unwanted species on such sites, but disturbed sites often recover more quickly when Russian-thistle is left on-site because its presence accelerates the rate of revegetation (Howard, 1992).

Howard (1992) also states that if topsoil remains on the site, Russian-thistle roots are readily invaded by mychorrhizal fungi harbored in the soil. Russian-thistle does not form mychorrhizal associations, and fungal invasion results in the death of the infected root. The fungi consequently invade other Russian-thistle roots. Russian-thistle populations decline, but mycorrizal fungus populations increase and subsequently invade the mycorrhizal association-forming species which comprise the next stage of plant succession. These species usually flourish as a consequence of increased mychorrhizal fungus populations. If topsoil is gone, however, Russian-thistle can dominate disturbed sites for up to 10 years. Such sites benefit more from the addition of topsoil than the removal of Russian-thistle. This reference and further information on *Salsola* can be found at http://www.fs.fed.us/database/feis/plants/forb/salkal/all.html.

During the establishment of the mature, secondary plant community, the DOE/Sandia propose the use of supplemental watering in order to facilitate the development of the native plant species.

Comment 2: Also in response to NOD Comment 17, the Permittees did not indicate the extent of foliar coverage that would represent acceptable establishment of vegetation on the final landfill cover. Propose a percentage of foliar cover relative to the total surface area of the landfill cover that will be considered as representative of acceptable establishment of foliage. Indicate also the size (in square feet) of any barren areas that would be considered unacceptable and would thus require re-seeding and/or other corrective measures to improve the foliar coverage of the barren areas.

Response 2: As proposed in the Long-Term Monitoring and Maintenance Plan (LTMMP), the operational criteria for achieving successful revegetation for the MWL cover under average annual precipitation conditions are as follows:

- The proposed percentage of foliar cover relative to the total surface area of the landfill cover that will be considered as representative of acceptable establishment of foliage is 25 percent (i.e., 25 percent of the land surface is covered with living plants). Of the 25 percent total foliar coverage, 50 percent or greater comprises native perennial species and less than 50 percent comprises annual species (including nonnative, transitory species).

- No contiguous bare spots greater than 200 square feet (approximately 14 by 14 feet) would be acceptable, and such bare spots would require re-seeding and/or other corrective measures to improve the foliar coverage.

Part 2 Comments

Comment 1: In response to NOD Comment 4, the Permittees state that future infiltration rates through the MWL cover (based on the natural analogue) would be less than the current infiltration rates (based on the engineered cover). This reduction in the future infiltration rates presumably is due to the increased evapotranspiration caused by increasing porosity and hydraulic conductivity of the landfill cap as it reverts to natural soil conditions. While this process may occur, it is not clear how this conclusion was reached. Clarify if the anticipated increase in evapotranspiration is based on empirical data (i.e., actual infiltration and/or groundwater recharge data from areas with natural soil), modeling simulations, or another method.

Response 1: The anticipated increase in evapotranspiration is based on empirical data and site-specific data that were used in the Unsaturated Water and Heat Flow (UNSAT-H) code model simulations. Daily potential evapotranspiration (PET) values were calculated using the Hydrologic Evaluation of Landfill Performance (HELP) code Version 3 (Schroeder et al. 1994) with its embedded functions and database for Albuquerque, New Mexico (Peace and Goering, 2005). Site-specific data such as root depth, root length density, leaf area index, growing season and percent bare area were used in the vegetative input for the UNSAT-H code. Soil hydraulic properties used in the UNSAT-H code for the natural analogue and the engineered cover were obtained from site-specific empirical data obtained from the instantaneous profile (IP) test site that was located near the MWL.

Comment 2: In response to NOD Comment 6, Section 4, Pages E-59 and E-59a, the Permittees indicate that monitoring triggers are considered preliminary and are to be finalized in the Long-Term Monitoring and Maintenance Plan (LTMMP). This is not an acceptable approach, as the NMED Secretary's Final Order issued on May 25, 2006 requires that the triggers be developed as part of the CMI Plan. The relevant part of the Final Order states: "As part of the Corrective Measures Implementation Plan that incorporates the remedy (described in the draft permit modification in Paragraph V.3), Sandia shall additionally include the following: ..., b) triggers for future action, that identify and detail specific monitoring results that will require additional testing or the implementation of an additional or different remedy."

Although the trigger levels and the environmental media that they apply to must be established as part of the CMI Plan, the specific methods, locations, and frequencies

of monitoring, and other related details can be established through approval of the LTMMP. Trigger levels, once accepted by the NMED through its review and approval of the CMI Plan, must be incorporated into the proposed LTMMP.

Additionally, the trigger evaluation process described in Section 4 and in Figure E-25 (of pages E-59 and E-59a), and as revised by the Permittees' response, is not an acceptable approach. In NOD Comment 6, and again through this Notice of Disapproval, the Permittees are instructed to revise the trigger evaluation process to follow the corrective action process described in the Consent Order (April 29, 2004) if a trigger level is exceeded, provided the Consent Order is still in force at the time. If the Consent Order has terminated, the trigger evaluation process should follow the corrective action process described in the Facility Permit. The Permittees should repeat sampling to confirm if a trigger level has been exceeded. Repeat sampling should be the primary means to avoid implementation of corrective action based on false positives.

Response 2: Revisions to trigger levels are discussed in Response 7, below.

In addition, DOE/Sandia would like to withdraw Section 4.1, Appendix E entitled "Trigger Evaluation Process from the CMI Plan". This section includes Figure E-25 entitled "Trigger Evaluation Process for the Mixed Waste Landfill". The methods by which the analytical data and any trigger level exceedances will be evaluated will be addressed in the revised LTMMP.

Comment 3: In NOD Comment 9, the NMED concluded that the neutron probes will only be able to evaluate soil moisture at depths in the vadose-zone that are considerably deeper than the base of the soil cover. Because it would take substantial time for moisture to move through the vadose zone to the depths of the neutron probe access tubes, and because the current design does not monitor for breakthrough of moisture from the cover to the waste, NMED does not agree that such moisture monitoring offers the best possible design for an early warning system. Thus, NMED will place more emphasis on other types of monitoring in the LTMMP. No response is required by the Permittees for this comment.

Response 3: No response required.

Comment 4: In NOD Comment 14, the Permittees indicate that soil samples from animal burrows and ant hills will be collected every five years. NMED believes that every five years is too long of an interval between sampling events given that the MWL remedy and fate and transport model are to be re-evaluated every five years in accordance with the Final Order. The Permittees' current proposal involves only one round of sampling results to be available for each five year re-evaluation. The Permittees must propose a sampling frequency with a shorter interval between sampling events.

Response 4: DOE/Sandia will revise this sampling frequency to occur annually, if these features are found to exist following the annual inspection and survey, and there is adequate sample volume.

Comment 5: In NOD Comment 15, NMED indicated that soil gas in the vadose zone was to be monitored for tritium, radon, PCE, and total VOCs. The Permittees plan to install a FLUTe™ vadose zone soil-gas monitoring system around the MWL for VOCs, and propose trigger levels of 20 parts per million by volume (ppmv) for trichloroethylene (TCE) and tetrachloroethylene (PCE), and 25 ppmv for total VOCs to ensure protection of groundwater. However, the Permittees did not agree to monitor for tritium or radon in the soil gas on the basis that the data would be of limited value, and that the NMED did not have the authority to require monitoring of these radioactive constituents. Note that the U.S. Environmental Protection Agency (EPA) and NMED regulates gross beta in groundwater through drinking water standards. Tritium and some isotopes of radon are beta emitters. Furthermore, NMED disagrees that the data would be of limited value, as NMED believes that concentration trends are useful indicators of contamination migration. Thus, NMED expects the Permittees to monitor for tritium and radon in soil gas in the vadose zone. The Permittees must specify trigger levels for radon and tritium for soil gas in the vadose zone.

Response 5: On November 13, 2008, the NMED clarified in a personal communication (Griffith, 2008) that DOE/Sandia will not be required to sample for radon and tritium in subsurface soil-vapor samples nor specify trigger levels for radon and tritium in soil vapor in the vadose zone. Thus, no response is required.

Comment 6: In NOD Comment 19, NMED asked that the Permittees propose additional monitoring points at locations (surface and subsurface) within the landfill where contaminants were detected at their highest levels during the RCRA Facility Investigation of the MWL. No additional sampling was proposed by the Permittees, chiefly on the basis that intrusive monitoring techniques could possibly compromise cover integrity. However, NMED believes that additional monitoring points can be located within the landfill, and that such monitoring can be conducted without necessarily driving heavy vehicles over the landfill surface. The Permittees shall propose additional monitoring points at locations within the landfill where radon, tritium, and VOCs were detected at their highest levels during the RCRA Facility Investigation. These monitoring locations should consider air, surface soil, and subsurface soil as media to be monitored.

Response 6: On November 5, 2008, the NMED clarified in a personal communication (Griffith, 2008) that the subsurface samples refer to soil-vapor samples collected in the subsurface. DOE/Sandia proposes to install two permanent soil-vapor sampling points within the landfill boundary. The LTMMP will be revised to include sample collection points within the landfill boundary (on the cover) for air, surface soil, and soil vapor.

Soil-vapor samples will not be analyzed for radon and tritium (see Response 5).

Trigger levels for constituents in soil vapor will apply only to samples collected from the deepest sample points (i.e. from the 400-foot sample ports of the FLUTe™ vadose zone soil-vapor monitoring system installed around the perimeter of the cover).

Comment 7: In NOD Comment 18, and in Table 2 of the Permittees' January 19, 2007, responses to the NOD for Comment 20, Permittees did not agree to lower the trigger levels for the VOCs 1,1,1-TCA, ethylbenzene, styrene, toluene, and total xylenes (in groundwater). The Permittees continue to propose trigger levels based on one-half of the value of EPA Primary Drinking Water Standards, and state that there are no regulatory or technical reasons for further reducing the trigger levels for these VOCs. The Permittees also argue that there are analytical difficulties with measuring low concentrations of VOCs in groundwater which could lead to false detections of contaminants.

NMED finds that some of the proposed trigger levels are unacceptable because they fall within three general categories: a) they fail to take into account Consent Order (April 29, 2004) requirements for groundwater cleanup levels; b) they are erroneous; or c) they do not address all constituents of concern for the MWL. These deficiencies are discussed more specifically below. NMED also proposes alternative trigger levels for those considered to be unacceptable in the tables provided below.

A. Consent Order Requirements for Cleanup Levels

The Permittees assert that regulations do not require the cleanup of groundwater to concentrations that are below water quality standards; hence, setting trigger levels at one-half the water quality standard is adequate to protect groundwater. However, NMED may require corrective action at any solid waste management unit (SWMU) as necessary to protect human health and the environment from releases (20.4.1.500 NMAC incorporating 40 CFR 264.101). This is true even in cases where groundwater is known to be contaminated at levels below water quality standards. Additionally detection and prevention of the contamination of groundwater at any concentration should be the main goal of long-term monitoring at the MWL.

Any given trigger level applicable to groundwater beneath the MWL should be based on the appropriate water quality standard, which in general will be the most stringent of a state or federal standard for the constituent of interest. Section VI.K.1.a of the Consent Order states that "[g]roundwater cleanup levels are based on the WQCC standards and EPA MCLs for drinking water Contaminants. If both a WQCC standard and a MCL have been established for an individual substance, then the most stringent of the two levels shall be considered the cleanup level for that substance...If a WQCC standard or MCL has not been established for a specific substance, the EPA Region VI Human Health Medium Specific Screening Level for tap water shall be used as the screening level.

The purpose of establishing trigger levels is to provide for early warning of any unexpected releases so that action can be taken to prevent groundwater contamination, and especially to prevent contamination from exceeding a water quality standard. Groundwater investigations can take considerable time to complete; often such investigations may take many years. Thus, to be useful as part of an early warning system, trigger levels are generally set much lower than their corresponding standards, and especially in cases where standards are much higher than laboratory analytical detection limits.

For these reasons, NMED believes one-half of a water quality standard is too high for a trigger level for a give groundwater constituent where the standard is greater than about 0.040 mg/L. In cases where the standard is greater than 0.040 mg/L, NMED proposes that the trigger level for a groundwater constituent should be set at one-quarter (25%) of the standard, which should be sufficiently higher than most detection limits such that false positives should be uncommon. However, in the case of naturally occurring constituents, it may be necessary to set the trigger level to corresponding background levels whenever 25% of the standard falls below the approved maximum background concentration for the area.

The trigger levels for 1,1,1-TCA; 1,1-dichloroethene, toluene, vinyl chloride, total xylenes, chlorobenzene, ethylbenzene, styrene; cis 1,2-dichloroethene; trans 1,2-dichloroethene, and method 8260 VOCs in groundwater are not acceptable as they are not based on the lowest concentration of the applicable EPA MCL, WQCC standard, or if an applicable MCL or WQCC standard does not exist, the applicable EPA Region 6 Human Health Medium Specific Screening Level for tap (residential) water. NMED proposes alternate trigger levels for these constituents in the table below. The NMED's proposed alternate trigger levels should be incorporated into Table E-6 of Appendix E of the CMI Plan.

Environmental Medium	Parameter	NMED proposed trigger level	Comments
Groundwater	1,1,1-TCA	0.015 mg/L	25% of WQCC standard (0.060 mg/L)
Groundwater	1,1-dichloroethene	0.0025 mg/L	50% of WQCC standard (0.005 mg/L)
Groundwater	toluene	0.1875 mg/L	25% of WQCC standard (0.750 mg/L)
Groundwater	vinyl chloride	0.0005 mg/L	50% of WQCC standard (0.001 mg/L)
Groundwater	total xylenes	0.155 mg/L	25% of WQCC standard (0.620 mg/L)
Groundwater	chlorobenzene	0.025 mg/L	25% of EPA MCL
Groundwater	ethylbenzene	0.175 mg/L	25% of EPA MCL
Groundwater	styrene	0.025 mg/L	25% of EPA MCL
Groundwater	cis 1,2-dichloroethene	0.0175 mg/L	25% of EPA MCL
Groundwater	trans 1,2-dichloroethene	0.025 mg/L	25% of EPA MCL
Groundwater	method 8260 VOCs	50% of the most stringent of EPA MCL, WQCC	As explained in the column to the left.

		standard, or EPA Region 6 Human Health Medium Specific Screening Level for tap water, as applicable. Trigger level to be set at 25% of the standard if the standard is greater than 0.040 mg/L.	

B. Erroneous Trigger Levels

The trigger levels for cadmium and mercury in surface soil are not acceptable for the reasons indicated in the column for "Comments" in the following table. NMED also proposes alternate trigger levels for these constituents in the following table. The alternate trigger levels are based on NMED industrial/occupational soil screening levels. The NMED's proposed alternate trigger levels should be incorporated into Table E-6 of Appendix E of the CMI Plan.

Environmental Medium	Parameter	NMED proposed trigger level	Comments
Surface soil	cadmium	564 mg/kg	Screening value was listed incorrectly in Table 2.
Surface soil	mercury	6.84 mg/kg	Screening value for methyl mercury is more conservative. Use of elemental mercury not supported by waste inventory.

C. Additional Metals of Concern at the MWL

For each given medium listed in the left-most column of the table below, add the following additional constituents and their corresponding trigger levels to Table E-6 of Appendix E of the CMI Plan. The trigger levels for soil are based on NMED industrial/occupational soil screening levels. The NMED's proposed additional trigger levels should be incorporated into Table E-6 of Appendix E of the CMI Plan.

Environmental Medium	Parameter	NMED proposed trigger level
Surface soil	Copper	45,400 mg/kg
Surface soil	Nickel	22,700 mg/kg
Surface soil	Vanadium	1,140 mg/kg

Surface soil	**Zinc**	**100,000 mg/kg**
Surface soil	**Cobalt**	**20,500 mg/kg**
Surface soil	**Beryllium**	**2,250 mg/kg**
Groundwater	**Chromium (total)**	**0.043 mg/L (background)**
Groundwater	**Cadmium**	**0.0025 mg/L (50% of EPA MCL)**
Groundwater	**Nickel**	**0.050 mg/L (25% of WQCC standard of 0.2 mg/L)**
Groundwater	**Dichlorodifluoromethane**	**0.0975 mg/L (25% EPA Region 6 screening level for compound)**
Groundwater	**tritium**	**4 mrem/year (EPA MCL)**
Groundwater	**radon**	**300 pCi/L (proposed EPA MCL)**

Response 7: DOE/Sandia applied the formula proposed by the NMED to determine the trigger levels for method 8260 VOCs in groundwater. The following table details the NMED proposed trigger levels for method 8260 VOCs in groundwater with an additional third column representing the DOE/Sandia agreement to apply those without a cited trigger value and includes a DOE/Sandia counterproposal for the following four (4) VOC trigger levels: bromodichloromethane, dibromochloromethane, cis-1,3-dichloropropene, and trans-1,3-dichloropropene.

Table 1. Proposed Trigger Levels for VOCs in Groundwater

Analyte	NMED Proposed Trigger Level (µg/L)	DOE/Sandia Counterproposal Trigger Level (µg/L)
1,1,1-Trichloroethane (1,1,1-TCA)	15	
1,1,2,2-Tetrachloroethane	5	
1,1,2-Trichloroethane	1	
1,1-Dichloroethane	12.5	
1,1-Dichloroethene	2.5	
1,2-Dichloroethane	2.5	
1,2-Dichloropropane	2.5	
2-Butanone (methyl ethyl ketone)	1775	
2-Hexanone	none	
4-methyl-, 2-Pentanone (Methyl isobutyl ketone)	500	
Acetone	1375	
Benzene	2.5	
Bromodichloromethane	0.09	0.9
Bromoform	4.25	
Bromomethane	4.25	
Carbon disulfide	250	
Carbon tetrachloride	2.5	
Chlorobenzene	25	
Chloroethane (ethyl chloride)	1.95	
Chloroform	25	
Chloromethane	48	
Dibromochloromethane	0.065	0.65
Ethyl benzene	175	
Methylene chloride	2.5	
Styrene	25	
Tetrachloroethene (PCE)	2.5	
Toluene	187.5	
Trichloroethene (TCE)	2.5	
Vinyl acetate	103	
Vinyl chloride	0.5	
Xylene	155	
cis-1,2-Dichloroethene	17.5	
cis-1,3-Dichloropropene (1,3-Dichloropropene)	0.2	2.0
trans-1,2-Dichloroethene	25	
trans-1,3-Dichloropropene	0.2	2.0

The proposed trigger levels for bromodichloromethane, dibromochloromethane, cis-1,3-dichloropropene, and trans-1,3-dichloropropene are less than the method detection limit of the contract analytical laboratory. Accordingly, the DOE/Sandia offer a counterproposal for these constituents based on the following considerations:

- The NMED triggers levels for these carcinogens were selected using the EPA Region 6 Human Health Medium Specific Screening Level for tap (residential) water per NMED Comment 7 criteria, which uses a target cancer risk of 1.0E-06.
- DOE/Sandia propose to adjust these triggers to use the target cancer risk of 1.0E-05 as presented in the NMED Soil Screening Levels (June 2006).

The revised triggers levels increase by an order of magnitude, as a result of using the higher target cancer risk.

In reference to the surface soil trigger levels listed in Comment 7, Table B, Erroneous Triggers Levels, the DOE/Sandia will apply the cadmium trigger level of 564 mg/kg in surface soil samples.

The trigger level value for methyl mercury as it appears in Comment 7 is assumed to be incorrect. DOE/Sandia will use a corrected value of 68.4 mg/kg for industrial/occupation soil (NMED Soil Screening Levels, June 2006).

The DOE/Sandia agree to apply the proposed trigger levels listed in Comment 7, Table C, Additional Metals of Concern at the MWL.

Volume I

TAB 16

Conditional Approval: Mixed Wasted Landfill Corrective Measures Implementation Plan, November 2005

From: NMED/Bearzi
To: SNL/Davis

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BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

NEW MEXICO ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

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RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

December 22, 2008

Kimberly A. Davis
Acting Manager
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U.S. Department of Energy
P.O. Box 5400 MS 0184
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Francis B. Nimick
Deputy Director
Nuclear Energy & Global Securities Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: CONDITIONAL APPROVAL
MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION PLAN, NOVEMBER 2005
SANDIA NATIONAL LABORATORIES, NM5890110518
SNL-05-025

Dear Ms. Davis and Mr. Nimick:

The New Mexico Environment Department (NMED) has reviewed the U.S. Department of Energy/Sandia Corporation's (Permittees) November 26, 2008 responses to NMED's second Notice of Disapproval (NOD) for the Sandia National Laboratories Mixed Waste Landfill (MWL) Corrective Measures Implementation (CMI) Plan. The MWL CMI Plan was originally submitted in November 2005. The NOD was the second addressing deficiencies in the CMI Plan, the first having been issued on November 20, 2006. The Permittees responded to these NODs on December 15, 2006 (Comment Response Set #1); January 19, 2007 (Comment Response Set #2); and, in the aforementioned response, on November 26, 2008.

The MWL CMI Plan is hereby approved, subject to the following conditions.

1. The Permittees must implement various changes proposed by the Permittees in their responses to the NODs. Specifically:

a. The proposal presented in the Permittees' November 26, 2008, response to comment #2 (Part 1 Comments) concerning what constitutes acceptable foliage cover must be incorporated into the Long-Term Monitoring and Maintenance Plan (LTMMP).

b. NMED agrees with the Permittees' withdrawal of Section 4.1, Appendix E and associated Figure E-25 from the CMI Plan. A new evaluation method for data and trigger levels must be incorporated into the LTMMP. NMED believes that a statistical approach could be designed that would be acceptable.

c. The proposal presented in the Permittees' November 26, 2008, response to comment #4 (Part 2 Comments) concerning the annual sampling of animal burrows and ant hills, must be incorporated into the LTMMP.

d. The proposal presented in the Permittees' November 26, 2008, response to comment #6 (Part 2 Comments) concerning the installation of two permanent soil-vapor sampling points and other sampling collection points for air, surface soil, and soil vapor located within the landfill boundary, must be incorporated into the LTMMP.

e. All of the trigger levels for all media need to be incorporated into the LTMMP. These trigger levels are found in the original submittal of the CMI Plan, Comment Response Set #2, and the Permittees' responses dated November 26, 2008 (Comment #7, Part 2 Comments). NMED accepts the Permittees' trigger levels in the November 26, 2008 responses for bromodichloromethane, dibromochloromethane; cis-1,3 dichloropropene, and trans-1,3 dichloropropene.

f. The Permittees must adhere to the construction schedule proposed in Comment Response Set #1 (see Comment #2 in Set #1). The Permittees may have an additional 90 days to complete any necessary contracts to begin construction of the cover.

g. The Permittees must implement the change to the CMI Plan under comment response 10 of Comment Response Set #1 concerning the seeding of borrow pits that are no longer needed.

h. The Permittees must implement the change to the CMI Plan under comment response 11 of Comment Response Set #1 concerning the use of heavy equipment within three feet of any monitoring well or measurement device.

i. The Permittees must implement the change to the CMI Plan under comment response 15 of Comment Response Set #1 concerning quality control data, and as corrected in Comment Response Set #2.

2. The Permittees provided evidence that tumbleweed may actually be helpful to establish other types of vegetation. However, the roots of tumbleweed plants can potentially extend to depths of about two meters. Such deep roots could reach the waste layer and provide a pathway for contaminants to migrate to the surface. The Permittees therefore may not allow tumbleweed to grow on the MWL cover. However, NMED accepts the Permittees' proposal to implement a supplemental watering plan as a means to help establish a mature plant community on the MWL cover. The method, timing, and amount of supplemental watering should be included in a revision of the LTMMP.

NMED has reconsidered its position as stated in its letter of October 10, 2008, and now agrees that radon and tritium would not have to be monitored in soil gas because of the difficulty in

obtaining sufficient quantities of gas for accurate measurements. Radon and tritium will be monitored in the groundwater and at the surface of the landfill through methods that are to be fully developed in the LTMMP.

Please contact William Moats of my staff at (505) 222-9551 if you have any questions.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED, HWB
W. Moats, NMED, HWB
L. King, EPA-Region 6 (6PD-N)
J. Gould, DOE/NNSA/SSO, MS 0184
J. Cochran, SNL, MS 0719
File: Reading and SNL, 2008

Volume I

TAB 17

Replacement Pages for the Mixed Waste Landfill

Corrective Measures Implementation Plan, November 2005

From: SNL/Davis
To: NMED/Bearzi

Back of Tab 17

Notes for Volume I, Tab 17:

Only the DOE/SNL letter and explanation page regarding replacement pages submitted in response to the December 22, 2008 letter from NMED, "Conditional Approval: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005" are included herein. The replacement pages included in this submission have been integrated into the "Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005," which can be found in Justification Binder Volume I, Tab 4.

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

FEB 1 8 2009

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Bldg. 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

On behalf of the U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) and Sandia Corporation (Sandia), DOE/NNSA is submitting requested changes in the form of replacement pages for the response to the letter from the New Mexico Environment Department (NMED) dated December 22, 2008 regarding the Corrective Measures Implementation (CMI) Plan for the Mixed Waste Landfill at Sandia National Laboratories/New Mexico. The NMED letter is entitled "*Conditional Approval: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005 Sandia National Laboratories,* NM5890110518 SNL-05-025". This Conditional Approval is a result of the NMED review of earlier DOE/NNSA and Sandia responses to two Notice of Disapprovals (dated November 20, 2006, and November 26, 2008). Items in Part 1 of the NMED Conditional Approval letter (conditions g, h, and i) are to implement changes to the CMI Plan, specifically.

Other items in the NMED Conditional Approval letter (conditions Part 1a, b, c, d, e, f, and Part 2) are to be addressed in the Long-Term Monitoring and Maintenance Plan at a later date.

Sincerely,

Kimberly A. Davis
Acting Manager

Enclosure

cc: (w/enclosure):
W. Moats, NMED (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB (2 copies)
Records Center, SNL/NM, MS 1089
Zimmerman Library, UNM (c/o SNL/NM)
J. Lehr, NA-56/HQ/FORS

cc: (w/o enclosure):
A. Blumberg, SNL/NM, MS 0141
F. Nimick, SNL/NM, MS. 0701
D. Miller, SNL/NM, MS 0718
J. Cochran, SNL/NM, MS 0719
S. Griffith, SNL/NM, MS 1089
B. Langkopf, SNL/NM, MS 1089
C. Daniel, SNL/NM, MS 1089
J. Gould, SSO
K. Agogino, SSO
C. Wimberly, SSO

AOP 95-45, 06

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Replacement Pages for the Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005 Sandia National Laboratories, NM5890110518 SNL-05-025", January 2009.**

Document author: **Stacy Griffith, Department 06765**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 1/26/09
Date

Francis B. Nimick
Deputy Director to the
Nuclear Energy & Global Security Technologies
Center 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ 2/12/09
Date

Kimberly Davis
Acting Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Sandia Corporation
Albuquerque, New Mexico
January 2009

Replacement Pages for the Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005

INTRODUCTION

The U. S. Department of Energy/National Nuclear Security Administration (DOE/NNSA), and Sandia Corporation (Sandia) is submitting requested changes in the form of replacement pages for the response to the letter from the New Mexico Environment Department (NMED) dated December 22, 2008 regarding the Corrective Measures Implementation (CMI) Plan for the Mixed Waste Landfill (MWL) at Sandia National Laboratories/New Mexico (SNL/NM). The NMED letter is entitled "Conditional Approval: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005 Sandia National Laboratories, NM5890110518 SNL-05-025". This Conditional Approval is a result of the NMED review of earlier DOE/NNSA and Sandia responses to two Notice of Disapprovals (dated November 20, 2006, and November 26, 2008). Items in Part 1 of the NMED Conditional Approval letter (conditions g, h, and i) are to implement changes to the CMI Plan, specifically.

The replacement pages for the CMI Plan are contained in this document and address conditions g, h, and i of Part 1 as listed below:

g. The Permittees must implement the change to the CMI Plan under comment response 10 of Comment Response Set #1 concerning the seeding of borrow pits that are no longer needed.

h. The Permittees must implement the change to the CMI Plan under comment response 11 of Comment Response Set #1 concerning the use of heavy equipment within three feet of any monitoring well or measurement device.

i. The Permittees must implement the change to the CMI Plan under comment response 15 of Comment Response Set #1 concerning quality control data, and as corrected in Comment Response Set #2.

The replacement pages contain an under-scored item (material that is being added or corrected). There may also be a strikethrough item (material to be omitted) in the case of replacement. There is a total of three replacement pages.

Other items in the NMED Conditional Approval letter (conditions Part 1a, b, c, d, e, f, and Part 2) are to be addressed in the Long-Term Monitoring and Maintenance Plan at a later date.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.

Sandia National Laboratories

Justification for Class 3 Permit Modification
Corrective Action Complete with Controls
Solid Waste Management Unit 76
Mixed Waste Landfill

October 2014

Volume II of VIII
Corrective Measures Implementation Plan
Soil-Vapor Investigation and Subgrade Preparation

Environmental Restoration Operations

U.S. DEPARTMENT OF ENERGY

United States Department of Energy
Sandia Field Office

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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2	NMED Notice of Public Comment Period on Mixed Waste Landfill Soil-Vapor Sampling and Analysis Plan	NMED/ Kieling	Interested Citizen	02/05/2007	6
3	Notice of Public Dialogue on the Mixed Waste Landfill Soil-Vapor Sampling and Analysis Plan	NMED/ Kieling	Interested Citizen	04/13/2007	4
4	Response to Public Comment and Approval with Modifications Soil-Vapor Sampling and Analysis Plan for the Mixed Waste Landfill	NMED/ Bearzi	SNL/ Wagner	02/14/2008	4
5	Notice of Approval and Response to Public Comment on Soil-Vapor Sampling and Analysis Plan for Mixed Waste Landfill	NMED/ Kieling	Interested Party	02/15/2008	24
6	Request for Deadline Extension of Investigation Report Soil-Vapor Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill	SNL/ Wagner	NMED/ Bearzi	07/10/2008	4
7	Time Extension Request to Submit Soil-Vapor Investigation Report Mixed Waste Landfill, Letter of July 10, 2008	NMED/ Bearzi	SNL/ Wagner	07/25/2008	2
8	Investigation Report on the Soil-Vapor Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill, August 2008	SNL/ Wagner	NMED/ Bearzi	08/26/2008	288
9	Notice of Approval: Investigation Report on the Soil-Vapor Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill, August 2008	NMED/ Bearzi	SNL/ Wagner	09/26/2008	2
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11	Fence Removal and Subgrade Preparation, Mixed Waste Landfill	NMED/ Bearzi	SNL/ Wagner	09/18/2006	2
12	Notification of Precautionary Measures to Prevent Damage to the Mixed Waste Landfill Subgrade Pending Installation of the Cover	SNL/ Wagner	NMED/ Bearzi	03/13/2007	4
13	Mixed Waste Landfill Corrective Measures Implementation Plan, Letter of March 13, 2007	NMED/ Bearzi	SNL/ Wagner	03/23/2007	2
14	Extension Request for Submittal of Burn Site Corrective Measures Evaluation Report and Mixed Waste Landfill Corrective Measures Implementation Report	SNL/ Wagner	NMED/ Bearzi	08/10/2007	4

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08/02/2005	NMED/Kieling	SNL/Wagner	Remedy Decision and Class 3 Permit Modification Request to Incorporate into RCRA Permit Corrective Measures for Mixed Waste Landfill (SWMU 76)	I	2	50
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11/21/2006	NMED/Kieling	Interested Citizen	NMED Responses to Public Comments on the Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005	I	10	62
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01/28/2011	NMED/Kieling	Interested Citizen	Extension of Public Comment Period for Sandia National Laboratories Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	14	2
05/20/2011	NMED/Kieling	SNL/Wagner	NOD: Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	15	6
05/20/2011	NMED/Kieling	SNL/Wagner	NMED Response to Public Comments Regarding the Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	16	16
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05/27/2009	SNL/Davis	NMED/Bearzi	Mixed Waste Landfill Annual Groundwater Monitoring Report, Calendar Year 2008	VII	4	112
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07/02/2007	NMED/Bearzi	SNL/Wagner	Replacement of Mixed Waste Landfill Groundwater Monitoring Wells MWL-MW1 and MWL-MW3	VIII	4	2
08/03/2007	SNL/Wagner	NMED/Bearzi	Response to NOD: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1; Installation of Well MWL-BW2, April 9, 2007; and Submittal of Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1; Installation of Well MWL-BW2, Revision 1	VIII	5	32
08/10/2007	SNL/Wagner	NMED/Bearzi	Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Wells MWL-MW1 and MWL-MW-3; Installation of Wells MWL-MW7 and MWL-MW8	VIII	6	24
10/10/2007	NMED/Bearzi	SNL/Wagner	Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2, Revision 1	VIII	7	2
10/12/2007	NMED/Bearzi	SNL/Wagner	Correction for Notice of Approval Dated October 10, 2007 Regarding Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2,	VIII	8	2
10/30/2007	NMED/Bearzi	SNL/Wagner	Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Wells MWL-MW1 and MWL-MW3; Installation of Wells MWL-MW7 and MWL-MW8	VIII	9	2
12/05/2007	SNL/Wagner	NMED/Bearzi	Response to October 30, 2007 Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Wells MWL-MW1 and MWL-MW3; Installation of Wells MWL-MW7 and MWL-MW8	VIII	10	6
02/12/2008	NMED/Bearzi	SNL/Wagner	Location of Monitoring Wells MWL-MW7 and MWL-MW8	VIII	11	2
03/06/2008	SNL/Wagner	NMED/Bearzi	Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-MW2 Installation of Well MWL-MW9	VIII	12	20
03/21/2008	NMED/Bearzi	SNL/Wagner	Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-MW2, Installation of Well MWL-MW9	VIII	13	2
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Date	From	To	Description	Volume	Tab	Number of Pages
08/25/2008	NMED/Bearzi	SNL/Wagner	Notice of Disapproval: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2	VIII	15	4
09/23/2008	SNL/Davis	NMED/Bearzi	Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Wells MWL-MW1, MWL-MW2, MWL-MW3, Installation of Wells MWL-MW7, MWL-MW8, MWL-MW9	VIII	16	150
10/03/2008	SNL/Davis	NMED/Bearzi	Responses to NOD: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2	VIII	17	14
10/31/2008	NMED/Bearzi	SNL/Wagner	Notice of Approval: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2	VIII	18	2
01/15/2009	NMED/Bearzi	SNL/Davis	Notice of Approval: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Wells MWL-MW1, MWL-MW2, MWL-MW3, Installation of Wells MWL-MW7, MWL-MW8, MWL-MW9	VIII	19	2
Groundwater Studies						
04/30/2010	NMED/Bearzi	SNL/Wagner	Toluene Detections in Groundwater Samples from Mixed Waste Landfill	VIII	20	2
05/21/2010	SNL/Wagner	NMED/Bearzi	Extension Request for the Toluene Investigation Report Required for the Mixed Waste Landfill	VIII	21	4
06/04/2010	NMED/Bearzi	SNL/Wagner	Approval of Extension Request for Toluene Investigation Report Mixed Waste Landfill, May 21, 2010	VIII	22	2
08/18/2010	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Toluene Investigation Report, August 2010	VIII	23	236
09/28/2010	NMED/Bearzi	SNL/Wagner	NOD: Mixed Waste Landfill Toluene Investigation Report August 2010	VIII	24	2
10/14/2010	SNL/Wagner	NMED/Bearzi	Response to September 28, 2010, NMED comments on the Mixed Waste Landfill Toluene Investigation Report	VIII	25	142
01/13/2011	NMED/Bearzi	SNL/Wagner	Notice of Approval: Mixed Waste Landfill Toluene Investigation Report, Revised October 2010	VIII	26	2
05/20/2014	SNL/Todd	NMED/Kieling	Mixed Waste Landfill Groundwater Monitoring Report - Monitoring Well MWL -MW4 Metals Data – Calendar Year 2013	VIII	27	44
07/24/2014	NMED/Kieling	SNL/ Beausoleil	Mixed Waste Landfill Groundwater Monitoring Report – Monitoring Well MWL-MW4 Metals Data – Calendar Year 2013, May 2014 (NMED Recommendations Letter)	VIII	28	2

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Corrective Measures Implementation Plan – Soil-Vapor Investigation

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Volume II

TAB 1

Soil-Vapor Sampling and Analysis Plan for Soil-Vapor Volatile Organic Compounds, Tritium, and Radon at the Mixed Waste Landfill

From: SNL/Wagner
To: NMED/Bearzi

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Note for Volume II, Tab 1:

The "Sampling and Analysis Plan for Soil Gas Volatile Organic Compounds, Tritium, and Radon at the Mixed Waste Landfill," December 2006, included herein is Appendix A of the DOE/SNL response to comments received in the NMED "Notice of Disapproval (NOD) and Requirement for Soil Vapor Sampling and Analysis Plan," dated November 20, 2006. The December 21, 2006 response can be found in Justification Binder Volume I, Tab 12.

APPENDIX A

Sampling and Analysis Plan for Soil Gas Volatile Organic Compounds, Tritium, and Radon at the Mixed Waste Landfill

SANDIA NATIONAL LABORATORIES/NEW MEXICO

DECEMBER 2006

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Acronyms and Abbreviations

AOP	Administrative Operating Procedure
bgs	below ground surface
DQO	data quality objective
EB	equipment blank
FOP	field operating procedure
GC/MS	gas chromatograph/mass spectrometer
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
pCi/m2/s	picocuries per meter squared per second
PID	photoionization detector
ppm	part(s) per million
QA/QC	quality assurance/quality control
SAP	sampling and analysis plan
SMO	Sample Management Office
SNL/NM	Sandia National Laboratories/New Mexico
SOW	Statement of work
TBD	to be determined
VOCs	volatile organic compounds

1.0 *Executive Summary*

The Mixed Waste Landfill (MWL) is located in the north-central part of Sandia National Laboratories/New Mexico (SNL/NM) Technical Area III. Soil gas volatile organic compound (VOC) and tritium sampling was conducted at the MWL in 1993 and 1994 during a Phase 2 RCRA Investigation, but no recent data regarding VOC concentrations in soil gas and tritium in soils has been collected. This Sampling and Analysis Plan was developed in response to a request by the New Mexico Environment Department (NMED) to obtain more current soil gas VOC and tritium data for the MWL. NMED has also requested that sampling for potential radon emissions from the MWL be completed. The NMED request was submitted in a letter dated November 20, 2006 and entitled "Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Work Plan, November 2005, and Requirement for Soil-Vapor Sampling and Analysis Plan, Sandia National Laboratories".

This sampling and analysis plan (SAP) has been prepared to meet the NMED request. SNL/NM proposes to collect soil gas VOC and tritium soil samples from six previous 1994 locations within the MWL, and from two background locations southwest of the landfill. SNL/NM also proposes to monitor for potential radon emissions by placing radon detectors at ten locations around the MWL perimeter after the final landfill cover is installed, and at two additional background locations southwest of the landfill.

It is anticipated that the soil gas VOC and tritium soil sampling will be completed in early 2007. Radon measurements will be conducted after the permanent perimeter fence around the MWL has been constructed. Analytical results for the soil gas VOC, tritium, and radon sampling will be summarized in two separate investigation reports that will be submitted to the NMED for review.

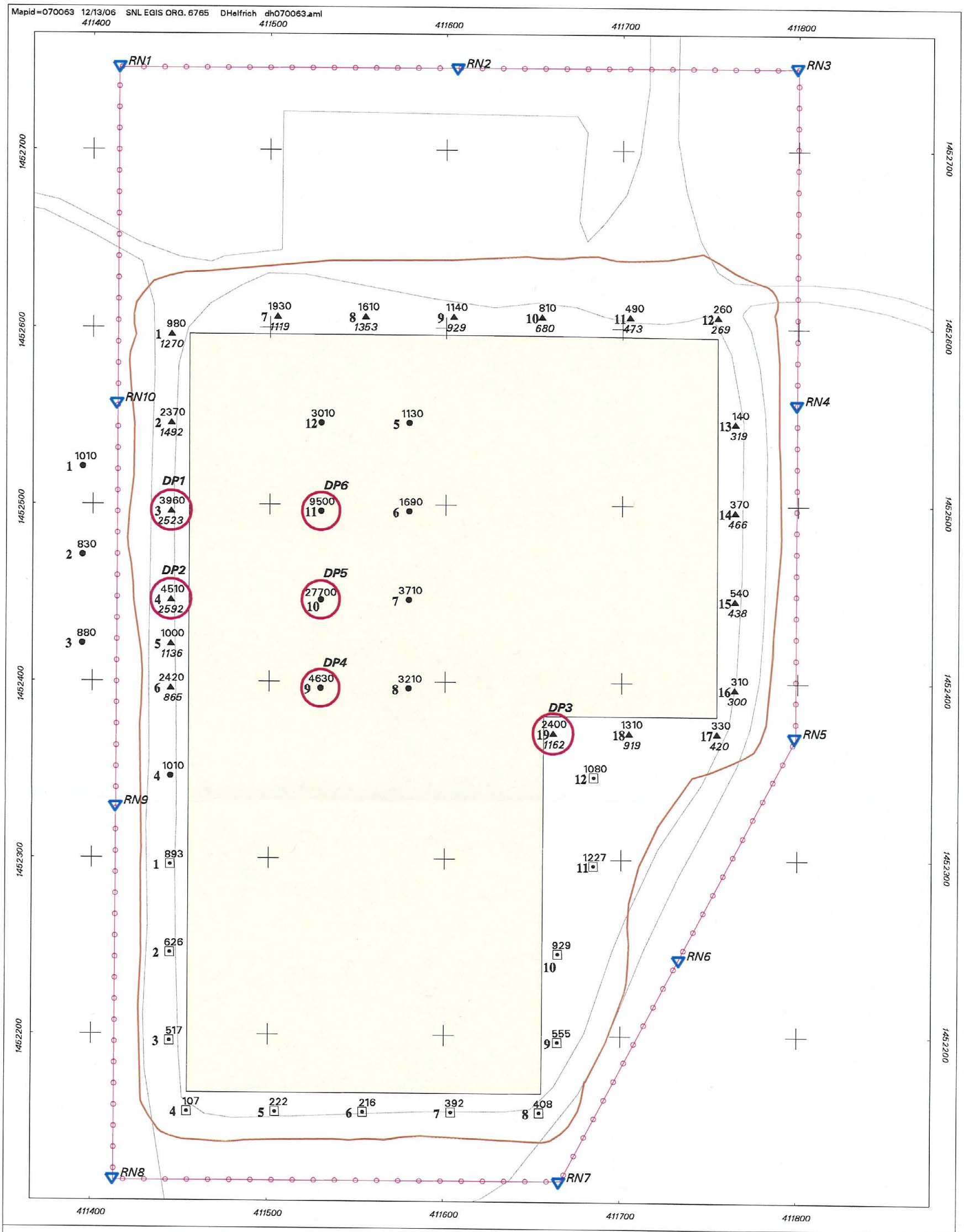
2.0 *Introduction and Background Information*

Active soil gas samples were collected from 43 locations in and around the MWL in June-October 1994, as shown on Figure 2-1. Soil gas samples were retrieved from target depths of 10 and 30 feet below ground surface (bgs) at each location with GeoProbe ™ soil gas collection equipment, and were collected in both 500 ml glass bulbs and SUMMA canisters. The glass bulb samples were analyzed with an on-site gas chromatograph/mass spectrometer (GC/MS), and the SUMMA canister samples were analyzed by an off-site commercial laboratory for VOCs by EPA Method TO-14.

Analytical results for the 1994 soil gas samples are presented and discussed in the "Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation, Sandia National Laboratories, New Mexico" (SNL/NM September 1996). Eight individual VOCs were detected in the 10 and 30-ft samples, with total VOC concentrations ranging from 0.03 to 30.7 parts per million (ppm) in the 10-ft bgs samples, and from 0.107 to 27.7 ppm in the 30-ft bgs samples (Figure 2-1).

The Mixed Waste Landfill Corrective Measures Implementation Work Plan was written and submitted to the NMED Hazardous Waste Bureau in November 2005 (SNL/NM November 2005). NMED reviewed the document, and responded with a "Notice of Disapproval" letter dated November 20, 2006 (NMED November 2006). This letter described a number of deficiencies related to both the MWL cover, construction plans, performance and fate and transport modeling, and monitoring triggers. The letter also included a requirement for additional soil gas sampling at the landfill, as follows:

"As the Permittees are aware, most site characterization data for the MWL (other than groundwater data) dates before the mid 1990's. Because the rupturing of containers and leaking of their contents could have occurred since the mid 1990's, the NMED requires more current soil-gas data to help resolve this issue. The Permittees shall therefore collect and analyze active soil-gas samples taken at depths of 10 and 30 feet at a minimum of three locations within the landfill where previous sampling has detected the highest soil-gas concentrations in the past. The soil-gas samples shall be analyzed for volatile organic compounds, tritium, and radon. Pursuant to Section VI.A of the Order on Consent (April 29, 2004), the Permittees shall provide for approval to the NMED within 30 days of receipt of this letter a work plan to conduct the active soil-vapor sampling described above. The work plan shall be prepared in accordance with Section X.B of the Consent Order." (NMED November 2006).



Legend

6 ▲450 — 1994 First-round sample location, borehole number, and total soil gas VOC concentration at 30 feet(ppb)

4 ●720 — 1994 Second-round sample location, borehole number, and total soil gas VOC concentration at 30 feet(ppb)

1 ⊡47 — 1994 Third-round sample location, borehole number, and total soil gas VOC concentration at 30 feet(ppb)

RN1 — 2007 Radon Track Etch sampling locations and name

DP1 — 2007 Re-sample location and new borehole name

Current Unpaved Road

Proposed Final Fence

Proposed Toe of Landfill Cover

SWMU 76, Former MWL Extent

Figure 2-1
1994 Soil Gas VOC Sampling Locations, Soil Gas VOC Concentrations at 30 Feet, and Proposed 2007 Soil Gas VOC, Tritium, and Radon Sampling Locations, Mixed Waste Landfill

0 60 120
Scale in Feet

0 14 28
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

3.0 Scope of Activities

This SAP has been prepared to address the NMED requirement for additional sampling at the MWL. This document provides guidance and instructions for collecting and analyzing for VOCs in soil gas, tritium in soil moisture, and Radon flux at locations in and around the landfill. This SAP also presents specifications for field sampling, laboratory analysis, data validation and evaluation, and reporting. It is also designed to ensure that future soil gas VOC and tritium sampling procedures are consistent with past practices and produce defensible analytical results that can be compared to historical results. Analytical results for the new soil gas VOC samples will be compared to those results obtained from the 1994 samples to determine if significant changes in soil gas VOC concentrations have occurred in MWL subsurface soils since the 1994 samples were collected. Tritium activities in soil moisture that are detected in the new samples will also be compared to tritium activities detected in soil samples collected in 1994, and that were presented in the 1996 Phase 2 RFI report (SNL/NM September 1996). Ambient radon concentrations measured by Track-Etch radon detectors will be compared to the proposed trigger value of 4 pCi/L, presented in the "Probabilistic Fate and Transport Modeling of the Mixed Waste Landfill at Sandia National Laboratories" (Ho, C.H., et al February 2006).

3.1 Soil Gas VOC and Tritium Sampling Locations, Depths, and Frequency

One round of soil gas VOC and tritium soil moisture samples will be collected at depths of 10 and 30 feet below the original surface of the landfill. Since boreholes will be drilled through the recently-completed subgrade, the added thickness of the subgrade at each boring location will have to be accounted for, in order that the samples are collected from the same depths that were sampled in 1994. Samples will be collected from six MWL sampling locations where the highest soil gas VOC concentrations were detected at the 30-ft depth samples in 1994. It is anticipated that these samples will be collected in early 2007. As shown in Figure 2-1, the six highest total VOC concentrations in the 30-ft deep soil gas samples collected in 1994 were detected at the first round locations 3, 4, and 19, and second round locations 9, 10, and 11. For comparison purposes, background soil gas VOC and tritium soil samples will also be collected from two additional locations in an area approximately 600 feet southwest of the southwest corner of the landfill that is not believed to be impacted by anthropogenic activities. Actual background sampling locations will be selected during the sampling event.

Each soil gas and soil sample will be identified with a unique location identification number, as specified in Table 3-1. Duplicate soil gas and tritium samples will be collected from the 30-ft depths at second round locations 10 and 11 (Figure 2-1) where the highest soil gas VOC concentrations were detected in 1994. In addition, one aqueous tritium equipment blank (EB) sample will be collected on each day that drilling and sampling occur. All data will be reviewed and validated according to "Data Validation Procedure for Chemical and Radiochemical Data," - Administrative Operating Procedure (AOP) 00-03, Rev. 01 (SNL/NM December 2003).

Table 3-1 also correlates original sample locations from the Phase 2 RFI Active Soil Gas sampling events with the proposed locations for the current samples. Sample location coordinates shown in the table utilize the same MWL coordinate system that was used back in 1994, and are based on distance and relative direction from the northwest corner of the landfill.

3.2 Radon Track Etch Sampling

As shown on Figure 2-1, radon levels around the perimeter of the MWL will be measured using Track Etch radon detectors. A total of 10 detectors will be placed at corners and midpoints of the future perimeter fence that will be constructed once the final MWL cover has been constructed. For comparison purposes, two additional detectors will also be placed in the area at which the soil gas VOC and tritium background samples will be collected. These detectors will remain in place for one quarter (three months), and at the end of that period will be returned to the manufacturer for analysis.

Table 3-1

Summary of Soil Gas VOC and Tritium Soil Sample IDs and Sample Depths

Phase 2 RFI Active Soil Gas Sampling Location (Figure 2-1)	MWL Coordinate Locations	Borehole ID	VOC Soil Gas Sample ID	Tritium Soil Sample ID	Sample Depths (ft below original landfill surface)	VOC Soil Gas Duplicate Sample ID	Tritium Duplicate Soil Sample ID
First Round, Location #3	100S, 10W	MWL-DP1	MWL-DP1-10-SG MWL-DP1-30-SG	MWL-DP1-10-S MWL-DP1-30-S	10 ft 30 ft	NA	NA
First Round, Location #4	150S, 10W	MWL-DP2	MWL-DP2-10-SG MWL-DP2-30-SG	MWL-DP2-10-S MWL-DP2-30-S	10 ft 30 ft	NA	NA
First Round, Location #19	225S, 207E	MWL-DP3	MWL-DP3-10-SG MWL-DP3-30-SG	MWL-DP3-10-S MWL-DP3-30-S	10 ft 30 ft	NA	NA
Second Round, Location #9	200S, 75E	MWL-DP4	MWL-DP4-10-SG MWL-DP4-30-SG	MWL-DP4-10-S MWL-DP4-30-S	10 ft 30 ft	NA	NA
Second Round, Location #10	150S, 75E	MWL-DP5	MWL-DP5-10-SG MWL-DP5-30-SG	MWL-DP5-10-S MWL-DP5-30-S	10 ft 30 ft	MWL-DP5-30-SG-DUP	MWL-DP5-30-S-DUP
Second Round, Location #11	100S, 75E	MWL-DP6	MWL-DP6-10-SG MWL-DP6-30-SG	MWL-DP6-10-S MWL-DP6-30-S	10 ft 30 ft	MWL-DP6-30-SG-DUP	MWL-DP6-30-S-DUP
NA	Background location #1 approximately 600 ft SW of MWL[1]	MWL-DP7	MWL-DP7-10-SG MWL-DP7-30-SG	MWL-DP7-10-S MWL-DP7-30-S	10 ft 30 ft	NA	NA
NA	Background location #2 approximately 600 ft SW of MWL[1]	MWL-DP8	MWL-DP8-10-SG MWL-DP8-30-SG	MWL-DP8-10-S MWL-DP8-30-S	10 ft 30 ft	NA	NA
Equipment Blank	NA	NA	NA	MWL-EB1 MWL-EB2	NA	NA	NA

Table 3-1 (concluded)
Summary of Soil Gas VOC and Tritium Soil Sample IDs and Sample Depths

[1]Actual location to be determined in the field.

DP = Direct push
DUP = Duplicate
E = East
EB = Epuipment blank
ft = foot, feet
ID = Identification
MWL = Mixed Waste Landfill
NA = Not applicable
RFI = RCRA Facility Investigation
RCRA = Resource Conservation and Recovery Act
S = Soil, south
SG = Soil gas
SW = Southwest
VOC = Volatile organic compounds
W = West

4.0 Data Quality Objectives

The main data quality objective (DQO) is to produce representative, accurate, and defensible soil gas VOC, tritium, and radon analytical results to support the monitoring objectives. This SAP is designed to ensure that soil-gas and soil sampling procedures are consistent with past practices and produce defensible analytical results that can be compared to historical results. This DQO will be accomplished through the implementation of standard field methods, analytical procedures/methods, and data validation and evaluation protocol consistent with procedures that have been utilized for the collection of soil gas samples at other SNL/NM sites.

4.1 Data Accuracy

Proper sampling procedures such as purging, preparation of sampling containers, and use of quality assurance/quality control (QA/QC) samples such as blanks will help to reduce random and systematic sampling error or bias. Accurate estimates of contaminant concentration can be reliably obtained through use of qualified laboratories, appropriate analytical methodologies, and effective QA/QC procedures. These measures along with consistent implementation of this SAP should satisfy the DQO for accuracy.

4.2 Data Consistency and Compatability

To produce comparable analytical data, QA/QC procedures used to collect future soil gas VOC and tritium soil samples must be comparable with procedures used to collect historic soil gas VOC and tritium in soil moisture samples. Data consistency and comparability will be achieved through implementation of this SAP, which defines field and laboratory procedures designed for this purpose. Consistency in methods and procedures will be maintained in the following areas to ensure that future soil gas VOC and soil tritium sample data are consistent and comparable to historic data sets:

- Field sample collection and management
- Use of an off-site contract laboratory selected by the SNL/NM Sample Management Office (SMO) that complies with the SMO analytical laboratory statement of work (SOW)
- Analyzing soil gas VOC samples by EPA Method TO-14 (EPA January 1999) and soil tritium samples by EPA Method 906.0 (EPA August 1980). Radon measurements around the MWL perimeter will be completed with Track Etch radon samplers.

- Utilizing soil gas VOC and tritium soil moisture analytical data review and validation procedure "Data Validation Procedure for Chemical and Radiochemical Data," Administrative Operating Procedure (AOP) 00-03, Rev. 01 (SNL/NM December 2003)

4.3 Data Verification and Validation

After soil gas VOC and tritium analytical results are received from the laboratory, the SNL/NM SMO will review the laboratory report for completeness and conformance to the performance criteria, and arrange for data validation. If problems are noted that require corrective action during these verification and validation reviews, corrective action will be implemented as defined in the analytical laboratory SOW. The scope of the data verification and validation process addresses field sample management and custody requirements, as well as adherence to QA/QC requirements by the off-site laboratory performing the analyses. These processes are discussed in more detail in Section 5.0.

5.0 *Investigation Methods, and Monitoring and Sampling Program*

This section describes the field and laboratory measures to be taken in producing soil gas VOC, tritium, and radon analytical results that meet the DQOs presented in Section 2.0. Prior to initiating soil gas and soil sampling, field personnel will make sure that all necessary equipment is functioning properly in accordance with applicable FOPs and that the necessary arrangements have been made with the SMO and off-site analytical laboratory for sample shipment and analysis. As appropriate, operating procedures will be reviewed and support personnel will be notified.

5.1 Soil Gas VOC Sampling

Soil gas VOC sampling will generally be conducted in accordance with procedures specified in SNL/NM Field Operations Procedure (FOP) 94-21 (SNL/NM March 1994). Soil gas VOC samples will be collected by using truck mounted direct push sampling equipment provided by a commercial drilling company. This equipment will initially be decontaminated at the SNL/NM decontamination pad in Technical Area III prior to commencement of sampling activities at the MWL. The decontaminated equipment will then be taken to the first sampling location at the landfill and sampling activities will commence. At each sample location, a reusable drive-point fitted with a polyethylene tube will be attached to steel drive pipe, and the tip and drive pipe will be driven to the desired sampling using a hydraulic hammer. Once the sampling depth has been reached, the drive pipe will be retracted approximately 3 to 6 inches to create a void between the tip and pipe, and expose the sampling equipment to a short section of open borehole. The vacuum pump will be activated to extract soil gas from the sampling port. The stream of extracted soil gas will be screened with a photoionization detector (PID) instrument containing an ultraviolet lamp with an ionization potential of 11.8 electron volts. PID readings will be monitored during purging and recorded in the fieldbook or on a sampling form once they have stabilized to within plus or minus 10 percent.

When the PID readings have stabilized, the soil gas sample will then be collected in a 6-liter SUMMA canister. The canister will be filled with soil gas, the valve will be closed, and the canister will be shipped back to the laboratory with an analysis request/chain-of-custody form containing the sample identification number, sample location, date and time, depth, and ambient pressure. The canisters require no special preservation during transport and storage. The soil gas samples will be analyzed for VOCs by EPA Method TO-14.

After each soil gas sample is collected, all field equipment used in the process will be removed from the borehole and decontaminated by washing with Alconox and distilled water. The polyethylene sample tubing will be completely purged with nitrogen gas after each soil gas sample is collected. After purging, the tube will be checked with the PID to ensure that it has been completely evacuated of VOCs.

5.2 Tritium Soil Sampling

Following completion of collection of the soil gas VOC sample in a particular interval, the direct push drive pipe and drive point used for collection of the soil gas sample will be withdrawn from the borehole. The sampling equipment will again be decontaminated, and a 2-inch outside diameter (OD) by 2-ft long stainless steel split spoon sampler will be attached to the end of the drive pipe. The sampler and drive pipe will then be inserted back into the borehole and pushed down to the designated sampling depth at the bottom of the borehole. The split spoon sampler will then be hydraulically driven downward two feet into the undisturbed soil to fill the sampler. The drive pipe and sampler will be retrieved to the surface, and the soil will be transferred to the appropriate sample container. Approximately two liters of soil are required by the laboratory for a soil moisture tritium analysis. A 2-inch OD by 2-ft. long sampler will retrieve approximately 1 liter of soil, so at a minimum a second two-foot long run will be required to retrieve additional soil. If the split spoon sampler is not completely filled during each two-foot sampling run, additional runs will be made until the required volume of soil is obtained. The filled sample containers will be immediately placed in a sampling cooler and shipped to the offsite commercial laboratory for analysis by EPA Method 906.0.

The tritium EBs will be collected by pouring deionized water through a decontaminated split spoon sampler, collecting the rinsate in sample containers, and analyzing the water for tritium by EPA Method 906.0.

Soil gas VOC and tritium soil sample requirements are summarized in Table 5.1. If the borehole remains open following removal of the drilling equipment, it will be backfilled with bentonite chips. A small amount of water will be added to the borehole to hydrate the chips, if they are used.

Table 5.1
Soil Gas VOC and Tritium Soil Sample Requirements

Quantity	Container	Matrix	Parameter	Preservative
18	6-Liter SUMMA canister	Soil Gas	VOCs (EPA Method TO-14)	None
18	(2) 1-liter wide mouth poly	Soil	Tritium (EPA Method 906.0)	None
2 or 3 (depends on number of days in the field)	(1) 250 ml. amber glass	Water	Tritium (EPA Method 906.0)	None

EPA = U.S. Environmental Protection Agency
ml. = Milliliter
VOCs = Volatile organic compounds

5.3 Radon Sampling

Track Etch radon detectors will be used to monitor potential Radon flux that may be emanating from the MWL once the final cover has been installed. These detectors consist of a piece of plastic material which can register alpha particles that hit it. This alpha radiation, which comes from radon and its progeny does microscopic damage to the surface of the plastic. At the end of the monitoring period, the exposed detectors are returned to the laboratory from which they were obtained for analysis. The damaged area is then chemically etched, and the damaged area is enlarged and seen as tracks. The tracks can be counted and related to the radon concentration in the air in which the detector was exposed.

As shown on Figure 2-1, the detectors will be placed at 10 locations around the the MWL perimeter fence. The detectors will be placed on MWL perimeter fence posts at a breathing level height of approximately six feet above the ground surface. In addition, for comparison purposes two additional detectors will also be placed in the area at which the soil gas VOC and tritium background samples will be collected. These detectors will remain in place for one quarter (three months) to collect the initial round of baseline data, and at the end of that period will be returned to the manufacturer for analysis. A report summarizing results of the analyses of the detectors will be prepared and transmitted to the NMED for review.

5.4 Laboratory Analysis and Data Review

Laboratory analysis and data review includes the methods and procedures used to obtain the soil gas VOC and tritium results and confirm the quality of the information. All soil gas and tritium samples will be submitted to an off-site analytical laboratory that was selected by the SMO and follows the SMO SOW. The soil gas VOC and tritium samples will be analyzed using EPA Methods TO-14 and 906.0, respectively. The off-site laboratory is responsible for implementing the requirements of the method, including analytical methodology, target analytes for quantification, and internal QA/QC procedures. After the analytical results are received from the laboratory, the SMO will review the laboratory report for completeness and conformance to the current off-site commercial laboratory performance criteria. If problems are noted that require corrective action, corrective action will be implemented as defined in the analytical laboratory SOW.

5.5 Data Validation

After the data verification review is completed, the SMO will arrange for the validation of the data by an outside contractor. The scope of the data validation process addresses field sample management and custody requirements, as well as adherence to the analytical method and internal laboratory QA/QC requirements by the off-site laboratory performing the analyses. The purpose of data validation is to determine the usability and establish the defensibility of the numerical results. Data qualification is based upon review of laboratory-supplied QC data, the specific QC criteria, and the DQOs identified in the procedures for EPA Methods TO-14 and 906.0. Data validation will be conducted according to the requirements of Administrative Operating Procedure (AOP) 00-03, Rev. 01, "Data Validation Procedure for Chemical and Radiochemical Data." (SNL/NM December 2003) All associated data validation reports will be provided along with the results for each sampling event.

5.6 Data Management and Reporting

Technical evaluation and reporting activities will be initiated after data validation is completed. Analytical results of the future soil gas VOC and tritium soil samples, and results of the radon Track Etch measurements will be summarized and reported in investigation report that includes the elements specified in Section X.C of the NMED Compliance Order on Consent (NMED April 2004).

5.7 Records Management

Records associated with the soil gas VOC, tritium, and radon sampling effort include this SAP, field documentation, laboratory analytical results, data validation reports, and technical data evaluations. These records will be maintained at the SNL/NM Customer Funded Records Center.

6.0 Schedule

6.1 Soil Gas VOC and Tritium Sampling, Analysis, and Reporting

It is anticipated that the soil gas VOC and tritium soil samples will be collected in early 2007. Preparations for field work and sample collection activities are expected to take approximately one week. Approximately two months will be required for sample analysis (assumes normal [21 working day] laboratory turnaround), SNL/NM SMO contract verification and data validation, and data entry into an electronic database. Once the validated results are entered into the database, a report summarizing the results of the sampling will be prepared and submitted to the NMED for review. The report production, peer review, and transmittal process will require approximately six weeks. The total time from start of field work preparations through transmittal of the final report to NMED is anticipated to be approximately 3.5 months.

6.2 Radon Track Etch Sampling, Analysis, and Reporting

Radon track etch samplers will be placed at ten locations on the perimeter fence that will be installed once the MWL final cover has been completed, and at two background location southwest of the landfill. These samplers will remain in place for three months to obtain one full quarter's worth of data, and will be returned to the manufacturer for analysis at the end of this period. Approximately one month is required for detector analyses and reporting by the manufacturer. A report summarizing the results of the radon track etch sampling will then be prepared and submitted to the NMED. The report production process and transmittal is also anticipated to take approximately six weeks. Therefore, total time from deployment of the track etch samplers in the field to submittal of the final summary report to NMED is anticipated to be approximately 5.5 months.

7.0 References

Ho, C.H., T.J. Goering, J.L. Peace, M.L. Miller, February 2006, "Probabilistic Fate and Transport Modeling of the Mixed Waste Landfill at Sandia National Laboratories", in *Waste Management Symposium 2006*, held in Tucson, Arizona, February 26-March 2, 2006. Sandia National Laboratories, Albuquerque, NM, 2006. [Published in Proceedings].

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Volume II

TAB 2

NMED Notice of Public Comment Period on Mixed Waste Landfill

Soil-Vapor Sampling and Analysis Plan

From: NMED/Kieling
To: Interested Citizen

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State of New Mexico
ENVIRONMENT DEPARTMENT
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Telephone (505) 476-6000
Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

CINDY PADILLA
DEPUTY ECRETARY

February 5, 2007

SUBJECT: PUBLIC COMMENT PERIOD SOIL-VAPOR SAMPLING AND ANALYSIS PLAN FOR MIXED WASTE LANDFILL SANDIA NATIONAL LABORATORIES

Dear Interested Citizen:

Enclosed is a **Public Notice** regarding the U. S. Department of Energy (DOE)/Sandia Corporation's (Permittees) Soil-Vapor Sampling and Analysis Plan (SAP) for the Sandia National Laboratories (SNL) Mixed Waste Landfill (MWL). The Soil-Vapor SAP was developed by the Permittees for the purpose of obtaining at the MWL more current soil-gas data for volatile organic compounds, tritium, and radon.

The DOE is owner, and with Sandia Corporation, co-operator of SNL. The Permittees are located at the following addresses: SNL, 1515 Eubank SE, Albuquerque, NM, 87123; and NNSA/DOE, Sandia Site Office, KAFB-East, Pennsylvania & H Street, Albuquerque, NM 87116.

The enclosed Public Notice provides locations where the Soil-Vapor SAP may be reviewed by any member of the public. Comments will be received through **5:00 p.m. on March 7, 2007**.

Any person seeking additional information regarding this notice may contact either:

Mr. John E. Kieling, Program Manager
New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87508-6303
E-mial: john.kieling@state.nm.us
Telephone: (505) 476-6000
Fax: (505) 476-6030

Mr. William Moats
New Mexico Environment Department
Hazardous Waste Bureau
5500 San Antonio, NE
Albuquerque, NM 87109
E-mail: William.moats@state.nm.us
Telephone: (505) 222-9551
Fax: (505) 222-9510

Sincerely,

John E. Kieling
Program Manager
Permits Management Program
Hazardous Waste Bureau

State of New Mexico
ENVIRONMENT DEPARTMENT
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
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BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

CINDY PADILLA
DEPUTY SECRETARY

PUBLIC NOTICE NO. 07-01

NEW MEXICO ENVIRONMENT DEPARTMENT
HAZARDOUS WASTE BUREAU
SANTA FE, NEW MEXICO
February 5, 2007

NOTICE OF PUBLIC COMMENT PERIOD
MIXED WASTE LANDFILL SOIL-VAPOR SAMPLING AND ANALYSIS PLAN FOR SANDIA NATIONAL LABORATORIES

The federal Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §§ 6901 to 6992(k), provides for the regulation of hazardous waste. Congress waived the immunity of the United States for actions brought under state hazardous and solid waste laws as well as under RCRA. Pursuant to Section 3006 of RCRA, 42 U.S.C § 6926, the U.S. Environmental Protection Agency (EPA) delegated to the New Mexico Environment Department (NMED), on April 16, 1985 by delegation numbers 8-31 and 8-32, the authority to enforce the New Mexico Hazardous Waste Act (HWA) and its implementing regulations, the New Mexico Hazardous Waste Management Regulations (HWMR), 20.4.1 NMAC, in lieu of EPA enforcement through RCRA. NMED has maintained its delegation from EPA over hazardous waste management in New Mexico and from time to time has amended its state program to conform to statutory or regulatory changes in RCRA. The HWMR require corrective action at solid waste management units (SWMUs) where releases of hazardous waste or hazardous constituents have or may have occurred.

The U. S. Department of Energy, owner and operator, and Sandia Corporation, co-operator, (hereinafter referred to as the Permittees) have been issued a RCRA Permit for the Sandia National Laboratories (SNL) Facility, located in Bernalillo County, New Mexico, EPA ID# NM5890110518. The Permittees must comply with the HWA, the HWMR, and the SNL RCRA Permit, and must conduct corrective action as required under the SNL Order on Consent (April 29, 2004) to protect human health and the environment.

On May 26, 2005, the NMED Secretary approved a final permit and ordered a final remedy for SNL's Mixed Waste Landfill (MWL). The Secretary also directed that the public be given the opportunity to comment on all major documents regarding the MWL prior to any final action being taken by the NMED. On November 20, 2006, the NMED required the Permittees to submit for approval a sampling and analysis plan (SAP) to obtain at the MWL more current soil-vapor data for volatile organic compounds, tritium, and radon. Subsequently, a Soil-Vapor SAP was submitted by the Permittees to the NMED on December 21, 2006. Pursuant to the Secretary's order, the NMED is seeking public comment on the Soil-Vapor SAP prior to making a final decision on whether to approve the plan.

LOCATION OF THE SNL FACILTY AND THE MWL

The Permittees are located at the following addresses: SNL, 1515 Eubank SE, Albuquerque, NM, 87123; and NNSA/DOE, Sandia Site Office, KAFB-East, Pennsylvania & H Street, Albuquerque, NM 87116. The Permittee's primary contact for this action is Mr. John Gould, NNSA/Sandia Site Office, DOE, at P.O. Box 5400, Albuquerque, NM 87185.

SNL is located within the boundaries of Kirtland Air Force Base (KAFB), south of Albuquerque in Bernalillo County, New Mexico. KAFB occupies 52,233 acres. SNL research and administration facilities occupy 2,842 acres and are divided into five Technical Areas (TAs), (designated 1 through 5) and several test areas. TA-1, TA-2, and TA-4 are separate research facilities in the north-central portion of KAFB. TA-3 and TA-5 are contiguous research facilities forming a 4.5-square-mile rectangular area in the southwestern portion of KAFB.

The Mixed Waste Landfill (MWL) is located approximately 5 miles southeast of the Albuquerque International Sunport. The landfill occupies 2.6 acres in the north-central portion of TA-3.

FACILITY OPERATIONS

SNL, in operation since 1945, is engaged in research and development of conventional and nuclear weapons, alternative energy sources, and a wide variety of national security related research and development. As a result of these activities, SNL has generated hazardous, radioactive, mixed (those wastes containing both hazardous and radioactive components), and solid wastes. From 1945 to 1988 most of these wastes were disposed of at SNL at numerous locations, which have been classified by the NMED as Solid Waste Management Units (SWMUs) or Areas of Concern (AOCs). The SWMUs and AOCs include unpermitted landfills, septic-system drainfields and seepage pits, outfalls, waste piles, and test areas. Past waste management activities at SNL have caused the release of hazardous and radioactive contaminants into the environment. The Mixed Waste Landfill is classified as SWMU 76.

DESCRIPTION AND HISTORY OF THE MIXED WASTE LANDFILL

The MWL was opened as the "TA-3 low-level radioactive waste dump" in March 1959. The MWL accepted low-level radioactive waste and mixed waste from SNL research facilities and off-site generators from March 1959 to December 1988. Approximately 100,000 cubic feet of radioactive waste containing 6,300 curies (Ci) of activity (at the time of disposal) were disposed of at the MWL in unlined trenches and pits.

Investigations at the landfill indicate that tritium is the primary contaminant that has been released from the landfill. Results of a risk assessment prepared by the Permittees indicate that releases of contaminants from the MWL pose little risk to human health or the environment under an industrial land use scenario. Tritium activities at the MWL will decrease steadily with time due to its relatively short half-life of 12.3 years. Because of tritium's short half-life and in consideration of current activity levels, the NMED does not believe that tritium releases at the MWL pose a threat to groundwater, human health, or the environment.

REGULATORY BACKGROUND

NMED issued a RCRA Permit for storage of hazardous waste at SNL on August 6, 1992. On February 6, 2002, the Permittees applied to the NMED to renew their RCRA permit (the old Permit remains in effect until a final decision is made on the renewal request). On October 11, 2001, the NMED directed the Permittees to conduct a Corrective Measures Study (CMS) for the MWL because of concerns raised by the public. The CMS Work Plan was approved with conditions by the NMED on October 10, 2002.

After approval of the CMS Work Plan, the CMS was conducted by the Permittees to identify, develop, and evaluate corrective measures alternatives and to recommend a final remedy to be taken at the MWL. The results of the CMS were documented in a CMS Report following completion of the study; the report was transmitted to the NMED on May 21, 2003. The CMS Report was deemed complete by the NMED on January 5, 2004.

On January 23, 2004, the Permittees proposed a Class 3 modification of the SNL RCRA Permit, requesting that the NMED select a final remedy for the MWL. As part of a 60-day public notice and comment period initiated by the Permittees, a public meeting was held on February 26, 2004 in Albuquerque, New Mexico. Following completion of the Permittees public comment period, the NMED issued a public notice and began an additional public comment period starting August 11, 2004.

A public hearing on the selection of a final remedy for the MWL was held by the NMED on December 2-3 and 8-9, 2004; the NMED public comment period was held from August 11, 2004 to December 2, 2004, and extended until December 9, 2004. Based on the administrative record and the Hearing Officer's Report, on May 26, 2005, the NMED Secretary approved a final permit and ordered a final remedy for SNL's Mixed Waste Landfill, selecting a vegetative soil cover with bio-intrusion barrier as the final remedy.

The Permittees were required under their RCRA Permit to submit to NMED a Corrective Measures Implementation (CMI) Work Plan within 180 days after approval of the final remedy. The CMI Work Plan was submitted by the Permittees on November 3, 2005. On November 20, 2006, the NMED issued a Notice of Deficiency for the CMI Work Plan, which included the requirement to submit the Soil-Vapor SAP. The Permittees submitted a response to the Notice of Deficiency on December 21, 2006; this response includes the Soil-Vapor SAP.

PUBLIC REVIEW OF THE SOIL-VAPOR SAMPLING AND ANALYSIS PLAN

The Soil-Vapor SAP may be reviewed by any member of the public at the following locations during the public comment period:

NMED - Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
(505) 476-6000
Monday - Friday from 8:00 a.m. to 5:00 p.m.
Contact: Pam Allen

NMED - District 1 Albuquerque Office
5500 San Antonio NE
Albuquerque, New Mexico 87109
(505) 222-9500
Monday - Friday from 8:00 a.m. to 5:00 p.m.
Contact: William Moats

The Soil-Vapor SAP [*Sampling and Analysis Plan for VOCs, Tritium, and Radon at MWL (12-2006)*] is also available electronically on the NMED web site at: www.nmenv.state.nm.us/HWB/snlperm.html under Mixed Waste Landfill under Corrective Measures Implementation Work Plan.

To obtain a copy of the Soil-Vapor SAP or a portion thereof, in addition to further information, please contact Ms. Pam Allen at (505) 476-6000, or at the Santa Fe address given above. NMED will provide copies, or portions thereof, of the requested information at a cost to the requestor.

NMED issues this public notice on **February 5, 2007**, to announce the beginning of a 30-day comment period that will end at **5:00 p.m., March 7, 2007**. Any person who wishes to comment should submit written or electronic mail (e-mail) comment(s) with the commenter's name and address to the respective address below. Only comments received on or before **5:00 p.m., March 7, 2007** will be considered. To be considered relevant to this matter, written comments must be based on the Soil-Vapor SAP.

Submit written comments to:

John E. Kieling, Program Manager
Hazardous Waste Bureau - New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303
Reference: Sandia National Laboratories – MWL Soil-Vapor SAP
or by e-mail: john.kieling@state.nm.us

The NMED must ensure that the approved Soil-Vapor SAP will be consistent with the New Mexico Hazardous Waste Management Regulations. Written comments submitted will become part of the administrative record, will be considered in formulating a final decision, and may cause the Soil-Vapor SAP to be modified. NMED will respond in writing to all significant public comment. The response will specify which provisions, if any, of the Soil-Vapor SAP have been changed in the final decision, and the reasons for the change. This response will also be posted on the NMED web site in addition to NMED notifying all persons providing written comments.

After consideration of the written public comments received, NMED will approve, or approve with modifications the Soil-Vapor SAP. If NMED modifies the Soil-Vapor SAP, the Permittees shall be provided by mail a copy of the modified plan and a detailed written statement of reasons for the modifications. NMED will make the final decision publicly available and shall notify the Permittees by certified mail. NMED's decision shall constitute a final agency decision. All persons on the mailing list, or that provided written comments, or who requested notification in writing, will be notified of the final decision by mail.

The final decision will become effective immediately upon service of the decision to the Permittees, unless a later date is specified.

ARRANGEMENTS FOR PERSONS WITH DISABILITIES

Any person with a disability requiring assistance or auxiliary aid to participate in this process should contact Judy Bentley by 10 days prior to the end of the public comment period at the following address: New Mexico Environment Department, Room N-4030, P.O. Box 26110, 1190 St. Francis Drive, Santa Fe, New Mexico 87502-6110, (505) 827-9872. TDD or TDY users please access Ms. Bentley's number via the New Mexico Relay Network at 1-800-659-8331.

Volume II

TAB 3

Notice of Public Dialogue on the Mixed Waste Landfill

Soil-Vapor Sampling and Analysis Plan

From: NMED/Kieling
To: Interested Citizen

Back of Tab 3

State of New Mexico
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www.nmenv.state.nm.us

BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

CINDY PADILLA
DEPUTY SECRETARY

April 13, 2007

SUBJECT: NOTICE OF PUBLIC DIALOGUE ON THE SOIL-VAPOR SAMPLING AND ANALYSIS PLAN FOR THE U. S. DEPARTMENT OF ENERGY/SANDIA NATIONAL LABORATORIES' MIXED WASTE LANDFILL

Dear Interested Citizen:

The New Mexico Environment Department (NMED) will host a public dialogue to discuss technical issues related to the Soil-Vapor Sampling and Analysis Plan for the Sandia National Laboratories' Mixed Waste Landfill. The public dialogue will be held at the Los Griegos Health and Social Services Center, 1231 Candelaria Road, NW, from **9:00 a.m. to 3:30 p.m., on May 1, 2007**. All members of the public are invited to attend this forum.

Enclosed is a public meeting notice providing additional information on the subject meeting. If you need further information regarding this forum please contact Mr. William Moats of my staff at (505) 222-9551.

Sincerely,

John E. Kieling
Program Manager
Permits Management Program
Hazardous Waste Bureau

State of New Mexico
ENVIRONMENT DEPARTMENT
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
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www.nmenv.state.nm.us

BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

CINDY PADILLA
DEPUTY SECRETARY

PUBLIC MEETING NOTICE

NEW MEXICO ENVIRONMENT DEPARTMENT
HAZARDOUS WASTE BUREAU
Santa Fe, New Mexico
April 15, 2007

NOTICE OF PUBLIC DIALOGUE ON THE SOIL-VAPOR SAMPLING AND ANALYSIS PLAN FOR THE U. S. DEPARTMENT OF ENERGY/SANDIA NATIONAL LABORATORIES' MIXED WASTE LANDFILL

The New Mexico Environment Department (NMED) will host a public dialogue to discuss technical issues regarding the Soil-Vapor Sampling and Analysis Plan for the U. S. Department of Energy/Sandia National Laboratories' (SNL) Mixed Waste Landfill (MWL). The public dialogue will be held at the Los Griegos Health and Social Services Center, 1231 Candelaria Road, NW, from **9:00 a.m. to 3:30 p.m**., on **May 1, 2007**. The public is invited to attend this forum on the technical issues related to the Soil-Vapor Sampling and Analysis Plan (SAP).

The MWL occupies approximately 2.6 acres and is located in technical Area III of Sandia National Laboratories, approximately 5 miles southeast of the Albuquerque International Sunport. Radioactive and mixed waste from SNL research facilities and off-site generators was disposed in the MWL from March 1959 to December 1988. Mixed waste has both radioactive and hazardous components. Approximately 100,000 cubic feet of radioactive waste containing 6,300 Curies (Ci) of activity (at the time of disposal) were disposed of at the MWL.

Low levels of contaminants in soil vapor were detected in active soil-gas surveys conducted at the MWL during the early 1990's. Since that time, no additional data of this type has been acquired. On November 20, 2006, the NMED issued a Notice of Disapproval for the MWL Corrective Measures Implementation (CMI) Plan. As part of this Notice, the U. S. Department of Energy and Sandia Corporation were directed to submit to the NMED a Soil-Vapor SAP to provide current data on soil-gas concentrations beneath the landfill. The Soil-Vapor SAP is not considered to be part of the CMI Plan, but instead, is a stand alone document. The Soil Vapor SAP was submitted on December 15, 2006. The NMED issued a public notice on February 5, 2007, for the purpose of receiving public comments on the Soil-Vapor SAP. The public comment period was held from February 5, 2007, to March 7, 2007. Because of public interest and the public dialogue to be held on the Soil-Vapor SAP, the NMED is extending the time period to allow for the submittal of additional public comments on the SAP to **5:00 p.m., May 15, 2007**.

For further information on the Public Dialogue Forum, please contact Mr. William Moats of the New Mexico Environment Department at (505) 222-9551.

PUBLIC REVIEW OF THE SOIL-VAPOR SAMPLING AND ANALYSIS PLAN

The Soil-Vapor SAP may be reviewed by any member of the public at the following locations during the
public comment period:

NMED - Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
(505) 476-6000
Monday - Friday from 8:00 a.m. to 5:00 p.m.
Contact: Pam Allen

NMED - District 1 Albuquerque Office
5500 San Antonio NE
Albuquerque, New Mexico 87109
(505) 222-9500
Monday - Friday from 8:00 a.m. to 5:00 p.m.
Contact: William Moats

The Soil-Vapor SAP [*Sampling and Analysis Plan for VOCs, Tritium, and Radon at MWL (12-2006)*] is also available electronically on the NMED web site at: www.nmenv.state.nm.us/HWB/snlperm.html under Mixed Waste Landfill under Corrective Measures Implementation Work Plan.

To obtain a copy of the Soil-Vapor SAP or a portion thereof, in addition to further information, please contact Ms. Pam Allen at (505) 476-6000, or at the Santa Fe address given above. NMED will provide copies, or portions thereof, of the requested information at a cost to the requestor.

Any person who wishes to comment should submit written or electronic mail (e-mail) comment(s) with the commenter's name and address to the respective address below. Only comments received on or before **5:00 p.m., May 15, 2007** will be considered. To be considered relevant to this matter, written comments must be based on the Soil-Vapor SAP.

Submit written comments to:

John E. Kieling, Program Manager
Hazardous Waste Bureau - New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303
Reference: Sandia National Laboratories – MWL Soil-Vapor SAP
or by e-mail: john.kieling@state.nm.us

ARRANGEMENTS FOR PERSONS WITH DISABILITIES

Any person with a disability requiring assistance or auxiliary aid to participate should contact Judy Bentley by 10 days prior to the meeting at the following address or phone number: New Mexico Environment Department, Room N-4030, P. O. Box 26110, 1190 St. Francis Drive, Santa Fe, New Mexico 87502-6110, (505) 827-9872. TDD or TDY users please access Ms. Bentley's number via the New Mexico Relay Network at 1-800-659-8331.

Volume II

TAB 4

Response to Public Comment and Approval with Modifications

Soil-Vapor Sampling and Analysis Plan for the Mixed Waste Landfill

From: NMED/Bearzi
To: SNL/Wagner

Back of Tab 4

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

NEW MEXICO ENVIRONMENT DEPARTMENT

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RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL, RETURN RECEIPT REQUESTED

February 14, 2008

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Securities Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: RESPONSE TO PUBLIC COMMENT AND APPROVAL WITH MODIFICATIONS SOIL-VAPOR SAMPLING AND ANALYSIS PLAN FOR THE U. S. DEPARTMENT OF ENERGY/SANDIA NATIONAL LABORATORIES' MIXED WASTE LANDFILL
SANDIA NATIONAL LABORATORIES, EPA ID NM5890110518
HWB-SNL-05-025

Dear Ms. Wagner and Mr. Nimick:

The Soil-Vapor Sampling and Analysis Plan (SV SAP) for the Sandia National Laboratories' (SNL's) Mixed Waste Landfill (MWL) was required by the New Mexico Environment Department (NMED) in the Notice of Disapproval (NOD) issued on November 20, 2006, for the MWL Corrective Measures Implementation Plan. The SV SAP was submitted to the NMED in December 2006 as part of SNL's response to the NOD.

Public comment was received on the SV SAP from February 5, 2007, through March 7, 2007, and from April 15, 2007, through May 15, 2007. Additionally, a public meeting on the SV SAP was held at the Los Griegos Health and Social Services Center in Albuquerque on May 1, 2007. Representatives from the U. S. Department of Energy and Sandia Corporation (Permittees) attended this meeting. A copy of NMED's response to public comment on this matter is enclosed.

Based on our review of the SV SAP, and in consideration of the public comment received NMED hereby approves the SV SAP with the following modifications:

1. Six boreholes for the collection of soil gas and soil samples shall be drilled at the locations shown on the enclosed map (at locations DP1-DP6). Two other boreholes (DP7 and DP8), planned for background locations southwest of the landfill, may be drilled at the background locations as proposed in the SV SAP.

Soil-gas and soil samples from DP1-DP8 are to be analyzed for volatile organic compounds (VOCs) and tritium, as appropriate, as described in the SV SAP. As shown on the enclosed map, the locations for DP4 and DP5 shall be the same as those shown on Figure 2-1 of the SV SAP; the rest of the boreholes, DP1-DP3 and DP6, are to be moved to different locations (see the enclosed map) because of the heterogeneous nature of waste placed into the MWL. To protect workers, the borehole locations for DP1-DP6 may be adjusted by a maximum of 20 feet in any horizontal direction to avoid drilling directly through waste buried in the MWL.

As discussed in the SV SAP, duplicate samples are to be taken from DP5 and DP6. Because the location of DP6 is to be changed, the Permittees may choose a different borehole than DP6 for the collection of the second set of duplicate samples.

The Permittees shall collect soil samples to be analyzed for tritium prior to collecting soil-gas samples in each borehole, opposite of the sequence noted in the SV SAP.

2. Soil-gas and soil samples from boreholes DP2, DP3, and DP5 shall be collected at depths of 10, 30, and a minimum of 50 feet. Samples from all other boreholes shall be collected at depths of 10 and 30 feet.

3. The radon detectors proposed in the SV SAP (track-etch type) are not the same type as those used in the 1997 radon survey for the MWL. To ensure that radon data are directly comparable with the 1997 data, the Permittees shall use the same radon detector type as those used in the 1997 survey (*i.e.*, 4-inch diameter activated-charcoal radon canisters to be analyzed for radon by gamma spectroscopy).

4. Nine radon detectors (RN1-RN9) shall be deployed at the locations shown on the enclosed map. These locations were selected, in part, based on the highest flux rates for radon as determined in the 1997 survey, and do not include the two background locations proposed in the SV SAP. The locations for RN1, RN3, RN4, RN5, RN6, RN7, and RN8 correspond to locations 30, 5, 8, 44, 13, 64, and 18 of the 1997 survey, respectively. The locations of RN2 and RN9 are new.

5. The radon data shall be submitted at the same time as the VOC and tritium data.

6. In addition to VOCs, all soil-gas samples shall be analyzed for methane.

7. The data and results of the SV SAP shall be submitted in writing to the NMED for its review and approval no later than July 31, 2008.

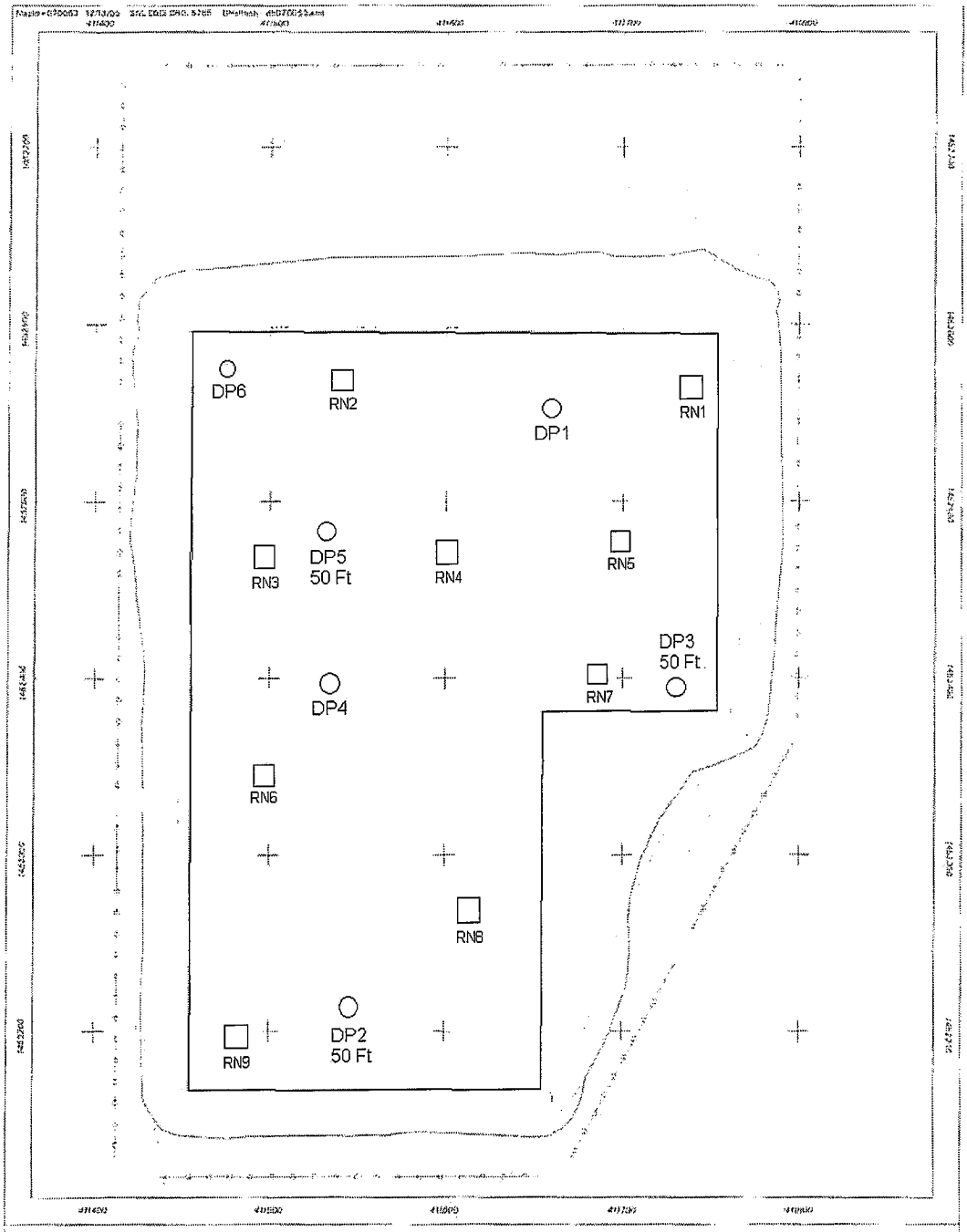
If you have any questions regarding this matter, please contact William Moats of my staff at (505) 222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

enclosures

cc: J. Kieling, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
P. Freshour, SNL MS 1089
J. Gould, DOE, MS 0184
File: SNL 2008 and Reading
SNL-05-025



Legend

- Soil Vapor and Tritium Sampling Location (DP1-DP6)
- Radon Sampling Location (RN1-RN9)
- Proposed Final Fence
- Proposed Toe of Landfill Cover
- SWMU 76, Former MWL Extent

Soil Gas VOC, Tritium, and Radon Sampling Locations, Mixed Waste Landfill

0 60 120
Scale in Feet

0 14 28
Scale in Meters

Volume II

TAB 5

Notice of Approval and Response to Public Comment on Soil-Vapor Sampling and Analysis Plan for Mixed Waste Landfill

From: NMED/Kieling
To: Interested Citizen

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BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

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RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

February 15, 2008

SUBJECT: NOTICE OF APPROVAL AND RESPONSE TO PUBLIC COMMENT ON SOIL-VAPOR SAMPLING AND ANALYSIS PLAN FOR THE U. S. DEPARTMENT OF ENERGY/SANDIA NATIONAL LABORATORIES' MIXED WASTE LANDFILL

Dear Interested Person:

The New Mexico Environment Department (NMED) has approved, with modifications, the Soil-Vapor Sampling and Analysis Plan (SV SAP) for the Sandia National Laboratories' Mixed Waste Landfill. Public comment was received on the SV SAP from February 5, 2007, through March 7, 2007, and from April 15, 2007 through May 15, 2007. Additionally, a public meeting on the SV SAP was held at the Los Griegos Health and Social Services Center in Albuquerque on May 1, 2007. NMED's response to public comment on this matter can be found on the NMED website at http://www.nmenv.state.nm.us/hwb/snlperm.html under Mixed Waste Landfill (MWL).

The SV SAP was modified after consideration of public comment. The approval letter may also be reviewed at website above.

Sincerely,

John E. Kieling
Program Manager
Permits Management Program
Hazardous Waste Bureau

Index of Public Comments Received On Time:
Sandia National Laboratories Mixed Waste Landfill Soil Vapor Plan
February 2008

Commenter ID	Date of Letter or e-mail	Commenter and Association (if Applicable)
A	2/13/07	Deirdre Lennihan
B	2/28/07	Citizen Action New Mexico/David McCoy
C	4/27/07	Citizen Action New Mexico/David McCoy
D	5/1/07	Citizen Action New Mexico/David McCoy
E	5/15/07	Citizen Action New Mexico/David McCoy
F	5/15/07	Robert H. Gilkeson
G	3/1/07	Southwest Research and Information Center/Paul Robinson
H	5/15/07	Southwest Research and Information Center/Paul Robinson
I	3/5/2007	Jeanne House

NMED Response to Public Comments on the Mixed Waste Landfill (MWL) Soil-Vapor (SV) Sampling and Analysis Plan (SAP) February 2008

Commenter ID	Association/ Commenter	Topic Area	Comment Summary	NMED Response Number	NMED Response
A	Deirdre Lennihan	Regulation of hazardous and radioactive wastes	The commenter expressed that the New Mexico Environment Department (NMED) should strictly enforce the hazardous waste management regulations at the federal government laboratories in the state. The commenter assumes the NMED has the authority to also strictly enforce regulations concerning radioactive waste management.	R1	The NMED enforces the state's Hazardous Waste Management Regulations (HWMR), 20.4.1 NMAC, at all facilities in New Mexico, including the federal facilities. Over the past several years NMED has taken several enforcement actions against federal facilities in New Mexico for violations of the HWMR. Some of these enforcement actions have included the issuance and recovery of some of the largest fines ever levied for violations of the HWMR. The NMED has the authority under the Resource Conservation and Recovery Act (RCRA) and the HWMR to regulate the hazardous component of mixed waste (mixed waste contains both radioactive and hazardous components). However, under federal law, the NMED does not have authority to regulate the radioactive component of mixed waste or a radioactive waste that lacks a hazardous component.
D	Citizen Action New Mexico/ David McCoy (5/1/07)		The commenter asks why NMED did not require waste in Pits SP-4, SP-35, and SP-36 be removed and disposed of elsewhere, in accordance with applicable regulatory requirements.	R2	The comment is not relevant to the Soil-Vapor Sampling and Analysis Plan (SV SAP). The SV SAP concerns the one-time sampling of soil vapor and soil moisture at the Mixed Waste Landfill (MWL). The SV SAP, once implemented, will provide current data regarding releases of volatile organic compounds (VOCs), radon, and tritium at specifically targeted locations. The new data at minimum will be compared with historical data to determine if there has been any significant increase in contaminant levels in the vadose zone over the past 10 years. With respect to the development of the SV SAP, SNL was

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					directed by the NMED to propose a plan to investigate contaminants in the vadose zone at two depths at a minimum of three locations for the aforementioned reason. Thus, the SV SAP was never intended to be a plan to investigate contaminant releases from individual pits and trenches, or repeat the extensive soil-vapor studies done under the RCRA Facility Investigation (RFI). Additionally, the SV SAP is also not a plan to conduct corrective measures (such as to excavate pits), to conduct groundwater monitoring, or to conduct long-term monitoring and maintenance.
D	Citizen Action New Mexico/ David McCoy (5/1/07)	Regulatory framework of the MWL	The commenter states that the Consent Order requires vadose zone monitoring that is compliant with the Technical Enforcement Guidance Document (TEGD) issued by the U. S. Environmental Protection Agency in November 1992 and RCRA regulations at 40 CFR § 264.98.	R3	The comment is not relevant to the SV SAP because it concerns long-term monitoring (see response R2 concerning the scope of the SV SAP). The Sandia Consent Order does not require that vadose zone monitoring be conducted in accordance with the TEGD. Additionally, the RCRA regulations at 40 CFR § 264.98 (which are not applicable to the MWL in any case) do not address vadose-zone monitoring.
D	Citizen Action New Mexico/ David McCoy (5/1/07)		The commenter argues that the MWL is subject to the detection monitoring requirements for groundwater under 40 CFR § 264.98.	R4	The comment is not relevant to the SV SAP (see response R2 concerning the scope of the SV SAP). The MWL is not subject to the groundwater monitoring requirements of 40 CFR § 264.98.
D	Citizen Action New Mexico/ David McCoy (5/1/07)		The commenters state that vadose-zone monitoring of soil gas is required under RCRA, but such monitoring does not exist at the landfill.	R5	The comment is not relevant to the SV SAP because it concerns long-term monitoring (see response R2 concerning the scope of the SV SAP). There are no RCRA regulations that explicitly require the

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F	Robert H. Gilkeson (5/15/07)				installation of vadose-zone monitoring systems. However, the regulations at 40 CFR § 264.101 require that the owner/operator of a facility seeking a permit for the management of hazardous waste to institute corrective action as necessary to protect human health and the environment from all releases regardless of the time at which waste was placed into a unit. These regulatory requirements could include vadose monitoring at solid waste management units, where and when the NMED finds it necessary.
E	Citizen Action New Mexico/ David McCoy (5/15/07)		The commenter argues that the landfill is subject to permitting requirements under RCRA for post-closure care. The commenter also states that the landfill is subject to DOE Orders, including 5820.2A	R6	The comment is not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP. The NMED does not have the authority to enforce DOE Orders.
F	Robert H. Gilkeson (5/15/07)		The commenter states that the MWL contains commingled radioactive and hazardous waste that would not be acceptable for land disposal under RCRA. The commenter further states that RCRA regulations would prohibit disposal in unlined pits and trenches.	R7	The comment is not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP. Waste disposal at the MWL began prior to the existence of RCRA and the HWMR. Even if the landfill had operated as an interim status unit, the MWL closed prior to any effective date that a lining system would have been required under RCRA (see 40 CFR § 265.301(a)).
D	Citizen Action New Mexico/ David McCoy (5/1/07)	Long-term monitoring	The commenters are concerned that a program needs to be required for continuous monitoring of soil gas, not just occasional monitoring of	R8	The comments received about long-term monitoring are not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP. Long-term monitoring, which will include regularly scheduled monitoring events, is to be conducted under

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E F H	Citizen Action New Mexico/ David McCoy (5/15/07) Robert H. Gilkeson (5/15/07) Southwest Research and Information Center/Paul Robinson (5/15/07)		soil-gas, although one commenter recommended that semi-annual monitoring be implemented. One commenter states that all sampling must be in accordance with Section g.4 of the "HSWA Permit". Other comments on long-term monitoring included discussion that real time monitoring should be done because the landfill was not constructed with a liner, that three FLUTE wells for long-term monitoring of soil gas is inadequate, and that because the landfill doesn't have an engineered liner or other features, a large network of deep vertical and angle monitoring wells is needed for long-term monitoring of soil gas and soil moisture.		a different plan ordered by the NMED Secretary. The long-term monitoring plan was submitted by SNL earlier than required (September 25, 2007); however, this plan has not been reviewed or approved by the NMED at this time. It has, however, been subject to public comment. There is no Section g.4 in Module IV of the SNL RCRA Permit (Module IV is entitled *Special Conditions Pursuant to the 1984 Hazardous and Solid Waste Amendments (HSWA) to RCRA for Sandia National Laboratory, EPA I.D. Number NM5890110518*).
H	Southwest Research and Information Center/Paul Robinson (5/15/07)	Baseline for long-term monitoring	The commenter recommends that data obtained from the implementation of the SV SAP be used as baseline data for long-term monitoring.	R9	See response R2. The SV SAP is not a long-term monitoring plan. Although the data may be thought of as "baseline data", the Department may choose different sampling locations and other methods of monitoring for the purpose of long-term monitoring. It will likely be necessary to install permanent soil-vapor wells for the purpose of long-term monitoring, whereas, only temporary boreholes will be utilized to implement the SV SAP.
E F	Citizen Action New Mexico/ David McCoy (5/15/07) Robert H. Gilkeson (5/15/07)	Trigger levels	The commenters provide extensive discussion that trigger levels for tritium, soil moisture, and volatile organic compounds are set too high.	R10	The comment is not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP. Triggers are to be included in the long-term monitoring plan, and are being developed under the CMI Plan.

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C	Citizen Action New Mexico/ David McCoy (4/27/07)	Relationship of SV SAP to CMI Plan	The commenter argues that the SV SAP should be considered a part of the CMI Plan, and thus the public is being denied the right to a public hearing and a right to appeal.	R11	The SV SAP is not part of the CMI Plan. The two plans are not related. The CMI Plan concerns the implementation of the remedy (installation of the cover system), development of a Fate and Transport Model, and developing triggers for long-term monitoring. These triggers are to be incorporated into the long-term monitoring and maintenance plan for the landfill. See response R2 concerning the scope of the SV SAP. Regardless of whether the SV SAP would be considered a part of the CMI Plan (which it is not), the CMI Plan is not subject to the requirements for hearings and appeal as provided under the HWMR (20.4.1.901 NMAC) and the New Mexico Hazardous Waste Act (NMSA 1978, 74-4-14). The CMI Plan, however, is subject to review and comment from the public, and consideration and response by NMED under the Secretary's Final Decision on the MWL.
B G	Citizen Action New Mexico/ David McCoy (2/28/07) Southwest Research and Information Center/Paul Robinson (3/1/07)	Extend public comment period	The commenters request that the public comment period for the SV SAP be extended. One commenter also argues that construction of the subgrade has created confusion, and thus, additional time was needed for the public to review the SV SAP.	R12	After the initial 30-day comment period was held from February 5, 2007, to March 7, 2007, the NMED extended the public comment period for another 30 days from April 15, 2007, to May 15, 2007.
G	Southwest Research and Information Center/Paul Robinson (3/1/07)	Public meeting	The commenter requested that a public meeting be convened to discuss technical issues about the SV SAP.	R13	The NMED conducted a public dialogue meeting on May 1, 2007 at the request of the commenter to discuss technical issues related to the SV SAP.
B	Citizen Action New Mexico/	Public hearing	The commenter requested that a public hearing be granted regarding	R14	The comment is not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP.

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	David McCoy (2/28/07)		the construction of the subgrade at the landfill and the efficacy of the monitoring systems.		The request for a public hearing was denied. Instead, a public technical meeting (see response R13) was held that allowed members of the public to discuss these issues and the SV SAP with NMED and SNL, and was a more appropriate forum for such a discussion. The commenter was in attendance at this public meeting.
B	Citizen Action New Mexico/ David McCoy (2/28/07)	Cease and desist order for cover construction	The commenter requested that the NMED issue a cease and desist order for construction of the evapotranspiration cover system at the Mixed Waste Landfill.	R15	The comment is not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP. The Corrective Measures Implementation (CMI) Plan is the controlling document for cover construction, not the SV SAP. NMED understands that no additional work on the cover has occurred at the MWL since subgrade preparation was completed.
B	Citizen Action New Mexico/ David McCoy (2/28/07)	Subgrade	The commenter is concerned that construction of the subgrade for the MWL cover system will adversely impact implementation of the SV SAP by having to account for the additional depth of the boreholes to reach the targeted depths for sampling.	R16	The NMED does not expect the additional 2-3 feet (average) of fill in the subgrade to present any problems with implementation of the SV SAP.
F	Robert H. Gilkeson (5/15/07)		The commenter recommends coring the landfill surface to measure the thickness of the subgrade.	R17	The comment is not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP.
B	Citizen Action New Mexico/ David McCoy (2/28/07)	Revising Fate and Transport Model based on new data from SV SAP	The commenter is concerned about how data obtained from implementation of the SV SAP will be utilized in the Fate and Transport Model that has been prepared by SNL for the landfill.	R18	The NMED Secretary's Final Order issued on May 26, 2005, requires that SNL update the Fate and Transport Model every five years. It is possible that data derived from the SV SAP may be used to update the Fate and Transport Model. However, other data obtained from future monitoring of the landfill may be available and may be used instead for this purpose.

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					Should the data from the SV SAP indicate that a significant increase in contaminant levels has occurred, the NMED will require SNL to conduct whatever corrective action is necessary, if any. As part of any such additional corrective action, the NMED may require portions of the Fate and Transport Model to be updated immediately using the newly acquired data for the contaminant(s) of concern.
D	Citizen Action New Mexico/ David McCoy (5/1/07)	Public meeting for Fate and Transport Model	The commenter states that a public meeting should be held on the Fate and Transport Model because the model is, in his opinion, lacking of any predictive value for releases of contaminants. The commenter also provides quotes from an article by Shlomo P. Nueman indicating that models are sometimes used to demonstrate that site characterization has been completed such that additional sampling would be of little benefit. Additionally, the commenter states that the Fate and Transport Model should be subject to a public hearing.	R19	The comment is not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP. Additionally, a meeting was held on May 25, 2006, to discuss the CMI Plan. The Fate and Transport Model, being a part of the CMI Plan, was discussed at this public meeting and dominated much of the discussion at the meeting.
D E F	Citizen Action New Mexico/ David McCoy (5/1/07) Citizen Action New Mexico/ David McCoy (5/15/07)	Validity of the Fate and Transport Model	A number of comments were received concerning the Fate and Transport Model that was developed for the MWL. Comments included the following topics: the Fate and Transport Model relies on assumed values rather than data obtained from the field, current and comprehensive data are needed to verify and calibrate the Fate and Transport Model, the model predicts that	R20	These comments are not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP. The Fate and Transport Model predicts that PCE (the primary volatile organic compound at the MWL) has only a small (1 %) chance of contaminating groundwater to a level that would exceed the drinking water standard. This result is based on PCE concentrations of up to ten times those actually detected and conservative assumptions that maximize the rate of migration of PCE. Groundwater has not been contaminated by releases of contaminants from the MWL.

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G H	Robert H. Gilkeson (5/15/07) Southwest Research and Information Center/Paul Robinson (3/1/07) Southwest Research and Information Center/Paul Robinson (5/15/07)		VOCs will reach groundwater, the detection of any VOCs should be considered "high" no matter the level because there are no natural background concentrations for these compounds, and that the Fate and Transport Model should be abandoned because the model was not based on physical data, did not predict groundwater contamination by the migration of chromium and nickel, and because models may be misused to predict a pre-determined outcome.		There are no natural background concentrations for volatile organic compounds listed as hazardous constituents under RCRA. However, low detections should not necessarily be considered as "high" (significant) if they do not represent unacceptable risk to human health or the environment. See also response R57.
H	Southwest Research and Information Center/Paul Robinson (5/15/07)	Characterization of containers	The commenter recommends that a geophysical survey be conducted to investigate the condition of containers and their distribution.	R21	The comment is not relevant to the SV SAP. See response R2 concerning the intended scope of the SV SAP.
B D G H	Citizen Action New Mexico/ David McCoy (2/28/07) Citizen Action New Mexico/ David McCoy (5/1/07) Southwest Research and Information Center/Paul Robinson (3/1/07) Southwest	Ruptured Containers	The commenters are concerned that buried containers could have been ruptured as a result of heavy equipment used during subgrade preparation of the landfill's surface. The ruptured containers could then release contaminants to the environment.	R22	The comment is not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP. If any containers were ruptured, and the containers released contaminants in the form of vapors, any such release that would pose unacceptable risk to human health and the environment would likely be revealed by implementation of the SV SAP or during long-term monitoring of the landfill. Vadose zone monitoring will be conducted under the Long-Term Monitoring and Maintenance Plan**.**

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	Research and Information Center/Paul Robinson (5/15/07)				
F	Robert H. Gilkeson (5/15/07)				
B	Citizen Action New Mexico/ David McCoy (2/28/07)	Compaction effects on soil-gas migration	The commenter is concerned that compaction of the subgrade would cause the migration of soil-gases.	R23	The comment is not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP. The fill materials used for the subgrade are clean soils imported from off-site of the MWL. Thus, there were no contaminants to migrate from this soil during construction.
G	Southwest Research and Information Center/Paul Robinson (3/1/07)				
H	Southwest Research and Information Center/Paul Robinson (5/15/07)				
F	Robert H. Gilkeson (5/15/07)				
F	Robert H. Gilkeson (5/15/07)	Sampling Locations	The commenters state that soil-gas data obtained during the RFI are too few in number to properly characterize soil-gas at the MWL.	R24	The comment is not relevant to the SV SAP. Questions concerning the adequacy of the RFI were asked and answered by the NMED at the hearing on the MWL Corrective Measures Study. For the MWL, a 2.6 acre site, SNL deployed 92 passive soil-gas samplers at locations ranging from about 20-50 feet apart, and later conducted active soil-gas sampling at 43 locations at depths of 10 and 30 feet at each location; most of the 43 locations selected were predicted to have the highest concentrations of
H	Southwest Research Information Center/Paul Robinson (5/15/07)				

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					VOCs based on the results of the passive soil-gas survey. Additionally, in 1992-1993, 42 samplers for measuring the surface flux of tritium, and in 1997, 89 samplers for measuring the surface flux of radon were also deployed. The number and locations of samples collected and analyzed for tritium, radon, and VOCs were adequate to characterize these contaminants at the landfill. Any plume with concentrations or activity levels high enough to represent unacceptable risk to human health or the environment would have been discovered by the density and locations of the various samplers deployed.
D F	Citizen Action New Mexico/ David McCoy (5/1/07) Robert H. Gilkeson (5/15/07)		One commenter states that the proposed sampling in the SV SAP is too little and should be increased to at least 100 sampling points in three-dimensions. The other commenter suggested that about 30 locations be sampled at depths of 10, 30, and 60 feet in and around the classified portion of the landfill, and that 30 or more locations also be sampled at points surrounding and within the unclassified portion of the landfill and at the same three depths.	R25	NMED did not intend nor is it necessary for the SV SAP to duplicate the characterization effort and comprehensive coverage of samplers that were deployed as part of the RFI (see response R2). It is also not necessary for the SV SAP to include 100 or more locations for the purpose of sampling soil-gas for comparison to historical data. Any plume with concentrations or activity levels high enough to represent unacceptable risk to human health or the environment would be discovered by a smaller number of sampling devices. NMED will require that some samples be collected at deeper depths below the landfill as explained in response R31.
E	Citizen Action New Mexico/		The commenter indicates that wastes containing volatile organic compounds, semi-volatile organic	R26	Metals are not detectable using soil-gas sampling technologies, and are not among the contaminants that will easily migrate from the landfill.

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	David McCoy (5/15/07)		compounds, and metals were placed into the landfill in a heterogeneous manner, thus the SV SAP should include soil-gas sampling locations that are more widely distributed across the landfill. The commenter specifically recommends that tritium hot spots and the acid pit area are sampled under the SV SAP.		Although the Department originally directed the Permittees to select locations for soil-gas sampling in the SV SAP to correspond to where the highest soil-gas concentrations for volatile organic compounds were found during the RFI, the NMED agrees that wastes were placed in the landfill in a heterogeneous manner. Thus, the Department will direct the Permittees to move some of the sampling locations proposed in the SV SAP to other places within and along the boundary of the landfill. This includes sampling for volatile organic compounds and tritium near the acid pit. Some radon samplers will be deployed at or near areas where the highest activity levels (hot spots) were found. The soil-gas surveys conducted during the RFI clearly indicated that the highest soil-gas concentrations of PCE and other volatile organic compounds are in the northern half of the unclassified portion of the landfill. The active soil-gas survey specifically targeted the areas where PCE was detected by passive soil-gas sampling (compare Figures 4.5-3 and 4.5-11 with 4.5-21 and 4.5-27 in the Phase 2 RFI Report). Soil and tritium flux sampling indicate that the highest levels of tritium contamination are located at the classified portion of the landfill, not the unclassified portion (see Figures 4.4-1, 4.4.-2, 4.4-3, 4.4-4, 4.6-1, 4.6-2, 4.6-3, 4.6-4, and Tables 4.6-2 and 4.6-8 of the Phase 2 RFI Report). This finding was expected based on the landfill's inventory and previous sampling. Thus, future tritium monitoring should especially target the classified portion of the landfill.

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F	Robert H. Gilkeson (5/15/07)		The commenter states that the SV SAP is inadequate to identify releases from discrete pits and trenches.	R27	See response R2 concerning the scope of the SV SAP.
F	Robert H. Gilkeson (5/15/07)		The commenter states that the SV SAP is inadequate because the proposed monitoring wells are to be installed at locations outside the boundary of the MWL.	R28	The comment is not relevant to the SV SAP because it concerns long-term monitoring (see response R2 concerning the scope of the SV SAP). The locations proposed by SNL for soil-gas sampling are all located within or along the proposed fenced boundary of the landfill other than the two locations selected as background points. The sampling locations are not monitoring well locations, as soil-vapor samples will be collected only once during implementation of the SV SAP (see response R2 concerning the scope of the SV SAP and response R26 concerning modifications to the SV SAP).
F	Robert H. Gilkeson (5/15/07)		The commenter states that the proposal by SNL to obtain soil-gas samples from 6 locations is nonresponsive to the NOD issued by the NMED. He states that none of the sampling locations are above or below the disposal trenches and pits.	R29	SNL was required by NMED to propose a minimum of three locations and to sample soil gas at each location at two different depths. SNL proposed six locations within the landfill and agreed to sample soil-vapor at each of the two required sampling depths of 10 and 30 feet. Thus, SNL was responsive through its submittal of the SV SAP and has addressed NMED's original requirements. A depth of 10 feet corresponds to an elevation near the top of the waste. A depth of 30 feet corresponds to an elevation just below the waste. NMED does not recommend the sampling of soil gas via drilling purposely through any of the pits and trenches due to the need to protect the health and safety of site workers.

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					Boreholes placed near the pits and trenches are sufficient to accomplish the objectives of the SV SAP and also protect workers.
D E F G	Citizen Action New Mexico/ David McCoy (5/1/07) Citizen Action New Mexico/ David McCoy (5/15/07) Robert H. Gilkeson (5/15/07) Southwest Research and Information Center/Paul Robinson (3/1/07)	Sampling depths	Two commenters state that soil-gas monitoring and sampling should be conducted through the vadose zone from the surface to the uppermost aquifer. One commenter states that soil gas should be sampled to a depth that soil vapor may have been released by compaction of the subgrade or to a depth where VOCs are no longer detected.	R30	That part of the comment concerning monitoring is not relevant to the SV SAP (see response R2 concerning long-term monitoring). If soil vapor concentrations remain sufficiently low at the level of the waste (at 10 feet), and just below the waste (at 30 feet), there is no critical need to sample for soil gas at greater depths. See also response R31.
D F	Citizen Action New Mexico/ David McCoy (5/1/07) Robert H. Gilkeson (5/15/07)		The commenters argue that soil-gas concentrations generally increase with depth based on Department comments in a NOD issued in 1997, and as demonstrated by the Phase 2 RFI Report.	R31	There does not appear to be a significant increase in soil-gas concentrations between the depths of 10 and 30 feet. Nonetheless, the NMED will direct SNL to modify the SV SAP to collect at least three samples at a minimum depth of 50 feet instead of a maximum depth of 30 feet. The soil-gas samples are to be analyzed for VOCs; tritium will be analyzed in soil-moisture samples.

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F	Robert H. Gilkeson (5/15/07)	Passive Soil-Gas Surveys	The commenter argues that there were insufficient samplers deployed to characterize VOC concentrations. The commenter also argues that passive soil gas samples should be collected now.	R32	See response R2 concerning the scope of the SV SAP. See also response R24. An active soil-gas sampling method will be employed so that the concentrations of VOCs can be quantified and directly compared to historical data. Passive soil-gas surveys, while they can be more sensitive, provide only qualitative information and cannot be used to rigorously assess concentration levels of contaminants.
D	Citizen Action New Mexico/ David McCoy (5/1/07)	Tritium characterization	The commenter indicated, according to the NOD, that the Department found that tritium activity levels in soil at depths below the water table in well boring MW4 exceeded background.	R33	The comment is not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP. Data included in the Phase 2 RCRA Facility Investigation Report for the MWL indicated that tritium activity levels at depths below the water table exceeded the background level. However, it was later determined that most tritium levels originally reported in the Phase 2 RFI Report were incorrect due to an error in converting activity levels from pCi/L of soil water to pCi/g of soil. The actual tritium levels are 100 times lower than originally reported in the Phase 2 RFI Report, and thus are actually below the background level in well MW4 at depths at and below the water table.
E	Citizen Action New Mexico/ David McCoy (5/15/07)		The commenters state that tritium should be measured in soil gas.	R34	The NMED originally required tritium to be measured in soil gas. However, for the new data to be directly comparable to historical data, tritium should be measured in soil moisture. However, NMED may require soil gas to be monitored for tritium as part of long-term monitoring at the MWL.
F	Robert H. Gilkeson (5/15/07				

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E	Citizen Action New Mexico/ David McCoy (5/15/07)		The commenter argues that a proposed trigger level of 20,000 pCi/L of tritium in soil moisture is too high for the early detection of tritium.	R35	The comment is not relevant to the SV SAP. Trigger levels meant for long-term monitoring requirements are being developed as part of the CMI Plan. See response R2 concerning the scope of the SV SAP.
E	Citizen Action New Mexico/ David McCoy (5/15/07)		The commenter argues that tritium should be monitored around the entire perimeter of the landfill and at all previously identified hot spots.	R36	The comment is not relevant to the SV SAP because it concerns long-term monitoring (see response R2 concerning the scope of the SV SAP).
F	Robert H. Gilkeson (5/15/07)		The commenter claims that the Permittees have developed a "scheme… to shirk from the responsibility to monitor tritium…".	R37	The comment is not relevant to the SV SAP because it concerns long-term monitoring (see response R2 concerning the scope of the SV SAP). The SV SAP contains provisions for the sampling of tritium.
F	Robert H. Gilkeson (5/15/07)	Helium monitoring	The commenter suggests that helium isotopes should be monitored and studied as a possible surrogate for tritium.	R38	The comment is not relevant to the SV SAP because it concerns long-term monitoring (see response R2 concerning the scope of the SV SAP). The NMED believes that tritium should be monitored by direct methods, especially given that is possible to do so.
F	Robert H. Gilkeson (5/15/07)	Methane monitoring	The commenter believes that methane should be sampled for at the landfill.	R39	NMED will direct SNL to modify the SV SAP to analyze soil-vapor samples for methane in addition to other VOCs.
D	Citizen Action New Mexico/ David McCoy (5/1/07)	Radon characterization	The commenter states that radon has not been characterized in the vadose zone beneath the MWL.	R40	The primary concern for radon is emissions to the atmosphere. The NMED believes that sampling the radon flux on the surface of the landfill is adequate for the purpose of the SV SAP (see response R2 regarding the scope of the SV SAP).

Commenter ID	Association/ Commenter	Topic Area	Comment Summary	NMED Response Number	NMED Response
					The radon flux from the ground into the atmosphere was evaluated by deploying sampling devices on the surface of the landfill. The sampling method proposed in the SV SAP is different than that used to characterize the radon flux from the landfill during the RFI. However, the Department will require SNL to employ the same method to measure radon flux as was used in the RFI so that the data obtained through implementation of the SV SAP are directly comparable. If emissions of radon are detected on the surface of the MWL at levels that are appreciably above background, then it may be become necessary to monitor the groundwater beneath the landfill for radon.
E	Citizen Action New Mexico/ David McCoy (5/15/07)		The commenter argues that radon should be monitored around the entire perimeter of the landfill and at all previously identified hot spots.	R41	The comment is not relevant to the SV SAP because it concerns long-term monitoring (see response R2 concerning the scope of the SV SAP).
D	Citizen Action New Mexico/ David McCoy (5/1/07)		The commenter states that radon gas monitoring should be conducted before construction of the cover.	R42	The comment is not relevant to the SV SAP because it concerns long-term monitoring (see response R2 concerning the scope of the SV SAP). The cover will not prevent radon emissions from the landfill. Thus, the sampling of radon can be done either prior to or after cover construction. NMED prefers that the radon samplers be deployed prior to cover construction so that new data for radon will be available sooner.

Commenter ID	Association/ Commenter	Topic Area	Comment Summary	NMED Response Number	NMED Response
E	Citizen Action New Mexico/ David McCoy (5/15/07)		The commenter argues that radon should be measured in soil gas.	R43	The method used to measure radon in the past, and that which will be required for the SV SAP, is a method that measures radon in soil gas. See also response R40.
H	Southwest Research and Information Center/Paul Robinson (5/15/07		The commenter recommends that the radon samplers be deployed at ground level.	R44	The method used to measure radon in the past, and that which will be required for the SV SAP, is a method where the radon samplers are deployed at ground level. See also response R40.
E F	Citizen Action New Mexico/ David McCoy (5/15/07) Robert H. Gilkeson (5/15/07)	Laboratory analysis of VOCs	The commenters state that analysis of VOCs should include all volatile organic compounds known to occur in the landfill. One commenter also states that detection limits should be less than 20 ppmv.	R45	All VOCs detected by EPA method TO-14 are to be analyzed for and reported on an individual basis. Detection limits for each type of VOC are expected to be lower than 20 ppmv.
D E	Citizen Action New Mexico/ David McCoy (5/1/07) Citizen Action New Mexico/ David McCoy (5/15/07)	Storm-water runoff	The commenter recommends that surface soil samples be collected and analyzed to characterize storm-water runoff from the MWL.	R46	This comment is not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP. The subgrade is constructed of clean soil, thus no contaminants will be released by storm events.
D	Citizen Action New Mexico/ David McCoy	Timing of monitoring relative to cover	The commenter states that long-term monitoring should be initiated prior to cover construction	R47	This comment is not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP.

Commenter ID	Association/ Commenter	Topic Area	Comment Summary	NMED Response Number	NMED Response
E	(5/1/07) Citizen Action New Mexico/ David McCoy (5/15/07)	construction			
D	Citizen Action New Mexico/ David McCoy (5/1/07)	Extraction of Soil Gas	The commenter states that the extraction and treatment of soil gas should be anticipated and may be necessary.	R48	Based on the results of the Phase 2 RFI, the remediation of soil gas is not expected to be necessary. See also response R18.
D E	Citizen Action New Mexico/ David McCoy (5/1/07) Citizen Action New Mexico/ David McCoy (5/15/07)	Risk Assessment	The commenter states that a risk assessment should be done after characterization of the soil-gas, groundwater, and surface water pathways. The commenter also states that NMED should evaluate a 1995 risk assessment done for the MWL.	R49	These comments are not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP. Risk assessments have already been completed under the RFI and the Corrective Measures Study for the MWL. NMED will review the 1995 report prior to approving the CMI Plan.
E	Citizen Action New Mexico/ David McCoy (5/15/07)	Waste inventory	The commenter states that the waste inventory is incomplete, so more characterization is necessary and the selected remedy should be reconsidered.	R50	The comment is not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP.
E	Citizen Action New Mexico/ David McCoy (5/15/07)	Hydraulic characterization of surface soil	The commenter claims that determination of certain soil characteristics from a test location 500 feet away from the landfill was not justified because the distance is too large.	R51	The comment is not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP.
E	Citizen Action New Mexico/ David McCoy (5/15/07)	Long-term risk of fire and explosion	The commenter states that the SV SAP does not consider risks for fire and explosions.	R52	The planned intrusive sampling methods will not penetrate trenches and pits where waste is buried at the landfill. Thus, the risk of fire or explosions is expected to be small.

Commenter ID	Association/ Commenter	Topic Area	Comment Summary	NMED Response Number	NMED Response
G	Southwest Research and Information Center/Paul Robinson (5/15/07)	Erosion Control	The commenter states that a March 13, 2007, letter to the Department from the Permittees containing a request for precautionary erosion controls not be approved unless NMED receives detailed documentation on subgrade construction, and conducts a visual inspection of erosion and the landfill's surface.	R53	The comment is not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP.
I	Jeanne House (3/5/07)	What constitutes a major document	The commenter wants an explanation as to why the SV SAP is considered to be a major document for the MWL.	R54	The SV SAP describes a sampling effort intended to retrieve data that will be used to determine if contaminant levels have remained low at the MWL since the RFI. Given the need for this information, and because historical data are 10 years old, the SV SAP should be subject to public comment as a major document.
I	Jeanne House (3/5/07)	Approval of SV SAP	The commenter recommends that the SV SAP be approved and that construction of the cover begin immediately.	R55	The SV SAP will be approved with conditions. The conditions will be posted on the NMED web site in the approval letter for the SV SAP at: http://www.nmenv.state.nm.us/hwb/snlperm.html. Construction of the cover (beyond the subgrade) cannot begin until NMED grants approval of the CMI Plan, which cannot be further considered until SNL reports the results of the SV SAP implementation.
D	Citizen Action New Mexico/ David McCoy (5/1/07)	Environmental Justice	The commenter states that there has been a lack of concern for monitoring and controlling past, present, and future exposure to communities.	R56	Long-term monitoring will be implemented at the MWL to ensure that public health and the environment will remain protected at all times. The comment period for the SV SAP was conducted pursuant to the NMED Secretary's Final Order on the MWL remedy, which was formulated as a result of testimony received during the public hearing held on the Corrective Measures Study. The Secretary considered not only the technical testimony given by experts, but also non-technical testimony received from various communities in the area.

Commenter ID	Association/ Commenter	Topic Area	Comment Summary	NMED Response Number	NMED Response
D E F	Citizen Action New Mexico/ David McCoy (5/1/07) Citizen Action New Mexico/ David McCoy (5/15/07) Robert H. Gilkeson (5/15/07	Groundwater	Two commenters presented numerous comments concerning their opinion that there has been a release of many contaminants, including heavy metals from the landfill. Comments are made suggesting that groundwater beneath the MWL has been contaminated by releases from the landfill (such as chromium and nickel), that the groundwater monitoring well network is flawed and inadequate, that too few wells exist to monitor the site, that various hydrologic properties of the aquifer and groundwater flow direction have not been adequately characterized, and that the landfill is not being properly regulated under RCRA with respect to groundwater. Other comments include a recommendation that the detection level of tritium in groundwater be no more than 1 pCi/L, that a large network of groundwater monitoring wells is needed because the landfill does not meet regulatory requirements for the disposal of hazardous waste, that "The NMED NOD instructed DOE/SNL to propose the location of new groundwater monitoring wells at locations within the MWL where past studies identified hot spots of contamination", that cover construction should be delayed, that the monitoring of nickel isotopes in groundwater would provide	R57	Comments regarding groundwater are not relevant to the SV SAP. See response R2 concerning the scope of the SV SAP. SNL was instructed by the NMED to conduct soil-vapor sampling at hot spots, not to install groundwater monitoring wells. .

Commenter ID	Association/ Commenter	Topic Area	Comment Summary	NMED Response Number	NMED Response
			important information on the source of nickel (given the corrosion of stainless steel well screens), and that groundwater monitoring wells MW1, MW2, MW3, MW4 and MW5 should be replaced.		

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TAB 6

Request for Deadline Extension of Investigation Report Soil-Vapor Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill

From: SNL/Wagner
To: NMED/Bearzi

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MWL
ENTERED

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

JUL 10 2008

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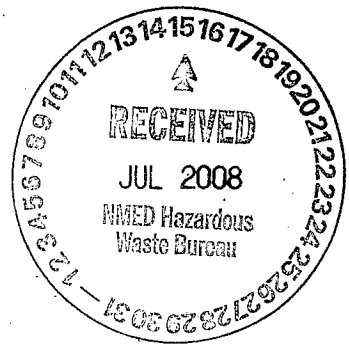

James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Bldg. 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

The Soil-Vapor Sampling and Analysis Plan (SV SAP) for the Sandia National Laboratories/New Mexico (SNL/NM) Mixed Waste Landfill (MWL) was required by the New Mexico Environment Department (NMED), and was submitted to NMED for review and approval in December 2006. Public comment was received on the SV SAP from February 5, 2007, through May 15, 2007, and a public meeting to discuss the SV SAP was held in Albuquerque on May 1, 2007.

The NMED reviewed the SV SAP, and also considered the public comments received on the document. The NMED approved the SV SAP with modifications in an approval letter to the Department of Energy (DOE) and Sandia Corporation dated February 14, 2008. The approval letter required that the data and results for the work required by the modified SV SAP be submitted in writing to the NMED by July 31, 2008.

In order to meet the July 31, 2008, report deadline, field work was originally scheduled to be completed at the MWL by mid-April 2008. However, the field work progressed at a slower pace than had been anticipated due to contractor scheduling, equipment problems, and weather delays. All required soil gas, soil, and radon canister sampling at the MWL was not completed until the end of May 2007. As a result of the delay in completing field work at the MWL, we request that the due date for the summary report, *Investigation Report Soil Gas Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill*, be extended for one month, to August 31, 2008. DOE/National Nuclear Security Administration and SNL/NM do not expect that this extension will have any impact on the proposed schedule for the MWL.

Please contact me at (505) 845-6036 or Joe Estrada of my staff at (505) 845-5326 with any questions regarding this request.

Sincerely,

Kimberly A Davis for

Patty Wagner
Manager

Enclosure

cc w/enclosure:
W. Moats, NMED (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB (2 copies)
A. Blumberg, SNL/NM, Org. 11100, MS-0141
F. Nimick, SNL, Org. 6790, MS-0701
D. Miller, SNL/NM, Org 6765, MS-0718
J. Cochran, SNL/NM, Org. 6765, MS-0719
M. Sanders, SNL/NM, Org. 6765, MS-1089
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J. Estrada, SSO
J. Gould, SSO
D. Pellegrino, SSO
M. Reynolds, SSO
J. Lehr, NA-56/HQ/FORS

AOP 95-45, 06

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Request for Extension for Investigation Report Soil Gas Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill**

Document author: **Mike Sanders, Department 06765**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: For Fran B. Nimick /s/ Gutierrez 7/1/08
Date

Deputy Director to the
Nuclear Energy & Global Security Technologies
Division 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: Kimberly A Davis for 7/10/08
Date

Patty Wagner
Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Volume II

TAB 7

Time Extension Request to Submit Soil-Vapor Investigation Report

Mixed Waste Landfill, Letter of July 10, 2008

From: NMED/Bearzi
To: SNL/Wagner

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BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

NEW MEXICO ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
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RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

July 25, 2008

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Securities Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: TIME EXTENSION REQUEST TO SUBMIT SOIL-VAPOR INVESTIGATION REPORT FOR THE U. S. DEPARTMENT OF ENERGY/SANDIA NATIONAL LABORATORIES' MIXED WASTE LANDFILL, LETTER OF JULY 10, 2008 SANDIA NATIONAL LABORATORIES, EPA ID NM5890110518 HWB-SNL-05-025

Dear Ms. Wagner and Mr. Nimick:

By letter of July 10, 2008, the U. S. Department of Energy, on behalf of Sandia National Laboratories, requested additional time to submit the soil-vapor investigation report for the Mixed Waste Landfill (MWL), originally due on July 31, 2008. According to the information presented in this letter, additional time is needed because of unexpected delays in contractor scheduling, equipment problems, and inclement weather. The New Mexico Environment Department (NMED) hereby approves the subject request for additional time to submit the report. The new due date for submittal of the soil-vapor investigation report to NMED is August 31, 2008.

If you have any questions regarding this matter, please contact William Moats of my staff at (505) 222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

JPB:wpm

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
J. Cochran, SNL MS 0719
J. Gould, DOE, MS 0184

File: SNL 2008 and Reading

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TAB 8

Investigation Report on the Soil-Vapor Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill, August 2008

From: SNL/Wagner
To: NMED/Bearzi

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National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

AUG 2 6 2008

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. James Bearzi
Chief, Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Bldg. 1
Santa Fe, NM 87505

SUBJECT: Investigation Report on the Soil-Vapor Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill.

Dear Mr. Bearzi:

On behalf of Sandia Corporation (Sandia) and the National Nuclear Security Administration (NNSA), we are submitting the Investigation Report on The Soil-Vapor Volatile Organic Compounds, Tritium, and Radon Sampling at The Mixed Waste Landfill.

This investigation was required by the New Mexico Environment Department (NMED), and was based on the Soil-Vapor Sampling and Analysis Plan (SV SAP) for the Sandia National Laboratories/New Mexico (SNL/NM) Mixed Waste Landfill. This document was submitted to NMED for review and approval in December 2006. Public comment was received on the SV SAP from February through May 2007, and a public meeting to discuss the document was held in May 2007. The SV SAP was approved with modifications by the NMED in February 2008, and field work at the landfill was completed in April and May 2008.

Should you have any questions regarding this notification, please contact me at (505) 845-6036, or Joe Estrada of my staff at (505) 845-5326.

Sincerely,

Patty Wagner
Manager

2 Enclosures:
Certification Statement for Approval and Final Release of Documents
Investigation Report On The Soil-Vapor Volatile Organic Compounds, Tritium, And Radon Sampling At The Mixed Waste Landfill

cc w/enclosure:
W. Moats, NMED (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB (2 copies)
J. Gould, SSO, MS 0184
D. Miller, SNL/NM, Org 6765, MS 0718
M. Sanders, SNL/NM, Org 6765, MS 1089
S. Griffith, SNL/NM, Org. 6765, MS 1089
Records Center, SNL/NM, Org.6765, MS 1089
Zimmerman Library, UNM
J. Lehr, NA-56/HQ/FORS

cc w/o enclosure:
A. Blumberg, SNL/NM, Org. 11100, MS 0141
J. Cochran, SNL/NM, Org 6765, MS 0719
M. Skelly, SNL/NM, Org. 6765, MS 1089
B. Langkopf, SNL/NM, Org. 6765, MS 1089
S. Lacy, SSO, MS 0184
C. Wimberly, SSO, MS 0184
T. Longo, NA-56/HQ/GTN

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Investigation Report On the Soil-Vapor Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill.**

Document author: **Mike Sanders, Department 06765**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 8/15/08
Date

Fran B. Nimick
Deputy Director to the
Nuclear Energy & Global Security Technologies
Division 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ 8-26-08
Date

Patty Wagner
Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Sandia National Laboratories/New Mexico
Environmental Restoration Project

INVESTIGATION REPORT ON THE SOIL-VAPOR VOLATILE ORGANIC COMPOUNDS, TRITIUM, AND RADON SAMPLING AT THE MIXED WASTE LANDFILL

August 2008

United States Department of Energy
Sandia Site Office

Sandia is a multiprogram laboratory managed and operated by Sandia Corporation, a wholly-owned subsidiary of Lockheed Martin Corporation, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

EXECUTIVE SUMMARY

The Mixed Waste Landfill (MWL) is designated as a Solid Waste Management Unit at Sandia National Laboratories/New Mexico (SNL/NM). SNL/NM is located within the boundaries of Kirtland Air Force Base, immediately south of the City of Albuquerque in Bernalillo County, New Mexico. SNL/NM is managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy.

The MWL is located 4 miles south of SNL/NM's central facilities and 5 miles southeast of Albuquerque International Sunport. The landfill is a fenced, 2.6-acre site in the north-central portion of Technical Area III. The MWL was established in 1959 as a disposal area for low-level radioactive waste generated by SNL/NM research facilities. Low-level radioactive and minor amounts of mixed waste were disposed of at the MWL from March 1959 through December 1988. Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies of activity were disposed of in the landfill.

Active soil-vapor volatile organic compound (VOC) samples, tritium soil samples, and radon samples were collected at the MWL in 1994, 1995, and 1997, respectively. In order to determine whether subsurface conditions at the MWL had changed since the mid-1990s, the New Mexico Environment Department (NMED) required that additional soil-vapor VOC and methane, tritium soil, and radon samples be collected at the site. A sampling and analysis plan describing the required sampling activities was approved by the NMED with modifications in February 2008, and the fieldwork for this investigation was completed at the site in April and May 2008.

A comparison of the 1997 and 2008 surface radon samples shows that radon emissions from the MWL and background areas have not significantly changed from 1997 to 2008. The maximum radon values at the MWL were 1.0 picocurie per meter squared per second (pCi/m^2s) in 1997 and 0.43 pCi/m^2s in 2008. The 2008 radon sampling data also confirmed that radon gas being released from the MWL is below background levels.

Because none of the 2008 tritium samples were collected from the same locations that were sampled in 1995, a direct comparison of the 1995 and 2008 tritium concentrations was not possible. However, in general, tritium concentrations in the majority of the 2008 samples are higher than those in the 1995 samples. The highest tritium concentrations were 7.80E+06 picocuries per liter (pCi/L) in 1995 and 3.95E+07 pCi/L in 2008. All of the 1995 tritium samples were collected from boreholes around the perimeter of the MWL, whereas 20 out of 24 of the 2008 samples were collected from the interior of the MWL. The overall higher tritium concentrations found in the 2008 samples were expected because most of these samples were collected in close proximity to waste pits and trenches in the landfill.

A risk assessment evaluation was performed based on the maximum tritium concentration detected in the 2008 samples. The calculated dose values for the hypothetical residential and industrial land-use scenarios (4.5E-01 and 6.7E-04 millirem per year [mrem/yr], respectively) are two to four orders of magnitude less than the respective dosage guidelines (75 and 15 mrem/yr, respectively). The risk assessment calculations show that the tritium concentrations at the MWL pose no threat to human health or the environment.

The 1994 and 2008 soil-vapor samples were not collected from the same locations; therefore a direct comparison of the 1994 and 2008 results was also not possible. However, in general, the 1994 and 2008 soil-vapor results for three individual VOCs that were detected at the highest concentrations in the 1994 and 2008 samples, as well as the 1994 and 2008 total VOC concentrations show that overall concentrations have declined substantially at the MWL since 1994. The maximum total VOC concentration detected in 1994 was 3.07E+04 parts per billion by volume (ppbv), and in 2008 it was 1.33E+03 ppbv. The 2008 soil-vapor samples were also analyzed for methane, which was not done in 1994. The maximum methane concentration is 2.30E+05 ppbv.

Because the findings of this investigation are consistent with the conceptual model of the MWL, the cover should be constructed. Radon and tritium surface sampling should be continued, and deeper vadose zone soil-vapor sampling should be completed, as described in the "Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, Sandia National Laboratories/New Mexico" (September 2007a).

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ACRONYMS AND ABBREVIATIONS

AOP	Administrative Operating Procedure
AR/COC	analysis request/chain-of-custody
BA	butyl acetate
bgs	below ground surface
CFC-12	dichlorodifluoromethane
CFR	Code of Federal Regulations
CMI	Corrective Measures Implementation
CVR	Contract Verification Review
DI	deionized
DOE	U.S. Department of Energy
DP	direct-push
EB	equipment blank
EDD	Electronic Data Deliverable
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ERG	Environmental Restoration Group, Inc.
°F	degrees Fahrenheit
GPS	global positioning system
HASP	Health and Safety Plan
HWB	Hazardous Waste Bureau
ID	identification number
LLW	low-level radioactive waste
LTMMP	Long-Term Monitoring and Maintenance Plan
MDL	method detection limit
mrem/yr	millirem per year
MWL	Mixed Waste Landfill
ND	not detected
NMED	New Mexico Environment Department
NOD	Notice of Disapproval
PCE	tetrachloroethene
pCi/g	picocurie(s) per gram
pCi/L	picocurie(s) per liter
pCi/m^2s	picocurie(s) per meter squared per second
PID	photoionization detector
ppbv	parts per billion by volume
PPE	personal protective equipment
RCRA	Resource Conservation and Recovery Act
RCT	radiological control technician
RFI	RCRA Facility Investigation
RPD	relative percent difference

ACRONYMS AND ABBREVIATIONS (Concluded)

Sandia	Sandia Corporation
SNL/NM	Sandia National Laboratories/New Mexico
SOW	statement of work
SV SAP	Soil-Vapor Sampling and Analysis Plan
TA	Technical Area
TB	trip blank
TCE	trichloroethene
TEDE	total effective dose equivalent
TWD	Technical Work Document
VOC	volatile organic compound

1.0 INTRODUCTION

The Mixed Waste Landfill (MWL) at Sandia National Laboratories/New Mexico (SNL/NM) is a Solid Waste Management Unit undergoing corrective action in accordance with the Resource Conservation and Recovery Act (RCRA) regulations (Title 40, Code of Federal Regulations [CFR], Part 260); the New Mexico Secretary of the Environment Department's Final Order in the Matter of Request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill No. HWB 04-11(M) (Curry May 2005); the New Mexico Environment Department (NMED) Class 3 Permit Modification for the MWL (NMED August 2005); and the Compliance Order on Consent (the Order) (NMED April 2004).

SNL/NM is located within the boundaries of Kirtland Air Force Base, adjacent to the City of Albuquerque in Bernalillo County, New Mexico (Figure 1-1). SNL/NM is managed and operated by Sandia Corporation (Sandia), a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy (DOE). The MWL is located 4 miles south of SNL/NM's central facilities and 5 miles southeast of Albuquerque International Sunport. The landfill is located in the north-central portion of Technical Area (TA)-III at SNL/NM (Figure 1-2).

The MWL accepted containerized and uncontainerized low-level radioactive waste (LLW) and minor amounts of mixed waste from SNL/NM research facilities and off-site DOE and U.S. Department of Defense generators from March 1959 to December 1988. Approximately 100,000 cubic feet of LLW (excluding packaging, containers, demolition and construction debris, and contaminated soil) containing 6,300 curies of activity (at the time of disposal) were disposed of at the MWL.

Two distinct disposal areas are present at the MWL: the classified area (occupying 0.6 acres) and the unclassified area (occupying 2.0 acres) (Figure 1-3). Wastes in the classified area were disposed of in a series of vertical, cylindrical pits. Historical records indicate that early pits were 3 to 5 feet in diameter and 15 feet deep; later pits were 10 feet in diameter and 25 feet deep. Once pits were filled with waste, they were backfilled with soil and capped with concrete. Wastes in the unclassified area were disposed of in a series of parallel, north-south trenches. Records indicate that trenches were 15 to 25 feet wide, 150 to 180 feet long, and 15 to 20 feet deep. Trenches were backfilled with soil on a quarterly basis and, once filled with waste, were capped with the original soil that had been excavated and locally stockpiled. None of the pits or trenches were lined.

Containment and disposal of routine waste commonly occurred using tied, double-polyethylene bags, sealed A/N cans (military ordnance metal containers of various sizes), fiberboard drums, wooden crates, cardboard boxes, and 55-gallon steel and polyethylene drums. Larger items, such as glove boxes, spent fuel shipping casks, and contaminated soil, were disposed of in bulk without containment. With the exception of a one-time disposal of coolant water to Trench D, disposal of free liquids at other disposal pits and trenches was not allowed at the MWL. Liquids such as acids, bases, and solvents were solidified with commercially available agents before containerization and disposal (SNL/NM September 2007a). A detailed MWL waste inventory, by pit and trench, is provided in the Environmental Restoration (ER) Project "Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation [RFI] Dated September 1996" (SNL/NM June 1998).

A Phase 1 RFI was conducted in 1989 and 1990 to determine whether a release of RCRA contaminants had occurred at the MWL (SNL/NM September 1990). A Phase 2 RFI was conducted from 1992 to 1995 to determine the contaminant source, define the nature and extent of contamination, identify potential contaminant transport pathways, evaluate potential risks posed by the levels of contamination identified, and provide remedial action alternatives for the landfill. Analytical results for the Phase 2 RFI were presented and discussed in the "Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation, Sandia National Laboratories, New Mexico" (SNL/NM September 1996). Both investigations revealed that tritium had migrated from the pits and trenches of the MWL. Results of the Phase 2 RFI soil and soil-vapor investigations are further discussed in Chapters 2.0 and 6.0.

The work completed for this 2008 field investigation was based upon requirements set forth in a Notice of Disapproval (NOD) letter dated November 20, 2006 (NMED November 2006) on the MWL Corrective Measures Implementation (CMI) Plan that was prepared by the DOE/Sandia and submitted to the NMED Hazardous Waste Bureau (HWB) in November 2005 (SNL/NM November 2005). Among other comments, the NMED HWB disapproval letter included a requirement for additional sampling at the landfill. The NMED was concerned that most of the site characterization data for the MWL was collected prior to the mid-1990s, and more current data were required to ensure that conditions had not changed.

To meet the NMED requirements, samples were collected and analyzed in April and May 2008. These samples were collected at 20 locations in and near the landfill and analyzed for radon (12 locations at the current land surface); tritium (8 locations at depths of 10, 30, or 50 feet below ground surface [bgs]); and volatile organic compounds (VOCs) and methane (8 locations at depths of 10, 30, or 50 feet bgs). As used in this report (and described in detail in Chapter 4.0), "radon samples" are gas samples collected in radon-flux canisters and analyzed using U.S. Environmental Protection Agency (EPA) Method 115 (EPA April 1996). "Tritium samples" are soil-moisture samples (incorporated in a soil matrix) collected in plastic sleeves and analyzed using EPA Method 906.0 (EPA August 1980). "VOC/methane samples" refer to soil-vapor samples that were collected in SUMMA™ canisters and analyzed using EPA Method TO-14A (EPA January 1999).

The outline of this report is based upon the required elements of an "Investigation Report" described in Section X.C of the Order (NMED April 2004):

- Chapter 2.0 discusses background information of pertinent earlier studies at the MWL.
- Chapter 3.0 presents the regulatory requirements for the work performed during the 2008 investigation.
- Chapter 4.0 describes the pre-fieldwork activities as well as the procedures used during the collection of the samples.
- Chapter 5.0 discusses the analytical results of the 2008 investigation.
- Chapter 6.0 compares the analytical data from the 2008 and mid-1990s previous investigations and incorporates the results into a current conceptual model of site contamination.

- Chapter 7.0 provides recommendations for future site activities based upon the current understanding of the distribution of contaminants at the site.

- The report figures, tables, and appendices are provided at the end of the document.

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2.0 PREVIOUS INVESTIGATIONS

This chapter summarizes three investigations that have been conducted at the MWL for VOCs, tritium, and radon prior to the 2008 investigation.

2.1 1994 Soil-Vapor Investigation

Active soil-vapor samples were collected from 43 locations in and around the MWL from June to October 1994. Soil-vapor samples were retrieved from target depths of 10 and 30 feet bgs with Geoprobe® soil-vapor collection equipment at each location and collected in both 500-milliliter glass bulbs and SUMMA™ canisters. The glass-bulb samples were analyzed with an on-site gas chromatograph/mass spectrometer, and the SUMMA™-canister samples were analyzed by an off-site commercial laboratory for VOCs by EPA Method TO-14A (EPA January 1999).

Analytical results from the 1994 active soil-vapor samples were presented and discussed in the Phase 2 RFI report (SNL/NM September 1996). Eight individual VOCs were detected in the 10- and 30-foot samples, with total VOC concentrations ranging from 30 to 3.07E+04 parts per billion by volume (ppbv) in the 10-foot-bgs samples, and from 107 to 2.77E+04 ppbv in the 30-foot-bgs samples. The 1994 soil-vapor borehole locations and sampling results are discussed in Chapter 6.0.

2.2 1995 Tritium Investigation

Soil samples were collected from 15 boreholes drilled with a resonant sonic drill rig around the perimeter of the MWL from April through June 1995. Boreholes 1 to 13 were drilled adjacent to the MWL fence at a 30-degree angle, and Boreholes 14 and 15 were drilled vertically 60 feet east of the classified area fence. Boreholes were drilled to a minimum target depth of 120 linear feet. Samples for tritium analysis were obtained every 20 linear feet in the boreholes beginning at 10 feet and continuing to total depth.

A total of 120 surface and subsurface soil samples were collected for tritium analysis. The samples were analyzed by Lockheed Analytical Services using Method LAL-91-SOP-0066. Tritium concentrations ranged from not detected (ND) to 7.80E+06 picocuries per liter (pCi/L) in the samples. Analytical results for the 1995 subsurface tritium soil samples are also presented in the Phase 2 RFI report (SNL/NM September 1996). The 1995 tritium soil borehole locations and sampling results are discussed in Chapter 6.0.

2.3 1997 Radon Investigation

Radon was measured using activated charcoal radon canisters at the MWL from September 30 to October 1, 1997. A total of 71 canisters were placed on the surface of the MWL, and an additional 18 canisters were placed at perimeter locations outside of the MWL fence. The radon canisters were analyzed by Thermo NUtech using gamma spectroscopy. Analytical results for the 1997 radon flux measurements ranged from 0.026 to 1 picocurie per meter squared per second (pCi/m^2s) and were presented in a report titled “Radon flux testing at the Mixed Waste

and the adjacent Classified Waste Landfills, Technical Area III, SNL/NM" (SNL/NM January 1998). The 1997 radon canister sampling locations and results are discussed in Chapter 6.0.

3.0 REGULATORY CRITERIA

This chapter addresses the regulatory criteria for this MWL investigation. The MWL CMI Plan was submitted to the NMED HWB in November 2005 (SNL/NM November 2005). The NMED HWB issued an NOD dated November 20, 2006 (NMED November 2006), which listed a number of deficiencies related to the MWL cover construction plans, performance modeling, fate and transport model, and monitoring triggers.

3.1 NMED Requirements

The NMED NOD for the MWL CMI Plan included a requirement for additional soil-vapor sampling at the landfill, as follows:

> As the Permittees are aware, most site characterization data for the MWL (other than groundwater data) dates before the mid 1990's. Because the rupturing of containers and leaking of their contents could have occurred since the mid 1990's, the NMED requires more current soil-gas data to help resolve this issue. The Permittees shall therefore collect and analyze active soil-gas samples taken at depths of 10 and 30 feet at a minimum of three locations within the landfill where previous sampling has detected the highest soil-gas concentrations in the past. The soil-gas samples shall be analyzed for volatile organic compounds, tritium, and radon. Pursuant to Section VI.A of the Order on Consent (April 29, 2004), the Permittees shall provide for approval to the NMED within 30 days of receipt of this letter a work plan to conduct the active soil-vapor sampling described above. The work plan shall be prepared in accordance with Section X.B of the Consent Order. (NMED November 2006).

The DOE/Sandia submitted a response to the NOD that included a work plan for the required VOC, tritium, and radon sampling titled, "Sampling and Analysis Plan for Soil-Gas Volatile Organic Compounds, Tritium, and Radon at the Mixed Waste Landfill" (SNL/NM December 2006).

Based upon the NMED review of the Soil-Vapor Sampling and Analysis Plan (SV SAP), and in consideration of public comments received, the NMED approved the SV SAP with modifications (NMED February 2008). The approval letter is provided in Appendix A. The modifications included the following:

- Six boreholes for the collection of soil-vapor and soil samples shall be drilled at the locations shown on a map provided by the NMED (Appendix A). Two other boreholes may be drilled at the background locations as proposed in the SV SAP.
- Soil-vapor and soil samples for VOC and tritium analysis, as appropriate, from three designated boreholes shall be collected at depths of 10, 30, and 50 feet. All other samples shall be collected at depths of 10 and 30 feet.
- The track-etch type radon detectors proposed in the SV SAP are not the same type used in the 1997 survey at the MWL. To ensure that radon data are directly comparable with the 1997 data, the DOE/Sandia shall use the same type of detector used in the 1997 survey.

- Nine radon detectors shall be deployed at locations shown on a map provided by the NMED (Appendix A).
- The radon data shall be submitted at the same time as the tritium and VOC data.
- In addition to VOCs, all soil-vapor samples shall be analyzed for methane.
- The report shall be submitted by a specified due date (that was subsequently extended).

Tritium soil sampling analytical results are included in this report and are provided voluntarily by the DOE/Sandia. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements of the Order. Additional information on radionuclides and the scope of the Order is available in Section III.A of the Order (NMED April 2004).

3.2 Report Organization

This report satisfies the reporting requirements as defined in the Order (NMED April 2004). The following table provides a cross-reference of each NMED report requirement and its correlation to sections within this document:

Required Elements of an Investigation Report (NMED April 2004)	Investigation Report on the Soil-Vapor VOCs, Tritium, and Radon Sampling at the MWL
1. Title Page and Signature Block (for the name, title, and organization of the preparer and the responsible DOE and Sandia Corporation representative)	Title Page Signatures for full SNL/NM and DOE chain-of-command on the transmittal document that accompanies the report from SNL/NM to the DOE to the NMED
2. Executive Summary	Executive Summary
3. Table of Contents	Table of Contents
4. Introduction	Chapter 1.0 Introduction
5. Background Information	Chapter 2.0 Previous Investigations
6. Scope of Activities	Chapter 4.0 Scope of Activities
7. Field Investigation Results	Chapter 5.0 2008 Field Investigation Results
8. Regulatory Criteria	Chapter 3.0 Regulatory Criteria
9. Site Contamination	Chapter 6.0 Summary of Results and Comparison of Investigations
10. Recommendations	Chapter 7.0 Recommendations
11. Tables	Tables 4-1, 4-2; 5-1 through 5-11; 6-1, 6-2, and 6-3
12. Figures	Figures 1-1, 1-2, 1-3; 4-1 through 4-4; 5-1 through 5-6; and 6-1 through 6-10
13. Appendices	Appendices A through E

4.0 SCOPE OF ACTIVITIES

This chapter describes the pre-fieldwork activities as well as procedures used during the collection of the radon, tritium, and VOC/methane samples.

4.1 Pre-Fieldwork Planning and Preparation

Planning and preparation for the fieldwork commenced immediately after SNL/NM received NMED approval of the modified SV SAP (Appendix A). The following lists the various plans, permits, and health and safety-related documents that were completed prior to the start of fieldwork:

- SNL/NM Excavation Permit (for identification of underground utilities)
- SNL/NM site-specific Health and Safety Plan (HASP)
- Programmatic and site-specific HASPs provided by the Geoprobe® contractor
- SNL/NM Preliminary Hazard Screening documents for sampling and waste management
- Radiological Work Permit and Technical Work Document (TWD) to address radiological health and safety issues at the site
- Contractor statement of work (SOW)
- SNL/NM Field Implementation Plan
- Biological survey to ensure that project activities would not significantly impact wildlife in the project area
- National Environmental Policy Act review and approval
- Safety inspection of Geoprobe® equipment
- Waste management plan and TWD, to address characterization and management of waste (soil, personal protective equipment [PPE]), and miscellaneous debris) generated as a result of project activities
- Analytical Laboratory SOW/Sampling Bottle Order

4.2 Sample Specifications and Locations

In the February 2008 approval letter (Appendix A), the NMED specified locations for radon, tritium, and VOC/methane samples; these locations are shown in Figure 4-1. To determine field locations, SNL/NM ER Project personnel digitized the NMED-specified locations, generated

New Mexico State Plane coordinates, and used global positioning system (GPS) equipment to place pin flags in the ground. For tritium and VOC/methane sampling, multiple direct pushes were required to retrieve the required sample volume (discussed in Section 4.4.1). All multiple direct pushes for a single location were placed within several feet of the original GPS-located pin flag.

For radon samples, the NMED required nine locations (RN1 through RN9) in the MWL. Duplicate radon samples were also collected adjacent to primary locations at RN1 and RN8, with a triplicate sample collected at RN3. For comparison purposes, three background samples (RN10 through RN12) were also collected at locations northwest, northeast, and southeast of the MWL outside the surface water pollution prevention earth berm that surrounds the MWL (Figure 4-1). Table 4-1 summarizes the sampling specifications for the radon samples. As shown in the table, each radon sample was identified with a unique location identification number (ID).

The NMED required six direct-push (DP) locations (DP1 through DP6) for tritium and VOC/methane samples within the MWL footprint, and two additional background locations (DP7 and DP8) southwest of the MWL. Five of the tritium and VOC/methane sampling locations were to be drilled to a depth of 30 feet bgs, and three were pushed to a depth of 50 feet below the original MWL surface grade (discussed in Section 4.4).

In order to protect site workers and to avoid potentially contacting buried waste, the NMED allowed a slight adjustment to the NMED-approved locations in the landfill of a maximum horizontal distance of 20 feet. After reviewing maps of waste burial locations (SNL/NM September 2007a), the locations for DP2 and DP3 were moved 20 feet west and 15 feet southwest, respectively, of the NMED-approved locations. The other four boring locations in the MWL were drilled at the NMED-approved locations. DP7 and DP8 were located approximately 525 and 665 feet, respectively, southwest of the MWL (Figure 4-1).

Table 4-2 summarizes the specifications and requirements for the tritium and VOC/methane samples. As shown in Table 4-2, samples were identified with a unique location ID, and duplicate samples were collected from Boreholes DP5 and DP6. In addition, aqueous equipment blank (EB) samples were collected during tritium sampling.

4.3 Radon Sampling

Radon sampling was conducted on April 1 and April 2, 2008, at 12 locations in and near the MWL.

4.3.1 Radon Sample Collection Procedures

As shown in Figure 4-1, sampling for radon using activated charcoal radon canisters was conducted at nine locations in the landfill and at three background locations outside of the MWL. For comparability of data, the same type of radon-flux detection canisters were used for both the 1997 and 2008 sampling events. The 8-inch-diameter radon canisters used for the 2008 sampling event were provided by Environmental Restoration Group, Inc. (ERG) located in Albuquerque, New Mexico.

On April 1, 2008, personnel from ERG and the SNL/NM ER Project placed a total of 16 radon canisters. The field crew placed primary canisters at nine locations, duplicate canisters at two locations, and triplicate canisters at one location in the MWL. In addition, canisters were placed at three background locations. The canisters were removed from the site by the field crew on April 2, 2008.

The radon-flux canisters were required to remain in position for a minimum of 24 hours, and actually remained on site for approximately 25 hours (from approximately 11 a.m. on April 1 to 12 p.m. on April 2). The radon analytical results (discussed in Section 5.1.1) are reported as flux, or the rate of concentration through an area, per unit time in pCi/m^2s. Therefore, the field crew was required to accurately measure and record the canister exposure time. To operate effectively and accurately, the radon canisters require dry conditions and temperatures above 35 degrees Fahrenheit (°F). During the canister exposure time, no precipitation was reported, and the temperature never fell below 35°F. In addition, 1 trip blank (TB) canister was included with the batch and analyzed (counted) with the other 16 canisters.

4.3.2 Radon Sample Analysis

The 17 canisters (including the TB) were analyzed at the ERG laboratory in Albuquerque, New Mexico, using EPA Method 115 (EPA April 1996). The EPA Method requirements were met for the measurements. In accordance with method quality assurance requirements, two independent standard charcoal sources (each containing a known quantity of radium-226) were used to calibrate the spectrometer, using identical geometry conditions to that of the canisters. The agreement between the two calibration factors was sufficient to meet quality assurance criteria (ERG April 2008, Appendix B).

4.4 Tritium Soil Sampling

The Geoprobe® sampling system was selected for tritium and VOC/methane sampling because, compared to hollow-stem auger or air-rotary drilling techniques, Geoprobe™ sampling techniques produce far less waste soil and minimize contaminant exposures to site workers and the environment. All materials retrieved from the subsurface with the Geoprobe® sampling system are fully contained in the butyl acetate (BA) sampling sleeves. In contrast, conventional drilling produces cuttings that could expose contaminants to site personnel or the environment, especially during windy conditions.

Tritium soil sampling activities occurred from April 8 through April 11, 2008, and May 5 through May 27, 2008. The field program took considerably more time to complete than originally expected; as a consequence, the sampling activities were conducted during two different time periods.

The elevation of the MWL land surface that existed in 1995 (hereafter referred to as the “original grade”) had been modified by the recently installed subgrade soil layer (SNL/NM November 2005). The thickness of the subgrade soil layer was accounted for during the 2008 field program to facilitate collecting samples from depths similar to those collected in 1995. The ER Geographic Information System personnel provided data that were used to calculate the location-specific depths to the original grade. The depth to the original grade at the sampling locations ranges up to 2.5 feet below the current MWL land surface.

As shown in Table 4-2, tritium samples were collected from three locations in the MWL at depths of 10 and 30 feet below the original grade and from three locations (DP2, DP3, and DP5) at depths of 10, 30, and 50 feet below the original grade. Samples from the two background locations were collected at depths starting at 10 and 30 feet bgs.

4.4.1 Tritium Sample Collection Procedures

Tritium samples were collected with a large, track-mounted, direct-push (Geoprobe®) Model 6620 DT rig provided by Earth Worx Environmental Services, LLC of Los Lunas, New Mexico (Figure 4-2). The Geoprobe® rig and related equipment were initially decontaminated with a pressure washer at the decontamination facility in TA-III prior to sampling operations. Soil samples were collected with a 4-foot-long by 1-inch inside diameter Geoprobe® sampling tube lined with a BA sampling sleeve.

The tritium analysis measures concentrations of tritium in soil moisture. Because of the relatively dry subsurface soil conditions in and around the MWL, a minimum of 2 liters of soil was required by the analytical laboratory. In order to obtain 2 liters of soil, a minimum of approximately 13 linear feet of soil-filled BA sleeves was required at each sampling depth interval. Therefore, each sampling interval required a minimum of four 4-foot-long direct pushes. Commonly, the BA sleeves were not completely filled with soil after a direct push into the sampling interval; therefore multiple direct pushes were required at one sampling location. In most cases, up to six direct pushes were necessary to meet the sample volume requirements.

The Geoprobe® soil sample collection procedure is described as follows:

- A solid, steel plug is fitted into the drive shoe at the bottom of the steel sampling tube.
- The tube is driven in a direct push (in the closed position) to either the top of the first designated sampling interval or until subsurface refusal occurs (typically at 7 or 8 feet below the original grade). At depth, the steel plug is removed, and the sampling tube is fitted with a BA sleeve.
- The now-opened sampling tube with the BA sleeve is then driven with the hydraulic hammer in a direct push to the top of the first sampling interval (10 feet below the original grade).
- The BA sleeve is retrieved from the borehole, and waste soil that has collected in the BA sleeve above or below the designated sampling interval is emptied into a waste soil drum at the site.
- The steel sampling tube is fitted with a new BA sleeve and then driven a total of 4 feet into undisturbed soil to collect the soil sample.
- The partially or completely soil-filled BA sleeve is retrieved, and the unfilled portion of the 4-foot BA sleeve is cut off with plastic cutting shears.

- The remaining filled portion of the sleeve is immediately capped with rubber end caps and sealed with tape.
- The soil-filled BA sleeve was scanned for radiological contamination as described in Section 4.6 (Figure 4-3).

Multiple direct pushes were completed using this procedure at each sampling location until the 2-liter sample volume was collected. Additional direct pushes were necessary to collect the NMED-required duplicate soil samples at two of the six MWL locations (DP5 and DP6). Duplicate soil samples were collected from the same depths as the corresponding primary soil samples. The soil samples consisted of slightly damp to dry, compacted fine sand, silty sand, and silt. A 2 to 3-foot-thick layer of rocky, caliche-rich soil that was difficult to penetrate was encountered in the six MWL borings at depths starting at 25 to 30 feet, depending on the location.

Reusable Geoprobe® sample collection equipment was decontaminated in the following manner:

- After each direct push, the reusable steel drive shoe is detached, and any excess soil adhering to the shoe is removed with a wire brush as a dry decontamination method.
- The drive shoe is then decontaminated inside and out with a heavy paper wipe moistened with deionized (DI) water.
- The decontaminated shoe is then attached to the sampling tube, and another sampling run is completed. This is repeated for all direct pushes at a sampling location.
- After the last direct push is completed at a location, the drive shoe, sampling tube, and drive pipe are all decontaminated using heavy paper wipes moistened with DI water.
- The decontaminated equipment is then transported to the next location.

4.4.2 Tritium Sample Analysis

Aqueous EB samples were collected and analyzed for tritium by pouring DI water through a decontaminated sampling tube drive shoe and collecting the rinsate in the appropriate sample container.

In order to prevent the loss of soil moisture during transfer into bottles, the samples were shipped in the capped BA sleeves. Tritium EB and soil samples were shipped to the analytical laboratory (General Engineering Laboratories, Inc. in Charleston, South Carolina) with an analysis request/chain-of-custody (AR/COC) form containing the sample ID, sampling location, date, time, and depth. The soil and EB samples required no special preservation during transport and storage and were analyzed for tritium by EPA Method 906.0 (EPA August 1980).

All analytical data provided by the laboratory were reviewed and validated according to “Data Validation Procedure for Chemical and Radiochemical Data,” Administrative Operating Procedure (AOP) 00-03, Rev. 02 (SNL/NM July 2007).

4.5 VOC/Methane Sampling

VOC/methane sampling activities occurred during April 9 and April 10, 2008, at the two background locations, DP7 and DP8, and from May 8 to May 27, 2008, at the remaining six locations (DP1 through DP6) in the MWL. As shown in Figure 4-1 and Table 4-2, VOC/methane samples were collected from the same sampling locations and starting sampling depths as the tritium samples. The VOC/methane locations were also specified by the NMED (NMED February 2008). To avoid potentially drilling through buried waste, the sampling locations DP2 and DP3 were relocated 20 feet west and 15 feet southwest, respectively, from their NMED-designated locations.

4.5.1 VOC/Methane Sample Collection Procedures

VOC/methane sampling was conducted in accordance with procedures specified in SNL/NM Field Operations Procedure 94-21 "Shallow Soil Gas Sampling" (SNL/NM March 1994). VOC/methane samples were collected with the same Geoprobe® rig used for soil sample collection. The soil-vapor sampling equipment was initially decontaminated at the TA-III decontamination pad prior to collecting VOC/methane samples.

At each sampling location, the following procedures were used to collect the VOC/methane samples:

- A reusable steel drive-point tip is attached to the steel drive pipe, and the tip and drive pipe are pushed to the desired sampling depths (10, 30, or 50 feet below the original grade of the MWL, and 10 and 30 feet bgs at the two background locations) using the Geoprobe® hydraulic hammer (Figure 4-4).

- At the designated sampling depth, the drive pipe is extracted approximately 6 inches to create a void between the tip and drive pipe that exposes the sampling equipment to the open borehole.

- A new piece of ¼-inch-diameter polyethylene tubing is inserted into the drive pipe and attached to the steel drive point.

- The tubing is then connected to a vacuum pump and the line is purged to remove stagnant gas from the sampling port and tubing.

- A minimum of 1 cubic foot (28.3 liters) of soil-vapor is purged from the sampling tubing and formation. During presample purging, soil-vapor is continuously screened for VOCs with a photoionization detector (PID) containing an ultraviolet lamp with an ionization potential of 11.8 electron volts. (No VOCs were detected during field screening at any sampling interval at the VOC/methane locations.)

- The pressure gauge on each 6-liter SUMMA™ canister is checked to confirm that the canister has not leaked since it left the laboratory. Each SUMMA™ canister contains the proper presample vacuum of minus 26 inches of mercury.

- The SUMMA™ canister is filled until the pressure gauge on the canister reads minus 10 inches of mercury, and the canister valve is closed tightly.

- After sampling is completed at a particular depth interval, the drive-point tip and drive pipe are then driven to the next sampling depth and the process repeated.

- Field equipment used during the process is removed from the borehole and decontaminated by wiping the equipment with paper wipes moistened with DI water.

- Decontaminated sampling equipment is then transported to the next sampling location.

Duplicate VOC/methane samples were required from all sampling depths at Locations DP5 and DP6 in the MWL (Figure 4-1). These duplicate samples were collected from the same depth interval as the primary samples by filling a second SUMMA™ canister immediately after the primary sample had been collected.

4.5.2 VOC/Methane Sample Analysis

The filled SUMMA™ canisters were shipped to the analytical laboratory (TestAmerica in Santa Ana, California) with an AR/COC form containing the sample ID, sampling location, date and time, depth, and ambient pressure. The SUMMA™ canisters required no special preservation during transport and storage. The soil-vapor samples were analyzed for VOCs plus methane by EPA Method TO-14A (EPA January 1999). All analytical data provided by the laboratory were reviewed and validated according to "Data Validation Procedure for Chemical and Radiochemical Data," AOP 00-03, Rev. 02 (SNL/NM July 2007).

4.6 Field Screening for VOCs and Radiation

A PID was also used during drilling activities to monitor VOC concentrations in the breathing zone (5 feet above ground). No evidence of a release of VOCs to the surface as a result of the drilling and sampling activities was detected with the PID during the project.

Because of the potential to drill into buried radioactive waste at the MWL, a radiological control technician (RCT) was present at all times during intrusive activities at the site. The RCT performed continuous radiological screening of equipment used for subsurface sampling and of soil samples collected from the boreholes. Equipment and soil samples were characterized by the RCT using real-time field instruments to survey sampling equipment and samples as soon as they were extracted from the subsurface.

In addition, radiological screening was conducted using 2-inch-diameter paper disks that were swiped on the outside surfaces of all reusable sampling equipment and soil-filled sampling sleeves as they were removed from boreholes. The swipe samples were analyzed via gamma spectroscopy and liquid scintillation methods by an on-site SNL/NM radiological laboratory. The samples were temporarily stored in a secure storage building at the site pending the results of the radiological swipe surveys. After Radiation Protection and Sample Management Office personnel determined the screening results acceptable, the samples were shipped to the off-site contract laboratory.

No evidence of radiological contamination was found on sampling equipment or samples during this project. At the conclusion of the project, the Geoprobe® rig and associated equipment were screened for radiological contamination. All equipment was cleared for release from the site by the RCT and allowed to leave the radiological-controlled area.

4.7 Waste Generation and Management

As specified by the requirements of the site-specific waste management plan, waste soil was transferred from the BA sleeves into a 5-gallon, plastic bucket at the sampling location and then into a 55-gallon, metal, waste soil storage drum at the site. The partially filled waste soil drum was removed from the MWL at the conclusion of the project activities and the soil was characterized, managed, and disposed of in accordance with established SNL/NM waste disposal policies and procedures.

Other types of waste that were generated (including PPE, empty BA sleeves, paper wipes used for equipment decontamination, plastic sheeting, etc.) were also containerized in steel drums and later removed from the site. The analytical results for the waste characterization soil samples were also used to characterize the associated PPE and debris.

5.0 2008 FIELD INVESTIGATION RESULTS

Investigation results for the 2008 radon, tritium, and VOC soil-vapor sampling are presented in this chapter. The analytical results for both the 2008 field investigation work and the 1997 radon samples, 1995 tritium soil samples, and 1994 VOC soil-vapor samples are also presented in figures and tables in this chapter, in order to avoid unnecessary duplication in different sections of this report. The old and new data are compared and discussed in Chapter 6.0.

5.1 2008 Radon Sampling Results

Figure 5-1 shows the 1997 and 2008 radon sampling locations and the analytical results for the samples collected at those locations. Table 5-1 also presents the analytical results for the 1997 and 2008 radon samples.

5.1.1 2008 Radon Samples

As described in Chapter 4.0, nine primary and four duplicate radon samples were collected in 2008 at nine measurement locations (RN1 through RN9) in the MWL. Duplicate canisters were placed adjacent to, and within, approximately 1 foot of one another at each of three MWL locations (RN1, RN3, and RN8) (Table 5-1) . Three background measurements were also determined at three locations (RN10 through RN12) southeast, northeast, and northwest of the MWL (Figure 5-1).

The observed radon concentrations range from 0.21 to 0.51 pCi/m^2s in the MWL and 0.56 to 0.65 pCi/m^2s at the background locations. The average value for the 13 primary and duplicate MWL samples is 0.33 pCi/m^2s, which is less than the mean of 0.60 pCi/m^2s for the three background measurements. Therefore, the average radon concentration at the nine MWL locations is approximately one-half of the average concentration at the three background locations.

5.1.2 Radon Quality Assurance and Primary/Duplicate Sample Comparison

One TB was included with the radon samples and was counted with the canisters. The measured radon concentration of the TB, which is –0.03 pCi/m^2s, is near the expected 0.00 pCi/m^2s value. The TB result indicates that the canisters had not been exposed to radon, confirming that the integrity of the bags that contained the canisters had not been compromised.

As shown in Table 5-1, one primary and one duplicate radon canister were placed at each of two locations (RN1 and RN8), and one primary and two duplicate canisters were placed at Location RN3 at the MWL. The radon sample analytical results for the primary and duplicate canisters at Location RN1 are 0.35 and 0.36 pCi/m^2s, respectively. The results for the primary and two duplicate canisters at Location RN3 are 0.21, 0.30, and 0.25 pCi/m^2s, respectively. Radon sampling results for the primary and duplicate canisters placed at Location RN8 are both 0.28 pCi/m^2s.

The summary report provided by the radon canister supplier (ERG) for the 2008 MWL radon flux study is provided in Appendix B (ERG April 2008).

5.2 2008 Tritium Sampling Results and Risk Assessment

Figure 5-2 shows the locations and tritium results for the 1995 and 2008 sampling events at the 10-, 30- and 50-foot depth intervals. Table 5-2 also presents the 1995 and 2008 tritium concentration data, sorted by sampling depth.

5.2.1 Tritium Sample Analyses

Tritium concentrations in the 2008 samples range from 165 to 3.95E+07 pCi/L (both estimated concentrations) in the six MWL borehole locations (DP1 through DP6), and from ND to 260 pCi/L (estimated concentration) in the two background borehole locations (DP7 and DP8). The highest MWL tritium concentration was detected in the primary sample from DP5 at the 10-foot depth interval. However, as shown in Table 5-2, the duplicate sample from this same location and depth interval contained 1.57E+07 pCi/L of tritium, which is less than one-half of that found in the primary sample.

Tritium concentration ranges and means for the 2008 samples at the three sampling depths in both MWL and background boreholes are summarized in Table 5-3. The highest mean and maximum concentrations were found in the 10-foot samples, and the maximum concentrations and means for the 30- and 50-foot samples show a decreasing trend with depth.

5.2.2 Tritium Primary and Duplicate Sample Comparison and Data Validation

As specified in the NMED Notice of Approval Letter for the SV SAP (NMED February 2008), duplicate tritium samples were also collected from the 10-, 30-, and 50-foot intervals at DP5 and from the 10- and 30-foot intervals at DP6. Relative percent differences (RPDs) were calculated for tritium concentrations detected in the primary and duplicate sample pairs and are presented in Table 5-4. Tritium concentration RPD values for the primary and duplicate sample pairs range from 10.98 to 86.23. No quality control acceptance criteria for the evaluation of field duplicates are currently in place.

All laboratory tritium data were also reviewed and verified/validated according to “Procedure for Electronic Data Deliverable (EDD) Processing, SMO-05-04, Issue 01, April 2007” (SNL/NM April 2007a); “Procedure for Completing the Contract Verification Review (CVR), SMO-05-03, Issue 03, April 2007” (SNL/NM April 2007b); and “Data Validation Procedure for Chemical and Radiochemical Data,” AOP 00-03, Rev. 02 (SNL/NM July 2007). Appendix C contains the data validation reports for the 2008 tritium soil samples collected at this site. The data verification and validation review indicated that the tritium sample analytical results are acceptable for MWL site characterization purposes.

5.2.3 Tritium Equipment Blank Sample Results

A total of 13 aqueous tritium EB samples were collected during tritium soil sampling activities at the site. The analytical results for the EB samples are presented in Table 5-2. Tritium was not detected in any of the EBs, which indicates that the equipment decontamination procedures used during collection of the tritium soil samples were acceptable. This demonstrates that transfer and cross-contamination of tritium between sampling locations from reusable sampling equipment did not occur.

5.2.4 2008 Tritium Risk Assessment

The maximum detected tritium activity in soil for the MWL April–May 2008 sampling event is 3.95E+07 pCi/L in the sample from DP5 at the 10-foot depth interval. For purposes of this risk assessment, a very conservative assumption was made that this tritium concentration is present on the surface of the MWL (rather then at 10 feet below the original MWL grade or 11.5 feet below the current surface where it was actually detected) and that direct contact with receptors is possible. The shielding effect of 11.5 feet of soil was not considered in the calculation.

This sample contained a gravimetric soil-moisture content of 3.56 percent, which converts to a tritium activity of approximately 1.41E+03 picocuries per gram (pCi/g). Based upon this activity, a corresponding dose was calculated using the RESRAD [residual radiation] computer program (Argonne National Laboratory July 2001) and the same methodology followed by the ER Project. These doses are summarized as follows for both the residential and industrial land-use scenarios.

The incremental total effective dose equivalent (TEDE) for the residential land-use scenario is 4.5E-01 millirem per year (mrem/yr). For comparison, the guideline being used is an excess TEDE of 75 mrem/yr (SNL/NM February 1998) for a complete loss of institutional controls (residential land use in this case). Therefore, the calculated dose value for the residential land-use scenario is approximately two orders of magnitude below this guideline, even with the extremely conservative assumption that surface contact is possible. The estimated excess cancer risk is 7.1E-07.

For the industrial land-use scenario, a TEDE was calculated that resulted in an incremental TEDE of 6.7E-04 mrem/yr. In accordance with EPA guidance found in Office of Solid Waste and Emergency Response Directive No. 9200.4-18 (EPA 1997), an incremental TEDE guideline of 15 mrem/yr is used for the probable land-use scenario (industrial in this case); the calculated dose value for the industrial land-use scenario is approximately four orders of magnitude below this guideline as well. The estimated excess cancer risk is 6.5E-09.

Surface tritium soil samples have been collected on an annual basis at the northeast, northwest, southwest, and southeast corners of the MWL since 1985. These MWL samples are collected as part of the SNL/NM Terrestrial Surveillance Monitoring Program and the results are reported on an annual basis in the “Annual Site Environmental Report for Sandia National Laboratories, New Mexico” (SNL/NM September 2007b). The latest samples were collected from the northeast, northwest, southwest, and southeast MWL corners on June 5, 2007, and contained tritium concentrations of 309, 218, 223, and 182 pCi/L, respectively. These concentrations are less than the SNL/NM background concentration of 420 pCi/L for tritium in soil (Tharp February 1999). These data demonstrate that concentrations of tritium being released from surface soil at the MWL are below background levels and that these releases pose no threat to human

health or the environment. These concentrations are also far below the trigger of 2.00E+04 pCi/L for tritium in surface soil presented in the "Long-Term Monitoring and Maintenance Plan [LTMMP] for the Mixed Waste Landfill, Sandia National Laboratories/New Mexico, Environmental Restoration Project" (SNL/NM September 2007a).

5.3 2008 VOC/Methane Soil-Vapor Sampling Results

The 2008 VOC sampling locations are shown in Figure 4-1. For ease of comparability, analytical results for dichlorodifluoromethane (CFC-12), tetrachloroethene (PCE), trichloroethene (TCE), and total VOCs in both the 1994 and 2008 soil-vapor samples are presented (the comparison is discussed in Chapter 6.0). Figures 5-3, 5-4, 5-5, and 5-6 show the locations and concentrations of the 1994 and 2008 sampling locations at the 10-, 30- and 50-foot depth intervals for CFC-12, PCE, TCE, and total VOCs, respectively. Tables 5-5 and 5-6 include CFC-12, PCE, TCE, and total VOC results for 1994 and 2008 samples at the 10- and 30-foot sampling depths. Table 5-7 presents 2008 results for the three constituents and total VOCs for the 50-foot depth only, as no 50-foot depth soil-vapor samples were collected in 1994. Finally, Table 5-8 presents methane-only results for the 2008 soil-vapor samples, as methane was required as an additional analyte by the NMED (NMED February 2008). Table 5-9 provides the method detection limits (MDLs) for the soil-vapor samples.

5.3.1 VOC/Methane Sample Analyses

The number of individual VOCs detected in each of the 2008 soil-vapor samples was variable, up to a maximum of 50 compounds. Most of the compounds were detected at very low concentrations (less than 10 ppbv). The analytical data reports that present all VOCs detected in the 2008 samples are provided in Appendix D.

The range of concentrations for CFC-12, PCE, TCE, total VOCs, and methane detected in the 2008 samples from the six MWL locations (DP1 through DP6) and two background locations (DP7 and DP8), as well as the locations at which the highest concentrations were found, are summarized in Table 5-10. In general, the highest total VOC concentrations at the six MWL borehole locations were detected in the 30-foot samples, and the lowest levels were detected in the 50-foot samples, although the highest total VOC concentration (1.33E+03 ppbv) was also found in a 50-foot MWL sample. The highest methane concentration (5.40E+06 ppbv) was also detected in a 50-foot sample.

5.3.2 VOC/Methane Primary and Duplicate Sample Comparison and Data Validation

As specified in the NMED Notice of Approval Letter for the SV SAP (NMED February 2008), duplicate VOC and methane samples were collected from the 10-, 30-, and 50-foot intervals in DP5 and in the 10- and 30-foot intervals in DP6. RPDs were calculated for CFC-12, PCE, TCE, total VOCs, and methane concentrations detected in the primary and duplicate sample pairs and are presented in Table 5-11. As shown in Table 5-11, RPD values for the three individual VOCs, total VOCs, and methane concentrations in the primary and duplicate sample pairs range from 0.0 to 197.49. No quality control acceptance criteria for the evaluation of field duplicates are currently in place.

All laboratory VOC data were also reviewed and verified/validated according to "Procedure for Electronic Data Deliverable (EDD) Processing, SMO-05-04, Issue 01, April 2007" (SNL/NM April 2007a); "Procedure for Completing the Contract Verification Review (CVR), SMO-05-03, Issue 03, April 2007" (SNL/NM April 2007b); and "Data Validation Procedure for Chemical and Radiochemical Data," AOP 00-03, Rev. 02 (SNL/NM July 2007). Appendix E contains the data validation reports for the VOC samples collected at this site. The data verification and validation review indicated that the VOC sample analytical results are acceptable for MWL site characterization purposes.

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6.0 SUMMARY OF RESULTS AND COMPARISON OF INVESTIGATIONS

This chapter summarizes and compares the results of the 1994 Soil-Vapor VOC, 1995 tritium, and 1997 radon investigations with the radon, tritium, and VOC investigations completed at the MWL in 2008, which are presented in Chapter 5.0. Applicable or relevant action levels are also discussed.

6.1 1997 and 2008 Radon Sample Comparison

The analytical results for the radon sampling conducted in 1997 and 2008 are presented in Figure 5-1 and Table 5-1 in Chapter 5.0. As shown in Figure 5-1, radon samples were collected from a total of 101 locations in and around the MWL in 1997 and 2008. Radon samples were collected from 21 locations around the perimeter of the MWL (18 in 1997 and 3 in 2008) and from 80 locations in the landfill (71 in 1997 and 9 in 2008).

The 1997 and 2008 MWL perimeter/background radon values and MWL radon values are plotted separately in Figure 6-1. The Figure 6-1 log-probability plot and other similar figures presented in this chapter were generated using Minitab 15^{TM} statistical plotting software. The figure contains pertinent summary statistics (N, mean, standard deviation, and minimum/median/maximum) for the data sets. For ease of viewing, the data were plotted on a log-probability scale. This allows the reader to see the range and variability of all the data at a glance. In order to construct the plot, all data were sorted from the lowest to the highest radon concentration, without respect to location. These log-probability plots are constructed such that one-half of the data points plot to the left, and one-half of the data points plot to the right, of the 50-percent value on the X-axis.

As shown in Figure 6-1, there is little difference between the mean, median, and minimum and maximum radon values for the 1997 and 2008 MWL radon data sets. The mean and maximum radon values at the MWL in 1997 were 0.35 and 1.00 pCi/m^{2}s, respectively, and 0.33 and 0.51 pCi/m^{2}s, respectively, for the 2008 samples.

The mean and maximum radon values for the 1997 perimeter (background) locations were 0.39 and 0.66 pCi/m^{2}s, respectively, and 0.60 and 0.65 pCi/m^{2}s for the 2008 background locations. The background mean for the 1997 samples is slightly lower than that for the 2008 background samples, and the maximum radon values are essentially the same. The 1997 background radon samples were collected within approximately 50 feet of the MWL, and the 2008 background radon samples were collected at three locations approximately 300 to 400 feet away from the MWL (Figure 5-1). These data indicate that the radon emissions from the naturally occurring sediments surrounding the MWL are essentially the same as those from the MWL itself. The two data sets also show that radon emissions from the MWL and background areas have not changed from 1997 to 2008. In addition, radon levels in both the 1997 and 2008 samples are one order of magnitude below the EPA 40 CFR 192 standard and the MWL cover design standard of 20 pCi/m^{2}s presented in the LTMMP for the MWL (SNL/NM September 2007a).

6.2 1995 and 2008 Tritium Sample Comparison

In Chapter 5.0, data and locations of the 1995 and 2008 tritium samples and the tritium concentrations that were detected at the 10-, 30-, and 50-foot depths in both 1995 and 2008 are presented in Table 5-2 and Figure 5-2. The 1995 tritium sampling results were originally reported in units of pCi/L by the analytical laboratory that performed the analyses. The results were then converted to pCi/g and presented in Table 4.6-8 of the "Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation, Sandia National Laboratories, Albuquerque, New Mexico," SAND Report SAND2002-2997 (SNL/NM September 2002). The tritium analytical results for the 1995 samples that are presented in Table 5-2 and Figure 5-2 were obtained directly from the analytical laboratory certificate of analyses reports and are again expressed in the original units (pCi/L) reported by the laboratory.

Because none of the 2008 tritium samples were collected from the same locations that were sampled in 1995, a direct comparison of 1995 and 2008 tritium concentrations was not possible. The 2008 and 1995 boreholes and locations in closest proximity to each other are DP6, which is located approximately 35 feet northeast of Borehole BH-5 and approximately 45 feet southwest of borehole BH-6. All three of these locations are near the northwest corner of the landfill (Figure 5-2). As shown in Table 6-1, tritium concentrations in the 10-foot samples from these three borehole locations are similar, while the 30-foot samples exhibit greater variability. Tritium concentrations for the 50-foot samples from BH-5 and BH-6 are also similar (50-foot samples were not collected at the 2008 DP6 location).

The 2008 DP3 location is the next-closest sampling location to 1995 boreholes. DP3 is located approximately 50 feet west and 50 feet east of 1995 Boreholes BH-11 and BH-12, respectively. All three of these locations are near the southern end of the classified area (Figure 5-2). Tritium concentrations in the 10-, 30-, and 50-foot samples from these three borehole locations exhibit substantial variability, as shown in Table 6-2. The highest tritium concentration at these three locations was detected in the 30-foot sample from BH-12.

In addition, the two highest tritium concentrations in the 2008 samples (3.95E+07 J and 1.57E+07 J pCi/L) were detected in the primary and duplicate sample pair from the 10-foot depth interval at DP5. This primary/duplicate sample pair indicates that the tritium concentrations can vary significantly in individual samples that are collected at the same depths and in close proximity to each other (less than 5 feet apart in this case).

Figure 6-2 was presented in the 2002 MWL SAND report (SNL/NM September 2002) and is a plan view that shows the results of tritium surface sampling that was conducted at the landfill in 1993. The contours shown in this figure are based upon a total of 92 surface soil samples that were collected from the surface of the MWL and northwest of the landfill. This figure demonstrates that the highest surface tritium concentrations were found in the northern portion of the MWL in 1993.

Figures 6-3, 6-4, and 6-5 present tritium concentration isopleths in plan view for the 2008 MWL samples at the 10-, 30-, and 50-foot depth intervals, respectively. The isopleth contouring pattern shown in these figures is based upon six sampling locations for each of the 10- and 30-foot depth intervals and only three locations for the 50-foot depth. In spite of this limitation, these figures demonstrate that the tritium concentration isopleths decrease with depth and that the maximum tritium concentrations are centered on DP5 in the northwest area of the landfill.

Figure 6-6 is a plot that shows the tritium concentrations for both 1995 and 2008 samples at the 10-, 30-, and 50-foot depths. The "N*" in the statistical text box of this figure denotes the number of tritium ND results in the 1995 data set. Tritium ND results are defined as laboratory-reported values that are either negative numbers or values less than the analytical error (Table 5-2). As shown in Figure 5-2, 1995 tritium samples were collected from 15 boreholes that were located around the perimeter of the MWL, and none of the 1995 samples were collected in the MWL. In 2008, tritium samples were collected from six borehole locations in the landfill, and from two background locations southwest of the MWL. The 2008 borehole location DP5, where the highest tritium concentrations were found, is located between, and close to, the edges of two waste disposal trenches in the northwestern portion of the MWL. The overall higher tritium concentrations detected in the 2008 samples were expected because most of these samples were collected in close proximity to waste pits and trenches in the landfill.

6.3 1994 and 2008 Soil-Vapor VOC Comparison

Figures and tables showing sampling locations and analytical results for CFC-12, PCE, TCE, total VOCs, and methane are presented in Chapter 5.0. The three VOC constituents that were detected at the highest concentrations in the 1994 soil-vapor samples included CFC-12, PCE, and TCE. Total VOCs in soil-vapor were also reported for the 1994 samples (SNL/NM September 1996). Therefore, these same three constituents and total VOCs in the 2008 samples were also selected for comparison with the 1994 data.

The analytical results for 98 individual VOCs plus methane were reported by the laboratory for the 2008 samples. As described in Section 5.3.1, up to 50 individual VOCs were detected in the 2008 soil-vapor samples but most were detected at very low concentrations (less than 10 ppbv), whereas up to eight individual VOCs were detected and reported for the 1994 active soil-vapor samples. The MDLs for the 1994 samples range from 10 to 1,000 ppbv. Laboratory analytical methodology and instrumentation have improved considerably since 1994, and much lower levels of analytical sensitivity are now possible. As a result, MDLs for the 2008 samples range from 0.5 to 25 ppbv, with all but 12 of those compounds having MDLs of less than 5 ppbv, and only one (benzyl chloride) having an MDL greater than 10 ppbv (Table 5-9). Improvements in laboratory analytical instrumentation are therefore the reason why more individual VOCs were detected in the 2008 samples, compared with the 1994 samples.

As shown in Table 5-8, methane concentrations range from ND to 4.30E+03 J ppbv in the 2008 MWL soil-vapor samples collected at 10 feet; ND to 2.20E+05 ppbv in the 30-foot MWL samples; and from ND to 5.40E+06 ppbv in the 50-foot MWL samples. Methane was not reported, nor was it an analyte for the 1994 soil-vapor samples. Very little to no methane was detected in the 10-foot samples, and somewhat elevated methane levels were detected only in the 30- and 50-foot samples from DP3.

As shown in Table 6-3, the mean, median, and maximum values for CFC-12, PCE, TCE, and total VOCs have all decreased markedly from 1994 to 2008. Vadose zone triggers for PCE, TCE, and total VOCs detected in MWL soil-vapor samples are presented in the LTMMP for the MWL (SNL/NM September 2007a). Trigger levels are 2.00E+04 ppbv for PCE and TCE, and 2.50E+04 ppbv for total VOCs. The maximum concentrations of PCE and TCE in the 1994 samples were less than the respective LTMMP triggers (SNL/NM September 2007a), and total VOCs exceeded the trigger. In 2008, the maximum concentrations of PCE, TCE, and total VOCs are all much lower than the respective triggers.

Figures 6-7 through 6-10 show concentrations in active soil-vapor samples for CFC-12, PCE, TCE, and total VOC samples, respectively, collected at the 10- and 30-foot depths (1994 and 2008 samples) and at 50 feet (2008 samples only). For plotting purposes, ND results were converted to values that are one-half of the MDL. It is apparent from these four figures that overall concentrations of CFC-12, PCE, TCE, and total VOCs have declined at the MWL since 1994.

6.4 Overall Comparison

A comparison of the mid-1990s and 2008 radon, tritium, and VOC sample data showed that:

- Radon emissions from the MWL were at background levels in the 1997 and 2008 samples and have not changed over time.
- Tritium concentrations in the 2008 soil samples are in general higher than those in the 1995 samples because most of the 2008 samples were collected in the landfill, while the 1995 samples were collected from around the MWL perimeter.
- CFC-12, PCE, TCE, and total VOC concentrations in the 2008 soil-vapor samples are lower than those in the 1994 samples.

The results of this investigation are consistent with the MWL conceptual model and support the recommendations described in the MWL LTMMP (SNL/NM September 2007a) to complete the vegetative soil cover with a biointrusion barrier and continue long-term air, biota, surface soil, vadose zone, and groundwater monitoring to ensure that the final remedy for the MWL is protective of human health and the environment. The half-life of tritium is 12.6 years, and tritium concentrations will continue to decrease over time. If the current trend continues, VOC concentrations would also be expected to continue to decline over time. Completing the cover will also further reduce the potential for infiltration of precipitation into the subsurface of the landfill.

7.0 RECOMMENDATIONS

This chapter presents recommendations for future activities at the MWL based upon the 2008 radon, tritium, and VOC sampling results.

7.1 Radon Monitoring

Radon sampling on the surface of the MWL, completed in both 1997 and 2008, shows that background levels of radon are being released from the landfill. The mean and maximum radon concentrations at the nine 2008 MWL radon sampling locations are also lower than concentrations detected at the three 2008 background locations.

Continued monitoring for radon is recommended in the LTMMP for the MWL (SNL/NM September 2007a). The proposed radon monitoring will be conducted on a quarterly basis in Years 1 and 2 following cover completion to establish initial concentration data, then on a semiannual basis for Years 3 and 4, and then on an annual basis in Year 5 and subsequent years. Completion of the MWL cover installation, as described in the MWL CMI Plan (SNL/NM November 2005), should further reduce radon emissions from the MWL. It is recommended that radon monitoring at the MWL be conducted as described in the LTMMP.

7.2 Tritium Monitoring

Studies conducted at the MWL in 1992, 1993, and 2003 revealed that the tritium flux from the MWL to the atmosphere is at low levels and does not pose a threat to human health or the environment. These studies indicate that, as expected, tritium released from the landfill to the atmosphere declined significantly from 1993 to 2003 (SNL/NM September 2007a).

The SNL/NM Terrestrial Surveillance Program has monitored concentrations of tritium in surface soil at four corners of the MWL on an annual basis since 1985. These concentrations have been diminishing with time due to natural radioactive decay of tritium, and the tritium concentrations in the latest surface soil samples collected at the site in June 2007 were all below background values (SNL/NM September 2007b). Tritium concentrations at the landfill surface do not pose a threat to human health or the environment.

Continued surface soil sampling at the four corners of the landfill on an annual basis for long-term tritium monitoring is proposed in the MWL LTMMP. Tritium is very mobile and should a significant release from the landfill contents occur, increased tritium would be detected in soil samples during the annual sampling events. A significant release is defined as a release greater than the proposed LTMMP trigger of 2.00E+04 pCi/L of tritium in surface soil (SNL/NM September 2007a). It is therefore recommended that the surface tritium sampling described in the LTMMP be implemented.

7.3 Vadose Zone VOC Monitoring

The 1994 and 2008 soil-vapor VOC data demonstrate that VOC concentrations in soil-vapor at 10 and 30 feet bgs have decreased since 1994. In addition, CFC-12, PCE, TCE, and total VOC concentrations in the 50-foot samples collected in 2008 are less than those in the 30-foot samples, which indicate that soil-vapor VOC concentrations decrease with depth.

Continued monitoring for vadose zone VOCs is recommended in the LTMMP for the MWL (SNL/NM September 2007a). Three soil-vapor monitoring wells will be constructed at the MWL. Soil-vapor sampling ports will be installed at depths of 50, 100, 200, 300, and 400 feet bgs. Soil-vapor VOC data collected from the wells will be used to further assess current VOC distributions with depth and to monitor VOC concentrations over time, allowing early identification of any potential threats to groundwater. The VOC data from the wells will also be included in the MWL fate and transport model updated every five years. It is therefore recommended that vadose zone VOC monitoring plans presented in the LTMMP be implemented.

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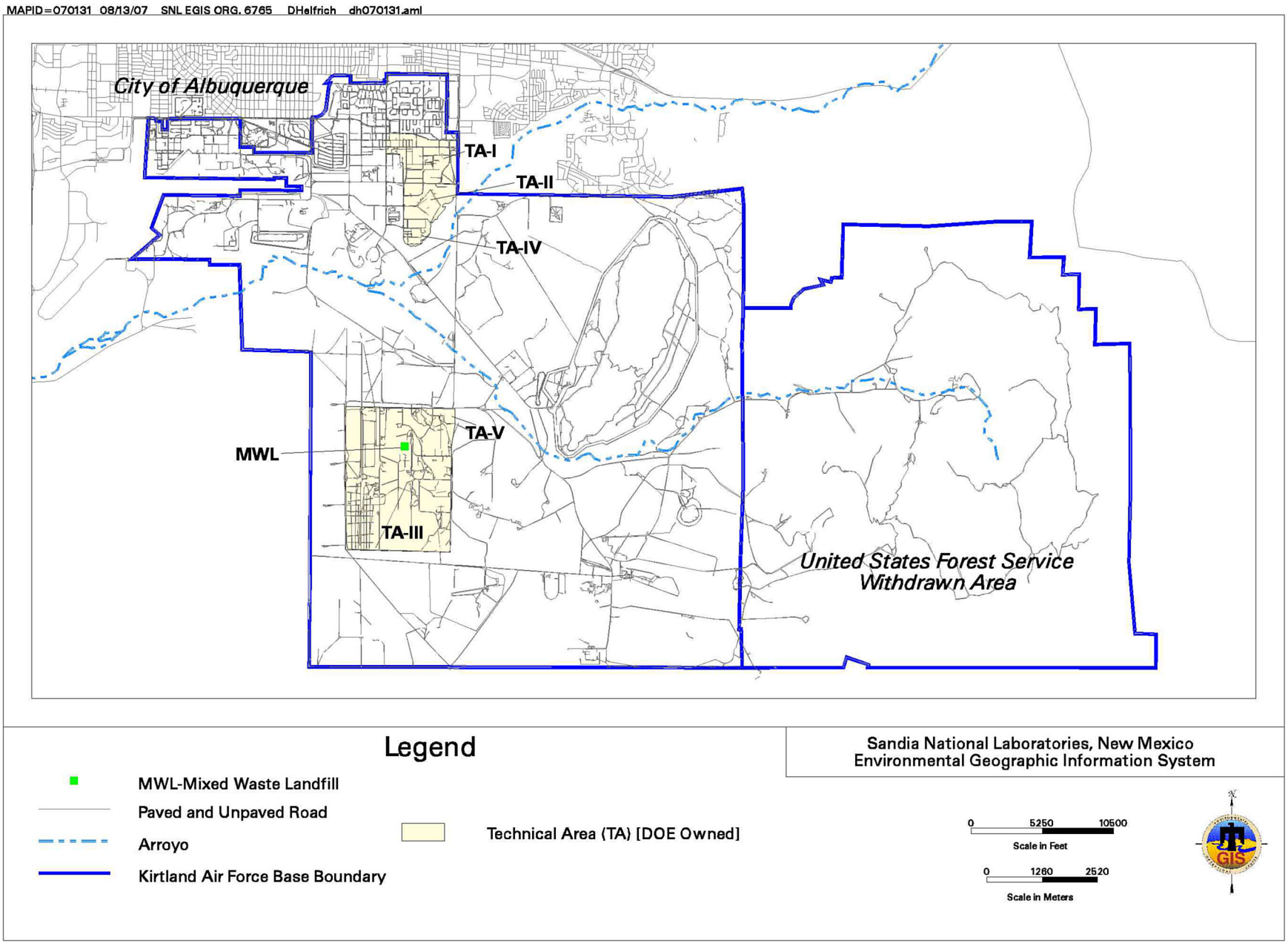
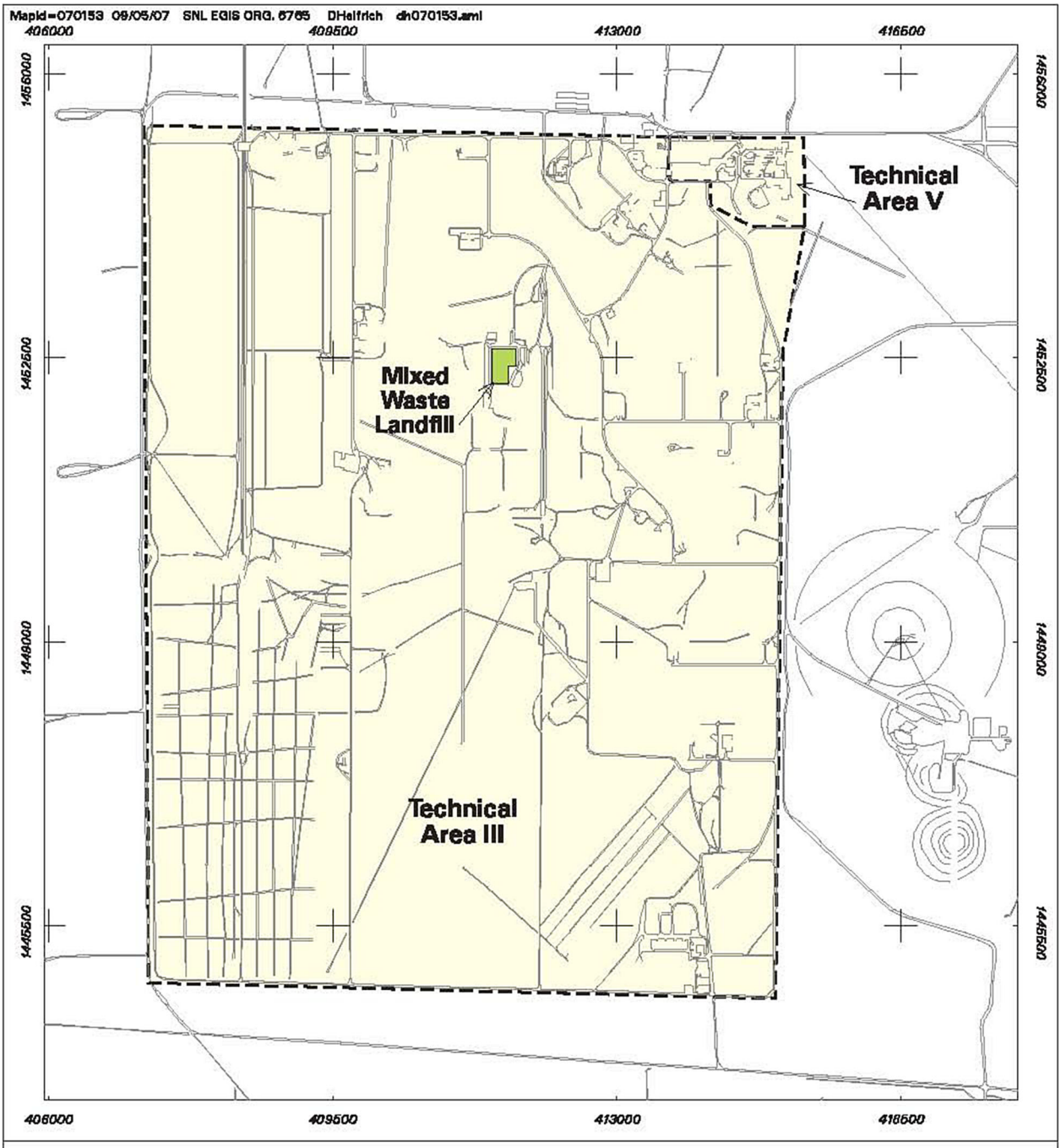
FIGURES



840857.04330000 A5

Figure 1-1
Location of Sandia National Laboratories and Kirtland Air Force Base



Legend

Paved and Unpaved Road

Technical Area

Mixed Waste Landfill

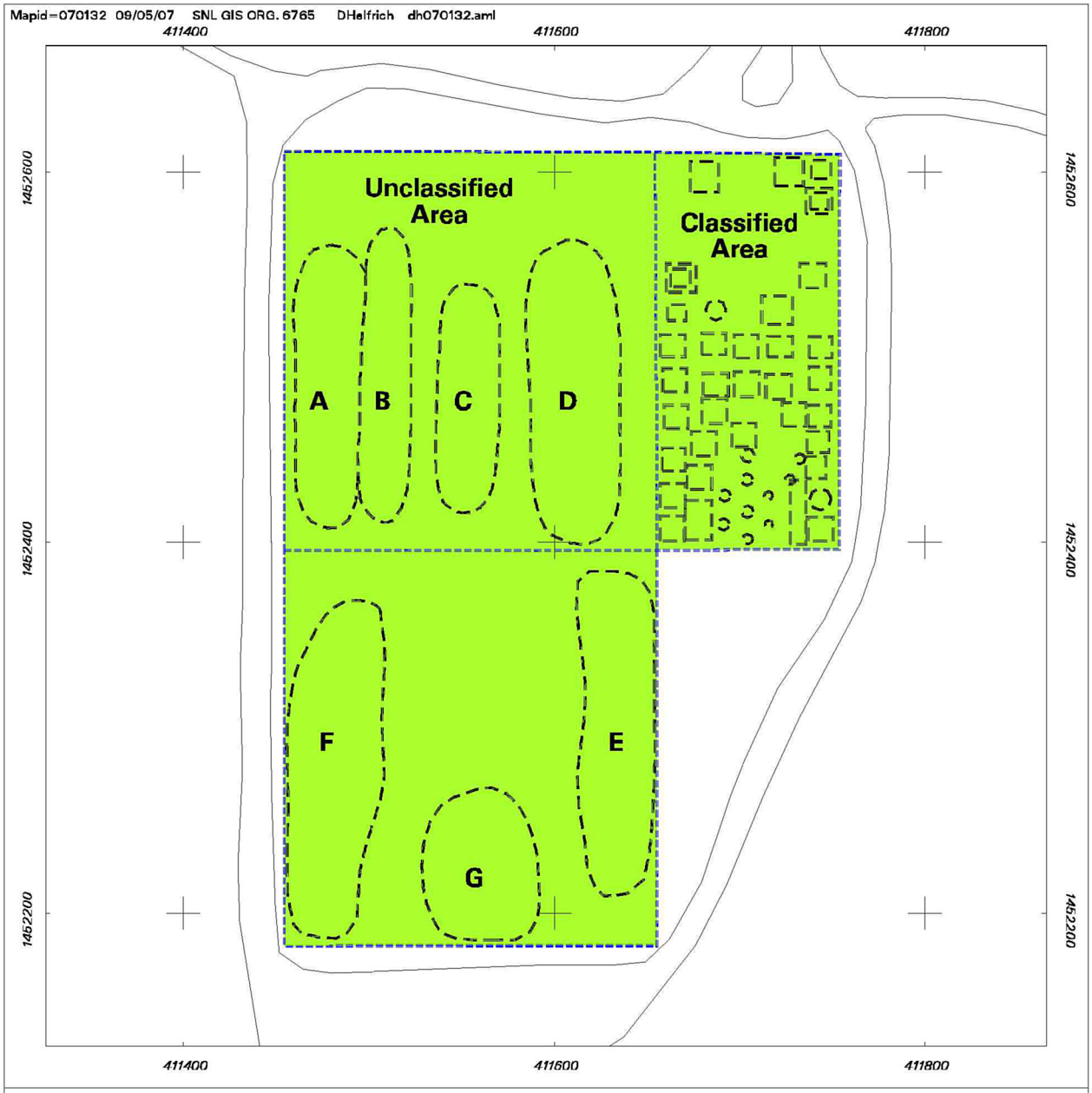
Figure 1-2
Location of the Mixed Waste Landfill within Technical Area III

0 1000 2000
Scale in Feet

0 240 480
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04330000 A6



Legend

- Former MWL Fence
- Pits and Trenches
- Former Road
- MWL Extent

Figure 1-3
Map of the Mixed Waste Landfill

0 45 90
Scale in Feet

0 10.8 21.6
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04330000 A7

Mapid=080099 08/01/08 SNL EGIS ORG. 4131 DHelfrich dh080099.aml

411000 411500 412000

1452500 1452000 1451500

RN12 RN11

DP6 RN2 RN1 DP1 DP5 RN3 RN4 RN5 DP4 RN7 DP3 RN6 RN8 DP2 RN9

DP7 RN10

DP8

Legend

- 2008 Radon Sampling Location
- 2008 VOC Soil-Vapor and Tritium Soil Sampling Location
- Toe of Landfill Subgrade
- MWL Boundary, Trench & Pit Location
- Edge of unpaved Road

Figure 4-1
2008 Radon, Tritium, and Soil-Vapor VOC Sampling Locations at the Mixed Waste Landfill

0 140 280
Scale in Feet

0 34 68
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04330000 B6

Figure 4-2
Collecting Tritium Soil Samples with the Geoprobe® at the Mixed Waste Landfill, April 10, 2008 (view to the northeast).

Figure 4-3
Scanning a Soil-Filled Geoprobe® Butyl Acetate Sleeve for Radiological Contamination at the Mixed Waste Landfill, April 11, 2008 (view to the east).

Figure 4-4
Collecting a Soil-Vapor VOC Sample at the
Mixed Waste Landfill, May 14, 2008 (view to the west).

Mapid=080107 08/01/08 SNL EGIS ORG. 4131 DHelfrich dh080107.aml

411500

1452500

A 0.16
B 0.25
C 0.29
D 0.35
E 0.54
F 0.55
G 0.45
H 0.26
I 0.44
J 0.45
K 0.19
L 0.34
M 0.63
N 0.35
O 0.46
P 0.66
Q 0.28
R 0.30

RN1 0.35 (0.36)
RN2 0.43
RN3 0.21 (0.30, 0.25)
RN4 0.30
RN5 0.33
RN6 0.32
RN7 0.51
RN8 0.28 (0.28)
RN9 0.34
RN10 0.65
RN11 0.56
RN12 0.58

1 0.413
2 0.33
3 0.44
4 0.30
5 0.68
6 0.58
7 0.55
8 0.15
9 0.28
10 0.44
11 0.43
12 0.061
13 0.63
14 0.095
15 0.52
16 0.35
17 0.16
18 0.099
19 0.30
20 0.30
21 0.23
22 0.39
23 0.45
24 0.18
25 0.19
26 0.26
27 0.33
28 0.33
29 0.026
30 0.20
31 0.61
32 0.58
33 0.18
34 0.18
35 0.19
36 0.25
37 0.38
38 0.29
39 0.19
40 0.12
41 0.41
42 0.60
43 0.19
44 0.72
45 0.15
46 0.33
47 0.57
48 0.43
49 0.12
50 0.22
51 0.61
52 0.34
53 0.48
54 0.26
55 0.22
56 0.60
57 0.61
58 0.21
59 0.29
60 0.035
61 0.55
62 0.48
63 0.069
64 1.0
65 0.078
66 0.63
67 0.56
68 0.48
69 0.46
70 0.34
71 0.16

Former MWL Boundary

Note: Inset shows surrounding radon background locations at a smaller scale.

411500

Legend

N 0.35 — 1997 Radon sampling location and result (pCi/m^{2}s)

RN2 0.43 — 2008 Radon sampling location and result (duplicate) (pCi/m^{2}s)

Former MWL Boundary

Toe of Landfill Subgrade

Trench & Pit Location

Edge of unpaved Road / Berm

Figure 5-1
1997 and 2008 Radon Sampling Locations and Sample Results at the Mixed Waste Landfill

0 60 120
Scale in Feet
0 14 28
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04330000 B10

Mapid=080086 06/25/08 SNL EGIS ORG. 4131 DHelfrich dh080086.aml

411500

1452500

BH-6
2.43E+03
5.89E+03 (5.64E+03)
ND

BH-7
2.65E+03
ND (ND)
ND

DP6
6.82E+03 (6.11E+03)
165 (189)

BH-8
9.53E+03
7.4E+03 (8.05E+03)
530

BH-5
4.28E+03
ND
ND (430)

DP1
7.54E+04
1.27E+06

BH-14
1.68E+03
730 (710)
1.38E+03

BH-9
2.35E+04
4.68E+04 (4.3E+04)
1.86E+04

DP5
3.95E+07 (1.57E+07)
4.8E+06 (6.82E+06)
2.41E+05 (3.19E+05)

BH-15
4.03E+04
2.4E+03 (1.6E+0
750

BH-4
1.65E+03
780 (1.1E+03)
ND

BH-10
4.74E+04
5.46E+05
1.81E+04 (5.13E+04)

DP4
2.5E+05
5.32E+03

BH-11
7.0E+03
1.15E+03 (1.31E+03)
1.06E+03

DP3
1.89E+05
8.21E+05
5.1E+03

BH-12
6.7E+05
7.8E+06
2.11E+05 (2.15E+05)

BH-3
1.72E+03
ND
ND

BH-13
1.16E+03
ND (710)
330

BH-2
790
ND
ND

DP2
4.71E+04
4.91E+03
1.7E+03

BH-1
700
790 (900)
ND

DP7
156
180

DP8
ND
260

*Note: Inset shows background locations at a smaller scale. Actual locations are approximately **525** and **665** feet southwest of the southwest corner of the original MWL boundary (see Figure 4-1)*

411500

Legend

DP2
4.7E+04
2008 Tritium sampling location and result (pCi/L) at 10 and 30 ft. (two values), and 10, 30, and 50 ft. (three values) (duplicate)

BH-1
700
1995 Soil-Vapor and Tritium sampling location and result (pCi/L) at 10, 30, and 50 ft. (duplicate)

Toe of Landfill Subgrade

Trench & Pit location, former MWL Boundary

Edge of unpaved Road

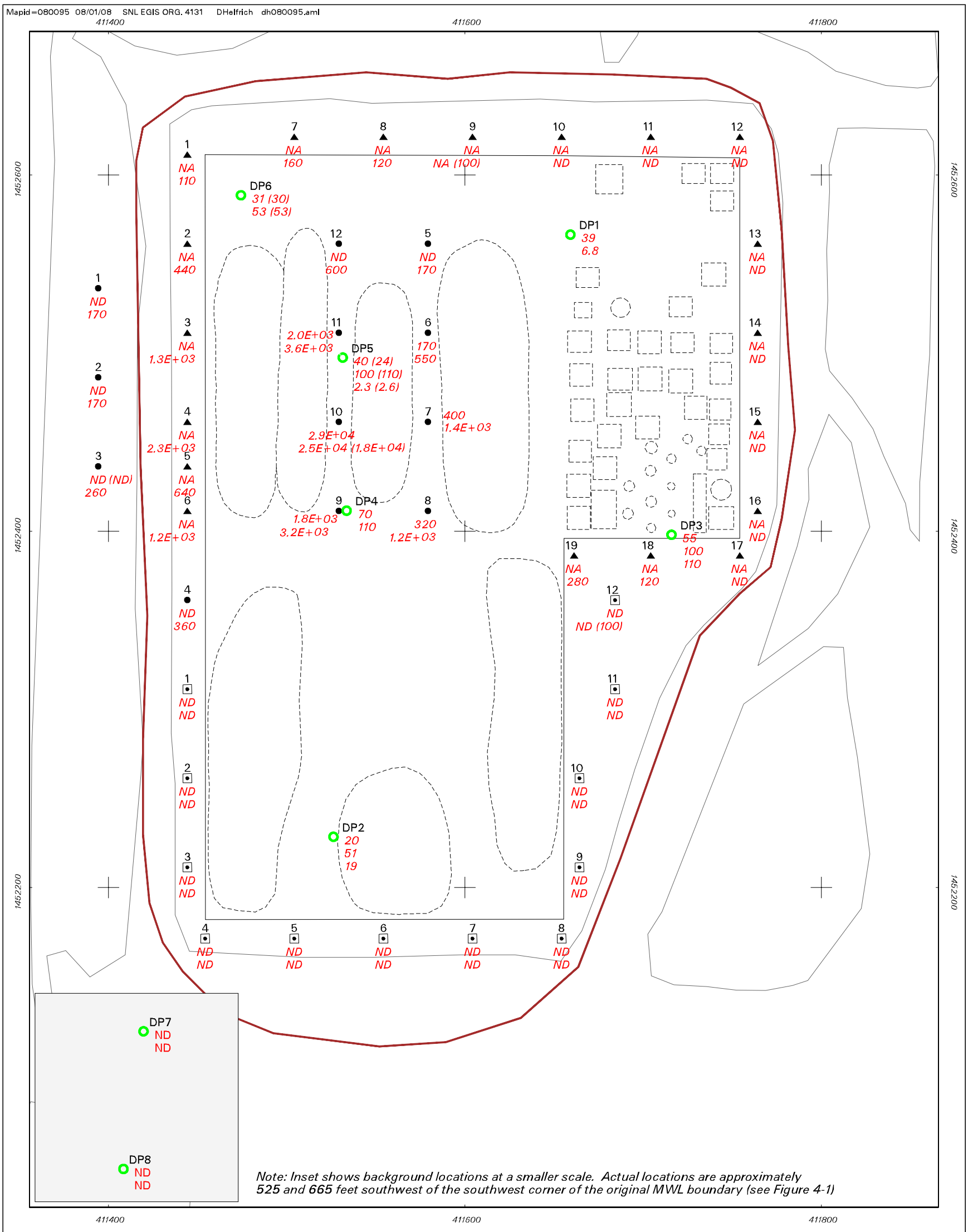
Figure 5-2
1995 and 2008 Tritium Soil Sampling Locations and Sample Results at 10-, 30-, and 50-Foot Depths at the Mixed Waste Landfill

0 60 120
Scale in Feet
0 14 28
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04330000 B1

Mapid=080095 08/01/08 SNL EGIS ORG. 4131 DHelfrich dh080095.aml



*Note: Inset shows background locations at a smaller scale. Actual locations are approximately **525** and **665** feet southwest of the southwest corner of the original MWL boundary (see Figure 4-1)*

Legend

1 ▲ 110 — 1994 First-round sample location, borehole number, and CFC-12 result (ppbv) at 10 and 30 ft. (duplicate)

6 ● 170 — 1994 Second-round sample location, borehole number, and CFC-12 result (ppbv) at 10 and 30 ft. (duplicate)

5 ⊡ ND — 1994 Third-round sample location, borehole number, and CFC-12 result (ppbv) at 10 and 30 ft. (duplicate)

DP2 ○ 20 — 2008 sample location, borehole number, and CFC-12 result (ppbv) at 10 and 30 ft. (two values) and 10, 30 and 50 ft. (three values) (duplicate)

Former MWL Boundary

Toe of Landfill Subgrade

Trench & Pit location

Edge of unpaved Road

Figure 5-3
1994 and 2008 Soil-Vapor Dichlorodifluoromethane (CFC-12) Sampling Locations and Sample Results at 10-, 30-, and 50-Foot Depths at the Mixed Waste Landfill

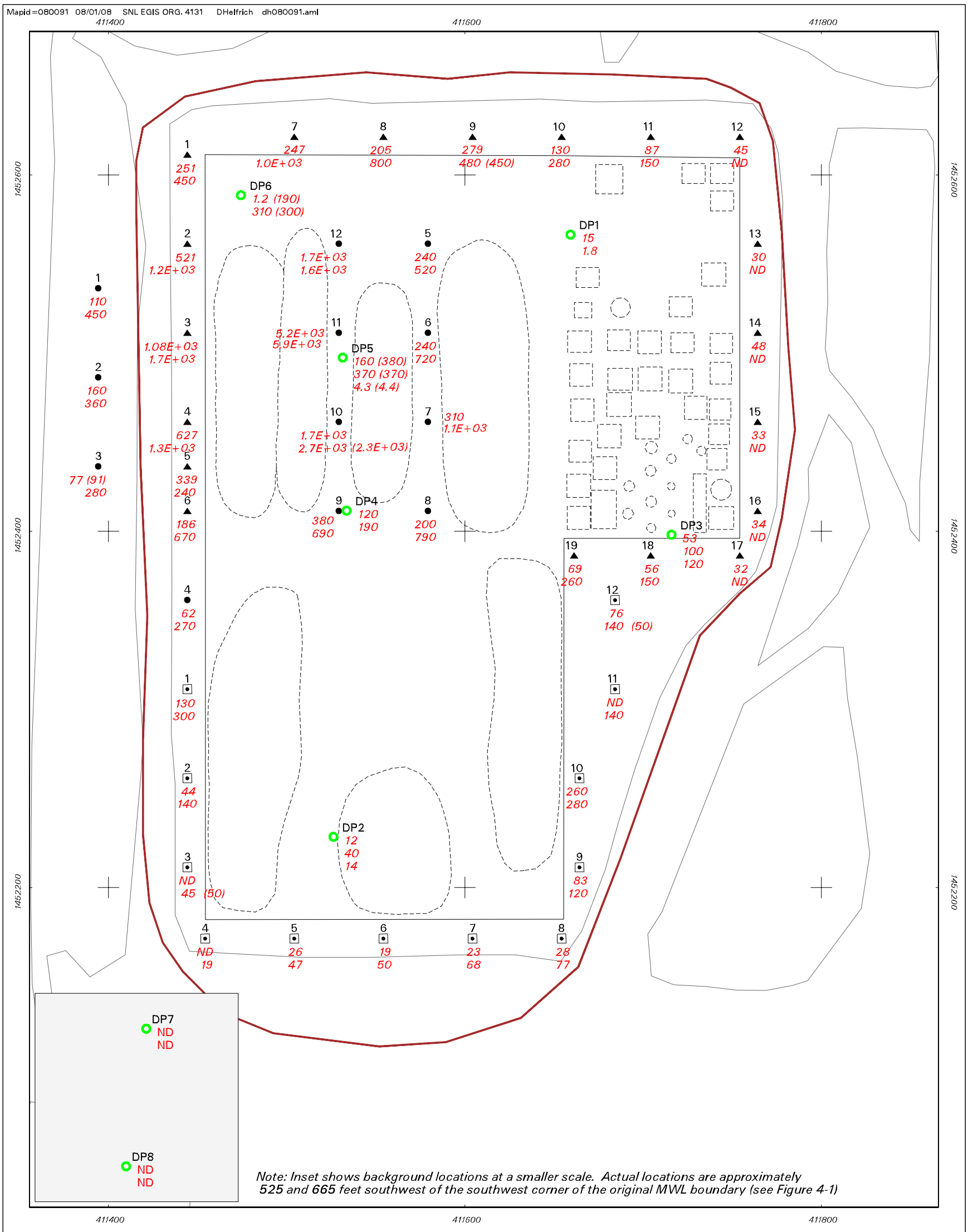
0 60 120
Scale in Feet

0 14 28
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04330000 B5

Mapid=080091 08/01/08 SNL EGIS ORG. 4131 DHelfrich dh080091.aml



Note: Inset shows background locations at a smaller scale. Actual locations are approximately 525 and 665 feet southwest of the southwest corner of the original MWL boundary (see Figure 4-1)

Legend

1 ▲ 251 — 1994 First-round sample location, borehole number, and PCE result (ppbv) at 10 and 30 ft. (duplicate)

6 ● 240 — 1994 Second-round sample location, borehole number, and PCE result (ppbv) at 10 and 30 ft. (duplicate)

5 ⊡ 26 — 1994 Third-round sample location, borehole number, and PCE result (ppbv) at 10 and 30 ft. (duplicate)

DP2 12 — 2008 sample location, borehole number, and PCE result (ppbv) at 10 and 30 ft. (two values) and 10, 30, and 50 ft. (three values) (duplicate)

Former MWL Boundary

Toe of Landfill Subgrade

Trench & Pit location

Edge of unpaved Road

Figure 5-4
1994 and 2008 Soil-Vapor Tetrachloroethene (PCE) Sampling Locations and Sample Results at 10-, 30-, and 50-Foot Depths at the Mixed Waste Landfill

0 60 120
Scale in Feet

0 14 28
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04330000 B3

Mapid=080089 08/01/08 SNL EGIS ORG. 4131 DHelfrich dh080089.aml

411400 411600 411800

1452600 1452400 1452200

1 131 230
2 210 450
3 310 530
4 279 490
5 185 120
6 114 330
7 124 460
8 123 400
9 210 350 (320)
10 126 250
11 86 160
12 53 120
13 72 140
14 113 240
15 93 250
16 84 210
17 76 230
18 435 630
19 220 630

DP6 4.2 (42) 110 (110)

1 ND 230
2 ND 190
3 51 (58) 210

DP5 10 (20) 68 (71) 1.6 (1.7)
1 540 ND
2 290 570
3 ND 280
4 100 270
5 ND ND (600)
6 100 540
7 110 520

DP4 34 100
8 180 370

DP1 14 ND

DP3 39 110 140

1 39 230
2 140 350
3 36 220
4 ND 77 (60)
5 13 38
6 35 99
7 42 130
8 43 160
9 49 210
10 120 250
11 98 250
12 230 390 (420)
13 120 270

DP2 11 30 13

DP7 ND ND

DP8 ND ND

Note: Inset shows background locations at a smaller scale. Actual locations are approximately 525 and 665 feet southwest of the southwest corner of the original MWL boundary (see Figure 4-1)

411400 411600 411800

Legend

1 ▲ 131 — 1994 First-round sample location, borehole number, and TCE result (ppbv) at 10 and 30 ft. (duplicate)

6 ● ND — 1994 Second-round sample location, borehole number, and TCE result (ppbv) at 10 and 30 ft. (duplicate)

5 ⊡ 35 — 1994 Third-round sample location, borehole number, and TCE result (ppbv) at 10 and 30 ft. (duplicate)

DP2 11 — 2008 sample location, borehole number, and TCE result (ppbv) at 10 & 30 ft. (two values) and 10, 30, & 50 ft. (three values) (duplicate)

Former MWL Boundary

Toe of Landfill Subgrade

Trench & Pit location

Edge of unpaved Road

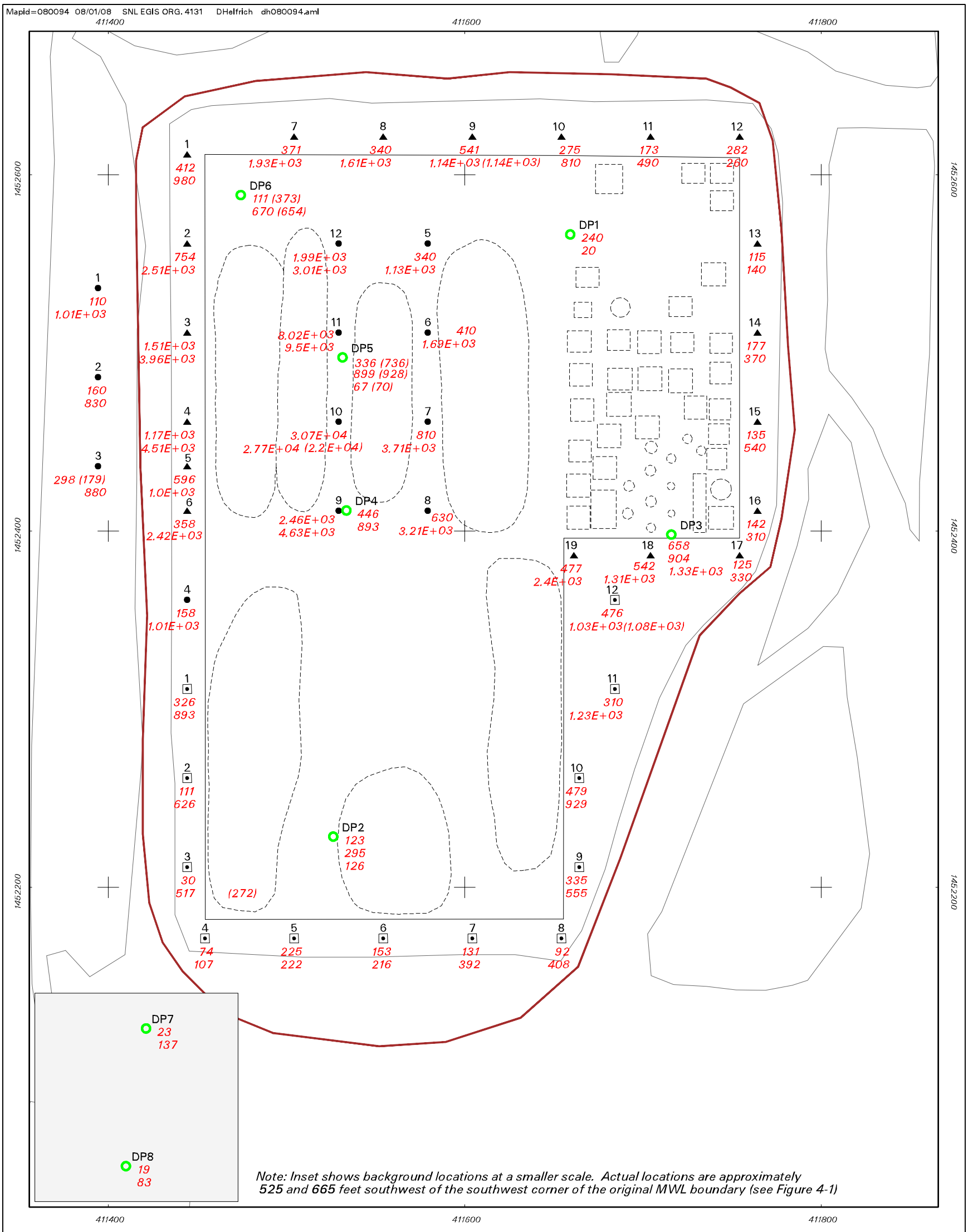
Figure 5-5
1994 and 2008 Soil-Vapor Trichloroethene (TCE) Sampling Locations and Sample Results at 10-, 30-, and 50-Foot Depths at the Mixed Waste Landfill

0 60 120
Scale in Feet
0 14 28
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04330000 B2

Mapid=080094 08/01/08 SNL EGIS ORG. 4131 DHelfrich dh080094.aml



Legend

- 1994 First-round sample location, borehole number, and total soil-vapor VOC result (ppbv) at 10 and 30 ft. (duplicate)
- 1994 Second-round sample location, borehole number, and total soil-vapor VOC result (ppbv) at 10 and 30 ft. (duplicate)
- 1994 Third-round sample location, borehole number, and total soil-vapor VOC result (ppbv) at 10 and 30 ft. (duplicate)
- 2008 sample location, borehole number, and total soil-vapor VOC result (ppbv) at 10 & 30 ft. (two values) and 10, 30, & 50 ft. (three values) (duplicate)
- Former MWL Boundary
- Toe of Landfill Subgrade
- Trench & Pit location
- Edge of unpaved Road

Figure 5-6
1994 and 2008 Soil-Vapor Total Volatile Organic Compound (VOC) Sampling Locations and Sample Results at 10-, 30-, and 50-Foot Depths at the Mixed Waste Landfill

0 60 120
Scale in Feet
0 14 28
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04330000 B4

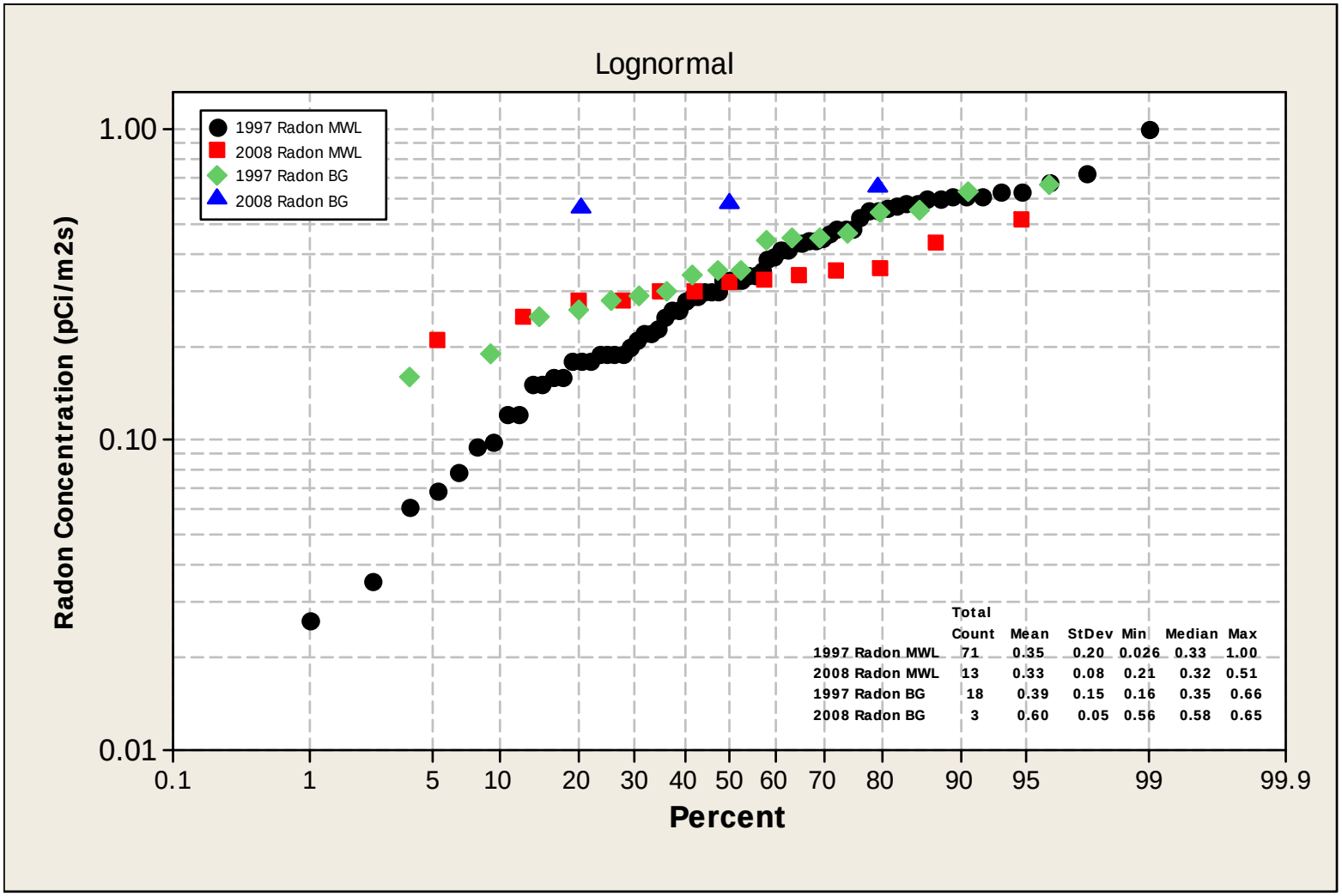


Figure 6-1
Comparison of 1997 and 2008 Radon Sample Analytical Results at the Mixed Waste Landfill

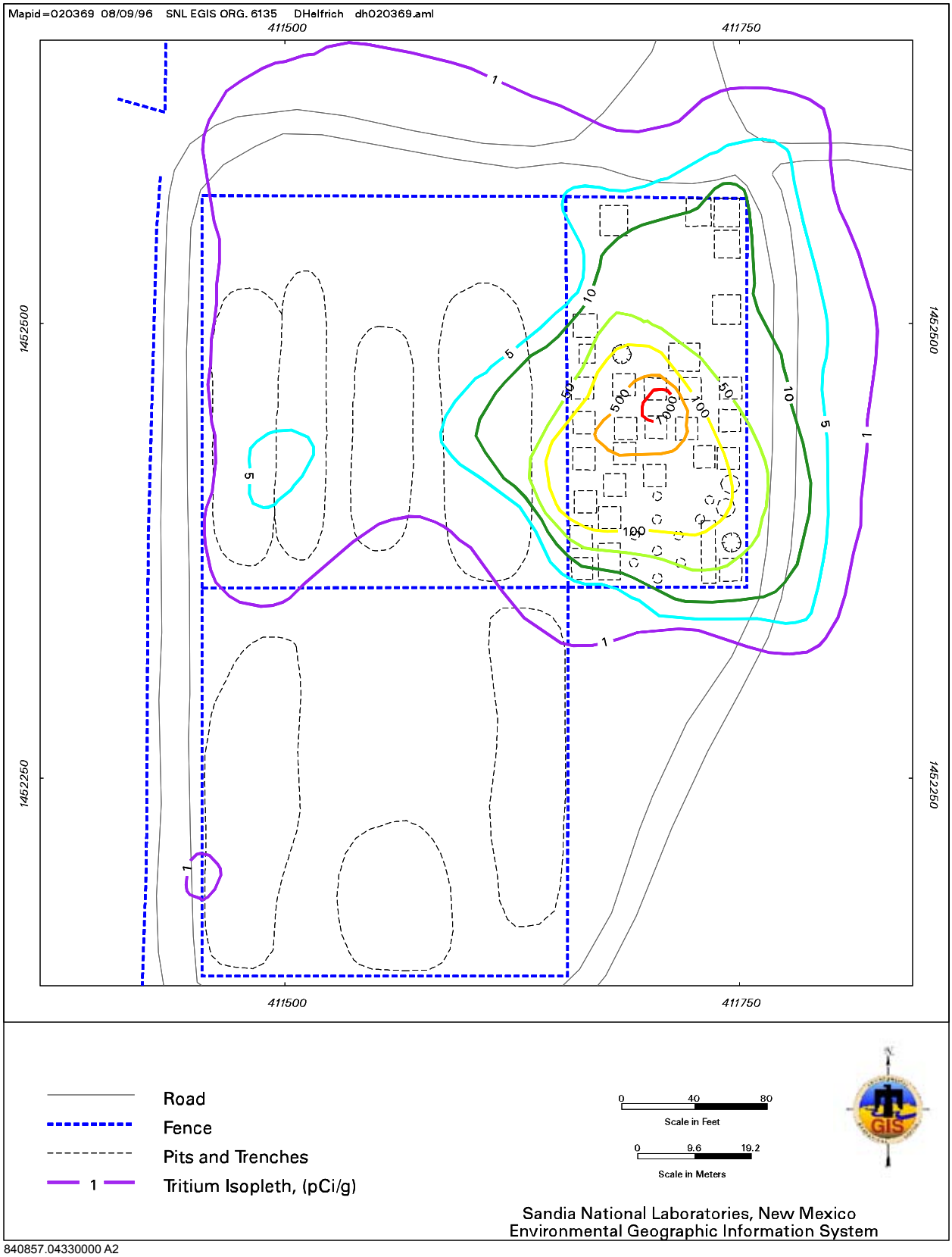


Figure 6-2
1993 Tritium Surface Soil Sampling Results at the Mixed Waste Landfill

Legend

DP1
7.54E+04
2008 Tritium Sampling Location and Result (pCi/L) at 10-ft. depth (duplicate)

BH-1
1995 Tritium Sampling Location

Toe of Landfill Subgrade

Trench & Pit location, former MWL Boundary

Edge of unpaved Road

E+04
Tritium Concentration Isopleth (pCi/L), dashed where inferred

Figure 6-3
2008 Tritium Soil Sample Concentration Isopleths at the 10-Foot Depth at the Mixed Waste Landfill

0 60 120
Scale in Feet

0 14 28
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04330000 B7

Mapid=080105 08/01/08 SNL EGIS ORG. 4131 DHelfrich dh080105.aml

411500

1452500

BH-6
BH-7
BH-8
BH-5
BH-14
BH-9
BH-15
BH-4
BH-10
BH-11
BH-12
BH-3
BH-13
BH-2
BH-1

E+02
E+04
E+06
E+05
E+03

DP6
165 (189)

DP1
1.27E+06

DP5
4.8E+06 (6.82E+06)

DP4
5.32E+03

DP3
8.21E+05

DP2
4.91E+03

411500

1452500

Legend

DP1
1.27E+06
2008 Tritium Sampling Location and Result (pCi/L) at 30-ft. depth (duplicate)

BH-1
1995 Tritium Sampling Location

Toe of Landfill Subgrade

Trench & Pit location, former MWL Boundary

Edge of unpaved Road

E+04
Tritium Concentration Isopleth (pCi/L), dashed where inferred

Figure 6-4
2008 Tritium Soil Sample Concentration Isopleths at the 30-Foot Depth at the Mixed Waste Landfill

0 60 120
Scale in Feet

0 14 28
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04330000 B8

Mapid=080106 08/01/08 SNL EGIS ORG. 4131 DHelfrich dh080106.aml

411500

1452500

BH-6
BH-7
BH-8
DP6
DP1
BH-5
BH-14
E+05
DP5
2.41E+05 (3.19E+05)
BH-9
BH-15
BH-4
BH-10
DP4
E+04
DP3
BH-11
BH-12
5.15E+03
BH-3
BH-13
BH-2
DP2
1.7E+03
E+03
BH-1

411500

Legend

DP3
5.15E+03
2008 Tritium Sampling Location and Result (pCi/L) at 50-ft. depth (duplicate)

BH-1
1995 Tritium Sampling Location

Toe of Landfill Subgrade

Trench & Pit location, former MWL Boundary

Edge of unpaved Road

E+04
Tritium Concentration Isopleth (pCi/L), dashed where inferred

Figure 6-5
2008 Tritium Soil Sample Concentration Isopleths at the 50-Foot Depth at the Mixed Waste Landfill

0 60 120
Scale in Feet

0 14 28
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04330000 B9

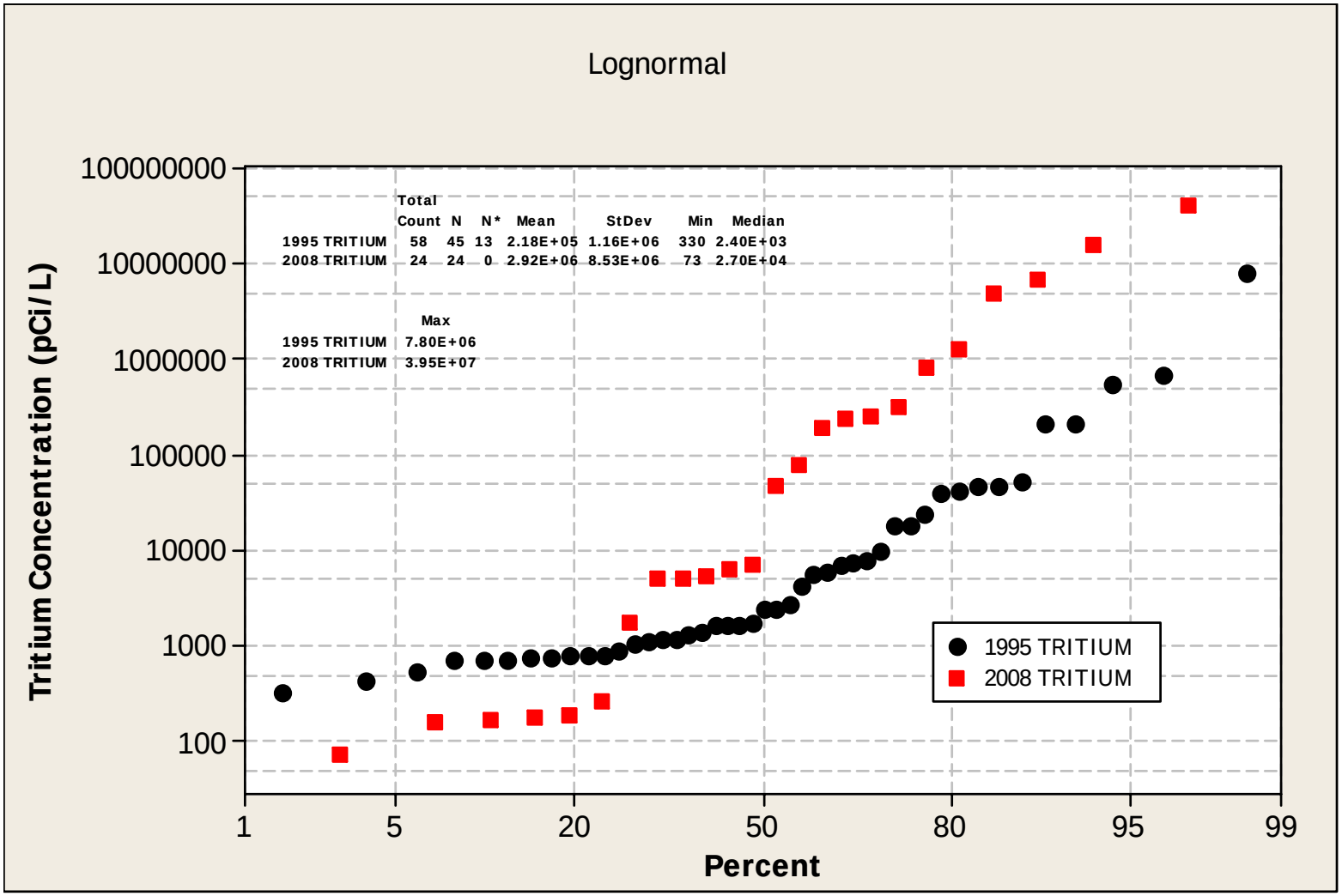


Figure 6-6
Comparison of 1997 and 2008 Tritium Soil Sample
Analytical Results for 10-, 30-, and 50-Foot-Depth Samples at the Mixed Waste Landfill

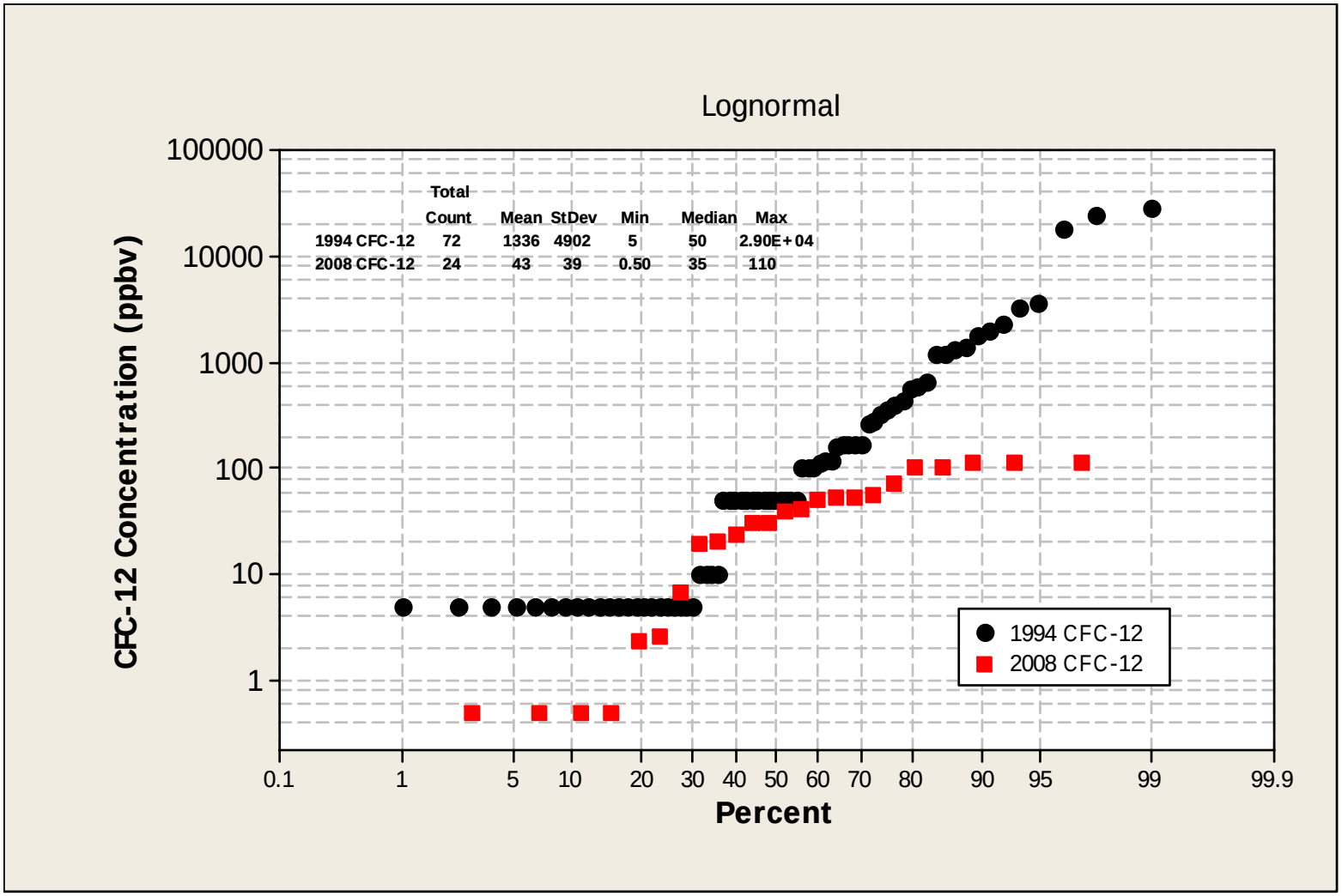


Figure 6-7
Comparison of 1994 and 2008 CFC-12 Soil-Vapor Sample Analytical Results at the Mixed Waste Landfill

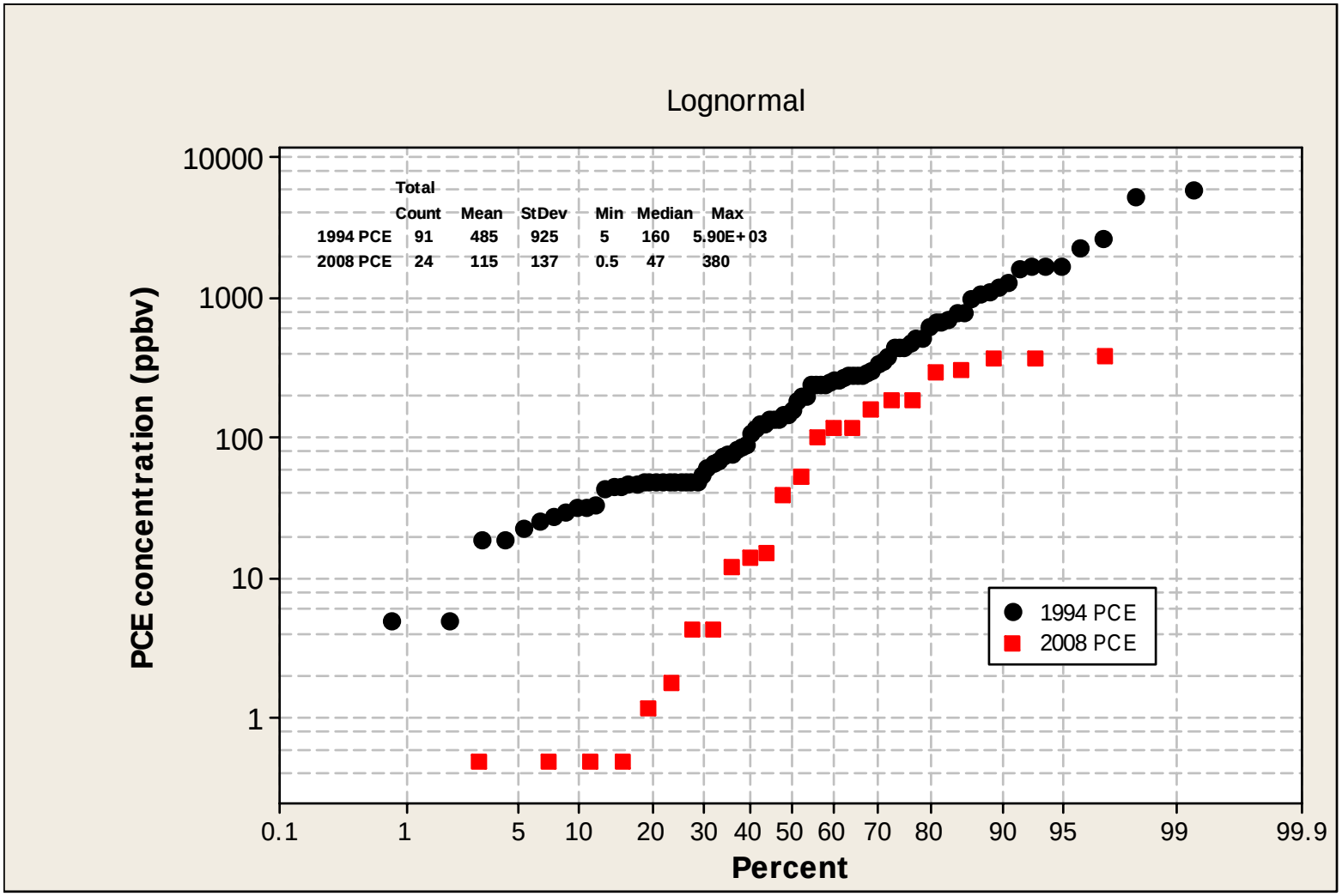


Figure 6-8
Comparison of 1994 and 2008 PCE Soil-Vapor Sample Analytical Results at the Mixed Waste Landfill

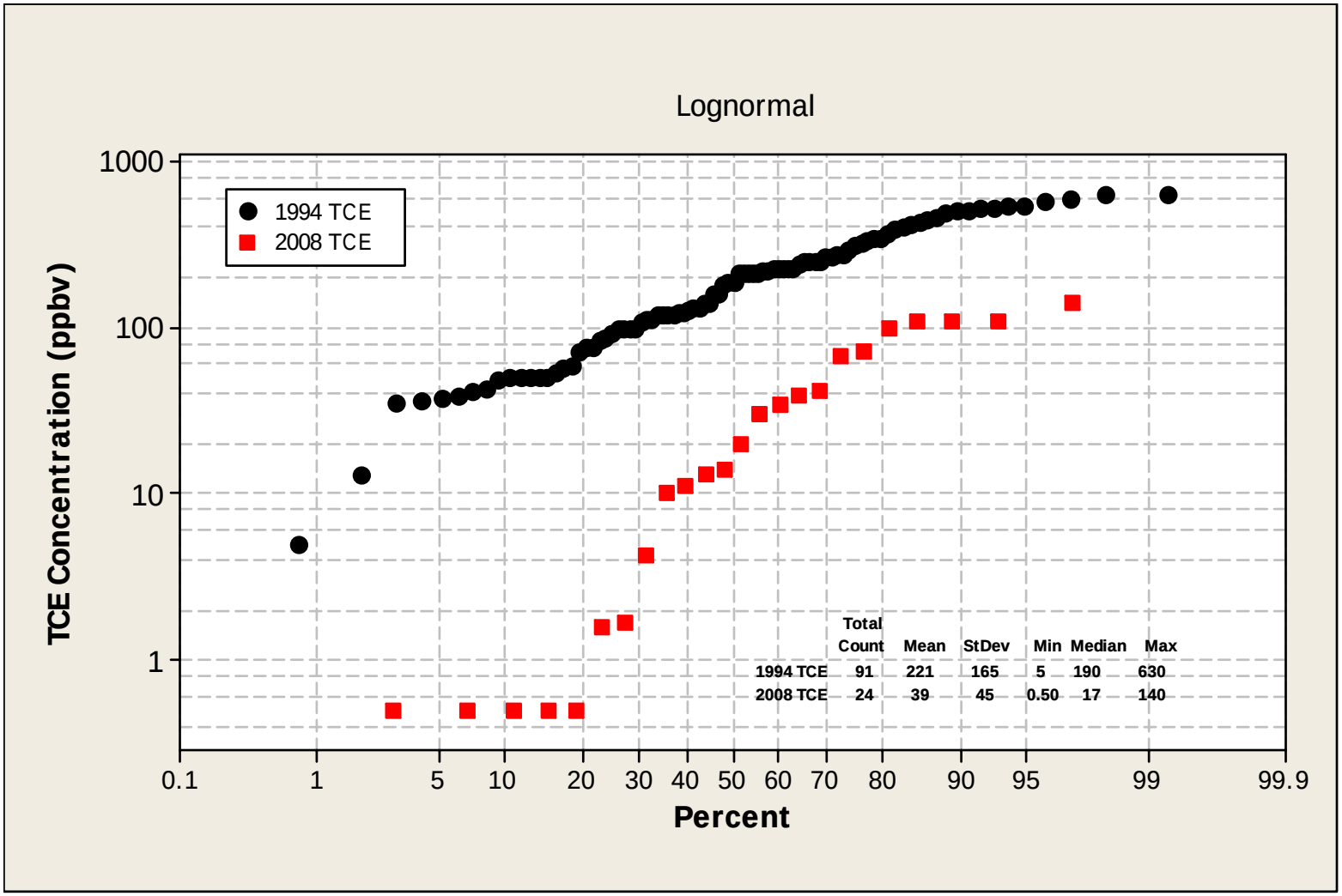


Figure 6-9
Comparison of 1994 and 2008 TCE Soil-Vapor Sample Analytical Results at the Mixed Waste Landfill

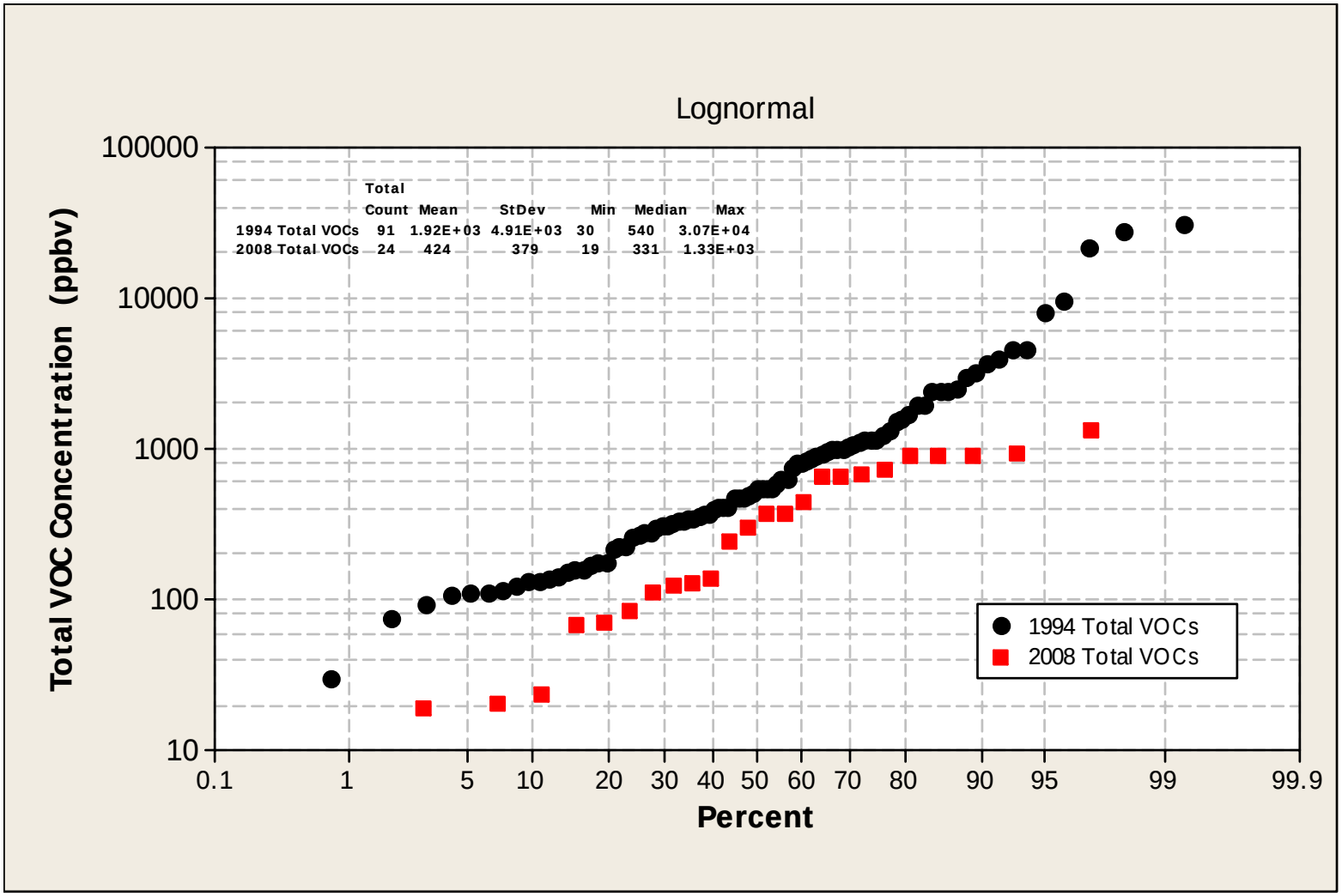


Figure 6-10
Comparison of 1994 and 2008 Total VOC Soil-Vapor Sample Analytical Results at the Mixed Waste Landfill

TABLES

Table 4-1
Summary of 2008 Radon Sample IDs and Locations at the Mixed Waste Landfill

Sampling Location (Figure 4-1)	Sample Description	Sample ID
RN1	Surface of the MWL	MWL-RN1
RN2	Surface of the MWL	MWL-RN2
RN3	Surface of the MWL	MWL-RN3
RN4	Surface of the MWL	MWL-RN4
RN5	Surface of the MWL	MWL-RN5
RN6	Surface of the MWL	MWL-RN6
RN7	Surface of the MWL	MWL-RN7
RN8	Surface of the MWL	MWL-RN8
RN9	Surface of the MWL	MWL-RN9
RN10	Background surface location, southeast of the MWL	MWL-RN10
RN11	Background surface location, northeast of the MWL	MWL-RN11
RN12	Background surface location, northwest of the MWL	MWL-RN12

ID = Identification number.
MWL = Mixed Waste Landfill.
RN = Radon.

Table 4-2
Summary of 2008 Soil-Vapor VOC and Tritium Soil Sample IDs and Sample Depths at the Mixed Waste Landfill

Sampling Location (Figure 4-1)	Boring Location	Borehole ID	Soil-Vapor VOC Sample ID	Soil Tritium Sample ID	Sample Depths (ft) (below original landfill surface)	Soil-Vapor VOC Duplicate Sample ID	Soil Tritium Duplicate Sample ID
DP1	MWL	MWL-DP1	MWL-DP1-10-SG MWL-DP1-30-SG	MWL-DP1-10-S MWL-DP1-30-S	10 30	NA	NA
DP2	MWL	MWL-DP2	MWL-DP2-10-SG MWL-DP2-30-SG MWL-DP2-50-SG	MWL-DP2-10-S MWL-DP2-30-S MWL-DP2-50-S	10 30 50	NA	NA
DP3	MWL	MWL-DP3	MWL-DP3-10-SG MWL-DP3-30-SG MWL-DP3-50-SG	MWL-DP3-10-S MWL-DP3-30-S MWL-DP3-50-S	10 30 50	NA	NA
DP4	MWL	MWL-DP4	MWL-DP4-10-SG MWL-DP4-30-SG	MWL-DP4-10-S MWL-DP4-30-S	10 30	NA	NA
DP5	MWL	MWL-DP5	MWL-DP5-10-SG MWL-DP5-30-SG MWL-DP5-50-SG	MWL-DP5-10-S MWL-DP5-30-S MWL-DP5-50-S	10 30 50	MWL-DP5-10-SG-DUP MWL-DP5-30-SG-DUP MWL-DP5-50-SG-DUP	MWL-DP5-10-S-DUP MWL-DP5-30-S-DUP MWL-DP5-50-S-DUP
DP6	MWL	MWL-DP6	MWL-DP6-10-SG MWL-DP6-30-SG	MWL-DP6-10-S MWL-DP6-30-S	10 30	MWL-DP6-10-SG-DUP MWL-DP6-30-SG-DUP	MWL-DP6-10-S-DUP MWL-DP6-30-S-DUP
DP7	Approximately 525 ft southwest of the MWL	MWL-DP7	MWL-DP7-10-SG MWL-DP7-30-SG	MWL-DP7-10-S MWL-DP7-30-S	10 30	NA	NA
DP8	Approximately 665 ft southwest of the MWL	MWL-DP8	MWL-DP8-10-SG MWL-DP8-30-SG	MWL-DP8-10-S MWL-DP8-30-S	10 30	NA	NA
Equipment Blank	NA	NA	NA	MWL-EB1, -EB2, etc.	NA	NA	NA

DP = Direct-push.
DUP = Duplicate.
EB = Equipment blank.
ft = Foot (feet).
ID = Identification number.
MWL = Mixed Waste Landfill.
NA = Not applicable.
S = Soil.
SG = Soil-gas.
VOC = Volatile organic compound.

Table 5-1
Summary of 1997 and 2008 Radon Sampling Results at the Mixed Waste Landfill

Location ID (Figure 5-1)	Flux pCi/m^2s	Flux Error pCi/m^2s	LLD pCi/m^2s
September–October 1997 MWL Samples			
1	0.413	0.17	0.26
2	0.33	0.15	0.22
3	0.44	0.17	0.25
4	0.30	0.27	0.43
5	0.68	0.18	0.26
6	0.58	0.28	0.43
7	0.55	0.28	0.43
8	0.15	0.16	0.25
9	0.28	0.16	0.25
10	0.44	0.15	0.22
11	0.43	0.17	0.25
12	0.061	0.16	0.26
13	0.63	0.29	0.43
14	0.095	0.15	0.24
15	0.52	0.28	0.43
16	0.35	0.17	0.26
17	0.16	0.16	0.26
18	0.099	0.16	0.25
19	0.30	0.16	0.25
20	0.30	0.28	0.44
21	0.23	0.17	0.26
22	0.39	0.16	0.25
23	0.45	0.17	0.26
24	0.18	0.16	0.26
25	0.19	0.14	0.22
26	0.26	0.16	0.25
27	0.33	0.15	0.22
28	0.33	0.16	0.24
29	0.026	0.16	0.26
30	0.20	0.16	0.26
31	0.61	0.28	0.43
32	0.58	0.17	0.25
33	0.18	0.16	0.26
34	0.18	0.16	0.26
35	0.19	0.16	0.26
36	0.25	0.16	0.25
37	0.38	0.17	0.25
38	0.29	0.16	0.24
39	0.19	0.17	0.26
40	0.12	0.16	0.26
41	0.41	0.17	0.26
42	0.60	0.17	0.25
43	0.19	0.16	0.16

Refer to footnotes at end of table.

Table 5-1 (Continued)
Summary of 1997 and 2008 Radon Sampling Results at the Mixed Waste Landfill

Location ID (Figure 5-1)	Flux pCi/m^2s	Flux Error pCi/m^2s	LLD pCi/m^2s
September–October 1997 MWL Samples (Continued)			
44	0.72	0.29	0.29
45	0.15	0.16	0.26
46	0.33	0.16	0.24
47	0.57	0.15	0.22
48	0.43	0.15	0.22
49	0.12	0.16	0.26
50	0.22	0.17	0.26
51	0.61	0.18	0.26
52	0.34	0.17	0.25
53	0.48	0.17	0.25
54	0.26	0.14	0.22
55	0.22	0.16	0.25
56	0.60	0.18	0.26
57	0.61	0.17	0.25
58	0.21	0.15	0.24
59	0.29	0.14	0.22
60	0.035	0.13	0.22
61	0.55	0.18	0.26
62	0.48	0.16	0.24
63	0.069	0.14	0.22
64	1.0	0.19	0.25
65	0.078	0.15	0.25
66	0.63	0.18	0.26
67	0.56	0.17	0.25
68	0.48	0.18	0.26
69	0.46	0.15	0.22
70	0.34	0.27	0.43
71	0.16	0.16	0.26
September–October 1997 Background Samples			
A	0.16	0.16	0.25
B	0.25	0.17	0.26
C	0.29	0.16	0.25
D	0.35	0.17	0.26
E	0.54	0.18	0.26
F	0.55	0.18	0.26
G	0.45	0.17	0.26
H	0.26	0.17	0.26
I	0.44	0.17	0.26
J	0.45	0.17	0.25
K	0.19	0.15	0.26
L	0.34	0.17	0.26
M	0.63	0.17	0.24
N	0.35	0.17	0.25

Refer to footnotes at end of table.

Table 5-1 (Concluded)
Summary of 1997 and 2008 Radon Sampling Results at the Mixed Waste Landfill

Location ID (Figure 5-1)	Flux pCi/m^2s	Flux Error pCi/m^2s	LLD pCi/m^2s
September–October 1997 Background Samples (Continued)			
O	0.46	0.18	0.26
P	0.66	0.29	0.43
Q	0.28	0.15	0.22
R	0.30	0.16	0.24
April 2008 MWL Samples			
RN1	0.35	0.04	0.1
RN1 DUP	0.36	0.04	0.1
RN2	0.43	0.04	0.1
RN3	0.21	0.04	0.1
RN3 DUP	0.30	0.04	0.1
RN3 DUP	0.25	0.04	0.1
RN4	0.30	0.04	0.1
RN5	0.33	0.04	0.1
RN6	0.32	0.04	0.1
RN7	0.51	0.04	0.1
RN8	0.28	0.04	0.1
RN8 DUP	0.28	0.04	0.1
RN9	0.34	0.04	0.1
April 2008 Background Samples			
RN10	0.65	0.04	0.1
RN11	0.56	0.04	0.1
RN12	0.58	0.04	0.1

DUP = Duplicate.
ID = Identification number.
LLD = Lower limit of detection.
MWL = Mixed Waste Landfill.
pCi/m^2s = Picocuries per meter squared per second.

Table 5-2
Summary of 1995 and 2008 Tritium Soil Sampling Results at the Mixed Waste Landfill

Sample Attributes			Tritium Activity (EPA Method 906.0[a]) (pCi/L)	
Record Number[b]	ER Sample ID	True Sample Depth (ft)[c]	Result	Error[d]
1995 Samples				
3381	BH-1-10	9	**700**	220
3387	BH-2-10	9	**790**	230
3174	BH-3-10	9	**1.72E+03**	370
3198	BH-4-10	9	**1.65E+03**	350
3226	BH-5-10	9	**4.28E+03**	490
3425	BH-6-10	9	**2.43E+03**	330
3445	BH-7-10	9	**2.65E+03**	440
3438	BH-8-10	9	**9.53E+03**	760
3449	BH-9-10	9	**2.35E+04**	1.30E+03
3449	BH-10-10	9	**4.74E+04**	2.10E+03
3456	BH-11-10	9	**7.00E+03**	560
3441	BH-12-10	9	**6.70E+05**	2.40E+04
3432	BH-13-10	9	**1.16E+03**	290
3465	BH-14-10	10	**1.68E+03**	340
3465	BH-15-10	10	**4.03E+04**	2.00E+03
3381	BH-1-30	26	**790**	400
3213	BH-1-30-DUP	26	**900**	240
3387	BH-2-30	26	ND (89)	160
3174	BH-3-30	26	ND (180)	380
3198	BH-4-30	26	**780**	520
3198	BH-4-30-DUP	26	**1.10E+03**	530
3226	BH-5-30	26	ND (100)	260
3425	BH-6-30	26	**5.89E+03**	530
3425	BH-6-30-DUP	26	**5.64E+03**	520
3445	BH-7-30	26	ND (130)	200
3445	BH-7-30-DUP	26	ND (130)	260
3438	BH-8-30	26	**7.40E+03**	660
3438	BH-8-30-DUP	26	**8.05E+03**	580
3449	BH-9-30	26	**4.68E+04**	2.20E+03
3449	BH-9-30-DUP	26	**4.30E+04**	2.00E+03
3449	BH-10-30	26	**5.46E+05**	2.00E+04
3456	BH-11-30	26	**1.15E+03**	430
3456	BH-11-30-DUP	26	**1.31E+03**	450
3459	BH-12-30	26	**7.80E+06**	2.80E+05
3432	BH-13-30	26	ND (110)	170
3432	BH-13-30-DUP	26	**710**	250
3465	BH-14-30	30	**730**	260
3465	BH-14-30-DUP	30	**710**	260
3465	BH-15-30	30	**2.40E+03**	380
3465	BH-15-30-DUP	30	**1.60E+03**	410
3213	BH-1-50	43	ND (92)	170
3387	BH-2-50	43	ND (89)	150
Tritium Background Soil Concentration at SNL/NM[e]			420	NA

Refer to footnotes at end of table.

Table 5-2 (Continued)
Summary of 1995 and 2008 Tritium Soil Sampling Results at the Mixed Waste Landfill

Sample Attributes			Tritium Activity (EPA Method 906.0[a]) (pCi/L)	
Record Number[b]	ER Sample ID	True Sample Depth (ft)[c]	Result	Error[d]
1995 Samples (Continued)				
3177	BH-3-50	43	ND (190)	420
3198	BH-4-50	43	ND (130)	230
3226	BH-5-50	43	ND (130)	310
3226	BH-5-50-DUP	43	**430**	230
3425	BH-6-50	43	ND (130)	250
3445	BH-7-50	43	ND (140)	340
3438	BH-8-50	43	**530**	220
3449	BH-9-50	43	**1.86E+04**	1.10E+03
3449	BH-10-50	43	**1.81E+04**	1.10E+03
3449	BH-10-50-DUP	43	**5.13E+04**	2.40E+03
3456	BH-11-50	43	**1.06E+03**	360
3459	BH-12-50	43	**2.11E+05**	8.00E+03
3459	BH-12-50-DUP	43	**2.15E+05**	8.20E+03
3432	BH-13-50	43	330	220
3465	BH-14-50	50	**1.38E+03**	320
3465	BH-15-50	50	**750**	290
2008 Samples				
611879	DP1-10-S	10	**7.54E+04**	1.04E+04
611873	DP2-10-S	10	**4.71E+04**	6.64E+03
611872	DP3-10-S	10	**1.89E+05**	2.60E+04
611875	DP4-10-S	10	**2.50E+05**	3.44E+04
611868	DP5-10-S	10	**3.95E+07 J**	5.44E+06
611868	DP5-10-S-DUP	10	**1.57E+07 J**	2.16E+06
611877	DP6-10-S	10	**6.82E+03**	1.00E+03
611877	DP6-10-S-DUP	10	**6.11E+03**	906
611813	DP7-10-S	10	156 J	94.4
611813	DP8-10-S	10	ND (64)	85.1
611879	DP1-30-S	30	**1.27E+06**	1.75E+05
611873	DP2-30-S	30	**4.91E+03**	903
611872	DP3-30-S	30	**8.21E+05**	1.13E+05
611875	DP4-30-S	30	**5.32E+03**	956
611868	DP5-30-S	30	**4.80E+06 J**	6.62E+05
611868	DP5-30-S-DUP	30	**6.82E+06 J**	9.39E+05
611877	DP6-30-S	30	165 J	94.2
611877	DP6-30-S-DUP	30	189 J	96.7
611813	DP7-30-S	30	180 J	97.8
611813	DP8-30-S	30	260 J	109
611873	DP2-50-S	50	**1.70E+03**	496
611872	DP3-50-S	50	**5.15E+03**	780
611868	DP5-50-S	50	**2.41E+05 J**	3.32E+04
611868	DP5-50-S-DUP	50	**3.19E+05 J**	4.40E+04
Tritium Background Soil Concentration at SNL/NM[e]			420	NA

Refer to footnotes at end of table.

Table 5-2 (Concluded)
Summary of 1995 and 2008 Tritium Soil Sampling Results at the Mixed Waste Landfill

Sample Attributes			Tritium Activity (EPA Method 906.0[a]) (pCi/L)	
Record Number[b]	ER Sample ID	True Sample Depth (ft)[c]	Result	Error[d]
2008 Quality Assurance/Quality Control Samples (pCi/L)				
611813	EB1	NA	ND (67)	77.4
611868	EB2	NA	ND (75.2)	86.7
611868	EB3	NA	ND (75.6)	89.3
611872	EB4	NA	ND (90.4)	104
611872	EB5	NA	ND (58.4)	75.3
611873	EB6	NA	ND (88.6)	104
611873	EB7	NA	ND (87.9)	105
611873	EB8	NA	ND (89.3)	105
611875	EB9	NA	ND (82.1)	95.8
611877	EB10	NA	ND (72.1)	89.7
611877	EB11	NA	ND (85.9)	105
611879	EB12	NA	ND (79.6)	90.4
611879	EB13	NA	ND (80.3)	84.6

Note: Values in **bold** exceed SNL/NM background tritium concentration.
[a]EPA August 1980.
[b]Analysis Request/Chain-of-Custody record.
[c]1995 Boreholes BH-1 through BH-13 were drilled at an angle of 30 degrees from vertical, and BH-14 and BH-15 were drilled vertically. All 2008 boreholes were drilled vertically. Sample depths reported in this table are true depths below the original MWL surface grade.
[d]Two standard deviations about the mean detected activity.
[e]Tharp February 1999.
BH = Borehole.
DP = Direct-push.
DUP = Duplicate.
EB = Equipment blank.
EPA = U.S Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification number.
J = Estimated concentration. See data validation report (Appendix C).
MDL = Method detection limit.
MWL = Mixed Waste Landfill.
NA = Not applicable.
ND = Not detected above the MDL, shown in parentheses.
pCi/L = Picocuries per liter.
S = Soil.
SNL/NM = Sandia National Laboratories/New Mexico.

Table 5-3
Summary of 2008 Tritium Soil Sample Concentration Ranges at the Mixed Waste Landfill

Depth (ft bgs)[a]	Tritium Concentration Range (pCi/L)	Location with the Maximum Concentration	Depth Interval Mean
MWL Boreholes DP1–DP6			
10 ft	6.11E+03–3.95E+07 J	DP5	6.97E+06
30 ft	165 J–6.82E+06 J	DP5	1.72E+06
50 ft	1.70E+03–3.19E+05 J	DP5	1.42E+05
Background Boreholes DP7 and DP8			
10 ft	ND–156 J	DP7	94
30 ft	180 J–260 J	DP8	220

Note: For mean calculations, ND values set at a tritium concentration of one-half of the MDA.
[a]Depth below the original MWL surface grade.
bgs = Below ground surface.
DP = Direct-push.
ft = Foot (feet).
J = Estimated concentration. See data validation report (Appendix C).
MDA = Minimum detectable activity.
MWL = Mixed Waste Landfill.
ND = Not detected.
pCi/L = Picocuries per liter.

Table 5-4
Summary of 2008 Tritium Soil Sample RPD Values for
Primary and Duplicate Samples at the Mixed Waste Landfill

Record Number[a]	ER Sample ID (Primary/Duplicate Samples)	Sample Depth (ft bgs)[b]	Primary Sample Tritium Concentration (pCi/L)	Duplicate Sample Tritium Concentration (pCi/L)	RPD[c]
611868	DP5-10-S / DP5-10-S-DUP	10	3.95E+07 J	1.57E+07 J	**86.23**
611868	DP5-30-S / DP5-30-S-DUP	30	4.80E+06 J	6.82E+06 J	**34.77**
611868	DP5-50-S / DP5-50-S-DUP	50	2.41E+05 J	3.19E+05 J	**27.86**
611877	DP6-10-S / DP6-10-S-DUP	10	6.82E+03	6.11E+03	**10.98**
611877	DP6-30-S / DP6-30-S-DUP	30	165 J	189 J	**13.56**

[a]Analysis Request/Chain-of-Custody record.
[b]Depth below the original MWL surface grade.
[c]RPD calculated as follows: $[(X_1 - X_2)/((X_1 + X_2)/2)] \times 100$ where X_1 and X_2 are the tritium concentrations in the primary and duplicate soil samples, respectively.

bgs = Below ground surface.
DP = Direct-push.
DUP = Duplicate.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification number.
J = Estimated concentration. See data validation report (Appendix C).
MWL = Mixed Waste Landfill.
pCi/L = Picocuries per liter.
RPD = Relative percent difference.
S = Soil.

Table 5-5
Summary of 1994 and 2008 Soil-Vapor Sample VOC Analytical Results for 10-Foot-Depth Samples at the Mixed Waste Landfill

Sample Attributes			VOCs (ppbv)			
Record Number[a]	ER Sample ID	Sample Depth (ft)	Dichloro-difluoromethane (CFC-12)	Tetrachloroethene (PCE)	Trichloroethene (TCE)	Total VOCs
1994 Round 1 samples (analyzed by an SNL/NM on-site laboratory with a GC/MS instrument)						
Unk	MWL-0N,10W (Rnd. 1, Pt. 1)	10	NA	251 Est	131	412
Unk	MWL-50S,10W (Rnd. 1, Pt. 2)	10	NA	521 Est	210	754
Unk	MWL-100S,10W (Rnd 1, Pt. 3)	10	NA	1.08E+03 Est	310 Est	1.51E+03
Unk	MWL-150S,10W (Rnd. 1, Pt. 4)	10	NA	627 Est	279 Est	1.17E+03
Unk	MWL-175S,10W (Rnd. 1, Pt. 5)	10	NA	339 Est	185	596
Unk	MWL-200S,10W (Rnd. 1, Pt. 6)	10	NA	186	114	358
Unk	MWL-10N,50E (Rnd. 1, Pt. 7)	10	NA	247 Est	124	371
Unk	MWL-10N,100E (Rnd 1, Pt. 8)	10	NA	205	123	340
Unk	MWL-10N,150E (Rnd. 1, Pt. 9)	10	NA	279 Est	210	541
Unk	MWL-10N,200E (Rnd. 1, Pt. 10)	10	NA	130	126	275
Unk	MWL-10N,250E (Rnd. 1, Pt. 11)	10	NA	87	86	173
Unk	MWL-10N,300E (Rnd. 1, Pt. 12)	10	NA	45	53	282
Unk	MWL-50S,310E (Rnd. 1, Pt. 13)	10	NA	30	72	115
Unk	MWL-100S,310E (Rnd. 1, Pt. 14)	10	NA	48	113	177
Unk	MWL-150S,310E (Rnd. 1, Pt. 15)	10	NA	33	93	135
Unk	MWL-200S,310E (Rnd. 1, Pt. 16)	10	NA	34	84	142
Unk	MWL-225S,300E (Rnd. 1, Pt. 17)	10	NA	32	76	125
Unk	MWL-225S,250E (Rnd. 1, Pt. 18)	10	NA	56	435 Est	542
Unk	MWL-225S,207E (Rnd. 1, Pt. 19)	10	NA	69	220	477
Soil-Vapor Trigger Levels[c]			NA	2.00E+04	2.00E+04	2.50E+04

Refer to footnotes at end of table.

Table 5-5 (Continued)
Summary of 1994 and 2008 Soil-Vapor Sample VOC Analytical Results for 10-Foot-Depth Samples at the Mixed Waste Landfill

Sample Attributes			VOCs (ppbv)			
Record Number[a]	ER Sample ID	Sample Depth (ft)	Dichloro-difluoromethane (CFC-12)	Tetrachloroethene (PCE)	Trichloroethene (TCE)	Total VOCs
1994 Round 2 (analyzed by an off-site commercial laboratory using EPA Method TO-14)						
622	MWL-60W/85S (Rnd. 2, Pt. 1)	10	ND (100)	110	ND (100)	110
622	MWL-60W/125S (Rnd. 2, Pt. 2)	10	ND (100)	160	ND (100)	160
622	MWL-60W/175S (Rnd. 2, Pt. 3)	10	ND (10)	77	51	298
622	MWL-60W/175S-D (Rnd. 2, Pt. 3 DUP)	10	ND (10)	91	58	179
622	MWL-10W/250S (Rnd. 2, Pt. 4)	10	ND (10)	62	39	158
622	MWL-125E/50S (Rnd. 2, Pt. 5)	10	ND (100)	240	100	340
622	MWL-125E/100S (Rnd. 2, Pt. 6)	10	170	240	ND (100)	410
622	MWL-125E/150S (Rnd. 2, Pt. 7)	10	400	310	100	810
622	MWL-125E/200S (Rnd. 2, Pt. 8)	10	320	200	110	630
622	MWL-75E/200S (Rnd. 2, Pt. 9)	10	1.80E+03 Sec	380	180	2.46E+03
622	MWL-75E/150S (Rnd. 2, Pt. 10)	10	2.90E+04 Est	1.70E+03	ND (1.00E+03)	**3.07E+04**
622	MWL-75E/100S (Rnd. 2, Pt. 11)	10	2.00E+03	5.20E+03 Sec	540	8.02E+03
622	MWL-75E/50S (Rnd. 2, Pt. 12)	10	ND (200)	1.70E+03	290	1.99E+03
1994 Round 3 (analyzed by an off-site commercial laboratory using EPA Method TO-14)						
919	MWL-300S/10W (Rnd. 3, Pt. 1)	10	ND (10)	130 Est	140 Est	326
919	MWL-350S/10W (Rnd. 3, Pt. 2)	10	ND (10)	44	36	111
919	MWL-400S/10W (Rnd. 3, Pt. 3)	10	ND (10)	ND (10)	ND (10)	30
919	MWL-BL/440S (Rnd. 3, Pt. 4)	10	ND (10)	ND (10)	13	74
919	MWL-50E/440S (Rnd. 3, Pt. 5)	10	ND (10)	26	35	225
919	MWL-100E/440S (Rnd. 3, Pt. 6)	10	ND (10)	19	42	153
919	MWL-150E/440S (Rnd. 3, Pt. 7)	10	ND (10)	23	43	131
919	MWL-200E/440S (Rnd. 3, Pt. 8)	10	ND (10)	28	49	92
1046	MWL-400S/210E (Rnd. 3, Pt. 9)	10	ND (10)	83	98	335
1046	MWL-350S/210E (Rnd. 3. Pt. 10)	10	ND (20)	260 Est	120	479
1046	MWL-300S/225E (Rnd. 3, Pt. 11)	10	ND (100)	ND (100)	120	310
919	MWL-250S/225E (Rnd. 3, Pt. 12)	10	ND (10)	76	230 Est	476
Soil-Vapor Trigger Levels[c]			NA	2.00E+04	2.00E+04	2.50E+04

Refer to footnotes at end of table.

Table 5-5 (Continued)
Summary of 1994 and 2008 Soil-Vapor Sample VOC Analytical Results for 10-Foot-Depth Samples at the Mixed Waste Landfill

Sample Attributes			VOCs (ppbv)			
Record Number[a]	ER Sample ID	Sample Depth (ft)	Dichloro-difluoromethane (CFC-12)	Tetrachloroethene (PCE)	Trichloroethene (TCE)	Total VOCs
2008 Soil-Vapor Data (analyzed by an off-site commercial laboratory using EPA Method TO-14A[b])						
611880	MWL-DP1-10-SG	10	39	15	14	240
611874	MWL-DP2-10-SG	10	20	12	11	123
611871	MWL-DP3-10-SG	10	55	53	39	658
611876	MWL-DP4-10-SG	10	70	120	34	446
611870	MWL-DP5-10-SG	10	40	160	10	366
611870	MWL-DP5-10-SG-DUP	10	24	380	20	736
611878	MWL-DP6-10-SG	10	31	1.2 J (2)	4.2	111
611878	MWL-DP6-10-SG-DUP	10	30	190	42	373
611812	MWL-DP7-10-SG	10	ND (1)	ND (1)	ND (1)	23
611812	MWL-DP8-10-SG	10	ND (1)	ND (1)	ND (1)	19
Soil-Vapor Trigger Levels[c]			NA	2.00E+04	2.00E+04	2.50E+04

Note: Values in **bold** exceed soil-vapor trigger level.
[a]Analysis request/chain-of-custody record.
[b]EPA January 1999.
[c]Soil vapor trigger levels for PCE, TCE, and total VOCs at the MWL presented in Section 5.2.3.1 of the Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill (SNL/NM September 2007a).
CFC-12 = Dichlorodifluoromethane.
DP = Direct-push.
DUP = Duplicate.
E = East.
Est = Estimated concentration greater than the upper limit of quantitation (1994 samples).
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GC/MS = Gas chromatograph/mass spectrometer.
J = Estimated value between the MDL and PQL, shown in parentheses.
ID = Identification number.
MDL = Method detection limit.
MWL = Mixed Waste Landfill.
N = North.
NA = Not applicable.

Table 5-5 (Concluded)
Summary of 1994 and 2008 Soil-Vapor Sample VOC Analytical Results for 10-Foot-Depth Samples at the Mixed Waste Landfill

ND = Not detected above the MDL, shown in parentheses.
PCE = Tetrachloroethene.
PQL = Practical quantitation limit.
Pt. = Point.
ppbv = Parts per billion by volume.
Rnd. = Round.
S = South.
Sec = Results due to (secondary) dilution (1994 samples).
SG = Soil-gas.
SNL/NM = Sandia National Laboratories/New Mexico.
TCE = Trichloroethene.
Unk = Unknown.
VOC = Volatile organic compound.
W = West.

Table 5-6
Summary of 1994 and 2008 Soil-Vapor Sample VOC Analytical Results for 30-Foot-Depth Samples at the Mixed Waste Landfill

Sample Attributes			VOCs (EPA Method TO-14 [1994 samples] and TO-14A[a] [2008 samples]) (ppbv)			
Record Number[b]	ER Sample ID	Sample Depth (ft)	Dichlorodifluoromethane (CFC-12)	Tetrachloroethene (PCE)	Trichloroethene (TCE)	Total VOCs
1994 Round 1 Samples						
498	MWL-0N,10W (Rnd. 1, Pt. 1)	30	110	450	230	980
498	MWL-50S,10W (Rnd. 1, Pt. 2)	30	440	1.20E+03	450	2.51E+03
498	MWL-100S,10W (Rnd 1, Pt. 3)	30	1.30E+03	1.70E+03	530	3.96E+03
498	MWL-150S,10W (Rnd. 1, Pt. 4)	30	2.30E+03	1.30E+03	490	4.51E+03
498	MWL-175S,10W (Rnd. 1, Pt. 5)	26	640	240	120	1.00E+03
498	MWL-200S,10W (Rnd. 1, Pt. 6)	26	1.20E+03	670	330	2.42E+03
498	MWL-10N,50E (Rnd. 1, Pt. 7)	30	160	1.00E+03	460	1.93E+03
498	MWL-10N,100E (Rnd 1, Pt. 8)	30	120	800	400	1.61E+03
498	MWL-10N,150E (Rnd. 1, Pt. 9)	30	ND (100)	480	350	1.14E+03
498	MWL-10N,150E-D (Rnd. 1, Pt. 9 DUP)	30	100	450	320	1.14E+03
498	MWL-10N,200E (Rnd. 1, Pt. 10)	30	ND (100)	280	250	810
498	MWL-10N,250E (Rnd. 1, Pt. 11)	30	ND (100)	150	160	490
498	MWL-10N,300E (Rnd. 1, Pt. 12)	30	ND (100)	ND (100)	120	260
498	MWL-50S,310E (Rnd. 1, Pt. 13)	27	ND (100)	ND (100)	140	140
498	MWL-100S,310E (Rnd. 1, Pt. 14)	28	ND (100)	ND (100)	240	370
498	MWL-150S,310E (Rnd. 1, Pt. 15)	30	ND (100)	ND (100)	250	540
498	MWL-200S,310E (Rnd. 1, Pt. 16)	28	ND (100)	ND (100)	210	310
498	MWL-225S,300E (Rnd. 1, Pt. 17)	30	ND (100)	ND (100)	230	330
498	MWL-225S,250E (Rnd. 1, Pt. 18)	30	120	150	630	1.31E+03
498	MWL-225S,207E (Rnd. 1, Pt. 19)	30	280	260	630	2.40E+03
1994 Round 2 Samples						
622	MWL-60W/85S (Rnd. 2, Pt. 1)	30	170	450	230	1.01E+03
622	MWL-60W/125S (Rnd. 2, Pt. 2)	30	170	360	190	830
622	MWL-60W/175S (Rnd. 2, Pt. 3)	28.5	260	280	210	880
622	MWL-10W/250S (Rnd. 2, Pt. 4)	30	360	270	230	1.01E+03
622	MWL-125E/50S (Rnd. 2, Pt. 5)	30	170	520	270	1.13E+03
622	MWL-125E/100S (Rnd. 2, Pt. 6)	30	550	720	280	1.69E+03
622	MWL-125E/150S (Rnd. 2, Pt. 7)	30	1.40E+03 Sec	1.10E+03	540	3.71E+03
622	MWL-125E/200S (Rnd. 2, Pt. 8)	30	1.20E+03	790	520	3.21E+03
622	MWL-75E/200S (Rnd 2, Pt. 9)	25	3.20E+03 Sec	690	370	4.63E+03
Soil-Vapor Trigger Levels[c]			NA	2.00E+04	2.00E+04	2.50E+04

Refer to footnotes at end of table.

Table 5-6 (Continued)
Summary of 1994 and 2008 Soil-Vapor Sample VOC Analytical Results for 30-Foot-Depth Samples at the Mixed Waste Landfill

Sample Attributes			VOCs (EPA Method TO-14 [1994 samples] and TO-14A[a] [2008 samples]) (ppbv)			
Record Number[b]	ER Sample ID	Sample Depth (ft)	Dichlorodifluoromethane (CFC-12)	Tetrachloroethene (PCE)	Trichloroethene (TCE)	Total VOCs
1994 Round 2 Samples (Continued)						
622	MWL-75E/200S (Rnd 2, Pt. 10)	30	2.50E+04 Est	2.70E+03	ND (100)	**2.77E+04**
622	MWL-75E/200S (Rnd 2, Pt. 10 DUP)	30	1.80E+04 Sec	2.30E+03	600	2.20E+04
622	MWL-75E/100S (Rnd. 2, Pt. 11)	27	3.60E+03	5.90E+03	ND (1.00E+03)	9.50E+03
622	MWL-75E/50S (Rnd. 2, Pt. 12)	30	600	1.60E+03	570	3.01E+03
1994 Round 3 Samples						
919	MWL-300S/10W (Rnd. 3, Pt. 1)	30	ND (10)	300 Est	350 Est	893
919	MWL-350S/10W (Rnd. 3, Pt. 2)	30	ND (10)	140 Est	220 Est	626
919	MWL-400S/10W (Rnd. 3, Pt. 3)	30	ND (10)	45	77	517
919	MWL-400S/10W-D (Rnd. 3, Pt. 3 DUP)	30	ND (10)	50	60	272
919	MWL-BL/440S (Rnd. 3, Pt. 4)	30	ND (10)	19	38	107
919	MWL-50E/440S (Rnd. 3, Pt. 5)	30	ND (10)	47	99	222
919	MWL-100E/440S (Rnd. 3, Pt. 6)	30	ND (20)	50	130	216
919	MWL-150E/440S (Rnd. 3, Pt. 7)	30	ND (20)	68	160	392
919	MWL-200E/440S (Rnd. 3, Pt. 8)	30	ND (10)	77	210 Est	408
1046	MWL-400S/210E (Rnd. 3, Pt. 9)	30	ND (20)	120	250 Est	555
1046	MWL-350S/210E (Rnd. 3. Pt. 10)	30	ND (10)	280 Est	250 Est	929
1049	MWL-300S/225E (Rnd. 3, Pt. 11)	30	ND (10)	140	270	1.23E+03
919	MWL-250S/225E (Rnd. 3, Pt. 12)	30	ND (100)	140	390	1.03E+03
919	MWL-250S/225E-D (Rnd. 3, Pt. 12 DUP)	30	100	50	420	1.08E+03
2008 Samples						
611880	MWL-DP1-30-SG	30	6.8	1.8 J (2)	ND (1)	20
611874	MWL-DP2-30-SG	30	51	40	30	295
611871	MWL-DP3-30-SG	30	100	100	110	904
611876	MWL-DP4-30-SG	30	110	190	100	893
611870	MWL-DP5-30-SG	30	100	370	68	899
611870	MWL-DP5-30-SG-DUP	30	110	370	71	928
611878	MWL-DP6-30-SG	30	53	310	110	670
611878	MWL-DP6-30-SG-DUP	30	53	300	110	654
611812	MWL-DP7-30-SG	30	ND (1)	ND (1)	ND (1)	137
611812	MWL-DP8-30-SG	30	ND (1)	ND (1)	ND (1)	83
Soil-Vapor Trigger Levels[c]			NA	2.00E+04	2.00E+04	2.50E+04

Table 5-6 (Concluded)
Summary of 1994 and 2008 Soil-Vapor Sample VOC Analytical Results for 30-Foot-Depth Samples at the Mixed Waste Landfill

Note: Values in **bold** exceed soil-vapor trigger level.
[a]EPA January 1999.
[b]Analysis request/chain-of-custody record.
[c]Soil-vapor trigger levels for PCE, TCE, and total VOCs at the MWL presented in Section 5.2.3.1 of the Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill (SNL/NM September 2007a).

CFC-12 = Dichlorodifluoromethane.
DP = Direct-push.
DUP = Duplicate.
E = East.
Est = Estimated concentration greater than the upper limit of quantitation (1994 samples).
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
J = Estimated value between the MDL and PQL, shown in parentheses.
ID = Identification number.
MDL = Method detection limit.
MWL = Mixed Waste Landfill.
N = North.
NA = Not applicable.
ND = Not detected above the MDL, shown in parentheses.
PCE = Tetrachloroethene.
PQL = Practical quantitation limit.
Pt. = Point.
ppbv = Parts per billion by volume.
Rnd. = Round.
S = South.
Sec = Results due to (secondary) dilution (1994 samples).
SG = Soil-gas.
SNL/NM = Sandia National Laboratories/New Mexico.
TCE = Trichloroethene.
VOC = Volatile organic compound.
W = West.

Table 5-7
Summary of 2008 Soil-Vapor Sample VOC Analytical Results for 50-Foot-Depth Samples at the Mixed Waste Landfill

Sample Attributes			VOCs (EPA Method TO-14A[a]) (ppbv)			
Record Number[b]	ER Sample ID	Sample Depth (ft)	Dichlorodifluoromethane (CFC-12)	Tetrachloroethene (PCE)	Trichloroethene (TCE)	Total VOCs
611874	MWL-DP2-50-SG	50	19	14	13	126
611871	MWL-DP3-50-SG	50	110	120	140	1.33E+03
611870	MWL-DP5-50-SG	50	2.3	4.3	1.6 J (2)	67
611870	MWL-DP5-50-SG-DUP	50	2.6	4.4	1.7 J (2)	70
Soil-Vapor Trigger Levels[c]			NA	2.00E+04	2.00E+04	2.50E+04

[a]EPA January 1999.
[b]Analysis request/chain-of-custody record.
[c]Soil-vapor trigger levels for PCE, TCE, and total VOCs at the MWL presented in Section 5.2.3.1 of the Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill (SNL/NM September 2007a).

CFC-12 = Dichlorodifluoromethane.
DP = Direct push.
DUP = Duplicate.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification number.
J = Estimated value between the MDL and PQL, shown in parentheses.
MDL = Method detection limit.
MWL = Mixed Waste Landfill.
NA = Not applicable.
PCE = Tetrachloroethene.
ppbv = Parts per billion by volume.
PQL = Practical quantitation limit.
SG = Soil gas.
TCE = Trichloroethene.
VOC = Volatile organic compounds.

Table 5-8
Summary of 2008 Soil-Vapor Sample Methane Analytical Results at the Mixed Waste Landfill

Sample Attributes			Methane (Method ASTM D1946) (ppbv[b])
Record Number[a]	ER Sample ID	Sample Depth (ft)	
611880	MWL-DP1-10-SG	10	4.30E+03 J (4.40E+03)
611874	MWL-DP2-10-SG	10	ND (1.70E+03)
611871	MWL-DP3-10-SG	10	ND (1.90E+03)
611876	MWL-DP4-10-SG	10	ND (1.90E+03)
611870	MWL-DP5-10-SG	10	ND (1.40E+03)
611870	MWL-DP5-10-SG-DUP	10	ND (1.30E+03)
611878	MWL-DP6-10-SG	10	ND (1.90E+03)
611878	MWL-DP6-10-SG-DUP	10	ND (1.70E+03)
611812	MWL-DP7-10-SG	10	ND (2.00E+03)
611812	MWL-DP8-10-SG	10	ND (1.90E+03)
611880	MWL-DP1-30-SG	30	1.90E+03 J (5.30E+03)
611874	MWL-DP2-30-SG	30	ND (1.70E+03)
611871	MWL-DP3-30-SG	30	2.20E+05
611876	MWL-DP4-30-SG	30	4.60E+03 J (5.60E+03)
611870	MWL-DP5-30-SG	30	2.20E+03 J (4.20E+03)
611870	MWL-DP5-30-SG-DUP	30	2.20E+03 J (4.40E+03)
611878	MWL-DP6-30-SG	30	ND (1.90E+03)
611878	MWL-DP6-30-SG-DUP	30	ND (1.90E+03)
611812	MWL-DP7-30-SG	30	ND (1.50E+03)
611812	MWL-DP8-30-SG	30	ND (1.70E+03)
611874	MWL-DP2-50-SG	50	ND (1.70E+03)
611871	MWL-DP3-50-SG	50	5.40E+06
611870	MWL-DP5-50-SG	50	1.80E+03 J (4.40E+03)
611870	MWL-DP5-50-SG-DUP	50	1.80E+03 J (4.30E+03)

[a]Analysis request/chain-of-custody record.
[b]Methane results converted from "% (v/v)" units reported by laboratory to ppbv by multiplying laboratory value by 10,000,000.
ASTM = American Society for Testing and Materials.
DP = Direct-push.
DUP = Duplicate.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification number.
J = Estimated value between the MDL and PQL, shown in parentheses.
MDL = Method detection limit.
MWL = Mixed Waste Landfill.
ND = Not detected above the MDL, shown in parentheses.
ppbv = Parts per billion by volume.
PQL = Practical quantitation limit.
SG = Soil-gas.

Table 5-9
Summary of 2008 Soil-Vapor VOC and Methane Analytical MDLs at the Mixed Waste Landfill

Analyte	EPA Method TO-14A[a] Detection Limit (ppbv)
1,1,1-Trichloroethane	0.99–3.1
1,1,2,2-Tetrachloroethane	0.99–3.1
1,1,2-Trichloroethane	0.99–3.1
1,1-Dichloroethane	0.99–3.1
1,1-Dichloroethene	0.99–3.1
1,2,2-tetrafluoroethane, 1,2-Dichloro-1	0.99–3.1
1,2,4-Trichlorobenzene	2.5–7.9
1,2,4-Trimethylbenzene	1.3–4.1
1,2-Dibromoethane	0.99–3.1
1,2-Dichlorobenzene	0.89–2.8
1,2-Dichloroethane	0.99–3.1
1,2-Dichloropropane	1.5–4.7
1,3,5-Trimethylbenzene	1.1–3.5
1,3-Dichlorobenzene	0.79–2.5
1,4-Dichlorobenzene	3–9.4
2,2-trifluoroethane, 1,1,2-Trichloro-1	0.99–3.1
2-Butanone	2–6.3
2-Hexanone	2–6.3
4-Ethyltoluene	0.7–2.2
4-methyl-, 2-Pentanone	2–6.3
Acetone	2.5–7.9
Benzene	1.5–4.7
Benzyl chloride	7.9–25
Bromodichloromethane	0.99–3.1
Bromoform	0.5–1.6
Bromomethane	2–6.3
Carbon disulfide	2–6.3
Carbon tetrachloride	0.99–3.1
Chlorobenzene	0.99–3.1
Chloroethane	1.5–4.7
Chloroform	0.99–3.1
Chloromethane	0.99–3.1
Dibromochloromethane	0.99–3.1
Dichlorodifluoromethane	0.99–3.1
Ethyl benzene	0.99–3.1
Hexachlorobutadiene	1.3–4.1
Methane	1.50E+03–2.00E+03
Methylene chloride	0.79–2.5
Styrene	0.99–3.1
Tetrachloroethene	1–4.4
Toluene	0.99–3.1
Trichloroethene	0.99–3.1
Trichlorofluoromethane	0.99–6.9
Vinyl acetate	2–6.3
Vinyl chloride	1.5–4.7
cis-1,2-Dichloroethene	0.79–2.5
cis-1,3-Dichloropropene	1.5–4.7

Refer to footnotes at end of table.

Table 5-9 (Concluded)
Summary of 2008 Soil-Vapor VOC and Methane Analytical MDLs at the Mixed Waste Landfill

Analyte	EPA Method TO-14A[a] Detection Limit (ppbv)
m-, p-Xylene	2–6.3
o-Xylene	0.99–3.1
trans-1,3-Dichloropropene	0.99–3.1

[a]EPA January 1999.
EPA = U.S. Environmental Protection Agency.
MDL = Method detection limit.
ppbv = Parts per billion by volume.
VOC = Volatile organic compound.

Table 5-10
Summary of 2008 CFC-12, PCE, TCE, and Total VOC Soil-Vapor Sample Concentration Ranges at the Mixed Waste Landfill

Sample Depth (ft bgs)[a]	CFC-12		PCE		TCE		Total VOCs		Methane	
	Range (ppbv)	Loc. with Max. Conc.	Range (ppbv)	Loc. with Max. Conc.	Range (ppbv)	Loc. with Max. Conc.	Range (ppbv)	Loc. with Max. Conc.	Range (ppbv)	Loc. with Max. Conc.
MWL Locations DP1–DP6										
10	20–70	DP4	1.2 J–380	DP5	4.2–42	DP6	111–736	DP5	ND–4.30E+03 J	DP1
30	6.8–110	DP4/ DP5	1.8 J–370	DP5	ND–110	DP3/ DP6	20–928	DP5	ND–2.20E+05	DP3
50	2.3–110	DP3	4.3–120	DP3	1.6 J–140	DP3	67–1.33E+03	DP3	ND–5.40E+06	DP3
Background Locations DP7 and DP8										
10	ND	NA	ND	NA	ND	NA	19–23	DP7	ND	NA
30	ND	NA	ND	NA	ND	NA	83–137	DP7	ND	NA

[a]Depth below the original MWL surface grade.
bgs = Below ground surface.
CFC-12 = Dichlorodifluoromethane.
Conc. = Concentration.
DP = Direct-push.
ft = Foot (feet).
J = Estimated concentration. See data validation report (Appendix E).
Loc. = Location.
Max. = Maximum.
MWL = Mixed Waste Landfill.
NA = Not applicable.
ND = Not detected.
PCE = Tetracholorethene.
ppbv = Parts per billion by volume.
TCE = Trichloroethene.
VOC = Volatile organic compound.

Table 5-11
Summary of 2008 CFC-12, PCE, TCE, Total VOCs, and Methane Soil-Vapor
Sample RPD Values for Primary and Duplicate Samples at the Mixed Waste Landfill

Sample Attributes			Primary and Duplicate Sample Soil-Vapor Concentration (ppbv)				
Record Number[a]	ER Sample ID	Sample Depth (ft)[b]	CFC-12	PCE	TCE	Total VOCs	Methane
611870	DP5-10-SG	10	40	160	10	366	ND
611870	DP5-10-SG-DUP	10	24	380	20	736	ND
	DP5-10-SG / SG DUP: RPD [c]	**NA**	**50**	**81.48**	**66.67**	**67.15**	**NA**
611870	DP5-30-SG	30	100	370	68	899	2.20E+03 J
611870	DP5-30-SG-DUP	30	110	370	71	928	2.20E+03 J
	DP5-30-SG / SG DUP: RPD	**NA**	**9.52**	**0.0**	**4.32**	**3.17**	**0.0**
611878	DP5-50-SG	50	2.3	4.3	1.6 J	67	1.80E+03 J
611878	DP5-50-SG-DUP	50	2.6	4.4	1.7 J	70	1.80E+03 J
	DP5-50-SG / SG DUP: RPD	**NA**	**12.24**	**2.30**	**6.06**	**4.38**	**0.0**
611878	DP6-10-SG	10	31	1.2 J	4.2	111	ND
611878	DP6-10-SG-DUP	10	30	190	42	373	ND
	DP6-10-SG / SG DUP: RPD	**NA**	**3.28**	**197.49**	**163.64**	**108.26**	**NA**
611878	DP6-30-SG	30	53	310	110	670	ND
611878	DP6-30-SG-DUP	30	53	300	110	654	ND
	DP6-30-SG / SG DUP: RPD	**NA**	**0.0**	**3.28**	**0.0**	**2.42**	**NA**

[a]Analysis Request/Chain-of-Custody record.
[b]Depth below the original MWL surface grade.
[c]RPD calculated as follows: $[(X_1 - X_2)/((X_1 + X_2)/2)] \times 100$ where X_1 and X_2 are the VOC concentrations in the primary and duplicate soil-vapor samples, respectively.

CFC-12 = Dichlorodifluoromethane.
DP = Direct-push.
DUP = Duplicate.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification number.
J = Estimated concentration. See data validation report (Appendix E).
MWL = Mixed Waste Landfill.
NA = Not applicable.
ND = Not detected.
PCE = Tetracholorethene.
ppbv = Parts per billion by volume.
RPD = Relative percent difference.
SG = Soil-gas.
TCE = Trichloroethene.
VOC = Volatile organic compound.

Table 6-1
Summary of Tritium Concentrations in 1995 Boreholes BH-5 and
BH-6 and 2008 Location DP6 at the Mixed Waste Landfill

Borehole	10-ft Samples (pCi/L)	30-ft Samples (pCi/L)	50-ft Samples (pCi/L)
DP6 (2008)	6.82E+03, 6.11E+03 (duplicate)	165 J, 189 J (duplicate)	NA
BH-5 (1995)	4.28E+03	ND	ND, 430 (duplicate)
BH-6 (1995)	2.43E+03	5.89E+03, 5.64E+03 (duplicate)	ND

BH = Borehole.
DP = Direct-push.
ft = Foot (feet).
J = Estimated value between the MDL and PQL, shown in parentheses.
MDL = Method detection limit.
NA = Not applicable.
ND = Not detected.
pCi/L = Picocuries per liter.
PQL = Practical quantitation limit.

Table 6-2
Summary of Tritium Concentrations in 1995 Boreholes BH-11 and
BH-12 and 2008 Location DP3 at the Mixed Waste Landfill

Borehole	10-ft Samples (pCi/L)	30-ft Samples (pCi/L)	50-ft Samples (pCi/L)
DP3 (2008)	1.89E+05	8.21E+05	5.15E+03
BH-11 (1995)	7.00E+03	1.15E+03, 1.31E+03 (duplicate)	1.06E+03
BH-12 (1995)	6.70E+05	7.80E+06	2.11E+05, 2.15E+05 (duplicate)

BH = Borehole.
DP = Direct-push.
ft = Foot (feet).
pCi/L = Picocuries per liter.

Table 6-3
Summary of Mean and Maximum Concentrations of CFC-12, PCE, TCE, and Total VOCs in Soil-Vapor Samples Collected at 10 and 30 Feet (1994) and at 10, 30, and 50 Feet (2008) at the Mixed Waste Landfill

Analyte(s) and Statistical Parameter	1994 Samples	2008 Samples
CFC-12 Mean	7.15E+02	44
CFC-12 Maximum	2.90E+04	110
CFC-12 Trigger[a]	**None**	**None**
PCE Mean	426	119
PCE Maximum	5.20E+03	380
PCE Trigger[a]	**2.00E+04**	**2.00E+04**
TCE Mean	221	40
TCE Maximum	630	140
TCE Trigger[a]	**2.00E+04**	**2.00E+04**
Total VOC Mean	1.92E+03	437
Total VOC Maximum	3.07E+04	1.33E+03
Total VOCs Trigger[a]	**2.50E+04**	**2.50E+04**

[a]Vadose zone triggers for PCE, TCE, and total VOCs from the Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill (SNL/NM September 2007a).

CFC-12 = Dichlorodifluoromethane.
PCE = Tetrachloroethene.
SNL/NM = Sandia National Laboratories/New Mexico.
TCE = Trichloroethene.
VOC = Volatile organic compound.

APPENDIX A
NMED Approval Letter for the Mixed Waste Landfill
Soil-Vapor Sampling and Analysis Plan

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

NEW MEXICO ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL, RETURN RECEIPT REQUESTED

February 14, 2008

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Securities Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: RESPONSE TO PUBLIC COMMENT AND APPROVAL WITH MODIFICATIONS SOIL-VAPOR SAMPLING AND ANALYSIS PLAN FOR THE U. S. DEPARTMENT OF ENERGY/SANDIA NATIONAL LABORATORIES' MIXED WASTE LANDFILL
SANDIA NATIONAL LABORATORIES, EPA ID NM5890110518
HWB-SNL-05-025

Dear Ms. Wagner and Mr. Nimick:

The Soil-Vapor Sampling and Analysis Plan (SV SAP) for the Sandia National Laboratories' (SNL's) Mixed Waste Landfill (MWL) was required by the New Mexico Environment Department (NMED) in the Notice of Disapproval (NOD) issued on November 20, 2006, for the MWL Corrective Measures Implementation Plan. The SV SAP was submitted to the NMED in December 2006 as part of SNL's response to the NOD.

Public comment was received on the SV SAP from February 5, 2007, through March 7, 2007, and from April 15, 2007, through May 15, 2007. Additionally, a public meeting on the SV SAP was held at the Los Griegos Health and Social Services Center in Albuquerque on May 1, 2007. Representatives from the U. S. Department of Energy and Sandia Corporation (Permittees) attended this meeting. A copy of NMED's response to public comment on this matter is enclosed.

Based on our review of the SV SAP, and in consideration of the public comment received NMED hereby approves the SV SAP with the following modifications:

1. Six boreholes for the collection of soil gas and soil samples shall be drilled at the locations shown on the enclosed map (at locations DP1-DP6). Two other boreholes (DP7 and DP8), planned for background locations southwest of the landfill, may be drilled at the background locations as proposed in the SV SAP.

Soil-gas and soil samples from DP1-DP8 are to be analyzed for volatile organic compounds (VOCs) and tritium, as appropriate, as described in the SV SAP. As shown on the enclosed map, the locations for DP4 and DP5 shall be the same as those shown on Figure 2-1 of the SV SAP; the rest of the boreholes, DP1-DP3 and DP6, are to be moved to different locations (see the enclosed map) because of the heterogeneous nature of waste placed into the MWL. To protect workers, the borehole locations for DP1-DP6 may be adjusted by a maximum of 20 feet in any horizontal direction to avoid drilling directly through waste buried in the MWL.

As discussed in the SV SAP, duplicate samples are to be taken from DP5 and DP6. Because the location of DP6 is to be changed, the Permittees may choose a different borehole than DP6 for the collection of the second set of duplicate samples.

The Permittees shall collect soil samples to be analyzed for tritium prior to collecting soil-gas samples in each borehole, opposite of the sequence noted in the SV SAP.

2. Soil-gas and soil samples from boreholes DP2, DP3, and DP5 shall be collected at depths of 10, 30, and a minimum of 50 feet. Samples from all other boreholes shall be collected at depths of 10 and 30 feet.

3. The radon detectors proposed in the SV SAP (track-etch type) are not the same type as those used in the 1997 radon survey for the MWL. To ensure that radon data are directly comparable with the 1997 data, the Permittees shall use the same radon detector type as those used in the 1997 survey (*i.e.*, 4-inch diameter activated-charcoal radon canisters to be analyzed for radon by gamma spectroscopy).

4. Nine radon detectors (RN1-RN9) shall be deployed at the locations shown on the enclosed map. These locations were selected, in part, based on the highest flux rates for radon as determined in the 1997 survey, and do not include the two background locations proposed in the SV SAP. The locations for RN1, RN3, RN4, RN5, RN6, RN7, and RN8 correspond to locations 30, 5, 8, 44, 13, 64, and 18 of the 1997 survey, respectively. The locations of RN2 and RN9 are new.

5. The radon data shall be submitted at the same time as the VOC and tritium data.

6. In addition to VOCs, all soil-gas samples shall be analyzed for methane.

7. The data and results of the SV SAP shall be submitted in writing to the NMED for its review and approval no later than July 31, 2008.

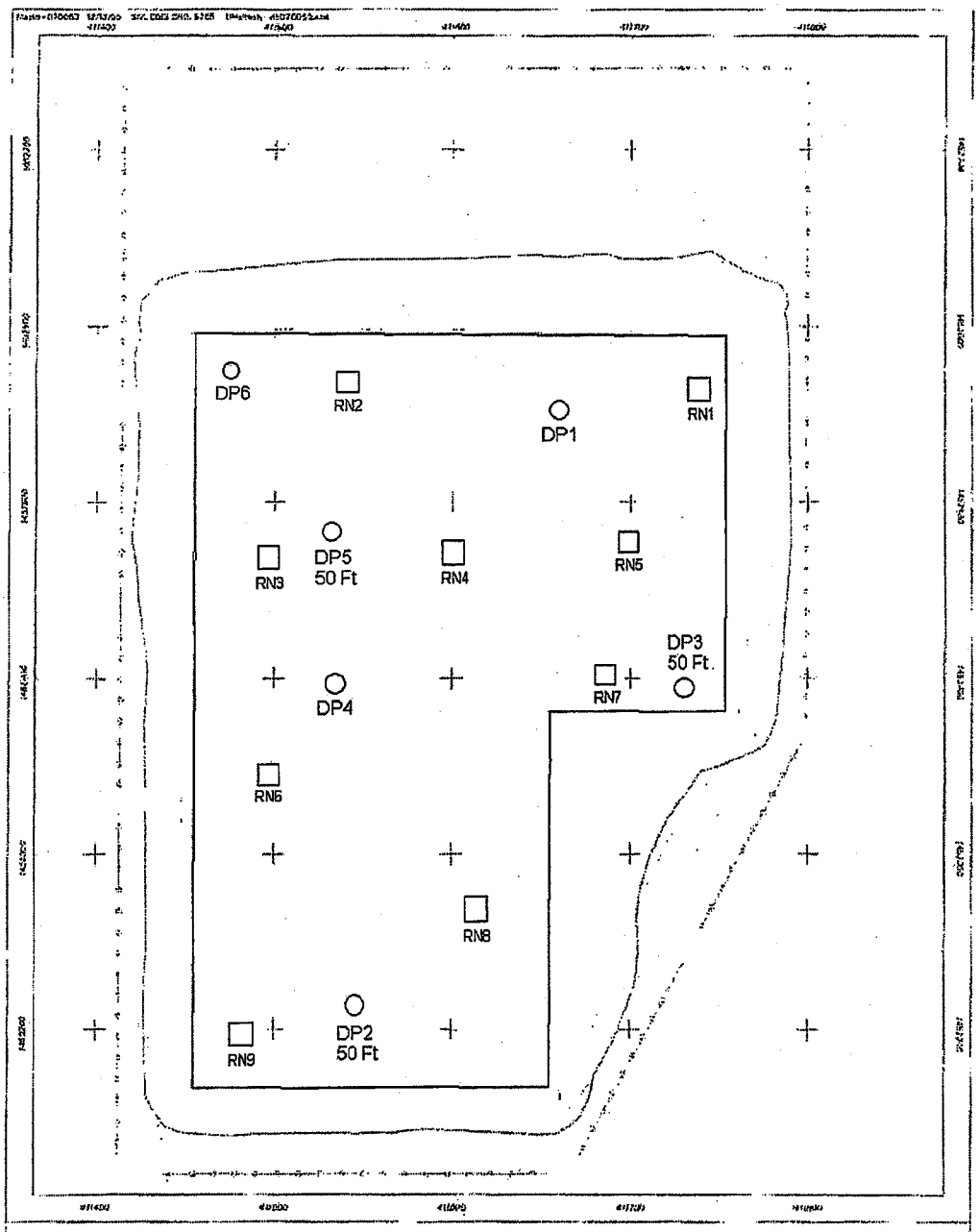
If you have any questions regarding this matter, please contact William Moats of my staff at (505) 222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

enclosures

cc: J. Kieling, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
P. Freshour, SNL MS 1089
J. Gould, DOE, MS 0184
File: SNL 2008 and Reading
SNL-05-025



Legend

- Soil Vapor and Tritium Sampling Location (DP1-DP6)
- Radon Sampling Location (RN1-RN9)
- Proposed Final Fence
- Proposed Toe of Landfill Cover
- SWMU 75, Former MWL Extent

Soil Gas VOC, Tritium, and Radon Sampling Locations, Mixed Waste Landfill

0 60 120
Scale in Feet
0 14 28
Scale in Meters

APPENDIX B
Environmental Restoration Group (ERG) 2008
Radon Investigation Report for the Mixed Waste Landfill

Radon Flux Measurements for the SNL Mixed Waste Landfill

April 2008

Prepared for:

Sandia National Laboratory

Prepared by:

Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113

1. Introduction

The Mixed Waste Landfill (MWL) is located approximately 5 miles southeast of Albuquerque International Sunport and 4 miles south of Sandia National Laboratories/New Mexico (SNL/NM) Technical Area (TA)-1. The landfill occupies 2.6 acres in the north-central portion of TA-3. The MWL accepted containerized and un-containerized low-level radioactive waste and minor amounts of mixed waste from SNL/NM research facilities and off-site generators from March 1959 to December 1988. Approximately 100,000 cubic feet of low-level radioactive waste (excluding packaging, containers, demolition and construction debris, and contaminated soil) containing 6300 curies (Ci) of activity (at the time of disposal) were disposed of at the MWL. The Resource Conservation and Recovery Act (RCRA) investigative process identified tritium as the primary contaminant of concern at the MWL. Tritium has been observed at the MWL since environmental studies were initiated in 1969. Tritium occurs in surface and near-surface soil in and around the classified area of the landfill.

On April 1 - 3, 2008 Environmental Restoration Group, Inc. (ERG) made radon flux measurements on the MWL. This report presents the data for these measurements.

2. Results

Fourteen (including two duplicates) flux readings were made at 12 locations on and around the landfill. Nine measurement locations were established on the MWL (MWL-RN1 through RN-9) and three background locations (MWL-RN10 through RN12) established in areas surrounding the MWL. The distribution of canisters was determined by SNL personnel. The canister locations are presented in Figure 1-1. Canisters 70 and 74 at Location MWL-RN1 and Canisters 78, 78B, and 56 at Location MWL-RN 3 are considered duplicates, with the canisters placed adjacent to one another at the same location. One trip blank, Canister 7, was included in the batch and counted with the canisters. The average flux on the MWL was 0.33 pCi/m^2s (including duplicates), which falls beneath the background mean of 0.60 pCi/m^2s. The observed flux ranges were 0.21 to 0.51 pCi/m^2s on the MWL and 0.56 to 0.65 pCi/m^2s in background. The results for the flux measurements for the MWL are presented in Table 1-1. Field and laboratory data sheets are attached in Appendix A.

3. Quality Assurance

The EPA Method 115 requirements were met for the measurements. No rainfall was reported during the 24 hours prior to the measurements. Also, the temperature exceeded 35 degrees Farenheit.

Two independent sources were used to calibrate the spectrometer, using identical geometry conditions to that of the canisters. Good agreement between calibration factors was obtained. The results of these measurements are presented in Table 1-2.

Every 10th canister was reanalyzed for comparison. The agreement between measurements is consistent with state-of-the art gamma spectroscopy results. These comparisons are presented in Table 1-3.

The measured flux of the trip blank, -0.03, is near the expected 0.00 pCi/m²s value. The trip blank result indicates that the canisters had not been exposed to radon, confirming the integrity of the bags that contained the canisters was not compromised.

As stated above, two sets of duplicates were placed on the MWL. Duplicate canisters 70 and 74 were placed at Location MWL-RN1. The radon flux results for these two canisters were 0.36 and 0.35 pCi/m²s, respectively. Duplicate canisters 78, 78B and 56 were placed at Location MWL-RN3. The radon flux results for the ~~two~~ three canisters are 0.30, 0.25, and 0.21 pCi/m²s, respectively. The agreement is better than expected since the canisters were only placed near one another, and were not true duplicates.

ERG Environmental Restoration Group, Inc.
8809 Washington St. NE Suite 150
Albuquerque, NM 87111

Table 1-1 **Radon Flux Measurements for SNL - Mixied Waste Landfill**

Canister Location	Canister Number	Lab Date	Start Count Time	Deploy Date	Deploy Time	Retrieve Date	Retrieve Time	Deployed Time (sec)	Count Time (sec)	Peak Counts	Bkg* counts	Detector Efficiency	Canister Activity(pCi	Flux pCi/m2s	Flux Error 1.00 S.D.	LLD pCi/m2s	Remarks
	BKG 1	4/2/2008	17:13	4/1/2008		04/02/08		86400	1200	2709	2706	1.11E-02	6.11E+00	0.00	0.04	0.1	OK
MWL-RN10	98	4/2/2008	17:35	4/1/2008	11:52	04/02/08	12:14	87720	1200	3957	2706	1.11E-02	2.55E+03	0.65	0.04	0.1	OK
MWL-RN1	74	4/2/2008	17:57	4/1/2008	11:24	04/02/08	11:43	87540	1200	3371	2706	1.11E-02	1.35E+03	0.35	0.04	0.1	OK
MWL-RN12	57	4/2/2008	18:18	4/1/2008	11:46	04/02/08	12:08	87720	1200	3802	2706	1.11E-02	2.23E+03	0.58	0.04	0.1	OK
MWL-RN2	15	4/2/2008	18:39	4/1/2008	11:38	04/02/08	11:55	87420	1200	3525	2706	1.11E-02	1.67E+03	0.43	0.04	0.1	OK
MWL-RN7	16	4/2/2008	19:03	4/1/2008	11:27	04/02/08	11:48	87660	1200	3673	2706	1.11E-02	1.97E+03	0.51	0.04	0.1	OK
MWL-RN11	202	4/2/2008	20:25	4/1/2008	11:42	04/02/08	12:05	87780	1200	3749	2706	1.11E-02	2.13E+03	0.56	0.04	0.1	OK
MWL-RN1	70	4/2/2008	20:46	4/1/2008	11:24	04/02/08	11:43	87540	1200	3377	2706	1.11E-02	1.37E+03	0.36	0.04	0.1	OK
MWL-RN5	95	4/2/2008	21:07	4/1/2008	11:26	04/02/08	11:47	87660	1200	3323	2706	1.11E-02	1.26E+03	0.33	0.04	0.1	OK
MWL-RN9	258	4/2/2008	21:29	4/1/2008	11:31	04/02/08	11:51	87600	1200	3341	2706	1.11E-02	1.29E+03	0.34	0.04	0.1	OK
MWL-RN8	9	4/2/2008	21:50	4/1/2008	11:30	04/02/08	11:50	87600	1200	3216	2706	1.11E-02	1.04E+03	0.28	0.04	0.1	OK
MWL-RN8	9B	4/2/2008	22:10	4/1/2008	11:30	04/02/08	11:50	87600	1200	3218	2706	1.11E-02	1.04E+03	0.28	0.04	0.1	OK
MWL-RN4	36	4/2/2008	22:31	4/1/2008	11:37	04/02/08	11:58	87660	1200	3251	2706	1.11E-02	1.11E+03	0.30	0.04	0.1	OK
MWL-RN6	37	4/3/2008	04:45	4/1/2008	11:33	04/02/08	11:53	87600	1200	3270	2706	1.11E-02	1.15E+03	0.32	0.04	0.1	OK
Trip Blank	7	4/3/2008	05:06	4/1/2008	11:24	04/02/08	12:24	90000	1200	2645	2706	1.11E-02	-1.24E+02	-0.03	0.04	0.1	OK
MWL-RN3	56	4/3/2008	05:27	4/1/2008	11:34	04/02/08	12:00	87960	1200	3072	2706	1.11E-02	7.46E+02	0.21	0.04	0.1	OK
MWL-RN3	78	4/3/2008	05:53	4/1/2008	11:34	04/02/08	12:00	87960	1200	3236	2706	1.11E-02	1.08E+03	0.30	0.04	0.1	OK
MWL-RN3	78B	4/3/2008	06:13	4/1/2008	11:34	04/02/08	12:00	87960	1200	3136	2706	1.11E-02	8.76E+02	0.25	0.04	0.1	OK
	BKG 2	4/3/2008	06:35	4/1/2008		04/02/08		86400	1200	2703	2706	1.11E-02	-6.11E+00	0.00	0.05	0.2	OK

Table 1-2 Quality Assurance Results of Standard Analysis

Standard	Date	Count Time (seconds)	Standard (nCi)	Counts	Average Bkg Counts	Efficiency	Error (1.00 SD)
STD 1A	04/02/08	1200	80	44208	2706	0.0117	6.0000E-05
STD 3	04/02/08	1200	78.83	39020	2706	0.0104	6.0000E-05
STD 1A	04/03/08	1200	80	44593	2706	0.0118	6.0000E-05
STD 3	04/03/08	1200	78.83	38980	2706	0.0103	6.0000E-05
Mean						0.0110	

Table 1-3 Comparison Data of Every Tenth Sample Analyzed

Cannister	First Analysis (A) pCi/m^2s	Second Analysis (B) pCi/m2s	Difference
9	0.17	0.17	0.0%
78	0.19	0.13	31.6%

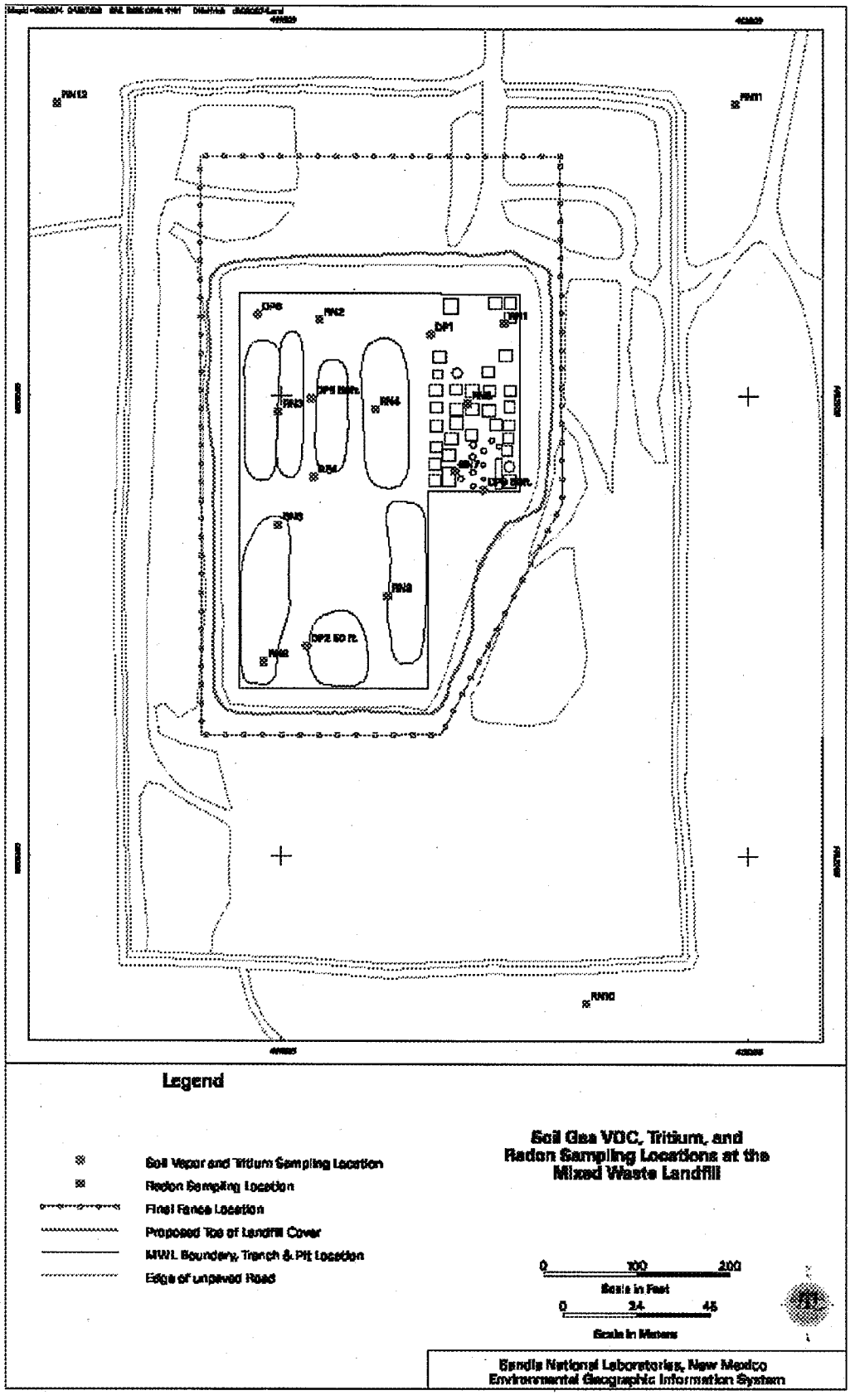


Figure 1-1. Radon Flux Canister Locations

APPENDIX C
Data Validation Reports for the 2008 Tritium Soil Samples Collected at the Mixed Waste Landfill

Cross-reference spreadsheet linking analytical laboratory SDG Numbers (shown on Analytical Quality Associates, Inc. data validation reports for the tritium soil samples) to the ER Sample ID names.			
AR/COC Number	ER Sample ID	Laboratory SDG Number	Sample Matrix
Data Sorted by AR/COC Number:			
611813	MWL-DP7-10-S	206875-001	SOIL
611813	MWL-DP7-30-S	206875-002	SOIL
611813	MWL-DP8-10-S	206875-003	SOIL
611813	MWL-DP8-30-S	206875-004	SOIL
611813	MWL-EB1	206875-005	AQUEOUS
611868	MWL-DP5-10-S	208452-001	SOIL
611868	MWL-DP5-10-S-DUP	208452-004	SOIL
611868	MWL-DP5-30-S	208452-002	SOIL
611868	MWL-DP5-30-S-DUP	208452-005	SOIL
611868	MWL-DP5-50-S	208452-003	SOIL
611868	MWL-DP5-50-S-DUP	208452-006	SOIL
611868	MWL-EB2	208452-007	AQUEOUS
611868	MWL-EB3	208452-008	AQUEOUS
611872	MWL-DP3-10-S	208452-009	SOIL
611872	MWL-DP3-30-S	208452-010	SOIL
611872	MWL-DP3-50-S	208452-011	SOIL
611872	MWL-EB4	208452-012	AQUEOUS
611872	MWL-EB5	208452-013	AQUEOUS
611873	MWL-DP2-10-S	208908-001	SOIL
611873	MWL-DP2-30-S	208908-002	SOIL
611873	MWL-DP2-50-S	208908-003	SOIL
611873	MWL-EB6	208908-005	AQUEOUS
611873	MWL-EB7	208908-006	AQUEOUS
611873	MWL-EB8	208908-008	AQUEOUS
611875	MWL-DP4-10-S	208908-007	SOIL
611875	MWL-DP4-30-S	208908-008	SOIL
611875	MWL-EB9	208908-009	AQUEOUS
611877	MWL-DP6-10-S	209226-001	SOIL
611877	MWL-DP6-10-S-DUP	209226-004	SOIL
611877	MWL-DP6-30-S	209226-002	SOIL
611877	MWL-DP6-30-S-DUP	209226-005	SOIL
611877	MWL-EB10	209226-003	AQUEOUS
611877	MWL-EB11	209226-006	AQUEOUS
611879	MWL-DP1-10-S	209226-007	SOIL
611879	MWL-DP1-30-S	209226-008	SOIL
611879	MWL-EB12	209226-009	AQUEOUS
611879	MWL-EB13	209226-010	AQUEOUS

Cross-reference spreadsheet linking analytical laboratory SDG Numbers (shown on Analytical Quality Associates, Inc. data validation reports for the tritium soil samples) to the ER Sample ID names.

AR/COC Number	ER Sample ID	Laboratory SDG Number	Sample Matrix
Data Sorted by Laboratory SDG Number:			
611813	MWL-DP7-10-S	206875-001	SOIL
611813	MWL-DP7-30-S	206875-002	SOIL
611813	MWL-DP8-10-S	206875-003	SOIL
611813	MWL-DP8-30-S	206875-004	SOIL
611813	MWL-EB1	206875-005	AQUEOUS
611868	MWL-DP5-10-S	208452-001	SOIL
611868	MWL-DP5-30-S	208452-002	SOIL
611868	MWL-DP5-50-S	208452-003	SOIL
611868	MWL-DP5-10-S-DUP	208452-004	SOIL
611868	MWL-DP5-30-S-DUP	208452-005	SOIL
611868	MWL-DP5-50-S-DUP	208452-006	SOIL
611868	MWL-EB2	208452-007	AQUEOUS
611868	MWL-EB3	208452-008	AQUEOUS
611872	MWL-DP3-10-S	208452-009	SOIL
611872	MWL-DP3-30-S	208452-010	SOIL
611872	MWL-DP3-50-S	208452-011	SOIL
611872	MWL-EB4	208452-012	AQUEOUS
611872	MWL-EB5	208452-013	AQUEOUS
611873	MWL-DP2-10-S	208908-001	SOIL
611873	MWL-DP2-30-S	208908-002	SOIL
611873	MWL-DP2-50-S	208908-003	SOIL
611873	MWL-EB6	208908-005	AQUEOUS
611873	MWL-EB7	208908-006	AQUEOUS
611875	MWL-DP4-10-S	208908-007	SOIL
611875	MWL-DP4-30-S	208908-008	SOIL
611873	MWL-EB8	208908-008	AQUEOUS
611875	MWL-EB9	208908-009	AQUEOUS
611877	MWL-DP6-10-S	209226-001	SOIL
611877	MWL-DP6-30-S	209226-002	SOIL
611877	MWL-EB10	209226-003	AQUEOUS
611877	MWL-DP6-10-S-DUP	209226-004	SOIL
611877	MWL-DP6-30-S-DUP	209226-005	SOIL
611877	MWL-EB11	209226-006	AQUEOUS
611879	MWL-DP1-10-S	209226-007	SOIL
611879	MWL-DP1-30-S	209226-008	SOIL
611879	MWL-EB12	209226-009	AQUEOUS
611879	MWL-EB13	209226-010	AQUEOUS

AR/COC = Analysis Request/Chain of Custody
DP = Direct push
DUP = Duplicate
EB = Equipment blank
ER = Environmental Restoration
ID = Identification
MWL = Mixed Waste Landfill
S = Soil
SDG = Sample Data Group

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Memorandum

Date: May 21, 2008

To: File

From: David Schwent

Subject: Radiochemical Data Review and Validation – SNL
Site: MWL Remediation
AR/COC: 611813
SDG: 206875
Laboratory: GEL
Project/Task No: 98045.02.02.02

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. This validation was performed according to SNL/NM ER Project AOP 00-03 Rev 2.

Summary

The samples were prepared and analyzed with accepted procedures using methods EPA906.0 (tritium) and ASTM D2216 (percent moisture). It should be noted that the percent moisture analysis was not evaluated for data validation. Problems were identified with the data package that result in the qualification of data.

Quantification: For samples 206875-003 and -005, the results of tritium were either < the associated 2-sigma total propagated uncertainty (TPU) or < the associated minimum detectable activity (MDA) and will be qualified "BD,FR3."

Quantification: For samples 206875-001, -002, and -004, the results of tritium were ≥ the associated MDA and <3X the MDA and will be qualified "J,FR7."

Data are acceptable. QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times/Preservation

All samples were analyzed within the prescribed holding times and properly preserved.

Calibration

All calibration QC acceptance criteria were met.

Quantification

All quantification QC acceptance criteria were met, except as noted above in the summary section.

Blanks

No target analytes were detected in the blanks.

Tracer/Carrier Recovery

No tracer analysis was required by this method.

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

All LCS QC acceptance criteria were met. No LCSD analyses were performed. The laboratory replicate analyses were used as measures of laboratory precision. No sample data will be qualified as a result.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

All MS QC acceptance criteria were met. No MSD analyses were performed. No sample data will be qualified as a result. It should be noted that the MS analysis for Batch 747192 was performed on a SNL sample of similar matrix from another SDG. No sample data will be qualified as a result.

Replicates

All laboratory replicate QC acceptance criteria were met. It should be noted that the laboratory replicate analysis for Batch 747192 was performed on a SNL sample of similar matrix from another SDG. No sample data will be qualified as a result.

Detection Limits/Dilutions

All detection limits were properly reported. No samples required dilution.

Other QC

No field blanks (FBs) or field duplicates (FDs) were submitted on the AR/COC.

No other specific issues were identified which affect data quality.

Sample Findings Summary

Site: MWL Remediation **AR/COC:** 611813 **Radiochemistry**

Sample ID	EPA906.0 (Tritium):	10028-17-8 (tritium)														
085821-001 MWL-DP7-10-S		J,FR7														
085821-002 MWL-DP7-30-S		J,FR7														
085822-001 MWL-DP8-10-S		BD,FR3														
085822-002 MWL-DP8-30-S		J,FR7														
085825-001 MWL-EB1		BD,FR3														

Validated By: David Schwartz **Date:** 05/21/08

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Memorandum

Date: May 29, 2008

To: File

From: David Schwent

Subject: Radiochemical Data Review and Validation – SNL
Site: MWL Remediation
AR/COC: 611868 and 611872
SDG: 208452
Laboratory: GEL
Project/Task No: 98045.02.02.02

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. This validation was performed according to SNL/NM ER Project AOP 00-03 Rev 2.

Summary

The samples were prepared and analyzed with accepted procedures using methods EPA906.0 (tritium) and ASTM D2216 (percent moisture). It should be noted that the percent moisture analysis was not evaluated for data validation. Problems were identified with the data package that result in the qualification of data.

Quantification: For samples 208452-007, -008, -012, and -013, the results of tritium were either < the associated 2-sigma total propagated uncertainty (TPU) or < the associated minimum detectable activity (MDA) and will be qualified "BD,FR3."

MS: In the MS analysis of Batch 755417, the QC sample concentration was >4X the spike concentration and the MS percent recovery (%R) was outside QC acceptance limits. As a result, the MS analysis was not used to evaluate the field sample data of Batch 755417. The associated results of samples 208452-001, -002, -003, -004, -005, and -006 were detects (> the MDA) and will be qualified "J,MS1" due to lack of matrix-specific accuracy information.

Data are acceptable. QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times/Preservation

All samples were analyzed within the prescribed holding times and properly preserved.

Calibration

All calibration QC acceptance criteria were met.

Quantification

All quantification QC acceptance criteria were met, except as noted above in the summary section.

Blanks

No target analytes were detected in the blanks.

Tracer/Carrier Recovery

No tracer analysis was required by this method.

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

All LCS QC acceptance criteria were met. No LCSD analyses were performed. The laboratory replicate analyses were used as measures of laboratory precision. No sample data will be qualified as a result.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

All MS QC acceptance criteria were met, except as noted above in the summary section. No MSD analyses were performed. No sample data will be qualified as a result.

Replicates

All laboratory replicate QC acceptance criteria were met.

Detection Limits/Dilutions

All detection limits were properly reported. No samples required dilution.

Other QC

No field blanks (FBs) were submitted on the AR/COCs. The field duplicate (FD) (samples 208452-004, -005 and -006) relative error ratios (RERs) were 3.13, 1.26, and 1.01, respectively. No QC acceptance criteria for the evaluation of FDs are currently in place.

No other specific issues were identified which affect data quality.

Sample Findings Summary

Site: MWL Remediation **AR/COC:** 611868 and 611872 **Radiochemistry**

Sample ID	EPA906.0 (Tritium):	10028-17-8 (tritium)														
085819-001 MWL-DP5-10-S		J,MS1														
085819-002 MWL-DP5-30-S		J,MS1														
085819-003 MWL-DP5-50-S		J,MS1														
085823-001 MWL-DP5-10-S-DUP		J,MS1														
085823-002 MWL-DP5-30-S-DUP		J,MS1														
085823-003 MWL-DP5-50-S-DUP		J,MS1														
085826-001 MWL-EB2		BD,FR3														
085827-001 MWL-EB3		BD,FR3														
085828-001 MWL-EB4		BD,FR3														
086225-001 MWL-EB5		BD,FR3														

Validated By: David Schwartz **Date:** 05/29/08

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Memorandum

Date: June 5, 2008

To: File

From: David Schwent

Subject: Radiochemical Data Review and Validation – SNL
Site: MWL Remediation
AR/COC: 611873 and 611875
SDG: 208908
Laboratory: GEL
Project/Task No: 98045.02.02.02

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. This validation was performed according to SNL/NM ER Project AOP 00-03 Rev 2.

Summary

The samples were prepared and analyzed with accepted procedures using methods GL-RAD-A-002 (tritium), EPA906.0 (tritium), and ASTM D2216 (percent moisture). It should be noted that the percent moisture analysis was not evaluated for data validation. No problems were identified with the data package that result in the qualification of data.

Data are acceptable. QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times/Preservation

All samples were analyzed within the prescribed holding times and properly preserved.

Calibration

All calibration QC acceptance criteria were met.

Quantification

All quantification QC acceptance criteria were met.

Blanks

No target analytes were detected in the blanks.

Tracer/Carrier Recovery

No tracer analysis was required by this method.

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

All LCS QC acceptance criteria were met. No LCSD analyses were performed. The laboratory replicate analyses were used as measures of laboratory precision. No sample data will be qualified as a result.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

All MS QC acceptance criteria were met. No MSD analyses were performed. No sample data will be qualified as a result.

Replicates

All laboratory replicate QC acceptance criteria were met.

Detection Limits/Dilutions

All detection limits were properly reported. No samples required dilution.

Other QC

No field blanks (FBs) or field duplicates (FDs) were submitted on the AR/COCs.

No other specific issues were identified that affect data quality.

Reviewed by: Kevin A. Lambert, Level I Peer Review, 06/06/08

Sample Findings Summary

Site: MWL Remediation **AR/COC:** 611873 and 611875 **Radiochemistry**

Sample ID	EPA906.0 (Tritium):															
	All Acceptance criteria met. No sample data will be qualified.															

Validated By: David Schwandt **Date:** 06/05/08

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Memorandum

Date: June 9, 2008

To: File

From: David Schwent

Subject: Radiochemical Data Review and Validation – SNL
Site: MWL Remediation
AR/COC: 611877 and 611879
SDG: 209226
Laboratory: GEL
Project/Task No: 98045.02.02.02

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. This validation was performed according to SNL/NM ER Project AOP 00-03 Rev 2.

Summary

The samples were prepared and analyzed with accepted procedures using methods EPA906.0 (tritium) and ASTM D2216 (percent moisture). It should be noted that the percent moisture analysis was not evaluated for data validation. Problems were identified with the data package that result in the qualification of data.

Quantification: For samples 209226-002 and -005, the results of tritium were ≥ the associated minimum detectable activity (MDA) and <3X the MDA and will be qualified "J,FR7."

Data are acceptable. QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times/Preservation

All samples were analyzed within the prescribed holding times and properly preserved.

Calibration

All calibration QC acceptance criteria were met.

Quantification

All quantification QC acceptance criteria were met, except as noted above in the summary section.

Blanks

No target analytes were detected in the blanks.

Tracer/Carrier Recovery

No tracer analysis was required by this method.

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

All LCS QC acceptance criteria were met. No LCSD analyses were performed. The laboratory replicate analyses were used as measures of laboratory precision. No sample data will be qualified as a result.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

All MS QC acceptance criteria were met. No MSD analyses were performed. No sample data will be qualified as a result.

Replicates

All laboratory replicate QC acceptance criteria were met.

Detection Limits/Dilutions

All detection limits were properly reported. No samples required dilution.

Other QC

No field blanks (FBs) were submitted on the AR/COCs. All field duplicate (FD) (samples 209226-004 and -005) relative error ratios (RERs) were <1. No QC acceptance criteria for the evaluation of FDs are currently in place.

No other specific issues were identified which affect data quality.

Reviewed by: Kevin A. Lambert, Level I Peer Review, 06/10/08

Sample Findings Summary

Site: MWL Remediation **AR/COC:** 611877 and 611879 **Radiochemistry**

Sample ID	EPA906.0 (Tritium):	10028-17-8 (tritium)														
085820-002 MWL-DP6-30-S		J,FR7														
085824-002 MWL-DP6-30-S-DUP		J,FR7														

Validated By: David Schwartz **Date:** 06/09/08

6.1 Data Qualifier Definitions

Data qualifiers are commonly used during the validation process to classify sample data as to their conformance to QC requirements. For the purposes of this procedure, the following code letters and associated definitions are provided:

BD	(below detection limit) - Used in radiochemistry to identify results that are not statistically different from zero.
J	The associated value is an estimated quantity.
J+	The associated numerical value is an estimated quantity with a suspected positive bias.
J-	The associated numerical value is an estimated quantity with a suspected negative bias.
N	Presumptive evidence of the presence of the material.
NJ	Presumptive evidence of the presence of the material at an estimated quantity.
NJ+	Presumptive evidence of the presence of the material at an estimated quantity with a suspected positive bias.
NJ-	Presumptive evidence of the presence of the material at an estimated quantity with a suspected negative bias.
R	The data are unusable (compound may or may not be present). Resampling and reanalysis are necessary for verification.
U	The analyte was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.
UJ	The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

Datum is unqualified if the quality parameters indicate the method was appropriate and that the reported result reflects the true value within the expected analytical uncertainty.

9.0 REASON CODES

Programs may require that general validation codes be included in their computer databases or EDDs. The following codes are the default codes used when this is required.

H1 - Holding time exceeded for sample analysis
H2 - Holding time exceeded for sample extraction
H3 - Holding time exceeded by greater than twice the specified holding time

TP1 - Sample improperly preserved
TP2 - Sample not preserved
TP3 - Sample not maintained at required temperature
TP4 - Required sample or extract clean up not performed
TP5 - Sample received unpreserved and preserved at the laboratory

I1 - Initial calibration not reported
I2 - Initial calibration not independently verified
I3 - Slope r^2 or RF %RSD criteria not met
I4 - Minimum RF / Slope not met
I5 - Intercept too large
I6 - Insufficient number of calibration standards used

C1 - Continuing calibration frequency not met
C2 - Continuing calibration %D failed high
C3 - Continuing calibration %D failed low

B - Method blank contamination at concentration greater than PQL
B1 - Trip blank contamination at concentration greater than PQL
B2 - Field/equipment blank contamination at concentration greater than PQL
B3 - Calibration blank contamination at concentration greater than PQL
B4 - Negative value for calibration blank - absolute value greater than the MDL
B5 - Negative value for method blank - absolute value greater than the MDL
B6 - Negative value for field/equipment/trip blank - absolute value greater than the MDL
B7 - Method blank contamination at activity greater than the MDA
B8 - Method blank frequency not met
B9 - Instrument or calibration blank frequency not met

IS1 - Internal standard / tracer recovery failed high
IS2 - Internal standard / tracer recovery failed low but greater than 10%
IS3 - Internal standard / tracer recovery failed low and less than 10%

S1 - Surrogate(s) failed high
S2 - Surrogate(s) failed low
S3 - Multiple random surrogate failures

FR1 - Result exceeds calibration range
FR2 - No result reported - sample lost or damaged
FR3 - Result is less than the MDA / MDL
FR4 - Negative result - absolute value greater than the MDA/MDL
FR5 - Retention time criteria not met
FR6 - Ion mass ratio criteria not met

MS1 - Matrix spike not analyzed or not analyzed on the client's sample
MS2 - Matrix spike analyte(s) recovery failed high
MS3 - Matrix spike analyte(s) recovery failed low
MS4 - Matrix spike analyte(s) recovery failed both high and low
MS5 - MS/MSD relative percent difference failed

RP1 - Replicate not analyzed or not analyzed on the client's sample
RP2 - Replicate relative percent difference failed

L1 - Laboratory control sample frequency not met
L2 - Laboratory control sample analyte(s) recovery failed high
L3 - Laboratory control sample analyte(s) recovery failed low
L4 - Laboratory control sample analyte(s) recovery failed both high and low
L5 - LCS/LCSD relative percent difference failed

DL1 - Reporting limit verification frequency not met
DL2 - Reporting limit verification percent recovery failed high
DL3 - Reporting limit verification percent recovery failed low

CK1 - Interference check sample frequency not met
CK2 - Interference check sample analyte(s) failed high
CK3 - Interference check sample analyte(s) failed low

D1 - Serial dilution failed percent recovery
D2 - Inappropriate initial dilution

V1 - Conformation analysis not done
V2 - Conformation RPD exceeds criteria

X1 - General data quality is suspect - see report
X2 - Analysis failed to meet method requirements - see report
X3 - Required QC documentation missing

APPENDIX D
Analytical Reports for the 2008 Soil-Vapor Samples
Collected at the Mixed Waste Landfill

Attachment 6
Page 1 of 1

CLEAN

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY

Page 1 of 1

Internal Lab

Batch No. SMO Use LRE0228

AR/COC 611880

Dept. No./Mail Stop:	6765/MS1089	Date Samples Shipped:	5-27-08	Project/Task No.:	98045/02.02.02
Project/Task Manager:	P. Freshour	Carrier/Waybill No.	40128	SMO Authorization:	
Project Name:	MWL Remediation	Lab Contact:	MTRUPTI MISTRY	Contract #:	PO691437
Record Center Code:		Lab Destination:	Test America CA SANTA ANA		
Logbook Ref. No.:		SMO Contact/Phone:	P. Puisant/505-844-3185		
Service Order No.	CF013-08	Send Report to SMO:	Rita Kavanaugh 284-2553		
Location	Tech Area				
Building	Room				

SEE BOTTLE ORDER

☐ Waste Characterization
-Send preliminary/copy report to:

☐ Released by COC No.:
☐ Validation Required

Bill To:Sandia National Labs (Accounts Payable)
P.O. Box 5800 MS 0154
Albuquerque, NM 87185-0154

Reference LOV(available at SMO)

Sample No.-Fraction	ER Sample ID or Sample Location Detail	Pump Depth (ft)	ER Site No.	Date/Time(hr) Collected	Sample Matrix	Container Type	Container Volume	Preserv-ative	Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID
085805-001	MWL-DP1-10-SG	N/A	MWL	0749/5-27-08	SG	SC	6L	NONE	G	SA	TO-14 + Methane	
085805-002	MWL-DP1-30-SG	N/A	MWL	0828/"	SG	SC	6L	NONE	G	SA	TO-14 + Methane	

RMMA ☑ Yes ☐ No Ref. No.
Sample Disposal ☐ Return to Client ☑ Disposal by lab
Turnaround Time 30 day ~~Normal~~ ☑ Rush
Return Samples By: Level of Rush: 7 DAY TAT QC inits.

Sample Tracking Smo Use
Date Entered(mm/dd/yy)
Entered by:

Special Instructions/QC Requirements
EDD ☑ Yes ☐ No
Level D Package ☐ Yes ☑ No
*Send report to:

Abnormal Conditions on Receipt

Lab Use

Sample Team Members	Name	Signature	Init	Company/Organization/Phone/Cellular
	Robert Lynch		RL	Weston/4133/505-844-1013
	Bill Gibson		WG	Weston/4133/505-284-5232

*Please list as separate report.

1.Relinquished by		Org. 4133	Date 5-27-08	Time 0845	4.Relinquished by		Org.	Date	Time
1. Received by	SMO	Org. 4133	Date 5-27-08	Time 0845	4. Received by		Org.	Date	Time
2.Relinquished by	SMO	Org. 4133	Date 5-27-08	Time 1030	5.Relinquished by		Org.	Date	Time
2. Received by		Org.	Date 5/28/08	Time 1000	5. Received by		Org.	Date	Time
3.Relinquished by		Org.	Date	Time	6.Relinquished by		Org.	Date	Time
3. Received by		Org.	Date	Time	6. Received by		Org.	Date	Time

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
1721 South Grand Avenue Santa Ana, CA 92705 * 714-258-8610 * Fax 714-258-0921

Sandia National Laboratories
Payment Processing, MS 1385 P.O. Box 5130
Albuquerque, NM 87185-0154
Rita Kavanaugh

Work Order: LRE0228
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/28/08 10:00
Reported: 06/02/08 15:31

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0228-01 (085805-001/MWL-DP1-10-SG - Air)							**Sampled: 05/27/08 07:49**			
EPA TO14A - Volatile Organic Compounds by GC/MS										
Acetone	**55**		ppbv	2.5	10	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Benzene	**17**		ppbv	1.5	3.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Benzyl chloride	ND		ppbv	8.0	25	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Bromodichloromethane	ND		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Bromoform	ND		ppbv	0.50	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Bromomethane	ND		ppbv	2.0	4.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
2-Butanone (MEK)	**13**		ppbv	2.0	10	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Carbon disulfide	ND		ppbv	2.0	10	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Carbon tetrachloride	ND		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Chlorobenzene	ND		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Dibromochloromethane	ND		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Chloroethane	ND		ppbv	1.5	4.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Chloroform	ND		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Chloromethane	ND		ppbv	1.0	4.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
1,2-Dibromoethane (EDB)	ND		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
1,2-Dichlorobenzene	ND		ppbv	0.90	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
1,3-Dichlorobenzene	ND		ppbv	0.80	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
1,4-Dichlorobenzene	ND		ppbv	3.0	6.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Dichlorodifluoromethane	**39**		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
1,1-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
1,2-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
cis-1,2-Dichloroethene	ND		ppbv	0.80	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
1,1-Dichloroethene	**1.4**	J	ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
1,2-Dichloropropane	ND		ppbv	1.5	3.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
trans-1,3-Dichloropropene	ND		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Ethylbenzene	**3.2**		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
4-Ethyltoluene	**2.8**		ppbv	0.70	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Hexachlorobutadiene	ND		ppbv	1.3	4.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
2-Hexanone	ND		ppbv	2.0	10	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Methylene chloride	**0.90**	J	ppbv	0.80	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
4-Methyl-2-pentanone (MIBK)	ND		ppbv	2.0	10	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Styrene	ND		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
1,1,2,2-Tetrachloroethane	ND		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Tetrachloroethene	**15**		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Toluene	**26**		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
1,2,4-Trichlorobenzene	ND		ppbv	2.5	5.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
1,1,1-Trichloroethane	**1.6**	J	ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
1,1,2-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Trichloroethene	**14**		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003

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Sandia National Laboratories
Payment Processing, MS 1385 P.O. Box 5130
Albuquerque, NM 87185-0154
Rita Kavanaugh

Work Order: LRE0228
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/28/08 10:00
Reported: 06/02/08 15:31

ANALYTICAL REPORT

Sample ID: LRE0228-01 (085805-001/MWL-DP1-10-SG - Air) - cont. **Sampled: 05/27/08 07:49**

EPA TO14A - Volatile Organic Compounds by GC/MS - cont.

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Trichlorofluoromethane	**16**		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
1,1,2-Trichloro-1,2,2-trifluoroethane	**8.0**		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
1,2,4-Trimethylbenzene	**4.4**		ppbv	1.3	3.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
1,3,5-Trimethylbenzene	**2.3**	J	ppbv	1.1	3.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Vinyl acetate	ND		ppbv	2.0	10	1.0	05/30/08 00:14	gcmsa	AA	8E30003
Vinyl chloride	ND		ppbv	1.5	3.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
m,p-Xylene	**16**		ppbv	2.0	4.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003
o-Xylene	**4.2**		ppbv	1.0	2.0	1.0	05/30/08 00:14	gcmsa	AA	8E30003

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Work Order: LRE0228
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/28/08 10:00
Reported: 06/02/08 15:31

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0228-01 (085805-001/MWL-DP1-10-SG - Air)							**Sampled: 05/27/08 07:49**			
ASTM D1946 - Fixed Gases										
Methane	**0.00043**	J	%(v/v)	0.00013	0.00044	2.2	05/29/08 17:20	GC8-Rear	EI	8E29006

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Work Order: LRE0228
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/28/08 10:00
Reported: 06/02/08 15:31

ANALYTICAL REPORT

Sample ID: LRE0228-02 (085805-002/MWL-DP1-30-SG - Air) **Sampled: 05/27/08 08:28**

EPA TO14A - Volatile Organic Compounds by GC/MS

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Acetone	**6.0**	J	ppbv	2.5	10	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Benzene	ND		ppbv	1.5	3.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Benzyl chloride	ND		ppbv	8.0	25	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Bromodichloromethane	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Bromoform	ND		ppbv	0.50	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Bromomethane	ND		ppbv	2.0	4.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
2-Butanone (MEK)	ND		ppbv	2.0	10	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Carbon disulfide	ND		ppbv	2.0	10	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Carbon tetrachloride	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Chlorobenzene	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Dibromochloromethane	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Chloroethane	ND		ppbv	1.5	4.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Chloroform	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Chloromethane	ND		ppbv	1.0	4.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
1,2-Dibromoethane (EDB)	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
1,2-Dichlorobenzene	ND		ppbv	0.90	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
1,3-Dichlorobenzene	ND		ppbv	0.80	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
1,4-Dichlorobenzene	ND		ppbv	3.0	6.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Dichlorodifluoromethane	**6.8**		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
1,1-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
1,2-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
cis-1,2-Dichloroethene	ND		ppbv	0.80	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
1,1-Dichloroethene	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
1,2-Dichloropropane	ND		ppbv	1.5	3.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
trans-1,3-Dichloropropene	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Ethylbenzene	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
4-Ethyltoluene	ND		ppbv	0.70	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Hexachlorobutadiene	ND		ppbv	1.3	4.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
2-Hexanone	ND		ppbv	2.0	10	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Methylene chloride	**1.0**	J	ppbv	0.80	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
4-Methyl-2-pentanone (MIBK)	ND		ppbv	2.0	10	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Styrene	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
1,1,2,2-Tetrachloroethane	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Tetrachloroethene	**1.8**	J	ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Toluene	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
1,2,4-Trichlorobenzene	ND		ppbv	2.5	5.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
1,1,1-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
1,1,2-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Trichloroethene	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003

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Rita Kavanaugh

Work Order: LRE0228
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/28/08 10:00
Reported: 06/02/08 15:31

ANALYTICAL REPORT

Sample ID: LRE0228-02 (085805-002/MWL-DP1-30-SG - Air) - cont. **Sampled: 05/27/08 08:28**

EPA TO14A - Volatile Organic Compounds by GC/MS - cont.

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Trichlorofluoromethane	**2.9**		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
1,1,2-Trichloro-1,2,2-trifluoroethane	**1.2**	J	ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
1,2,4-Trimethylbenzene	ND		ppbv	1.3	3.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
1,3,5-Trimethylbenzene	ND		ppbv	1.1	3.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Vinyl acetate	ND		ppbv	2.0	10	1.0	05/30/08 01:00	gcmsa	AA	8E30003
Vinyl chloride	ND		ppbv	1.5	3.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
m,p-Xylene	ND		ppbv	2.0	4.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003
o-Xylene	ND		ppbv	1.0	2.0	1.0	05/30/08 01:00	gcmsa	AA	8E30003

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Work Order: LRE0228
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/28/08 10:00
Reported: 06/02/08 15:31

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0228-02 (085805-002/MWL-DP1-30-SG - Air)							**Sampled: 05/27/08 08:28**			
ASTM D1946 - Fixed Gases										
Methane	0.00019	J	%(v/v)	0.00016	0.00053	2.6	05/29/08 17:39	GC8-Rear	EI	8E29006

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY

Internal Lab

Page 1 of 1

Batch No. N/A

SMO Use LRE0191

AR/COC 611874

Dept. No./Mail Stop:	6765/MS1089	Date Samples Shipped:	5-21-08	Project/Task No.:	98045/02.02.02
Project/Task Manager:	P. Freshour	Carrier/Waybill No.	89638	SMO Authorization	
Project Name:	MWL Remediation	Lab Contact:	TRUPTI MISTRY	Contract #:	PO691437
Record Center Code:		Lab Destination:	Test America CA SANTA ANA		
Logbook Ref. No.:		SMO Contact/Phone:	P. Puisant/505-844-3185		
Service Order No.	CF013-08	Send Report to SMO:	Rita Kavanaugh 284-2553		
Location	Tech Area				
Building	Room				

☐ **Waste Characterization**
-Send preliminary/copy report to:

☐ **Released by COC No.:**
☐ **Validation Required**

Bill To: Sandia National Labs (Accounts Payable)
P.O. Box 5800 MS 0154
Albuquerque, NM 87185-0154

Reference LOV(available at SMO)

Sample No.-Fraction	ER Sample ID or Sample Location Detail	Pump Depth (ft)	ER Site No.	Date/Time(hr) Collected	Sample Matrix	Container Type	Container Volume	Preserv-ative	Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID
085806-001	MWL-DP2-10-SG	N/A	MWL	5/16/08 1453	SG	SC	6L	NONE	G	SA	TO-14	
085806-002	MWL-DP2-30-SG	N/A	MWL	5/16/08 1519	SG	SC	6L	NONE	G	SA	TO-14	
085806-003	MWL-DP2-50-SG	N/A	MWL	5/16/08 1554	SG	SC	6L	NONE	G	SA	TO-14	

RMMA ☑ Yes ☐ No Ref. No.

Sample Disposal ☐ Return to Client ☑ Disposal by lab

Turnaround Time 30 day ☑ Normal ☐ Rush

Return Samples By:

Sample Tracking Smo Use
Date Entered(mm/dd/yy)
Entered by:

Level of Rush: QC Inits.

Special Instructions/QC Requirements
EDD ☑ Yes ☐ No
Level D Package ☐ Yes ☑ No
***Send report to:**

Abnormal Conditions on Receipt

Lab Use

Sample Team Members	Name	Signature	Init	Company/Organization/Phone/Cellular
	Robert Lynch		RL	Weston/4133/505-844-1013
	Bill Gibson		WJG	Weston/4133/505-284-5232

***Please list as separate report.**

1.Relinquished by		Org. 4133	Date 5/21/08	Time 0830	4.Relinquished by		Org.	Date	Time
1. Received by	SMO	Org. 4133	Date 5/21/08	Time 0830	4. Received by		Org.	Date	Time
2.Relinquished by	SMO	Org. 7133	Date 5/21/08	Time 1100	5.Relinquished by		Org.	Date	Time
2. Received by		Org.	Date 5/22/08	Time 1005	5. Received by		Org.	Date	Time
3.Relinquished by		Org.	Date	Time	6.Relinquished by		Org.	Date	Time
3. Received by		Org.	Date	Time	6. Received by		Org.	Date	Time

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Work Order: LRE0191
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/22/08 10:00
Reported: 05/28/08 16:16

ANALYTICAL REPORT

Sample ID: LRE0191-01 (085806-001/MWL-DP2-10-SG - Air) **Sampled: 05/16/08 14:53**

EPA TO14A - Volatile Organic Compounds by GC/MS

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Acetone	**8.5**	J	ppbv	2.5	10	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Benzene	ND		ppbv	1.5	3.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Benzyl chloride	ND		ppbv	8.0	25	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Bromodichloromethane	ND		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Bromoform	ND		ppbv	0.50	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Bromomethane	ND		ppbv	2.0	4.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
2-Butanone (MEK)	**3.3**	J	ppbv	2.0	10	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Carbon disulfide	ND		ppbv	2.0	10	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Carbon tetrachloride	ND		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Chlorobenzene	ND		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Dibromochloromethane	ND		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Chloroethane	ND		ppbv	1.5	4.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Chloroform	ND		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Chloromethane	ND		ppbv	1.0	4.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
1,2-Dibromoethane (EDB)	ND		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
1,2-Dichlorobenzene	ND		ppbv	0.90	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
1,3-Dichlorobenzene	ND		ppbv	0.80	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
1,4-Dichlorobenzene	ND		ppbv	3.0	6.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Dichlorodifluoromethane	**20**		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
1,1-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
1,2-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
cis-1,2-Dichloroethene	**6.9**		ppbv	0.80	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
1,1-Dichloroethene	ND		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
1,2-Dichloropropane	ND		ppbv	1.5	3.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
trans-1,3-Dichloropropene	ND		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Ethylbenzene	ND		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
4-Ethyltoluene	ND		ppbv	0.70	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Hexachlorobutadiene	ND		ppbv	1.3	4.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
2-Hexanone	ND		ppbv	2.0	10	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Methylene chloride	ND		ppbv	0.80	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
4-Methyl-2-pentanone (MIBK)	ND		ppbv	2.0	10	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Styrene	ND		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
1,1,2,2-Tetrachloroethane	ND		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Tetrachloroethene	**12**		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Toluene	ND		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
1,2,4-Trichlorobenzene	ND		ppbv	2.5	5.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
1,1,1-Trichloroethane	**25**		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
1,1,2-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Trichloroethene	**11**		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005

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Payment Processing, MS 1385 P.O. Box 5130
Albuquerque, NM 87185-0154
Rita Kavanaugh

Work Order: LRE0191
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/22/08 10:00
Reported: 05/28/08 16:16

ANALYTICAL REPORT

Sample ID: LRE0191-01 (085806-001/MWL-DP2-10-SG - Air) - cont. **Sampled: 05/16/08 14:53**

EPA TO14A - Volatile Organic Compounds by GC/MS - cont.

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Trichlorofluoromethane	**16**		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
1,1,2-Trichloro-1,2,2-trifluoroethane	**20**		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
1,2,4-Trimethylbenzene	ND		ppbv	1.3	3.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
1,3,5-Trimethylbenzene	ND		ppbv	1.1	3.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Vinyl acetate	ND		ppbv	2.0	10	1.0	05/22/08 22:26	gcmsa	AD	8E23005
Vinyl chloride	ND		ppbv	1.5	3.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
m,p-Xylene	ND		ppbv	2.0	4.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005
o-Xylene	ND		ppbv	1.0	2.0	1.0	05/22/08 22:26	gcmsa	AD	8E23005

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Work Order: LRE0191
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/22/08 10:00
Reported: 05/28/08 16:16

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0191-01 (085806-001/MWL-DP2-10-SG - Air)							**Sampled: 05/16/08 14:53**			
ASTM D1946 - Fixed Gases										
Methane	ND		%(v/v)	0.00017	0.00056	2.8	05/23/08 12:05	GC8	EI	8E27004

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Rita Kavanaugh

Work Order: LRE0191
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/22/08 10:00
Reported: 05/28/08 16:16

ANALYTICAL REPORT

Sample ID: LRE0191-02 (085806-002/MWL-DP2-30-SG - Air) **Sampled: 05/16/08 15:19**

EPA TO14A - Volatile Organic Compounds by GC/MS

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Acetone	**31**		ppbv	2.5	10	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Benzene	**1.7**	J	ppbv	1.5	3.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Benzyl chloride	ND		ppbv	8.0	25	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Bromodichloromethane	ND		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Bromoform	ND		ppbv	0.50	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Bromomethane	ND		ppbv	2.0	4.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
2-Butanone (MEK)	**7.7**	J	ppbv	2.0	10	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Carbon disulfide	ND		ppbv	2.0	10	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Carbon tetrachloride	ND		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Chlorobenzene	ND		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Dibromochloromethane	ND		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Chloroethane	ND		ppbv	1.5	4.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Chloroform	ND		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Chloromethane	ND		ppbv	1.0	4.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
1,2-Dibromoethane (EDB)	ND		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
1,2-Dichlorobenzene	ND		ppbv	0.90	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
1,3-Dichlorobenzene	ND		ppbv	0.80	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
1,4-Dichlorobenzene	ND		ppbv	3.0	6.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Dichlorodifluoromethane	**51**		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
1,1-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
1,2-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
cis-1,2-Dichloroethene	ND		ppbv	0.80	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
1,1-Dichloroethene	**4.2**		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
1,2-Dichloropropane	ND		ppbv	1.5	3.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
trans-1,3-Dichloropropene	ND		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Ethylbenzene	ND		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
4-Ethyltoluene	ND		ppbv	0.70	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Hexachlorobutadiene	ND		ppbv	1.3	4.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
2-Hexanone	ND		ppbv	2.0	10	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Methylene chloride	**0.85**	J	ppbv	0.80	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
4-Methyl-2-pentanone (MIBK)	ND		ppbv	2.0	10	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Styrene	ND		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
1,1,2,2-Tetrachloroethane	ND		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Tetrachloroethene	**40**		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Toluene	**2.5**		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
1,2,4-Trichlorobenzene	ND		ppbv	2.5	5.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
1,1,1-Trichloroethane	**40**		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
1,1,2-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Trichloroethene	**30**		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005

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Rita Kavanaugh

Work Order: LRE0191
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/22/08 10:00
Reported: 05/28/08 16:16

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0191-02 (085806-002/MWL-DP2-30-SG - Air) - cont.							**Sampled: 05/16/08 15:19**			
EPA TO14A - Volatile Organic Compounds by GC/MS - cont.										
Trichlorofluoromethane	**35**		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
1,1,2-Trichloro-1,2,2-trifluoroethane	**51**		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
1,2,4-Trimethylbenzene	ND		ppbv	1.3	3.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
1,3,5-Trimethylbenzene	ND		ppbv	1.1	3.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Vinyl acetate	ND		ppbv	2.0	10	1.0	05/22/08 23:07	gcmsa	AD	8E23005
Vinyl chloride	ND		ppbv	1.5	3.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
m,p-Xylene	ND		ppbv	2.0	4.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005
o-Xylene	ND		ppbv	1.0	2.0	1.0	05/22/08 23:07	gcmsa	AD	8E23005

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ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0191-02 (085806-002/MWL-DP2-30-SG - Air)							**Sampled: 05/16/08 15:19**			
ASTM D1946 - Fixed Gases										
Methane	ND		%(v/v)	0.00017	0.00055	2.8	05/23/08 12:18	GC8	EI	8E27004

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Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/22/08 10:00
Reported: 05/28/08 16:16

ANALYTICAL REPORT

Sample ID: LRE0191-03 (085806-003/MWL-DP2-50-SG - Air) **Sampled: 05/16/08 15:54**

EPA TO14A - Volatile Organic Compounds by GC/MS

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Acetone	**29**		ppbv	2.5	10	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Benzene	ND		ppbv	1.5	3.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Benzyl chloride	ND		ppbv	8.0	25	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Bromodichloromethane	ND		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Bromoform	ND		ppbv	0.50	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Bromomethane	ND		ppbv	2.0	4.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
2-Butanone (MEK)	**7.5**	J	ppbv	2.0	10	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Carbon disulfide	ND		ppbv	2.0	10	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Carbon tetrachloride	ND		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Chlorobenzene	ND		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Dibromochloromethane	ND		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Chloroethane	ND		ppbv	1.5	4.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Chloroform	ND		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Chloromethane	ND		ppbv	1.0	4.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
1,2-Dibromoethane (EDB)	ND		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
1,2-Dichlorobenzene	ND		ppbv	0.90	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
1,3-Dichlorobenzene	ND		ppbv	0.80	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
1,4-Dichlorobenzene	ND		ppbv	3.0	6.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Dichlorodifluoromethane	**19**		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
1,1-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
1,2-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
cis-1,2-Dichloroethene	ND		ppbv	0.80	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
1,1-Dichloroethene	**2.0**		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
1,2-Dichloropropane	ND		ppbv	1.5	3.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
trans-1,3-Dichloropropene	ND		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Ethylbenzene	ND		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
4-Ethyltoluene	ND		ppbv	0.70	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Hexachlorobutadiene	ND		ppbv	1.3	4.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
2-Hexanone	ND		ppbv	2.0	10	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Methylene chloride	**0.82**	J	ppbv	0.80	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
4-Methyl-2-pentanone (MIBK)	ND		ppbv	2.0	10	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Styrene	ND		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
1,1,2,2-Tetrachloroethane	ND		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Tetrachloroethene	**14**		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Toluene	**1.2**	J	ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
1,2,4-Trichlorobenzene	ND		ppbv	2.5	5.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
1,1,1-Trichloroethane	**9.5**		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
1,1,2-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Trichloroethene	**13**		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005

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Work Order: LRE0191
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/22/08 10:00
Reported: 05/28/08 16:16

ANALYTICAL REPORT

Sample ID: LRE0191-03 (085806-003/MWL-DP2-50-SG - Air) - cont. **Sampled: 05/16/08 15:54**

EPA TO14A - Volatile Organic Compounds by GC/MS - cont.

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Trichlorofluoromethane	**11**		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
1,1,2-Trichloro-1,2,2-trifluoroethane	**19**		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
1,2,4-Trimethylbenzene	ND		ppbv	1.3	3.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
1,3,5-Trimethylbenzene	ND		ppbv	1.1	3.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Vinyl acetate	ND		ppbv	2.0	10	1.0	05/22/08 23:50	gcmsa	AD	8E23005
Vinyl chloride	ND		ppbv	1.5	3.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
m,p-Xylene	ND		ppbv	2.0	4.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005
o-Xylene	ND		ppbv	1.0	2.0	1.0	05/22/08 23:50	gcmsa	AD	8E23005

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Received: 05/22/08 10:00
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ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0191-03 (085806-003/MWL-DP2-50-SG - Air)							**Sampled: 05/16/08 15:54**			
ASTM D1946 - Fixed Gases										
Methane	ND		%(v/v)	0.00017	0.00057	2.8	05/23/08 12:32	GC8	EI	8E27004

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY

Internal Lab

Page 1 of 1

Batch No. LRE01358 SMO Use

AR/COC 611871

Dept. No./Mail Stop:	4133 MS1042	Date Samples Shipped:	5-15-08	Project/Task No.:	98445/02.02.02
Project/Task Manager:	P. Freshour	Carrier/Waybill No.	89747	SMO Authorization:	BB SMO
Project Name:	MWL Remediation	Lab Contact:	Sonia Tabirara/714-258-8610	Contract #:	PO691437
Record Center Code:		Lab Destination:	Test America - CA		
Logbook Ref. No.:		SMO Contact/Phone:	P. Puisant/505-844-3185		
Service Order No.	CF013-08	Send Report to SMO:	Rita Kavanaugh 284-2553		
Location	Tech Area				
Building	Room				

☐ Waste Characterization
-Send preliminary/copy report to:

☐ Released by COC No.:
☐ Validation Required

Bill To: Sandia National Labs (Accounts Payable)
P.O. Box 5800 MS 0154
Albuquerque, NM 87185-0154

Reference LOV(available at SMO)

Sample No.-Fraction	ER Sample ID or Sample Location Detail	Pump Depth (ft)	ER Site No.	Date/Time(hr) Collected	Sample Matrix	Container Type	Container Volume	Preserv-ative	Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID
085807-001	MWL-DP3-10-SG	N/A	MWL	5/13/08 10:44	SG	SC	6L	NONE	G	SA	TO-14	
085807-002	MWL-DP3-30-SG	N/A	MWL	5/13/08 11:08	SG	SC	6L	NONE	G	SA	TO-14	
085807-003	MWL-DP3-50-SG	N/A	MWL	5/14/08 10:25	SG	SC	6L	NONE	G	SA	TO-14	

RMMA ☐ Yes ☐ No Ref. No.

Sample Disposal ☐ Return to Client ☑ Disposal by lab

Turnaround Time 30 day ☐ Normal ☐ Rush

Return Samples By: Level of Rush:

Sample Tracking Smo Use
Date Entered(mm/dd/yy):
Entered by:
QC inits.

Special Instructions/QC Requirements
EDD ☑ Yes ☐ No
Level D Package ☐ Yes ☑ No
*Send report to:

Abnormal Conditions on Receipt

Lab Use

Sample Team Members	Name	Signature	Init	Company/Organization/Phone/Cellular
	Robert Lynch		RL	Weston/4133/844-1013
	Danielle Nieto		DN	Sandia/4133/505-845-7706

*Please list as separate report.

1. Relinquished by		Org. 4133	Date 5/15/08	Time 0900	4. Relinquished by	Org.	Date Time
1. Received by		Org. 4133	Date 5-15-08	Time 0700	4. Received by	Org.	Date Time
2. Relinquished by		Org. 4133	Date 5-15-08	Time 1000	5. Relinquished by	Org.	Date Time
2. Received by		Org.	Date 5/16/08	Time 1945	5. Received by	Org.	Date Time
3. Relinquished by		Org.	Date	Time	6. Relinquished by	Org.	Date Time
3. Received by		Org.	Date	Time	6. Received by	Org.	Date Time

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Sandia National Laboratories
Payment Processing, MS 1385 P.O. Box 5130
Albuquerque, NM 87185-0154
Rita Kavanaugh

Work Order: LRE0138
Project: MWL Remediation
Project Number: 98045 02.02.02 / CF013-08

Received: 05/16/08 09:45
Reported: 05/27/08 18:58

ANALYTICAL REPORT

Sample ID: LRE0138-01 (085807-001/MWL-DP3-10-SG - Air) **Sampled: 05/13/08 10:44**

EPA TO14A - Volatile Organic Compounds by GC/MS

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Acetone	**47**		ppbv	2.5	10	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Benzene	ND		ppbv	1.5	3.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Benzyl chloride	ND		ppbv	8.0	25	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Bromodichloromethane	ND		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Bromoform	ND		ppbv	0.50	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Bromomethane	ND		ppbv	2.0	4.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
2-Butanone (MEK)	**29**		ppbv	2.0	10	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Carbon disulfide	ND		ppbv	2.0	10	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Carbon tetrachloride	ND		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Chlorobenzene	ND		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Dibromochloromethane	ND		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Chloroethane	ND		ppbv	1.5	4.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Chloroform	**3.1**		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Chloromethane	ND		ppbv	1.0	4.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
1,2-Dibromoethane (EDB)	ND		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
1,2-Dichlorobenzene	ND		ppbv	0.90	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
1,3-Dichlorobenzene	ND		ppbv	0.80	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
1,4-Dichlorobenzene	ND		ppbv	3.0	6.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Dichlorodifluoromethane	**55**		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
1,1-Dichloroethane	**2.2**		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
1,2-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
cis-1,2-Dichloroethene	ND		ppbv	0.80	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
1,1-Dichloroethene	**3.8**		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
1,2-Dichloropropane	ND		ppbv	1.5	3.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
trans-1,3-Dichloropropene	ND		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
1,2-Dichloro-1,1,2,2-tetrafluoroethane	**1.6**	J	ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Ethylbenzene	**1.6**	J	ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
4-Ethyltoluene	**17**		ppbv	0.70	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Hexachlorobutadiene	ND		ppbv	1.3	4.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
2-Hexanone	ND		ppbv	2.0	10	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Methylene chloride	ND		ppbv	0.80	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
4-Methyl-2-pentanone (MIBK)	**8.2**	J	ppbv	2.0	10	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Styrene	ND		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
1,1,2,2-Tetrachloroethane	ND		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Tetrachloroethene	**53**		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Toluene	**7.0**		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
1,2,4-Trichlorobenzene	ND		ppbv	2.5	5.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
1,1,1-Trichloroethane	**79**		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
1,1,2-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Trichloroethene	**39**		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001

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Rita Kavanaugh

Work Order: LRE0138
Project: MWL Remediation
Project Number: 98045 02.02.02 / CF013-08

Received: 05/16/08 09:45
Reported: 05/27/08 18:58

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0138-01 (085807-001/MWL-DP3-10-SG - Air) - cont.							**Sampled: 05/13/08 10:44**			
EPA TO14A - Volatile Organic Compounds by GC/MS - cont.										
1,1,2-Trichloro-1,2,2-trifluoroethane	**45**		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
1,2,4-Trimethylbenzene	**14**		ppbv	1.3	3.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
1,3,5-Trimethylbenzene	**14**		ppbv	1.1	3.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Vinyl acetate	ND		ppbv	2.0	10	1.0	05/17/08 19:11	gcmsb	AD	8E20001
Vinyl chloride	ND		ppbv	1.5	3.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
m,p-Xylene	**4.9**		ppbv	2.0	4.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001
o-Xylene	**3.2**		ppbv	1.0	2.0	1.0	05/17/08 19:11	gcmsb	AD	8E20001

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Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0138-01 (085807-001/MWL-DP3-10-SG - Air)							**Sampled: 05/13/08 10:44**			
ASTM D1946 - Fixed Gases										
Methane	ND		%(v/v)	0.00019	0.00063	3.2	05/20/08 10:25	GC8	EI	8E21003

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Received: 05/16/08 09:45
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ANALYTICAL REPORT

Sample ID: LRE0138-02 (085807-002/MWL-DP3-30-SG - Air) **Sampled: 05/13/08 11:08**

EPA TO14A - Volatile Organic Compounds by GC/MS

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Acetone	**24**		ppbv	2.5	10	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Benzene	ND		ppbv	1.5	3.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Benzyl chloride	ND		ppbv	8.0	25	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Bromodichloromethane	ND		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Bromoform	ND		ppbv	0.50	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Bromomethane	ND		ppbv	2.0	4.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
2-Butanone (MEK)	**8.2**	J	ppbv	2.0	10	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Carbon disulfide	ND		ppbv	2.0	10	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Carbon tetrachloride	ND		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Chlorobenzene	ND		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Dibromochloromethane	ND		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Chloroethane	ND		ppbv	1.5	4.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Chloroform	**6.2**		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Chloromethane	**1.0**	J	ppbv	1.0	4.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
1,2-Dibromoethane (EDB)	ND		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
1,2-Dichlorobenzene	ND		ppbv	0.90	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
1,3-Dichlorobenzene	ND		ppbv	0.80	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
1,4-Dichlorobenzene	ND		ppbv	3.0	6.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Dichlorodifluoromethane	**100**		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
1,1-Dichloroethane	**6.7**		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
1,2-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
cis-1,2-Dichloroethene	**2.0**	J	ppbv	0.80	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
1,1-Dichloroethene	**19**		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
1,2-Dichloropropane	ND		ppbv	1.5	3.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
trans-1,3-Dichloropropene	ND		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
1,2-Dichloro-1,1,2,2-tetrafluoroethane	**1.8**	J	ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Ethylbenzene	ND		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
4-Ethyltoluene	**1.3**	J	ppbv	0.70	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Hexachlorobutadiene	ND		ppbv	1.3	4.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
2-Hexanone	ND		ppbv	2.0	10	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Methylene chloride	**1.4**	J	ppbv	0.80	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
4-Methyl-2-pentanone (MIBK)	ND		ppbv	2.0	10	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Styrene	ND		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
1,1,2,2-Tetrachloroethane	ND		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Tetrachloroethene	**100**		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Toluene	**1.7**	J	ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
1,2,4-Trichlorobenzene	ND		ppbv	2.5	5.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
1,1,1-Trichloroethane	**110**		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
1,1,2-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Trichloroethene	**110**		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001

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Work Order: LRE0138
Project: MWL Remediation
Project Number: 98045 02.02.02 / CF013-08

Received: 05/16/08 09:45
Reported: 05/27/08 18:58

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0138-02 (085807-002/MWL-DP3-30-SG - Air) - cont.							**Sampled: 05/13/08 11:08**			
EPA TO14A - Volatile Organic Compounds by GC/MS - cont.										
Trichlorofluoromethane	**360**		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Trichlorofluoromethane	**310**		ppbv	6.9	14	6.9	05/19/08 13:47	gcmsb	DLK	8E21009
1,1,2-Trichloro-1,2,2-trifluoroethane	**100**		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
1,2,4-Trimethylbenzene	**1.8**	J	ppbv	1.3	3.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
1,3,5-Trimethylbenzene	**1.4**	J	ppbv	1.1	3.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Vinyl acetate	ND		ppbv	2.0	10	1.0	05/17/08 20:02	gcmsb	AD	8E20001
Vinyl chloride	ND		ppbv	1.5	3.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
m,p-Xylene	ND		ppbv	2.0	4.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001
o-Xylene	ND		ppbv	1.0	2.0	1.0	05/17/08 20:02	gcmsb	AD	8E20001

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ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0138-02 (085807-002/MWL-DP3-30-SG - Air)							**Sampled: 05/13/08 11:08**			
ASTM D1946 - Fixed Gases										
Methane	**0.022**		%(v/v)	0.00019	0.00062	3.1	05/20/08 10:41	GC8	EI	8E21003

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Project Number: 98045 02.02.02 / CF013-08

Received: 05/16/08 09:45
Reported: 05/27/08 18:58

ANALYTICAL REPORT

Sample ID: LRE0138-03 (085807-003/MWL-DP3-50-SG - Air) **Sampled: 05/14/08 10:25**

EPA TO14A - Volatile Organic Compounds by GC/MS

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Acetone	**190**		ppbv	2.5	10	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Benzene	ND		ppbv	1.5	3.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Benzyl chloride	ND		ppbv	8.0	25	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Bromodichloromethane	ND		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Bromoform	ND		ppbv	0.50	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Bromomethane	ND		ppbv	2.0	4.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
2-Butanone (MEK)	**77**		ppbv	2.0	10	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Carbon disulfide	ND		ppbv	2.0	10	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Carbon tetrachloride	ND		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Chlorobenzene	ND		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Dibromochloromethane	ND		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Chloroethane	ND		ppbv	1.5	4.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Chloroform	**6.7**		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Chloromethane	ND		ppbv	1.0	4.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
1,2-Dibromoethane (EDB)	ND		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
1,2-Dichlorobenzene	ND		ppbv	0.90	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
1,3-Dichlorobenzene	ND		ppbv	0.80	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
1,4-Dichlorobenzene	ND		ppbv	3.0	6.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Dichlorodifluoromethane	**110**		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
1,1-Dichloroethane	**8.9**		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
1,2-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
cis-1,2-Dichloroethene	**3.0**		ppbv	0.80	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
1,1-Dichloroethene	**25**		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
1,2-Dichloropropane	ND		ppbv	1.5	3.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
trans-1,3-Dichloropropene	ND		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Ethylbenzene	**1.2**	J	ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
4-Ethyltoluene	**3.3**		ppbv	0.70	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Hexachlorobutadiene	ND		ppbv	1.3	4.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
2-Hexanone	ND		ppbv	2.0	10	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Methylene chloride	**1.7**	J	ppbv	0.80	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
4-Methyl-2-pentanone (MIBK)	**7.9**	J	ppbv	2.0	10	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Styrene	ND		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
1,1,2,2-Tetrachloroethane	ND		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Tetrachloroethene	**120**		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Toluene	**3.3**		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
1,2,4-Trichlorobenzene	ND		ppbv	2.5	5.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
1,1,1-Trichloroethane	**120**		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
1,1,2-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Trichloroethene	**140**		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001

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Sandia National Laboratories
Payment Processing, MS 1385 P.O. Box 5130
Albuquerque, NM 87185-0154
Rita Kavanaugh

Work Order: LRE0138
Project: MWL Remediation
Project Number: 98045 02.02.02 / CF013-08

Received: 05/16/08 09:45
Reported: 05/27/08 18:58

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0138-03 (085807-003/MWL-DP3-50-SG - Air) - cont.							**Sampled: 05/14/08 10:25**			
EPA TO14A - Volatile Organic Compounds by GC/MS - cont.										
Trichlorofluoromethane	**390**		ppbv	6.4	13	6.4	05/19/08 14:24	gcmsb	DLK	8E21009
1,1,2-Trichloro-1,2,2-trifluoroethane	**110**		ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
1,2,4-Trimethylbenzene	**6.1**		ppbv	1.3	3.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
1,3,5-Trimethylbenzene	**2.7**	J	ppbv	1.1	3.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Vinyl acetate	ND		ppbv	2.0	10	1.0	05/17/08 20:47	gcmsb	AD	8E20001
Vinyl chloride	ND		ppbv	1.5	3.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
m,p-Xylene	**4.3**		ppbv	2.0	4.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001
o-Xylene	**2.0**	J	ppbv	1.0	2.0	1.0	05/17/08 20:47	gcmsb	AD	8E20001

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ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0138-03 (085807-003/MWL-DP3-50-SG - Air)							**Sampled: 05/14/08 10:25**			
ASTM D1946 - Fixed Gases										
Methane	0.54		%(v/v)	0.00015	0.00051	2.6	05/20/08 10:55	GC8	EI	8E21003

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY

Internal Lab

Batch No. WRE0192 SMO Use

AR/COC 611876

Dept. No./Mail Stop:	6765/MS1089	Date Samples Shipped:	5-21-08	Project/Task No.:	98045/02.02.02
Project/Task Manager:	P. Freshour	Carrier/Waybill No.	89838	SMO Authorization:	
Project Name:	MWL Remediation	Lab Contact:	TRUPTI MISTRY	Contract #:	PO691437
Record Center Code:		Lab Destination:	Test America CA, SANTA ANA		
Logbook Ref. No.:		SMO Contact/Phone:	P. Puisant/505-844-3185		
Service Order No.	CF013-08	Send Report to SMO:	Rita Kavanaugh 284-2553		
Location	Tech Area				
Building	Room				

☐ **Waste Characterization**
-Send preliminary/copy report to:

☐ **Released by COC No.:**_____

☐ **Validation Required**

Bill To:Sandia National Labs (Accounts Payable)
P.O. Box 5800 MS 0154
Albuquerque, NM 87185-0154

Reference LOV(available at SMO)

Sample No.-Fraction	ER Sample ID or Sample Location Detail	Pump Depth (ft)	ER Site No.	Date/Time(hr) Collected	Sample Matrix	Container Type	Container Volume	Preserv-ative	Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID
085808-001	MWL-DP4-10-SG	N/A	MWL	5/19/08 1538	SG	SC	6L	NONE	G	SA	TO-14	
085808-002	MWL-DP4-30-SG	N/A	MWL	5/19/08 1614	SG	SC	6L	NONE	G	SA	TO-14	

RMMA ☑ Yes ☐ No Ref. No.

Sample Disposal ☐ Return to Client ☑ Disposal by lab

Turnaround Time 30 day ☑ Normal ☐ Rush

Sample Tracking Smo Use
Date Entered(mm/dd/yy)
Entered by:

Special Instructions/QC Requirements
EDD ☑ Yes ☐ No
Level D Package ☐ Yes ☑ No

Abnormal Conditions on Receipt

Return Samples By: Level of Rush: QC inits.

Sample Team Members	Name	Signature	Init	Company/Organization/Phone/Cellular
	Robert Lynch		RL	Weston/4133/505-844-1013
	Bill Gibson			Weston/4133/505-284-5232

***Send report to:**

***Please list as separate report.**

Lab Use

1.Relinquished by		Org. 4133	Date 5/21/08	Time 0830	4.Relinquished by		Org.	Date	Time
1. Received by		Org. 4133	Date 5/21/08	Time 0830	4. Received by		Org.	Date	Time
2.Relinquished by		Org. 4133	Date 5/21/08	Time 1100	5.Relinquished by		Org.	Date	Time
2. Received by		Org.	Date 5/22/08	Time 1030	5. Received by		Org.	Date	Time
3.Relinquished by		Org.	Date	Time	6.Relinquished by		Org.	Date	Time
3. Received by		Org.	Date	Time	6. Received by		Org.	Date	Time

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Rita Kavanaugh

Work Order: LRE0192
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/22/08 10:00
Reported: 05/28/08 16:36

ANALYTICAL REPORT

Sample ID: LRE0192-01 (085808-001/MWL-DP4-10-SG - Air) **Sampled: 05/19/08 15:38**

EPA TO14A - Volatile Organic Compounds by GC/MS

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Acetone	**20**		ppbv	2.5	10	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Benzene	ND		ppbv	1.5	3.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Benzyl chloride	ND		ppbv	8.0	25	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Bromodichloromethane	ND		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Bromoform	ND		ppbv	0.50	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Bromomethane	ND		ppbv	2.0	4.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
2-Butanone (MEK)	**7.5**	J	ppbv	2.0	10	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Carbon disulfide	**3.1**	J	ppbv	2.0	10	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Carbon tetrachloride	ND		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Chlorobenzene	ND		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Dibromochloromethane	ND		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Chloroethane	ND		ppbv	1.5	4.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Chloroform	**1.0**	J	ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Chloromethane	ND		ppbv	1.0	4.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
1,2-Dibromoethane (EDB)	ND		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
1,2-Dichlorobenzene	ND		ppbv	0.90	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
1,3-Dichlorobenzene	ND		ppbv	0.80	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
1,4-Dichlorobenzene	ND		ppbv	3.0	6.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Dichlorodifluoromethane	**70**		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
1,1-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
1,2-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
cis-1,2-Dichloroethene	ND		ppbv	0.80	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
1,1-Dichloroethene	**2.9**		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
1,2-Dichloropropane	ND		ppbv	1.5	3.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
trans-1,3-Dichloropropene	ND		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Ethylbenzene	ND		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
4-Ethyltoluene	ND		ppbv	0.70	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Hexachlorobutadiene	ND		ppbv	1.3	4.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
2-Hexanone	ND		ppbv	2.0	10	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Methylene chloride	**0.95**	J	ppbv	0.80	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
4-Methyl-2-pentanone (MIBK)	ND		ppbv	2.0	10	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Styrene	ND		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
1,1,2,2-Tetrachloroethane	ND		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Tetrachloroethene	**120**		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Toluene	**1.8**	J	ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
1,2,4-Trichlorobenzene	ND		ppbv	2.5	5.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
1,1,1-Trichloroethane	**32**		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
1,1,2-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Trichloroethene	**34**		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005

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Rita Kavanaugh

Work Order: LRE0192
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/22/08 10:00
Reported: 05/28/08 16:36

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0192-01 (085808-001/MWL-DP4-10-SG - Air) - cont.							**Sampled: 05/19/08 15:38**			
EPA TO14A - Volatile Organic Compounds by GC/MS - cont.										
Trichlorofluoromethane	**83**		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
1,1,2-Trichloro-1,2,2-trifluoroethane	**71**		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
1,2,4-Trimethylbenzene	ND		ppbv	1.3	3.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
1,3,5-Trimethylbenzene	ND		ppbv	1.1	3.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Vinyl acetate	ND		ppbv	2.0	10	1.0	05/23/08 00:34	gcmsa	AD	8E23005
Vinyl chloride	ND		ppbv	1.5	3.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
m,p-Xylene	ND		ppbv	2.0	4.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005
o-Xylene	ND		ppbv	1.0	2.0	1.0	05/23/08 00:34	gcmsa	AD	8E23005

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Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0192-01 (085808-001/MWL-DP4-10-SG - Air)							**Sampled: 05/19/08 15:38**			
ASTM D1946 - Fixed Gases										
Methane	ND		%(v/v)	0.00019	0.00062	3.1	05/23/08 17:01	GC8	EI	8E27004

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ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0192-02 (085808-002/MWL-DP4-30-SG - Air)							**Sampled: 05/19/08 16:14**			
EPA TO14A - Volatile Organic Compounds by GC/MS										
Acetone	**84**		ppbv	2.5	10	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Benzene	**19**		ppbv	1.5	3.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Benzyl chloride	ND		ppbv	8.0	25	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Bromodichloromethane	ND		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Bromoform	ND		ppbv	0.50	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Bromomethane	ND		ppbv	2.0	4.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
2-Butanone (MEK)	**21**		ppbv	2.0	10	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Carbon disulfide	ND		ppbv	2.0	10	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Carbon tetrachloride	ND		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Chlorobenzene	ND		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Dibromochloromethane	ND		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Chloroethane	ND		ppbv	1.5	4.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Chloroform	**2.5**		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Chloromethane	ND		ppbv	1.0	4.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
1,2-Dibromoethane (EDB)	ND		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
1,2-Dichlorobenzene	ND		ppbv	0.90	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
1,3-Dichlorobenzene	ND		ppbv	0.80	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
1,4-Dichlorobenzene	ND		ppbv	3.0	6.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Dichlorodifluoromethane	**110**		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
1,1-Dichloroethane	**2.9**		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
1,2-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
cis-1,2-Dichloroethene	**2.0**	J	ppbv	0.80	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
1,1-Dichloroethene	**11**		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
1,2-Dichloropropane	ND		ppbv	1.5	3.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
trans-1,3-Dichloropropene	ND		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Ethylbenzene	**1.9**	J	ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
4-Ethyltoluene	**1.7**	J	ppbv	0.70	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Hexachlorobutadiene	ND		ppbv	1.3	4.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
2-Hexanone	ND		ppbv	2.0	10	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Methylene chloride	**1.4**	J	ppbv	0.80	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
4-Methyl-2-pentanone (MIBK)	ND		ppbv	2.0	10	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Styrene	ND		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
1,1,2,2-Tetrachloroethane	ND		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Tetrachloroethene	**190**		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Toluene	**22**		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
1,2,4-Trichlorobenzene	ND		ppbv	2.5	5.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
1,1,1-Trichloroethane	**46**		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
1,1,2-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Trichloroethene	**100**		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005

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Reported: 05/28/08 16:36

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0192-02 (085808-002/MWL-DP4-30-SG - Air) - cont.							**Sampled: 05/19/08 16:14**			
EPA TO14A - Volatile Organic Compounds by GC/MS - cont.										
Trichlorofluoromethane	**140**		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
1,1,2-Trichloro-1,2,2-trifluoroethane	**120**		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
1,2,4-Trimethylbenzene	**2.3**	J	ppbv	1.3	3.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
1,3,5-Trimethylbenzene	**1.4**	J	ppbv	1.1	3.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Vinyl acetate	ND		ppbv	2.0	10	1.0	05/23/08 01:17	gcmsa	AD	8E23005
Vinyl chloride	ND		ppbv	1.5	3.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
m,p-Xylene	**11**		ppbv	2.0	4.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005
o-Xylene	**2.5**		ppbv	1.0	2.0	1.0	05/23/08 01:17	gcmsa	AD	8E23005

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1721 South Grand Avenue Santa Ana, CA 92705 * 714-258-8610 * Fax 714-258-0921

Sandia National Laboratories
Payment Processing, MS 1385 P.O. Box 5130
Albuquerque, NM 87185-0154
Rita Kavanaugh

Work Order: LRE0192
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/22/08 10:00
Reported: 05/28/08 16:36

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0192-02 (085808-002/MWL-DP4-30-SG - Air)							**Sampled: 05/19/08 16:14**			
ASTM D1946 - Fixed Gases										
Methane	**0.00046**	J	%(v/v)	0.00017	0.00056	2.8	05/23/08 17:14	GC8	EI	8E27004

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY

Internal Lab

Batch No. N/A

SMO Use LRE0127

AR/COC 611870

Dept. No./Mail Stop:	4133/MS-1042	Date Samples Shipped:	5-12-08	Project/Task No.:	98045 02.02.02.
Project/Task Manager:		Carrier/Waybill No.	89633	SMO Authorization:	Signature SMO
Project Name:		Lab Contact:	Sonia Tabirara/714-258-8610	Contract #:	TO 37 Amendment 4 PO691437
Record Center Code:	ER/1345/DAT	Lab Destination:	Test America SANTA ANA CA.		
Logbook Ref. No.:	003	SMO Contact/Phone:	P. Pulsant/505-844-3185		see battle order
Service Order No.	CF029-08	Send Report to SMO:	Rita Kavanaugh 284-2553		
Location	Tech Area	Reference LOV(available at SMO)			
Building	Room				

☐ Waste Characterization
-Send preliminary/copy report to:

☐ Released by COC No.:
☐ Validation Required

Bill To:Sandia National Labs (Accounts Payable)
P.O. Box 5800 MS 0154
Albuquerque, NM 87185-0154

Sample No.-Fraction	ER Sample ID or Sample Location Detail	Pump Depth (ft)	ER Site No.	Date/Time(hr) Collected	Sample Matrix	Container Type	Container Volume	Preserv-ative	Collection Method	Sample Type	Parameter & Method Requested		Lab Sample ID
085809-001	MWL-DP5-10-SG	N/A	MWL	5/8/08 14:30	SG	SC	6L	NONE	G	SA	TO-14		
085809-002	MWL-DP5-30-SG	N/A	MWL	5/9/08 09:00	SG	SC	6L	NONE	G	SA	TO-14		
085809-003	MWL-DP5-50-SG	N/A	MWL	5/9/08 09:37	SG	SC	6L	NONE	G	SA	TO-14		
085813-001	MWL-DP5-10-SG-DUP	N/A	MWL	5/9/08 10:16	SG	SC	6L	NONE	G	SA	TO-14		
085813-002	MWL-DP5-30-SG-DUP	N/A	MWL	5/9/08 09:02	SG	SC	6L	NONE	G	SA	TO-14		
085813-003	MWL-DP5-50-SG-DUP	N/A	MWL	5/9/08 09:39	SG	SC	6L	NONE	G	SA	TO-14		

RMMA ☐ Yes ☑ No Ref. No.

Sample Disposal ☐ Return to Client ☑ Disposal by lab

Turnaround Time 30 day ~~☑ Normal~~ ☒ Rush

Return Samples By: ASAP Level of Rush: 15 DAY

Sample Tracking Smo Use
Date Entered(mm/dd/yy)
Entered by:
QC inits.

Special Instructions/QC Requirements
EDD ☑ Yes ☐ No
Level D Package ☐ Yes ☑ No
*Send report to:

Abnormal Conditions on Receipt

Lab Use

Sample Team Members	Name	Signature	Init	Company/Organization/Phone/Cellular
	Robert Lynch	Robert Lynch	RL	?/4133/844-1013
	Danielle Nieto	Danielle M Nieto	DN	Sandia/4133/505-845-7706

*Please list as separate report.

1.Relinquished by	Danielle M Nieto	Org.	4133	Date	5/12/08	Time	1145	4.Relinquished by		Org.	Date	Time
1. Received by	Robert Lynch SMO	Org.	4133	Date	5/12/08	Time	1145	4. Received by		Org.	Date	Time
2.Relinquished by	Robert Lynch SMO	Org.	4133	Date	5/12/08	Time	1238	5.Relinquished by		Org.	Date	Time
2. Received by		Org.		Date	5/15/08	Time	1200	5. Received by		Org.	Date	Time
3.Relinquished by		Org.		Date		Time		6.Relinquished by		Org.	Date	Time
3. Received by		Org.		Date		Time		6. Received by		Org.	Date	Time

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Sandia National Laboratories
Payment Processing, MS 1385 P.O. Box 5130
Albuquerque, NM 87185-0154
Rita Kavanaugh

Work Order: LRE0127
Project: MWL Remediation
Project Number: 98045 02.02.02 / CF013-08

Received: 05/15/08 12:00
Reported: 05/27/08 17:11

ANALYTICAL REPORT

Sample ID: LRE0127-01 (085809-001/MWL-DP5-10-SG - Air) **Sampled: 05/08/08 14:30**

EPA TO14A - Volatile Organic Compounds by GC/MS

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Acetone	**11**		ppbv	2.5	10	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Benzene	ND		ppbv	1.5	3.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Benzyl chloride	ND		ppbv	8.0	25	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Bromodichloromethane	ND		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Bromoform	ND		ppbv	0.50	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Bromomethane	ND		ppbv	2.0	4.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
2-Butanone (MEK)	**2.8**	J	ppbv	2.0	10	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Carbon disulfide	**2.4**	J	ppbv	2.0	10	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Carbon tetrachloride	ND		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Chlorobenzene	ND		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Dibromochloromethane	ND		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Chloroethane	ND		ppbv	1.5	4.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Chloroform	**1.2**	J	ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Chloromethane	ND		ppbv	1.0	4.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
1,2-Dibromoethane (EDB)	ND		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
1,2-Dichlorobenzene	ND		ppbv	0.90	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
1,3-Dichlorobenzene	ND		ppbv	0.80	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
1,4-Dichlorobenzene	ND		ppbv	3.0	6.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Dichlorodifluoromethane	**40**		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
1,1-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
1,2-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
cis-1,2-Dichloroethene	ND		ppbv	0.80	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
1,1-Dichloroethene	ND		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
1,2-Dichloropropane	ND		ppbv	1.5	3.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
trans-1,3-Dichloropropene	ND		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Ethylbenzene	ND		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
4-Ethyltoluene	ND		ppbv	0.70	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Hexachlorobutadiene	ND		ppbv	1.3	4.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
2-Hexanone	ND		ppbv	2.0	10	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Methylene chloride	ND		ppbv	0.80	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
4-Methyl-2-pentanone (MIBK)	ND		ppbv	2.0	10	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Styrene	ND		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
1,1,2,2-Tetrachloroethane	ND		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Tetrachloroethene	**160**		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Toluene	ND		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
1,2,4-Trichlorobenzene	ND		ppbv	2.5	5.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
1,1,1-Trichloroethane	**79**		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
1,1,2-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Trichloroethene	**10**		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005

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Rita Kavanaugh

Work Order: LRE0127
Project: MWL Remediation
Project Number: 98045 02.02.02 / CF013-08

Received: 05/15/08 12:00
Reported: 05/27/08 17:11

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0127-01 (085809-001/MWL-DP5-10-SG - Air) - cont.							**Sampled: 05/08/08 14:30**			
EPA TO14A - Volatile Organic Compounds by GC/MS - cont.										
Trichlorofluoromethane	**24**		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
1,1,2-Trichloro-1,2,2-trifluoroethane	**36**		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
1,2,4-Trimethylbenzene	ND		ppbv	1.3	3.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
1,3,5-Trimethylbenzene	ND		ppbv	1.1	3.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Vinyl acetate	ND		ppbv	2.0	10	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
Vinyl chloride	ND		ppbv	1.5	3.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
m,p-Xylene	ND		ppbv	2.0	4.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005
o-Xylene	ND		ppbv	1.0	2.0	1.0	05/15/08 23:55	gcmsb	DLK	8E16005

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Rita Kavanaugh

Work Order: LRE0127
Project: MWL Remediation
Project Number: 98045 02.02.02 / CF013-08

Received: 05/15/08 12:00
Reported: 05/27/08 17:11

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0127-01 (085809-001/MWL-DP5-10-SG - Air)							**Sampled: 05/08/08 14:30**			
ASTM D1946 - Fixed Gases										
Methane	ND		%(v/v)	0.00014	0.00045	2.3	05/15/08 14:47	GC8-Rear	EI	8E16006

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Project: MWL Remediation
Project Number: 98045 02.02.02 / CF013-08

Received: 05/15/08 12:00
Reported: 05/27/08 17:11

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0127-02 (085809-002/MWL-DP5-30-SG - Air)							**Sampled: 05/09/08 09:00**			
EPA TO14A - Volatile Organic Compounds by GC/MS										
Acetone	**33**		ppbv	2.5	10	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Benzene	**3.2**		ppbv	1.5	3.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Benzyl chloride	ND		ppbv	8.0	25	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Bromodichloromethane	ND		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Bromoform	ND		ppbv	0.50	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Bromomethane	ND		ppbv	2.0	4.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
2-Butanone (MEK)	**10**		ppbv	2.0	10	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Carbon disulfide	ND		ppbv	2.0	10	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Carbon tetrachloride	ND		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Chlorobenzene	ND		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Dibromochloromethane	ND		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Chloroethane	ND		ppbv	1.5	4.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Chloroform	**4.8**		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Chloromethane	ND		ppbv	1.0	4.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
1,2-Dibromoethane (EDB)	ND		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
1,2-Dichlorobenzene	ND		ppbv	0.90	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
1,3-Dichlorobenzene	ND		ppbv	0.80	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
1,4-Dichlorobenzene	ND		ppbv	3.0	6.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Dichlorodifluoromethane	**100**		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
1,1-Dichloroethane	**3.6**		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
1,2-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
cis-1,2-Dichloroethene	**1.3**	J	ppbv	0.80	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
1,1-Dichloroethene	**5.7**		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
1,2-Dichloropropane	ND		ppbv	1.5	3.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
trans-1,3-Dichloropropene	ND		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Ethylbenzene	ND		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
4-Ethyltoluene	**0.89**	J	ppbv	0.70	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Hexachlorobutadiene	ND		ppbv	1.3	4.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
2-Hexanone	ND		ppbv	2.0	10	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Methylene chloride	ND		ppbv	0.80	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
4-Methyl-2-pentanone (MIBK)	ND		ppbv	2.0	10	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Styrene	ND		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
1,1,2,2-Tetrachloroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Tetrachloroethene	**370**		ppbv	4.2	8.5	4.2	05/16/08 16:41	gcmsb	DLK	8E17001
Toluene	**4.0**		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
1,2,4-Trichlorobenzene	ND		ppbv	2.5	5.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
1,1,1-Trichloroethane	**150**		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
1,1,2-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Trichloroethene	**68**		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005

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Work Order: LRE0127
Project: MWL Remediation
Project Number: 98045 02.02.02 / CF013-08

Received: 05/15/08 12:00
Reported: 05/27/08 17:11

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0127-02 (085809-002/MWL-DP5-30-SG - Air) - cont.							**Sampled: 05/09/08 09:00**			
EPA TO14A - Volatile Organic Compounds by GC/MS - cont.										
Trichlorofluoromethane	**52**		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
1,1,2-Trichloro-1,2,2-trifluoroethane	**90**		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
1,2,4-Trimethylbenzene	**1.3**	J	ppbv	1.3	3.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
1,3,5-Trimethylbenzene	ND		ppbv	1.1	3.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Vinyl acetate	ND		ppbv	2.0	10	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
Vinyl chloride	ND		ppbv	1.5	3.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
m,p-Xylene	**2.9**	J	ppbv	2.0	4.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005
o-Xylene	ND		ppbv	1.0	2.0	1.0	05/16/08 00:42	gcmsb	DLK	8E16005

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Albuquerque, NM 87185-0154
Rita Kavanaugh

Work Order: LRE0127
Project: MWL Remediation
Project Number: 98045 02.02.02 / CF013-08

Received: 05/15/08 12:00
Reported: 05/27/08 17:11

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0127-02 (085809-002/MWL-DP5-30-SG - Air)							**Sampled: 05/09/08 09:00**			
ASTM D1946 - Fixed Gases										
Methane	**0.00022**	J	%(v/v)	0.00013	0.00042	2.1	05/15/08 15:04	GC8-Rear	EI	8E16006

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Work Order: LRE0127
Project: MWL Remediation
Project Number: 98045 02.02.02 / CF013-08

Received: 05/15/08 12:00
Reported: 05/27/08 17:11

ANALYTICAL REPORT

Sample ID: LRE0127-03 (085809-003/MWL-DP5-50-SG - Air) **Sampled: 05/09/08 09:37**

EPA TO14A - Volatile Organic Compounds by GC/MS

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Acetone	**38**		ppbv	2.6	10	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Benzene	ND		ppbv	1.5	3.1	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Benzyl chloride	ND		ppbv	8.2	26	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Bromodichloromethane	ND		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Bromoform	ND		ppbv	0.51	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Bromomethane	ND		ppbv	2.0	4.1	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
2-Butanone (MEK)	**15**		ppbv	2.0	10	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Carbon disulfide	ND		ppbv	2.0	10	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Carbon tetrachloride	ND		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Chlorobenzene	ND		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Dibromochloromethane	ND		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Chloroethane	ND		ppbv	1.5	4.1	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Chloroform	ND		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Chloromethane	ND		ppbv	1.0	4.1	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
1,2-Dibromoethane (EDB)	ND		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
1,2-Dichlorobenzene	ND		ppbv	0.92	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
1,3-Dichlorobenzene	ND		ppbv	0.82	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
1,4-Dichlorobenzene	ND		ppbv	3.1	6.1	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Dichlorodifluoromethane	**2.3**		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
1,1-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
1,2-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
cis-1,2-Dichloroethene	ND		ppbv	0.82	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
1,1-Dichloroethene	ND		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
1,2-Dichloropropane	ND		ppbv	1.5	3.1	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.1	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
trans-1,3-Dichloropropene	ND		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Ethylbenzene	ND		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
4-Ethyltoluene	ND		ppbv	0.72	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Hexachlorobutadiene	ND		ppbv	1.3	4.1	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
2-Hexanone	ND		ppbv	2.0	10	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Methylene chloride	ND		ppbv	0.82	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
4-Methyl-2-pentanone (MIBK)	ND		ppbv	2.0	10	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Styrene	ND		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
1,1,2,2-Tetrachloroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Tetrachloroethene	**4.3**		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Toluene	**1.3**	J	ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
1,2,4-Trichlorobenzene	ND		ppbv	2.6	5.1	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
1,1,1-Trichloroethane	**1.2**	J	ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
1,1,2-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Trichloroethene	**1.6**	J	ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005

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Rita Kavanaugh

Work Order: LRE0127
Project: MWL Remediation
Project Number: 98045 02.02.02 / CF013-08

Received: 05/15/08 12:00
Reported: 05/27/08 17:11

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0127-03 (085809-003/MWL-DP5-50-SG - Air) - cont.							**Sampled: 05/09/08 09:37**			
EPA TO14A - Volatile Organic Compounds by GC/MS - cont.										
Trichlorofluoromethane	**1.3**	J	ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
1,1,2-Trichloro-1,2,2-trifluoroethane	**2.0**	J	ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
1,2,4-Trimethylbenzene	ND		ppbv	1.3	3.1	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
1,3,5-Trimethylbenzene	ND		ppbv	1.1	3.1	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Vinyl acetate	ND		ppbv	2.0	10	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
Vinyl chloride	ND		ppbv	1.5	3.1	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
m,p-Xylene	ND		ppbv	2.0	4.1	1.0	05/16/08 01:28	gcmsb	DLK	8E16005
o-Xylene	ND		ppbv	1.0	2.0	1.0	05/16/08 01:28	gcmsb	DLK	8E16005

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ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0127-03 (085809-003/MWL-DP5-50-SG - Air)							**Sampled: 05/09/08 09:37**			
ASTM D1946 - Fixed Gases										
Methane	**0.00018**	J	%(v/v)	0.00013	0.00044	2.2	05/15/08 15:17	GC8-Rear	EI	8E16006

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ANALYTICAL REPORT

Sample ID: LRE0127-04 (085813-001/MWL-DP5-10-SG-DUP - Air) **Sampled: 05/09/08 10:16**

EPA TO14A - Volatile Organic Compounds by GC/MS

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Acetone	**25**		ppbv	2.5	10	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Benzene	ND		ppbv	1.5	3.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Benzyl chloride	ND		ppbv	8.0	25	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Bromodichloromethane	ND		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Bromoform	ND		ppbv	0.50	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Bromomethane	ND		ppbv	2.0	4.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
2-Butanone (MEK)	**6.9**	J	ppbv	2.0	10	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Carbon disulfide	ND		ppbv	2.0	10	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Carbon tetrachloride	ND		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Chlorobenzene	ND		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Dibromochloromethane	ND		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Chloroethane	ND		ppbv	1.5	4.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Chloroform	**2.4**		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Chloromethane	ND		ppbv	1.0	4.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
1,2-Dibromoethane (EDB)	ND		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
1,2-Dichlorobenzene	ND		ppbv	0.90	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
1,3-Dichlorobenzene	ND		ppbv	0.80	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
1,4-Dichlorobenzene	ND		ppbv	3.0	6.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Dichlorodifluoromethane	**24**		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
1,1-Dichloroethane	**1.1**	J	ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
1,2-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
cis-1,2-Dichloroethene	ND		ppbv	0.80	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
1,1-Dichloroethene	**1.2**	J	ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
1,2-Dichloropropane	ND		ppbv	1.5	3.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
trans-1,3-Dichloropropene	ND		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Ethylbenzene	ND		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
4-Ethyltoluene	ND		ppbv	0.70	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Hexachlorobutadiene	ND		ppbv	1.3	4.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
2-Hexanone	ND		ppbv	2.0	10	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Methylene chloride	ND		ppbv	0.80	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
4-Methyl-2-pentanone (MIBK)	ND		ppbv	2.0	10	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Styrene	ND		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
1,1,2,2-Tetrachloroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Tetrachloroethene	**380**		ppbv	4.3	8.6	4.3	05/16/08 18:55	gcmsb	DLK	8E17001
Toluene	ND		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
1,2,4-Trichlorobenzene	ND		ppbv	2.5	5.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
1,1,1-Trichloroethane	**150**		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
1,1,2-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Trichloroethene	**20**		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001

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Received: 05/15/08 12:00
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ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0127-04 (085813-001/MWL-DP5-10-SG-DUP - Air) - cont.							**Sampled: 05/09/08 10:16**			
EPA TO14A - Volatile Organic Compounds by GC/MS - cont.										
Trichlorofluoromethane	**53**		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
1,1,2-Trichloro-1,2,2-trifluoroethane	**72**		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
1,2,4-Trimethylbenzene	ND		ppbv	1.3	3.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
1,3,5-Trimethylbenzene	ND		ppbv	1.1	3.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Vinyl acetate	ND		ppbv	2.0	10	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
Vinyl chloride	ND		ppbv	1.5	3.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
m,p-Xylene	ND		ppbv	2.0	4.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001
o-Xylene	ND		ppbv	1.0	2.0	1.0	05/16/08 17:28	gcmsb	DLK	8E17001

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ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0127-04 (085813-001/MWL-DP5-10-SG-DUP - Air)							**Sampled: 05/09/08 10:16**			
ASTM D1946 - Fixed Gases										
Methane	ND		%(v/v)	0.00013	0.00043	2.2	05/15/08 15:32	GC8-Rear	EI	8E16006

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ANALYTICAL REPORT

Sample ID: LRE0127-05 (085813-002/MWL-DP5-30-SG-DUP - Air) **Sampled: 05/09/08 09:02**

EPA TO14A - Volatile Organic Compounds by GC/MS

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Acetone	**36**		ppbv	2.5	9.9	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Benzene	**3.1**		ppbv	1.5	3.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Benzyl chloride	ND		ppbv	7.9	25	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Bromodichloromethane	ND		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Bromoform	ND		ppbv	0.50	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Bromomethane	ND		ppbv	2.0	4.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
2-Butanone (MEK)	**13**		ppbv	2.0	9.9	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Carbon disulfide	ND		ppbv	2.0	9.9	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Carbon tetrachloride	ND		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Chlorobenzene	ND		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Dibromochloromethane	ND		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Chloroethane	ND		ppbv	1.5	4.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Chloroform	**5.1**		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Chloromethane	ND		ppbv	0.99	4.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
1,2-Dibromoethane (EDB)	ND		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
1,2-Dichlorobenzene	ND		ppbv	0.89	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
1,3-Dichlorobenzene	ND		ppbv	0.79	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
1,4-Dichlorobenzene	ND		ppbv	3.0	6.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Dichlorodifluoromethane	**110**		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
1,1-Dichloroethane	**3.8**		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
1,2-Dichloroethane	ND		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
cis-1,2-Dichloroethene	**1.3**	J	ppbv	0.79	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
1,1-Dichloroethene	**6.3**		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
1,2-Dichloropropane	ND		ppbv	1.5	3.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
trans-1,3-Dichloropropene	ND		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Ethylbenzene	ND		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
4-Ethyltoluene	**0.88**	J	ppbv	0.70	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Hexachlorobutadiene	ND		ppbv	1.3	4.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
2-Hexanone	ND		ppbv	2.0	9.9	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Methylene chloride	**0.94**	J	ppbv	0.79	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
4-Methyl-2-pentanone (MIBK)	ND		ppbv	2.0	9.9	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Styrene	ND		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
1,1,2,2-Tetrachloroethane	ND		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Tetrachloroethene	**370**		ppbv	4.4	8.7	4.4	05/17/08 00:26	gcmsb	DLK	8E17001
Toluene	**4.0**		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
1,2,4-Trichlorobenzene	ND		ppbv	2.5	5.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
1,1,1-Trichloroethane	**150**		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
1,1,2-Trichloroethane	ND		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Trichloroethene	**71**		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001

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Sandia National Laboratories
Payment Processing, MS 1385 P.O. Box 5130
Albuquerque, NM 87185-0154
Rita Kavanaugh

Work Order: LRE0127
Project: MWL Remediation
Project Number: 98045 02.02.02 / CF013-08

Received: 05/15/08 12:00
Reported: 05/27/08 17:11

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0127-05 (085813-002/MWL-DP5-30-SG-DUP - Air) - cont.							**Sampled: 05/09/08 09:02**			
EPA TO14A - Volatile Organic Compounds by GC/MS - cont.										
Trichlorofluoromethane	**56**		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
1,1,2-Trichloro-1,2,2-trifluoroethane	**94**		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
1,2,4-Trimethylbenzene	**1.3**	J	ppbv	1.3	3.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
1,3,5-Trimethylbenzene	ND		ppbv	1.1	3.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Vinyl acetate	ND		ppbv	2.0	9.9	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
Vinyl chloride	ND		ppbv	1.5	3.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
m,p-Xylene	**3.0**	J	ppbv	2.0	4.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001
o-Xylene	ND		ppbv	0.99	2.0	0.99	05/16/08 18:14	gcmsb	DLK	8E17001

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Work Order: LRE0127
Project: MWL Remediation
Project Number: 98045 02.02.02 / CF013-08

Received: 05/15/08 12:00
Reported: 05/27/08 17:11

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0127-05 (085813-002/MWL-DP5-30-SG-DUP - Air)							**Sampled: 05/09/08 09:02**			
ASTM D1946 - Fixed Gases										
Methane	**0.00022**	J	%(v/v)	0.00013	0.00044	2.2	05/15/08 15:58	GC8-Rear	EI	8E16006

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Work Order: LRE0127
Project: MWL Remediation
Project Number: 98045 02.02.02 / CF013-08

Received: 05/15/08 12:00
Reported: 05/27/08 17:11

ANALYTICAL REPORT

Sample ID: LRE0127-06 (085813-003/MWL-DP5-50-SG-DUP - Air) **Sampled: 05/09/08 09:39**

EPA TO14A - Volatile Organic Compounds by GC/MS

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Acetone	**39**		ppbv	2.5	10	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Benzene	ND		ppbv	1.5	3.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Benzyl chloride	ND		ppbv	8.0	25	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Bromodichloromethane	ND		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Bromoform	ND		ppbv	0.50	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Bromomethane	ND		ppbv	2.0	4.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
2-Butanone (MEK)	**16**		ppbv	2.0	10	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Carbon disulfide	ND		ppbv	2.0	10	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Carbon tetrachloride	ND		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Chlorobenzene	ND		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Dibromochloromethane	ND		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Chloroethane	ND		ppbv	1.5	4.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Chloroform	ND		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Chloromethane	ND		ppbv	1.0	4.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
1,2-Dibromoethane (EDB)	ND		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
1,2-Dichlorobenzene	ND		ppbv	0.90	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
1,3-Dichlorobenzene	ND		ppbv	0.80	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
1,4-Dichlorobenzene	ND		ppbv	3.0	6.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Dichlorodifluoromethane	**2.6**		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
1,1-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
1,2-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
cis-1,2-Dichloroethene	ND		ppbv	0.80	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
1,1-Dichloroethene	ND		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
1,2-Dichloropropane	ND		ppbv	1.5	3.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
trans-1,3-Dichloropropene	ND		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Ethylbenzene	ND		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
4-Ethyltoluene	ND		ppbv	0.70	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Hexachlorobutadiene	ND		ppbv	1.3	4.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
2-Hexanone	ND		ppbv	2.0	10	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Methylene chloride	ND		ppbv	0.80	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
4-Methyl-2-pentanone (MIBK)	ND		ppbv	2.0	10	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Styrene	ND		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
1,1,2,2-Tetrachloroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Tetrachloroethene	**4.4**		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Toluene	**1.2**	J	ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
1,2,4-Trichlorobenzene	ND		ppbv	2.5	5.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
1,1,1-Trichloroethane	**1.3**	J	ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
1,1,2-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Trichloroethene	**1.7**	J	ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001

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Payment Processing, MS 1385 P.O. Box 5130
Albuquerque, NM 87185-0154
Rita Kavanaugh

Work Order: LRE0127
Project: MWL Remediation
Project Number: 98045 02.02.02 / CF013-08

Received: 05/15/08 12:00
Reported: 05/27/08 17:11

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0127-06 (085813-003/MWL-DP5-50-SG-DUP - Air) - cont.							**Sampled: 05/09/08 09:39**			
EPA TO14A - Volatile Organic Compounds by GC/MS - cont.										
Trichlorofluoromethane	**1.3**	J	ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
1,1,2-Trichloro-1,2,2-trifluoroethane	**2.1**		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
1,2,4-Trimethylbenzene	ND		ppbv	1.3	3.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
1,3,5-Trimethylbenzene	ND		ppbv	1.1	3.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Vinyl acetate	ND		ppbv	2.0	10	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
Vinyl chloride	ND		ppbv	1.5	3.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
m,p-Xylene	ND		ppbv	2.0	4.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001
o-Xylene	ND		ppbv	1.0	2.0	1.0	05/16/08 19:42	gcmsb	DLK	8E17001

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Albuquerque, NM 87185-0154
Rita Kavanaugh

Work Order: LRE0127
Project: MWL Remediation
Project Number: 98045 02.02.02 / CF013-08

Received: 05/15/08 12:00
Reported: 05/27/08 17:11

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0127-06 (085813-003/MWL-DP5-50-SG-DUP - Air)							**Sampled: 05/09/08 09:39**			
ASTM D1946 - Fixed Gases										
Methane	**0.00018**	J	%(v/v)	0.00013	0.00043	2.1	05/15/08 16:15	GC8-Rear	EI	8E16006

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY

Internal Lab

Page _1_ of _1_

Batch No. N/A

SMO Use LRE0205

AR/COC 611878

Dept. No./Mail Stop:	6765/MS1089	Date Samples Shipped:	5-22-08	Project/Task No.:	98045/02.02.02
Project/Task Manager:	P. Freshour	Carrier/Waybill No.	900333	SMO Authorization:	
Project Name:	MWL Remediation	Lab Contact:	T. MURRAY	Contract #:	PO691437
Record Center Code:		Lab Destination:	Test America CA SWITH AAA SOO BOTTLE ORDER	☐ Waste Characterization -Send preliminary/copy report to:	
Logbook Ref. No.:		SMO Contact/Phone:	P. Puisant/505-844-3185	☐ Released by COC No.:	
Service Order No.	CF013-08	Send Report to SMO:	Rita Kavanaugh 284-2553	☐ Validation Required	

Bill To: Sandia National Labs (Accounts Payable)
P.O. Box 5800 MS 0154
Albuquerque, NM 87185-0154

Location	Tech Area
Building	Room

Reference LOV(available at SMO)

Sample No.-Fraction	ER Sample ID or Sample Location Detail	Pump Depth (ft)	ER Site No.	Date/Time(hr) Collected	Sample Matrix	Container Type	Container Volume	Preserv-ative	Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID
085810-001	MWL-DP6-10-SG	N/A	MWL	5/21/08 1432	SG	SC	6L	NONE	G	SA	TO-14 + Methane	
085810-002	MWL-DP6-30-SG	N/A	MWL	5/21/08 1504	SG	SC	6L	NONE	G	SA	TO-14 + Methane	
085814-001	MWL-DP6-10-SG-DUP	N/A	MWL	5/21/08 1432	SG	SC	6L	NONE	G	DUSA	TO-14 + Methane	
085814-002	MWL-DP6-30-SG-DUP	N/A	MWL	5/21/08 1504	SG	SC	6L	NONE	G	DUSA	TO-14 + Methane	

RMMA	☑ Yes ☐ No Ref. No.	Sample Tracking	Smo Use
Sample Disposal	☐ Return to Client ☑ Disposal by lab	Date Entered(mm/dd/yy)	
Turnaround Time	30 day ~~Std~~ ☑ Normal ☒ Rush	Entered by:	
Return Samples By:	Level of Rush: 7 DAY TAT	QC inits:	

Special Instructions/QC Requirements
EDD ☑ Yes ☐ No
Level D Package ☐ Yes ☑ No
*Send report to:

Abnormal Conditions on Receipt

Lab Use

Sample Team Members	Name	Signature	Init	Company/Organization/Phone/Cellular
	Robert Lynch		RL	Weston/4133/505-844-1013
	Bill Gibson			Weston/4133/505-284-5232

*Please list as separate report.

1.Relinquished by		Org.	4133	Date	5/22/08	Time	0800	4.Relinquished by	Org.	Date	Time
1. Received by		Org.	4133	Date	5/22/08	Time	0800	4. Received by	Org.	Date	Time
2.Relinquished by		Org.	4133	Date	5/22/08	Time	0900	5.Relinquished by	Org.	Date	Time
2. Received by		Org.	TA LA	Date	5/23/8	Time	0945	5. Received by	Org.	Date	Time
3.Relinquished by		Org.		Date		Time		6.Relinquished by	Org.	Date	Time
3. Received by		Org.		Date		Time		6. Received by	Org.	Date	Time

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Work Order: LRE0205
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/23/08 09:45
Reported: 05/30/08 16:32

ANALYTICAL REPORT

Sample ID: LRE0205-01 (085810-001/MWL-DP6-10-SG - Air) **Sampled: 05/21/08 14:32**

EPA TO14A - Volatile Organic Compounds by GC/MS

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Acetone	**9.3**	J	ppbv	2.5	10	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Benzene	ND		ppbv	1.5	3.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Benzyl chloride	ND		ppbv	8.0	25	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Bromodichloromethane	ND		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Bromoform	ND		ppbv	0.50	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Bromomethane	ND		ppbv	2.0	4.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
2-Butanone (MEK)	ND		ppbv	2.0	10	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Carbon disulfide	ND		ppbv	2.0	10	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Carbon tetrachloride	ND		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Chlorobenzene	ND		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Dibromochloromethane	ND		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Chloroethane	ND		ppbv	1.5	4.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Chloroform	**1.4**	J	ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Chloromethane	ND		ppbv	1.0	4.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
1,2-Dibromoethane (EDB)	ND		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
1,2-Dichlorobenzene	ND		ppbv	0.90	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
1,3-Dichlorobenzene	ND		ppbv	0.80	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
1,4-Dichlorobenzene	ND		ppbv	3.0	6.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Dichlorodifluoromethane	**31**		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
1,1-Dichloroethane	**1.0**	J	ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
1,2-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
cis-1,2-Dichloroethene	ND		ppbv	0.80	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
1,1-Dichloroethene	**3.6**		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
1,2-Dichloropropane	ND		ppbv	1.5	3.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
trans-1,3-Dichloropropene	ND		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Ethylbenzene	ND		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
4-Ethyltoluene	ND		ppbv	0.70	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Hexachlorobutadiene	ND		ppbv	1.3	4.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
2-Hexanone	ND		ppbv	2.0	10	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Methylene chloride	ND		ppbv	0.80	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
4-Methyl-2-pentanone (MIBK)	ND		ppbv	2.0	10	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Styrene	ND		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
1,1,2,2-Tetrachloroethane	ND		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Tetrachloroethene	**1.2**	J	ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Toluene	ND		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
1,2,4-Trichlorobenzene	ND		ppbv	2.5	5.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
1,1,1-Trichloroethane	**4.7**		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
1,1,2-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Trichloroethene	**4.2**		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005

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Albuquerque, NM 87185-0154
Rita Kavanaugh

Work Order: LRE0205
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/23/08 09:45
Reported: 05/30/08 16:32

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0205-01 (085810-001/MWL-DP6-10-SG - Air) - cont.							**Sampled: 05/21/08 14:32**			
EPA TO14A - Volatile Organic Compounds by GC/MS - cont.										
Trichlorofluoromethane	**12**		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
1,1,2-Trichloro-1,2,2-trifluoroethane	**44**		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
1,2,4-Trimethylbenzene	ND		ppbv	1.3	3.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
1,3,5-Trimethylbenzene	ND		ppbv	1.1	3.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Vinyl acetate	ND		ppbv	2.0	10	1.0	05/27/08 21:41	gcmsa	AD	8E28005
Vinyl chloride	ND		ppbv	1.5	3.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
m,p-Xylene	ND		ppbv	2.0	4.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005
o-Xylene	ND		ppbv	1.0	2.0	1.0	05/27/08 21:41	gcmsa	AD	8E28005

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Received: 05/23/08 09:45
Reported: 05/30/08 16:32

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0205-01 (085810-001/MWL-DP6-10-SG - Air)							**Sampled: 05/21/08 14:32**			
ASTM D1946 - Fixed Gases										
Methane	ND		%(v/v)	0.00019	0.00064	3.2	05/28/08 09:33	GC8	EI	8E29005

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Work Order: LRE0205
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/23/08 09:45
Reported: 05/30/08 16:32

ANALYTICAL REPORT

Sample ID: LRE0205-02 (085810-002/MWL-DP6-30-SG - Air) **Sampled: 05/21/08 15:04**

EPA TO14A - Volatile Organic Compounds by GC/MS

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Acetone	**23**	J	ppbv	7.9	31	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Benzene	ND		ppbv	4.7	9.4	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Benzyl chloride	ND		ppbv	25	79	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Bromodichloromethane	ND		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Bromoform	ND		ppbv	1.6	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Bromomethane	ND		ppbv	6.3	13	3.1	05/27/08 22:17	gcmsa	AD	8E28005
2-Butanone (MEK)	**10**	J	ppbv	6.3	31	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Carbon disulfide	ND		ppbv	6.3	31	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Carbon tetrachloride	ND		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Chlorobenzene	ND		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Dibromochloromethane	ND		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Chloroethane	ND		ppbv	4.7	13	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Chloroform	**3.7**	J	ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Chloromethane	ND		ppbv	3.1	13	3.1	05/27/08 22:17	gcmsa	AD	8E28005
1,2-Dibromoethane (EDB)	ND		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
1,2-Dichlorobenzene	ND		ppbv	2.8	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
1,3-Dichlorobenzene	ND		ppbv	2.5	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
1,4-Dichlorobenzene	ND		ppbv	9.4	19	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Dichlorodifluoromethane	**53**		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
1,1-Dichloroethane	**3.4**	J	ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
1,2-Dichloroethane	ND		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
cis-1,2-Dichloroethene	ND		ppbv	2.5	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
1,1-Dichloroethene	**11**		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
1,2-Dichloropropane	ND		ppbv	4.7	9.4	3.1	05/27/08 22:17	gcmsa	AD	8E28005
cis-1,3-Dichloropropene	ND		ppbv	4.7	9.4	3.1	05/27/08 22:17	gcmsa	AD	8E28005
trans-1,3-Dichloropropene	ND		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Ethylbenzene	ND		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
4-Ethyltoluene	ND		ppbv	2.2	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Hexachlorobutadiene	ND		ppbv	4.1	13	3.1	05/27/08 22:17	gcmsa	AD	8E28005
2-Hexanone	ND		ppbv	6.3	31	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Methylene chloride	ND		ppbv	2.5	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
4-Methyl-2-pentanone (MIBK)	ND		ppbv	6.3	31	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Styrene	ND		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
1,1,2,2-Tetrachloroethane	ND		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Tetrachloroethene	**310**		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Toluene	ND		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
1,2,4-Trichlorobenzene	ND		ppbv	7.9	16	3.1	05/27/08 22:17	gcmsa	AD	8E28005
1,1,1-Trichloroethane	**16**		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
1,1,2-Trichloroethane	ND		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Trichloroethene	**110**		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005

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Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

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ANALYTICAL REPORT

Sample ID: LRE0205-02 (085810-002/MWL-DP6-30-SG - Air) - cont. **Sampled: 05/21/08 15:04**

EPA TO14A - Volatile Organic Compounds by GC/MS - cont.

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Trichlorofluoromethane	**20**		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
1,1,2-Trichloro-1,2,2-trifluoroethane	**110**		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005
1,2,4-Trimethylbenzene	ND		ppbv	4.1	9.4	3.1	05/27/08 22:17	gcmsa	AD	8E28005
1,3,5-Trimethylbenzene	ND		ppbv	3.5	9.4	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Vinyl acetate	ND		ppbv	6.3	31	3.1	05/27/08 22:17	gcmsa	AD	8E28005
Vinyl chloride	ND		ppbv	4.7	9.4	3.1	05/27/08 22:17	gcmsa	AD	8E28005
m,p-Xylene	ND		ppbv	6.3	13	3.1	05/27/08 22:17	gcmsa	AD	8E28005
o-Xylene	ND		ppbv	3.1	6.3	3.1	05/27/08 22:17	gcmsa	AD	8E28005

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ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0205-02 (085810-002/MWL-DP6-30-SG - Air)							**Sampled: 05/21/08 15:04**			
ASTM D1946 - Fixed Gases										
Methane	ND		%(v/v)	0.00019	0.00063	3.1	05/28/08 09:50	GC8	EI	8E29005

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Work Order: LRE0205
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/23/08 09:45
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ANALYTICAL REPORT

Sample ID: LRE0205-03 (085814-001/MWL-DP6-10-SG-DUP - Air) **Sampled: 05/21/08 14:32**

EPA TO14A - Volatile Organic Compounds by GC/MS

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Acetone	**11**		ppbv	2.5	10	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Benzene	ND		ppbv	1.5	3.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Benzyl chloride	ND		ppbv	8.0	25	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Bromodichloromethane	ND		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Bromoform	ND		ppbv	0.50	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Bromomethane	ND		ppbv	2.0	4.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
2-Butanone (MEK)	**5.2**	J	ppbv	2.0	10	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Carbon disulfide	ND		ppbv	2.0	10	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Carbon tetrachloride	ND		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Chlorobenzene	ND		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Dibromochloromethane	ND		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Chloroethane	ND		ppbv	1.5	4.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Chloroform	**2.2**		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Chloromethane	ND		ppbv	1.0	4.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
1,2-Dibromoethane (EDB)	ND		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
1,2-Dichlorobenzene	ND		ppbv	0.90	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
1,3-Dichlorobenzene	ND		ppbv	0.80	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
1,4-Dichlorobenzene	ND		ppbv	3.0	6.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Dichlorodifluoromethane	**30**		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
1,1-Dichloroethane	**1.2**	J	ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
1,2-Dichloroethane	ND		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
cis-1,2-Dichloroethene	ND		ppbv	0.80	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
1,1-Dichloroethene	**4.3**		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
1,2-Dichloropropane	ND		ppbv	1.5	3.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
cis-1,3-Dichloropropene	ND		ppbv	1.5	3.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
trans-1,3-Dichloropropene	ND		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Ethylbenzene	ND		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
4-Ethyltoluene	ND		ppbv	0.70	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Hexachlorobutadiene	ND		ppbv	1.3	4.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
2-Hexanone	ND		ppbv	2.0	10	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Methylene chloride	**0.85**	J	ppbv	0.80	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
4-Methyl-2-pentanone (MIBK)	ND		ppbv	2.0	10	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Styrene	ND		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
1,1,2,2-Tetrachloroethane	ND		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Tetrachloroethene	**190**		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Toluene	ND		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
1,2,4-Trichlorobenzene	ND		ppbv	2.5	5.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
1,1,1-Trichloroethane	**11**		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
1,1,2-Trichloroethane	ND		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Trichloroethene	**42**		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005

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Payment Processing, MS 1385 P.O. Box 5130			Reported: 05/30/08 16:32
Albuquerque, NM 87185-0154	Project:	MWL Remediation	
Rita Kavanaugh	Project Number:	98045/02.02.02/CF013-08	

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0205-03 (085814-001/MWL-DP6-10-SG-DUP - Air) - cont.							**Sampled: 05/21/08 14:32**			
EPA TO14A - Volatile Organic Compounds by GC/MS - cont.										
Trichlorofluoromethane	**13**		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
1,1,2-Trichloro-1,2,2-trifluoroethane	**62**		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
1,2,4-Trimethylbenzene	ND		ppbv	1.3	3.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
1,3,5-Trimethylbenzene	ND		ppbv	1.1	3.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Vinyl acetate	ND		ppbv	2.0	10	1.0	05/27/08 22:56	gcmsa	AD	8E28005
Vinyl chloride	ND		ppbv	1.5	3.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
m,p-Xylene	ND		ppbv	2.0	4.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005
o-Xylene	ND		ppbv	1.0	2.0	1.0	05/27/08 22:56	gcmsa	AD	8E28005

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ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0205-03 (085814-001/MWL-DP6-10-SG-DUP - Air)							**Sampled: 05/21/08 14:32**			
ASTM D1946 - Fixed Gases										
Methane	ND		%(v/v)	0.00017	0.00056	2.8	05/28/08 10:09	GC8	EI	8E29005

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ANALYTICAL REPORT

Sample ID: LRE0205-04 (085814-002/MWL-DP6-30-SG-DUP - Air) **Sampled: 05/21/08 15:04**

EPA TO14A - Volatile Organic Compounds by GC/MS

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Acetone	**18**	J	ppbv	7.9	31	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Benzene	ND		ppbv	4.7	9.4	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Benzyl chloride	ND		ppbv	25	79	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Bromodichloromethane	ND		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Bromoform	ND		ppbv	1.6	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Bromomethane	ND		ppbv	6.3	13	3.1	05/27/08 23:31	gcmsa	AD	8E28005
2-Butanone (MEK)	**8.3**	J	ppbv	6.3	31	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Carbon disulfide	ND		ppbv	6.3	31	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Carbon tetrachloride	ND		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Chlorobenzene	ND		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Dibromochloromethane	ND		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Chloroethane	ND		ppbv	4.7	13	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Chloroform	**4.0**	J	ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Chloromethane	ND		ppbv	3.1	13	3.1	05/27/08 23:31	gcmsa	AD	8E28005
1,2-Dibromoethane (EDB)	ND		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
1,2-Dichlorobenzene	ND		ppbv	2.8	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
1,3-Dichlorobenzene	ND		ppbv	2.5	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
1,4-Dichlorobenzene	ND		ppbv	9.4	19	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Dichlorodifluoromethane	**53**		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
1,1-Dichloroethane	**3.3**	J	ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
1,2-Dichloroethane	ND		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
cis-1,2-Dichloroethene	ND		ppbv	2.5	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
1,1-Dichloroethene	**11**		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
1,2-Dichloropropane	ND		ppbv	4.7	9.4	3.1	05/27/08 23:31	gcmsa	AD	8E28005
cis-1,3-Dichloropropene	ND		ppbv	4.7	9.4	3.1	05/27/08 23:31	gcmsa	AD	8E28005
trans-1,3-Dichloropropene	ND		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Ethylbenzene	ND		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
4-Ethyltoluene	ND		ppbv	2.2	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Hexachlorobutadiene	ND		ppbv	4.1	13	3.1	05/27/08 23:31	gcmsa	AD	8E28005
2-Hexanone	ND		ppbv	6.3	31	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Methylene chloride	ND		ppbv	2.5	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
4-Methyl-2-pentanone (MIBK)	ND		ppbv	6.3	31	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Styrene	ND		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
1,1,2,2-Tetrachloroethane	ND		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Tetrachloroethene	**300**		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Toluene	ND		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
1,2,4-Trichlorobenzene	ND		ppbv	7.9	16	3.1	05/27/08 23:31	gcmsa	AD	8E28005
1,1,1-Trichloroethane	**16**		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
1,1,2-Trichloroethane	ND		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Trichloroethene	**110**		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
1721 South Grand Avenue Santa Ana, CA 92705 * 714-258-8610 * Fax 714-258-0921

Sandia National Laboratories
Payment Processing, MS 1385 P.O. Box 5130
Albuquerque, NM 87185-0154
Rita Kavanaugh

Work Order: LRE0205
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/23/08 09:45
Reported: 05/30/08 16:32

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0205-04 (085814-002/MWL-DP6-30-SG-DUP - Air) - cont.							**Sampled: 05/21/08 15:04**			
EPA TO14A - Volatile Organic Compounds by GC/MS - cont.										
Trichlorofluoromethane	**20**		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
1,1,2-Trichloro-1,2,2-trifluoroethane	**110**		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005
1,2,4-Trimethylbenzene	ND		ppbv	4.1	9.4	3.1	05/27/08 23:31	gcmsa	AD	8E28005
1,3,5-Trimethylbenzene	ND		ppbv	3.5	9.4	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Vinyl acetate	ND		ppbv	6.3	31	3.1	05/27/08 23:31	gcmsa	AD	8E28005
Vinyl chloride	ND		ppbv	4.7	9.4	3.1	05/27/08 23:31	gcmsa	AD	8E28005
m,p-Xylene	ND		ppbv	6.3	13	3.1	05/27/08 23:31	gcmsa	AD	8E28005
o-Xylene	ND		ppbv	3.1	6.3	3.1	05/27/08 23:31	gcmsa	AD	8E28005

TestAmerica
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1721 South Grand Avenue Santa Ana, CA 92705 * 714-258-8610 * Fax 714-258-0921

Sandia National Laboratories
Payment Processing, MS 1385 P.O. Box 5130
Albuquerque, NM 87185-0154
Rita Kavanaugh

Work Order: LRE0205
Project: MWL Remediation
Project Number: 98045/02.02.02/CF013-08

Received: 05/23/08 09:45
Reported: 05/30/08 16:32

ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	MDL	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
Sample ID: LRE0205-04 (085814-002/MWL-DP6-30-SG-DUP - Air)							**Sampled: 05/21/08 15:04**			
ASTM D1946 - Fixed Gases										
Methane	ND		%(v/v)	0.00019	0.00063	3.1	05/28/08 10:25	GC8	EI	8E29005

E8D210164

Attachment 6
Page 1 of 1

4/16/08 cont

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY

PAUL THROWOUR

E8D210164

Page 1 of 1

Internal Lab

Batch No. N/A

SMO Use

AR/COC **611812**

Dept. No./Mail Stop:	4133/MS-1042	Date Samples Shipped:	4/16/08	Project/Task No.:	98045/02.02.02
Project/Task Manager:	~~FRANK LAUFFER~~	Carrier/Waybill No.	58805	SMO Authorization:	
Project Name:	MWL REMEDIATION	Lab Contact:	TRUPTI MISTRY	Contract #:	PO691437
Record Center Code:	ER/1345/DAT	Lab Destination:	Test America SANTA ANA, CA.		
Logbook Ref. No.:	003	SMO Contact/Phone:	P. Pulsant/505-844-3185		
Service Order No.	~~CE029-08~~	Send Report to SMO:	Rita Kavanaugh 284-2553		

SOW BOTTLE ORDER.

☐ **Waste Characterization**
-Send preliminary/copy report to:

☐ **Released by COC No.:**
☐ **Validation Required**

Bill To: Sandia National Labs (Accounts Payable)
P.O. Box 5800 MS 0154
Albuquerque, NM 87185-0154

Location	Tech Area
Building	Room

Reference LOV(available at SMO)

Sample No.-Fraction	ER Sample ID or Sample Location Detail	Pump Depth (ft)	ER Site No.	Date/Time(hr) Collected	Sample Matrix	Container Type	Container Volume	Preserv-ative	Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID
085811-001	MWL-DP7-10-SG	N/A	MWL	4/10/08 09:50	SG	SC	6L	NONE	G	SA	TO-14 + MOTHKING	
085811-002	MWL-DP7-30-SG	N/A	MWL	4/10/08 10:10	SG	SC	6L	NONE	G	SA	TO-14	
085812-001	MWL-DP8-10-SG	N/A	MWL	4/09/08 11:30	SG	SC	6L	NONE	G	SA	TO-14	
085812-002	MWL-DP8-30-SG	N/A	MWL	4/09/08 11:50	SG	SC	6L	NONE	G	SA	TO-14	

RMMA	☐ Yes ☑ No Ref. No.	**Sample Tracking**	Smo Use
Sample Disposal	☐ Return to Client ☑ Disposal by lab	Date Entered(mm/dd/yy)	
Turnaround Time	30 day ☑ Normal ☐ Rush	Entered by:	
Return Samples By:		Level of Rush:	QC Inits.

Special Instructions/QC Requirements
EDD ☑ Yes ☐ No
Level D Package ☐ Yes ☑ No
***Send report to:**

Abnormal Conditions on Receipt

Lab Use

Sample Team Members	Name	Signature	Init	Company/Organization/Phone/Cellular
	Robert Lynch		RL	Weston/4133/844-1013
	Danielle Nieto		DN	Sandia/4133/505-845-7706

***Please list as separate report.**

1.Relinquished by		Org. 4133	Date 4/16/08	Time 0814	4.Relinquished by		Org.	Date	Time
1. Received by		Org. 4133	Date 4/16/08	Time 0814	4. Received by		Org.	Date	Time
2.Relinquished by		Org. 4133	Date 4/16/08	Time 1055	5.Relinquished by		Org.	Date	Time
2. Received by		Org. TA-LA	Date 4/21/08	Time 1230	5. Received by		Org.	Date	Time
3.Relinquished by		Org.	Date	Time	6.Relinquished by		Org.	Date	Time
3. Received by		Org.	Date	Time	6. Received by		Org.	Date	Time

3

Sandia National Laboratories

Client Sample ID: 085811-001/MWL-DP7-10-SG

GC/MS Volatiles

Lot-Sample #...: E8D210164-001	**Work Order #...:** KLPCA1AC	**Matrix.....:** AE
Date Sampled...: 04/10/08	**Date Received..:** 04/21/08	
Prep Date.....: 04/23/08	**Analysis Date..:** 04/23/08	
Prep Batch #...: 8114578	**Analysis Time..:** 03:11	
Dilution Factor: 1		
Analyst ID.....: 015590	**Instrument ID..:** MSA	
	Method.....: EPA-21 TO-14A	

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	**16**	**10**	**ppb(v/v)**	**2.5**
Benzene	**2.0 J**	**3.0**	**ppb(v/v)**	**1.5**
Benzyl chloride	ND	25	ppb(v/v)	8.0
Bromodichloromethane	ND	2.0	ppb(v/v)	1.0
Bromoform	ND	2.0	ppb(v/v)	0.50
Bromomethane	ND	4.0	ppb(v/v)	2.0
2-Butanone (MEK)	**3.2 J**	**10**	**ppb(v/v)**	**2.0**
Carbon disulfide	ND	10	ppb(v/v)	2.0
Carbon tetrachloride	ND	2.0	ppb(v/v)	1.0
Chlorobenzene	ND	2.0	ppb(v/v)	1.0
Dibromochloromethane	ND	2.0	ppb(v/v)	1.0
Chloroethane	ND	4.0	ppb(v/v)	1.5
Chloroform	ND	2.0	ppb(v/v)	1.0
Chloromethane	ND	4.0	ppb(v/v)	1.0
1,2-Dibromoethane (EDB)	ND	2.0	ppb(v/v)	1.0
1,2-Dichlorobenzene	ND	2.0	ppb(v/v)	0.90
1,3-Dichlorobenzene	ND	2.0	ppb(v/v)	0.80
1,4-Dichlorobenzene	ND	6.0	ppb(v/v)	3.0
Dichlorodifluoromethane	ND	2.0	ppb(v/v)	1.0
1,1-Dichloroethane	ND	2.0	ppb(v/v)	1.0
1,2-Dichloroethane	ND	2.0	ppb(v/v)	1.0
cis-1,2-Dichloroethene	ND	2.0	ppb(v/v)	0.80
1,1-Dichloroethene	ND	2.0	ppb(v/v)	1.0
1,2-Dichloropropane	ND	3.0	ppb(v/v)	1.5
cis-1,3-Dichloropropene	ND	3.0	ppb(v/v)	1.5
trans-1,3-Dichloropropene	ND	2.0	ppb(v/v)	1.0
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND	2.0	ppb(v/v)	1.0
Ethylbenzene	ND	2.0	ppb(v/v)	1.0
4-Ethyltoluene	ND	2.0	ppb(v/v)	0.70
Hexachlorobutadiene	ND	4.0	ppb(v/v)	1.3
2-Hexanone	ND	10	ppb(v/v)	2.0
Methylene chloride	ND	2.0	ppb(v/v)	0.80
4-Methyl-2-pentanone (MIBK)	ND	10	ppb(v/v)	2.0
Styrene	ND	2.0	ppb(v/v)	1.0
1,1,2,2-Tetrachloroethane	ND	2.0	ppb(v/v)	1.0

(Continued on next page)

Sandia National Laboratories

Client Sample ID: 085811-001/MWL-DP7-10-SG

GC/MS Volatiles

Lot-Sample #...: E8D210164-001 Work Order #...: KLPCA1AC Matrix.....: AE

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Tetrachloroethene	ND	2.0	ppb(v/v)	1.0
Toluene	**2.1**	**2.0**	**ppb(v/v)**	**1.0**
1,2,4-Trichloro-benzene	ND	5.0	ppb(v/v)	2.5
1,1,1-Trichloroethane	ND	2.0	ppb(v/v)	1.0
1,1,2-Trichloroethane	ND	2.0	ppb(v/v)	1.0
Trichloroethene	ND	2.0	ppb(v/v)	1.0
Trichlorofluoromethane	ND	2.0	ppb(v/v)	1.0
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	2.0	ppb(v/v)	1.0
1,2,4-Trimethylbenzene	ND	3.0	ppb(v/v)	1.3
1,3,5-Trimethylbenzene	ND	3.0	ppb(v/v)	1.1
Vinyl acetate	ND	10	ppb(v/v)	2.0
Vinyl chloride	ND	3.0	ppb(v/v)	1.5
m-Xylene & p-Xylene	ND	4.0	ppb(v/v)	2.0
o-Xylene	ND	2.0	ppb(v/v)	1.0

NOTE(S):

J Estimated result. Result is less than RL.

Sandia National Laboratories

Client Sample ID: 085811-001/MWL-DP7-10-SG

GC Volatiles

Lot-Sample #...:	E8D210164-001	Work Order #...:	KLPCA1AD	Matrix.....:	AE
Date Sampled...:	04/10/08	Date Received..:	04/21/08		
Prep Date.....:	04/23/08	Analysis Date..:	04/23/08		
Prep Batch #...:	8114474	Analysis Time..:	14:27		
Dilution Factor:	3.28				
Analyst ID.....:	999995	Instrument ID..:	GC8		
		Method.....:	ASTM D1946		

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Methane	ND	0.00066	%(v/v)	0.00020

Sandia National Laboratories

Client Sample ID: 085811-002/MWL-DP7-30-SG

GC/MS Volatiles

Lot-Sample #...: E8D210164-002 Work Order #...: KLPCD1AC Matrix.....: AE
Date Sampled...: 04/10/08 Date Received..: 04/21/08
Prep Date.....: 04/23/08 Analysis Date..: 04/23/08
Prep Batch #...: 8114578 Analysis Time..: 03:57
Dilution Factor: 1
Analyst ID.....: 015590 Instrument ID..: MSA
Method.....: EPA-21 TO-14A

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	**83**	**10**	**ppb(v/v)**	**2.5**
Benzene	**5.2**	**3.0**	**ppb(v/v)**	**1.5**
Benzyl chloride	ND	25	ppb(v/v)	8.0
Bromodichloromethane	ND	2.0	ppb(v/v)	1.0
Bromoform	ND	2.0	ppb(v/v)	0.50
Bromomethane	ND	4.0	ppb(v/v)	2.0
2-Butanone (MEK)	**17**	**10**	**ppb(v/v)**	**2.0**
Carbon disulfide	**7.7 J**	**10**	**ppb(v/v)**	**2.0**
Carbon tetrachloride	ND	2.0	ppb(v/v)	1.0
Chlorobenzene	ND	2.0	ppb(v/v)	1.0
Dibromochloromethane	ND	2.0	ppb(v/v)	1.0
Chloroethane	ND	4.0	ppb(v/v)	1.5
Chloroform	ND	2.0	ppb(v/v)	1.0
Chloromethane	**2.2 J**	**4.0**	**ppb(v/v)**	**1.0**
1,2-Dibromoethane (EDB)	ND	2.0	ppb(v/v)	1.0
1,2-Dichlorobenzene	ND	2.0	ppb(v/v)	0.90
1,3-Dichlorobenzene	ND	2.0	ppb(v/v)	0.80
1,4-Dichlorobenzene	ND	6.0	ppb(v/v)	3.0
Dichlorodifluoromethane	ND	2.0	ppb(v/v)	1.0
1,1-Dichloroethane	ND	2.0	ppb(v/v)	1.0
1,2-Dichloroethane	ND	2.0	ppb(v/v)	1.0
cis-1,2-Dichloroethene	ND	2.0	ppb(v/v)	0.80
1,1-Dichloroethene	ND	2.0	ppb(v/v)	1.0
1,2-Dichloropropane	ND	3.0	ppb(v/v)	1.5
cis-1,3-Dichloropropene	ND	3.0	ppb(v/v)	1.5
trans-1,3-Dichloropropene	ND	2.0	ppb(v/v)	1.0
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND	2.0	ppb(v/v)	1.0
Ethylbenzene	**1.7 J**	**2.0**	**ppb(v/v)**	**1.0**
4-Ethyltoluene	**1.4 J**	**2.0**	**ppb(v/v)**	**0.70**
Hexachlorobutadiene	ND	4.0	ppb(v/v)	1.3
2-Hexanone	ND	10	ppb(v/v)	2.0
Methylene chloride	**0.93 J**	**2.0**	**ppb(v/v)**	**0.80**
4-Methyl-2-pentanone (MIBK)	ND	10	ppb(v/v)	2.0
Styrene	ND	2.0	ppb(v/v)	1.0
1,1,2,2-Tetrachloroethane	ND	2.0	ppb(v/v)	1.0

(Continued on next page)

Sandia National Laboratories

Client Sample ID: 085811-002/MWL-DP7-30-SG

GC/MS Volatiles

Lot-Sample #...: E8D210164-002 Work Order #...: KLPCD1AC Matrix.....: AE

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Tetrachloroethene	ND	2.0	ppb(v/v)	1.0
Toluene	**6.8**	**2.0**	**ppb(v/v)**	**1.0**
1,2,4-Trichloro-benzene	ND	5.0	ppb(v/v)	2.5
1,1,1-Trichloroethane	ND	2.0	ppb(v/v)	1.0
1,1,2-Trichloroethane	ND	2.0	ppb(v/v)	1.0
Trichloroethene	ND	2.0	ppb(v/v)	1.0
Trichlorofluoromethane	ND	2.0	ppb(v/v)	1.0
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	2.0	ppb(v/v)	1.0
1,2,4-Trimethylbenzene	**1.6 J**	**3.0**	**ppb(v/v)**	**1.3**
1,3,5-Trimethylbenzene	ND	3.0	ppb(v/v)	1.1
Vinyl acetate	ND	10	ppb(v/v)	2.0
Vinyl chloride	ND	3.0	ppb(v/v)	1.5
m-Xylene & p-Xylene	**7.2**	**4.0**	**ppb(v/v)**	**2.0**
o-Xylene	**1.9 J**	**2.0**	**ppb(v/v)**	**1.0**

NOTE(S):

J Estimated result. Result is less than RL.

Sandia National Laboratories

Client Sample ID: 085811-002/MWL-DP7-30-SG

GC Volatiles

Lot-Sample #...:	E8D210164-002	Work Order #...:	KLPCD1AD	Matrix.....:	AE
Date Sampled...:	04/10/08	Date Received..:	04/21/08		
Prep Date.....:	04/23/08	Analysis Date..:	04/23/08		
Prep Batch #...:	8114474	Analysis Time..:	14:40		
Dilution Factor:	2.44				
Analyst ID.....:	999995	Instrument ID..:	GC8		
		Method.....:	ASTM D1946		

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Methane	ND	0.00049	%(v/v)	0.00015

Sandia National Laboratories

Client Sample ID: 085812-001/MWL-DP8-10-SG

GC/MS Volatiles

Lot-Sample #...: E8D210164-003 Work Order #...: KLPCE1AC Matrix.....: AE
Date Sampled...: 04/09/08 Date Received..: 04/21/08
Prep Date.....: 04/23/08 Analysis Date..: 04/23/08
Prep Batch #...: 8114578 Analysis Time..: 04:48
Dilution Factor: 1
Analyst ID.....: 015590 Instrument ID..: MSA
Method.....: EPA-21 TO-14A

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	**16**	**10**	**ppb(v/v)**	**2.5**
Benzene	ND	3.0	ppb(v/v)	1.5
Benzyl chloride	ND	25	ppb(v/v)	8.0
Bromodichloromethane	ND	2.0	ppb(v/v)	1.0
Bromoform	ND	2.0	ppb(v/v)	0.50
Bromomethane	ND	4.0	ppb(v/v)	2.0
2-Butanone (MEK)	**2.9 J**	**10**	**ppb(v/v)**	**2.0**
Carbon disulfide	ND	10	ppb(v/v)	2.0
Carbon tetrachloride	ND	2.0	ppb(v/v)	1.0
Chlorobenzene	ND	2.0	ppb(v/v)	1.0
Dibromochloromethane	ND	2.0	ppb(v/v)	1.0
Chloroethane	ND	4.0	ppb(v/v)	1.5
Chloroform	ND	2.0	ppb(v/v)	1.0
Chloromethane	ND	4.0	ppb(v/v)	1.0
1,2-Dibromoethane (EDB)	ND	2.0	ppb(v/v)	1.0
1,2-Dichlorobenzene	ND	2.0	ppb(v/v)	0.90
1,3-Dichlorobenzene	ND	2.0	ppb(v/v)	0.80
1,4-Dichlorobenzene	ND	6.0	ppb(v/v)	3.0
Dichlorodifluoromethane	ND	2.0	ppb(v/v)	1.0
1,1-Dichloroethane	ND	2.0	ppb(v/v)	1.0
1,2-Dichloroethane	ND	2.0	ppb(v/v)	1.0
cis-1,2-Dichloroethene	ND	2.0	ppb(v/v)	0.80
1,1-Dichloroethene	ND	2.0	ppb(v/v)	1.0
1,2-Dichloropropane	ND	3.0	ppb(v/v)	1.5
cis-1,3-Dichloropropene	ND	3.0	ppb(v/v)	1.5
trans-1,3-Dichloropropene	ND	2.0	ppb(v/v)	1.0
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND	2.0	ppb(v/v)	1.0
Ethylbenzene	ND	2.0	ppb(v/v)	1.0
4-Ethyltoluene	ND	2.0	ppb(v/v)	0.70
Hexachlorobutadiene	ND	4.0	ppb(v/v)	1.3
2-Hexanone	ND	10	ppb(v/v)	2.0
Methylene chloride	ND	2.0	ppb(v/v)	0.80
4-Methyl-2-pentanone (MIBK)	ND	10	ppb(v/v)	2.0
Styrene	ND	2.0	ppb(v/v)	1.0
1,1,2,2-Tetrachloroethane	ND	2.0	ppb(v/v)	1.0

(Continued on next page)

Sandia National Laboratories

Client Sample ID: 085812-001/MWL-DP8-10-SG

GC/MS Volatiles

Lot-Sample #...: E8D210164-003 Work Order #...: KLPCE1AC Matrix.....: AE

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Tetrachloroethene	ND	2.0	ppb(v/v)	1.0
Toluene	ND	2.0	ppb(v/v)	1.0
1,2,4-Trichloro-benzene	ND	5.0	ppb(v/v)	2.5
1,1,1-Trichloroethane	ND	2.0	ppb(v/v)	1.0
1,1,2-Trichloroethane	ND	2.0	ppb(v/v)	1.0
Trichloroethene	ND	2.0	ppb(v/v)	1.0
Trichlorofluoromethane	ND	2.0	ppb(v/v)	1.0
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	2.0	ppb(v/v)	1.0
1,2,4-Trimethylbenzene	ND	3.0	ppb(v/v)	1.3
1,3,5-Trimethylbenzene	ND	3.0	ppb(v/v)	1.1
Vinyl acetate	ND	10	ppb(v/v)	2.0
Vinyl chloride	ND	3.0	ppb(v/v)	1.5
m-Xylene & p-Xylene	ND	4.0	ppb(v/v)	2.0
o-Xylene	ND	2.0	ppb(v/v)	1.0

NOTE(S):

J Estimated result. Result is less than RL.

Sandia National Laboratories

Client Sample ID: 085812-001/MWL-DP8-10-SG

GC Volatiles

Lot-Sample #...:	E8D210164-003	Work Order #...:	KLPCE1AD	Matrix.....:	AE
Date Sampled...:	04/09/08	Date Received..:	04/21/08		
Prep Date.....:	04/23/08	Analysis Date..:	04/23/08		
Prep Batch #...:	8114474	Analysis Time..:	14:54		
Dilution Factor:	3.16				
Analyst ID.....:	999995	Instrument ID..:	GC8		
		Method.....:	ASTM D1946		

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Methane	ND	0.00063	%(v/v)	0.00019

Sandia National Laboratories

Client Sample ID: 085812-002/MWL-DP8-30-SG

GC/MS Volatiles

Lot-Sample #...: E8D210164-004 Work Order #...: KLPCF1AC Matrix.....: AE
Date Sampled...: 04/09/08 Date Received..: 04/21/08
Prep Date.....: 04/23/08 Analysis Date..: 04/23/08
Prep Batch #...: 8114578 Analysis Time..: 05:37
Dilution Factor: 1
Analyst ID.....: 015590 Instrument ID..: MSA
Method.....: EPA-21 TO-14A

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetone	**62**	**10**	**ppb(v/v)**	**2.5**
Benzene	ND	3.0	ppb(v/v)	1.5
Benzyl chloride	ND	25	ppb(v/v)	8.0
Bromodichloromethane	ND	2.0	ppb(v/v)	1.0
Bromoform	ND	2.0	ppb(v/v)	0.50
Bromomethane	ND	4.0	ppb(v/v)	2.0
2-Butanone (MEK)	**13**	**10**	**ppb(v/v)**	**2.0**
Carbon disulfide	**5.5 J**	**10**	**ppb(v/v)**	**2.0**
Carbon tetrachloride	ND	2.0	ppb(v/v)	1.0
Chlorobenzene	ND	2.0	ppb(v/v)	1.0
Dibromochloromethane	ND	2.0	ppb(v/v)	1.0
Chloroethane	ND	4.0	ppb(v/v)	1.5
Chloroform	ND	2.0	ppb(v/v)	1.0
Chloromethane	ND	4.0	ppb(v/v)	1.0
1,2-Dibromoethane (EDB)	ND	2.0	ppb(v/v)	1.0
1,2-Dichlorobenzene	ND	2.0	ppb(v/v)	0.90
1,3-Dichlorobenzene	ND	2.0	ppb(v/v)	0.80
1,4-Dichlorobenzene	ND	6.0	ppb(v/v)	3.0
Dichlorodifluoromethane	ND	2.0	ppb(v/v)	1.0
1,1-Dichloroethane	ND	2.0	ppb(v/v)	1.0
1,2-Dichloroethane	ND	2.0	ppb(v/v)	1.0
cis-1,2-Dichloroethene	ND	2.0	ppb(v/v)	0.80
1,1-Dichloroethene	ND	2.0	ppb(v/v)	1.0
1,2-Dichloropropane	ND	3.0	ppb(v/v)	1.5
cis-1,3-Dichloropropene	ND	3.0	ppb(v/v)	1.5
trans-1,3-Dichloropropene	ND	2.0	ppb(v/v)	1.0
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND	2.0	ppb(v/v)	1.0
Ethylbenzene	ND	2.0	ppb(v/v)	1.0
4-Ethyltoluene	ND	2.0	ppb(v/v)	0.70
Hexachlorobutadiene	ND	4.0	ppb(v/v)	1.3
2-Hexanone	ND	10	ppb(v/v)	2.0
Methylene chloride	ND	2.0	ppb(v/v)	0.80
4-Methyl-2-pentanone (MIBK)	ND	10	ppb(v/v)	2.0
Styrene	ND	2.0	ppb(v/v)	1.0
1,1,2,2-Tetrachloroethane	ND	2.0	ppb(v/v)	1.0

(Continued on next page)

Sandia National Laboratories

Client Sample ID: 085812-002/MWL-DP8-30-SG

GC/MS Volatiles

Lot-Sample #...: E8D210164-004 Work Order #...: KLPCF1AC Matrix.....: AE

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Tetrachloroethene	ND	2.0	ppb(v/v)	1.0
Toluene	**2.4**	**2.0**	**ppb(v/v)**	**1.0**
1,2,4-Trichloro-benzene	ND	5.0	ppb(v/v)	2.5
1,1,1-Trichloroethane	ND	2.0	ppb(v/v)	1.0
1,1,2-Trichloroethane	ND	2.0	ppb(v/v)	1.0
Trichloroethene	ND	2.0	ppb(v/v)	1.0
Trichlorofluoromethane	ND	2.0	ppb(v/v)	1.0
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	2.0	ppb(v/v)	1.0
1,2,4-Trimethylbenzene	ND	3.0	ppb(v/v)	1.3
1,3,5-Trimethylbenzene	ND	3.0	ppb(v/v)	1.1
Vinyl acetate	ND	10	ppb(v/v)	2.0
Vinyl chloride	ND	3.0	ppb(v/v)	1.5
m-Xylene & p-Xylene	ND	4.0	ppb(v/v)	2.0
o-Xylene	ND	2.0	ppb(v/v)	1.0

NOTE(S):

J Estimated result. Result is less than RL.

Sandia National Laboratories

Client Sample ID: 085812-002/MWL-DP8-30-SG

GC Volatiles

Lot-Sample #...: E8D210164-004	Work Order #...: KLPCF1AD	Matrix.....: AE	
Date Sampled...: 04/09/08	Date Received..: 04/21/08		
Prep Date.....: 04/23/08	Analysis Date..: 04/23/08		
Prep Batch #...: 8114474	Analysis Time..: 15:10		
Dilution Factor: 2.88			
Analyst ID.....: 999995	Instrument ID..: GC8		
	Method.....: ASTM D1946		

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Methane	ND	0.00058	%(v/v)	0.00017

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
1721 South Grand Avenue Santa Ana, CA 92705 * 714-258-8610 * Fax 714-258-0921

Sandia National Laboratories	Work Order:	LRE0138	Received:	05/16/08 09:45
Payment Processing, MS 1385 P.O. Box 5130			Reported:	05/27/08 18:58
Albuquerque, NM 87185-0154	Project:	MWL Remediation		
Rita Kavanaugh	Project Number:	98045 02.02.02 / CF013-08		

DATA QUALIFIERS AND DEFINITIONS

J	Estimated value. Analyte detected at a level less than the Reporting Limit (RL) and greater than or equal to the Method Detection Limit (MDL). The user of this data should be aware that this data is of limited reliability.
ND	Not detected at the reporting limit (or method detection limit if shown)

APPENDIX E
Data Validation Reports for the 2008 Soil-Vapor Samples Collected at the Mixed Waste Landfill

Cross-reference spreadsheet linking analytical laboratory SDG Numbers (shown on Analytical Quality Associates, Inc. data validation reports for the soil-vapor samples) to the ER Sample ID names.			
AR/COC Number	ER Sample ID	Laboratory SDG Number	Sample Matrix
Data Sorted by AR/COC Number:			
611812	MWL-DP7-10-SG	E8D210164-001	SOIL-VAPOR
611812	MWL-DP7-30-SG	E8D210164-002	SOIL-VAPOR
611812	MWL-DP8-10-SG	E8D210164-003	SOIL-VAPOR
611812	MWL-DP8-30-SG	E8D210164-004	SOIL-VAPOR
611870	MWL-DP5-10-SG	LRE0127-01	SOIL-VAPOR
611870	MWL-DP5-10-SG-DUP	LRE0127-04	SOIL-VAPOR
611870	MWL-DP5-30-SG	LRE0127-02	SOIL-VAPOR
611870	MWL-DP5-30-SG-DUP	LRE0127-05	SOIL-VAPOR
611870	MWL-DP5-50-SG	LRE0127-03	SOIL-VAPOR
611870	MWL-DP5-50-SG-DUP	LRE0127-06	SOIL-VAPOR
611871	MWL-DP3-10-SG	LRE0138-01	SOIL-VAPOR
611871	MWL-DP3-30-SG	LRE0138-02	SOIL-VAPOR
611871	MWL-DP3-50-SG	LRE0138-03	SOIL-VAPOR
611874	MWL-DP2-10-SG	LRE0191-01	SOIL-VAPOR
611874	MWL-DP2-30-SG	LRE0191-02	SOIL-VAPOR
611874	MWL-DP2-50-SG	LRE0191-03	SOIL-VAPOR
611876	MWL-DP4-10-SG	LRE0192-01	SOIL-VAPOR
611876	MWL-DP4-30-SG	LRE0192-02	SOIL-VAPOR
611878	MWL-DP6-10-SG	LRE0205-01	SOIL-VAPOR
611878	MWL-DP6-10-SG-DUP	LRE0205-03	SOIL-VAPOR
611878	MWL-DP6-30-SG	LRE0205-02	SOIL-VAPOR
611878	MWL-DP6-30-SG-DUP	LRE0205-04	SOIL-VAPOR
611880	MWL-DP1-10-SG	LRE0228-01	SOIL-VAPOR
611880	MWL-DP1-30-SG	LRE0228-02	SOIL-VAPOR

Cross-reference spreadsheet linking analytical laboratory SDG Numbers (shown on Analytical Quality Associates, Inc. data validation reports for the soil-vapor samples) to the ER Sample ID names.			
AR/COC Number	ER Sample ID	Laboratory SDG Number	Sample Matrix
Data Sorted by Laboratory SDG Number:			
611812	MWL-DP7-10-SG	E8D210164-001	SOIL-VAPOR
611812	MWL-DP7-30-SG	E8D210164-002	SOIL-VAPOR
611812	MWL-DP8-10-SG	E8D210164-003	SOIL-VAPOR
611812	MWL-DP8-30-SG	E8D210164-004	SOIL-VAPOR
611870	MWL-DP5-10-SG	LRE0127-01	SOIL-VAPOR
611870	MWL-DP5-30-SG	LRE0127-02	SOIL-VAPOR
611870	MWL-DP5-50-SG	LRE0127-03	SOIL-VAPOR
611870	MWL-DP5-10-SG-DUP	LRE0127-04	SOIL-VAPOR
611870	MWL-DP5-30-SG-DUP	LRE0127-05	SOIL-VAPOR
611870	MWL-DP5-50-SG-DUP	LRE0127-06	SOIL-VAPOR
611871	MWL-DP3-10-SG	LRE0138-01	SOIL-VAPOR
611871	MWL-DP3-30-SG	LRE0138-02	SOIL-VAPOR
611871	MWL-DP3-50-SG	LRE0138-03	SOIL-VAPOR
611874	MWL-DP2-10-SG	LRE0191-01	SOIL-VAPOR
611874	MWL-DP2-30-SG	LRE0191-02	SOIL-VAPOR
611874	MWL-DP2-50-SG	LRE0191-03	SOIL-VAPOR
611876	MWL-DP4-10-SG	LRE0192-01	SOIL-VAPOR
611876	MWL-DP4-30-SG	LRE0192-02	SOIL-VAPOR
611878	MWL-DP6-10-SG	LRE0205-01	SOIL-VAPOR
611878	MWL-DP6-30-SG	LRE0205-02	SOIL-VAPOR
611878	MWL-DP6-10-SG-DUP	LRE0205-03	SOIL-VAPOR
611878	MWL-DP6-30-SG-DUP	LRE0205-04	SOIL-VAPOR
611880	MWL-DP1-10-SG	LRE0228-01	SOIL-VAPOR
611880	MWL-DP1-30-SG	LRE0228-02	SOIL-VAPOR
AR/COC = Analysis Request/Chain of Custody			
DP = Direct push			
DUP = Duplicate			
EB = Equipment blank			
ER = Environmental Restoration			
ID = Identification			
MWL = Mixed Waste Landfill			
S = Soil			
SDG = Sample Data Group			

Analytical Quality Associates, Inc.
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Memorandum

DATE: May 16, 2008

TO: File

FROM: David Schwent

SUBJECT: Organic GC/MS Data Review and Validation - SNL
Site: MWL Remediation
AR/COC: 611812
SDG: E8D210164
Laboratory: TestAmerica
Project/Task No: 98045.02.02.02

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. This validation was performed according to SNL/NM ER Project AOP 00-03 Rev 2.

Summary

All samples were prepared and analyzed with approved procedures using method EPA-21 TO-14 (VOCs) and ASTM D1946 (methane). No problems were identified with the data package that result in the qualification of data.

Data are acceptable. QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times/Preservation

All samples were analyzed within the prescribed holding times and properly preserved.

Instrument Tune

All instrument tune requirements were met.

Calibration

All initial and continuing calibration QC acceptance criteria were met.

Blanks

No target analytes were detected in the blanks.

Internal Standards (ISs)

All IS area and RT QC acceptance criteria were met.

Surrogates

No surrogate analyses were required by these methods.

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

All LCS/LCSD QC acceptance criteria were met. It should be noted that only 23 of the 49 target analytes were analyzed in the LCS/LCSD. No sample data will be qualified as a result.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

No MS/MSD analyses were required by these methods. The LCSD analysis was used as a measure laboratory precision. No sample data will be qualified as a result.

Tentatively Identified Compounds (TICs)

Tentatively identified compounds were not requested.

Detection Limits/Dilutions

All detection limits were reported correctly. For methane, sample E8D210164-001 was diluted 3.28X, sample -002 was diluted 2.44X, sample -003 was diluted 3.16X and sample -004 was diluted 2.88X due to the nature of the matrix.

Other QC

No equipment blanks (EBs), field blanks (FBs) or field duplicates (FDs) were submitted on the AR/COC.

No other specific issues were identified which affect data quality.

Sample Findings Summary

Site: MWL Remediation **AR/COC:** 611812 **Organic**

Sample ID	VOCs (EPA-21 TO-14A):	Methane (ASTM D1946)															
	All Acceptance criteria met. No sample data will be qualified.	All Acceptance criteria met. No sample data will be qualified.															

Validated By: David Schwartz **Date:** 05/16/08

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Memorandum

DATE: June 2, 2008

TO: File

FROM: David Schwent

SUBJECT: Organic GC/MS Data Review and Validation - SNL
Site: MWL Remediation
AR/COC: 611870
SDG (Work Order): LRE0127
Laboratory: TestAmerica
Project/Task No: 98045.02.02.02

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. This validation was performed according to SNL/NM ER Project AOP 00-03 Rev 2.

Summary

All samples were prepared and analyzed with approved procedures using method EPA-21 TO-14 (VOCs). Problems were identified with the data package that result in the qualification of data.

Calibration: The continuing calibration verification (CCV) percent difference (%D) for 1,2,4-trimethylbenzene of Batch 8E17001 was >30% with positive bias. The associated result of sample LRE0127-05 was a detect and will be qualified "J+,C2."

Data are acceptable. QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times/Preservation

All samples were analyzed within the prescribed holding times and properly preserved.

Instrument Tune

All instrument tune requirements were met.

Calibration

All initial and continuing calibration QC acceptance criteria were met, except as noted above in the summary section and the following. The initial calibration percent relative standard deviation (%RSD) of vinyl acetate was >30% but <45%. However, all associated sample results were non-detects (NDs) and no other calibration QC acceptance criteria were exceeded. Therefore, no sample data will be qualified as a result. The CCV %Ds for chloromethane of Batches 8E16005 and 8E17001 were >30% but <45% with negative bias. However, all associated sample results were NDs and no other calibration QC acceptance

criteria were exceeded. Therefore, no sample data will be qualified as a result. The CCV %Ds for 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, and 1,2,4-trichlorobenzene of Batch 8E17001 were >30% with positive bias. However, all associated sample results, except the 1,2,4-trimethylbenzene result of sample LRE0127-05 (qualified above in the summary section), were NDs and will not be qualified. The CCV %D of 4-ethyltoluene was >30% with positive bias. However, the %D was above the QC acceptance limit by <1% and, based on professional judgment, no sample data will be qualified as a result.

Blanks

No target analytes were detected in the blanks.

Internal Standards (ISs)

All IS area and RT QC acceptance criteria were met.

Surrogates

No surrogate analyses were required by this method.

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

All LCS/LCSD QC acceptance criteria were met. It should be noted that only 16 of the 49 target analytes were analyzed in the LCS/LCSD. No sample data will be qualified as a result.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

No MS/MSD analyses were required by this method. The LCSD analysis was used as a measure laboratory precision. No sample data will be qualified as a result.

Tentatively Identified Compounds (TICs)

Tentatively identified compounds were not requested.

Detection Limits/Dilutions

All detection limits were reported correctly. Samples LRE0127-02, -04, and -05 were diluted 4.2X, 4.3X, and 4.4X, respectively, for tetrachloroethene due to high concentrations of the target analyte. No other samples required dilution.

Other QC

No equipment blanks (EBs) or field blanks (FBs) were submitted on the AR/COC. All relative percent differences (RPDs) of field duplicates (FDs) (samples LRE0127-05 and -06) were <30%. All RPDs of FD (sample -04) were <30%, except for the RPDs for the following target analytes: acetone (78%); 2-butanone (85%); chloroform (67%); dichlorodifluoromethane (50%); tetrachloroethene (58%); 1,1,1-trichloroethane (62%); trichloroethene (67%); trichlorofluoromethane (75%); and 1,1,2-trichloro-1,2,2-trifluoroethane (67%). No QC acceptance criteria for the evaluation of FDs are currently in place.

No other specific issues were identified which affect data quality.

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Memorandum

DATE: June 2, 2008

TO: File

FROM: David Schwent

SUBJECT: Organic GC Data Review and Validation – SNL
Site: MWL Remediation
AR/COC: 611870
SDG (Work Order): LRE0127
Laboratory: TestAmerica
Project/Task No: 98045.02.02.02

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. This validation was performed according to SNL/NM ER Project AOP 00-03 Rev 2.

Summary

All samples were prepared and analyzed with accepted procedures using method ASTM D1946 (methane by GC/Flame Ionization Detector/Thermal Conductivity Detector). It should be noted that the AR/COC did not request the methane analysis, but the client directed the lab to perform it (see Corrective Action Report in the data package). No problems were identified with the data package that result in the qualification of data.

Data are acceptable. QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times and Preservation

The samples were analyzed within the prescribed holding times and properly preserved.

Calibration

All initial and continuing calibration QC acceptance criteria were met.

Blanks

No target analytes were detected in the method blank.

Surrogates

No surrogate analysis was required by this method.

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

All LCS/LCSD QC acceptance criteria were met.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

No MS/MSD analyses were required by this method. The LCSD analysis was used as a measure laboratory precision. No sample data will be qualified as a result.

Target Compound Identification/Confirmation

No confirmation analysis was required for this method.

Detection Limits/Dilutions

All detection limits were reported correctly. Sample LRE0127-01 was diluted 2.3X, sample -02 was diluted 2.1X, sample -03 was diluted 2.2X, sample -04 was diluted 2.2X, sample -05 was diluted 2.2X, and sample -06 was diluted 2.1X due to the nature of the matrix.

Other QC

No equipment blanks (EBs) or field blanks (FBs) were submitted on the AR/COC. All field duplicate (FD) (samples LRE0127-04, -05, and -06) relative percent differences (RPDs) were <30%. No QC acceptance criteria for the evaluation of FDs are currently in place.

No other specific issues that affect data quality were identified.

Sample Findings Summary

Site: MWL Remediation **AR/COC:** 611870 **Organic**

Sample ID	VOCs (EPA-21 TO-14A):	95-63-6 (1,2,4-trimethylbenzene)	Methane (ASTM D1946)													
085813-002 MWL-DP5-30-SG-DUP		J+,C2	All Acceptance criteria met. No sample data will be qualified.													

Validated By: David Schmoll **Date:** 06/02/08

Analytical Quality Associates, Inc.
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Memorandum

DATE: June 5, 2008

TO: File

FROM: David Schwent

SUBJECT: Organic GC/MS Data Review and Validation - SNL
Site: MWL Remediation
AR/COC: 611871
SDG (Work Order): LRE0138
Laboratory: TestAmerica
Project/Task No: 98045.02.02.02

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. This validation was performed according to SNL/NM ER Project AOP 00-03 Rev 2.

Summary

All samples were prepared and analyzed with approved procedures using method EPA-21 TO-14 (VOCs). Problems were identified with the data package that result in the qualification of data.

Calibration: The continuing calibration verification (CCV) percent difference (%D) of 2-butanone was >30% with positive bias. All associated sample results were detects and will be qualified "J+,C2."

Calibration: The CCV %D of 1,2,4-trimethylbenzene was >30% with positive bias. All associated sample results were detects and will be qualified "J+,C2."

Data are acceptable. QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times/Preservation

All samples were analyzed within the prescribed holding times and properly preserved.

Instrument Tune

All instrument tune requirements were met.

Calibration

All initial and continuing calibration QC acceptance criteria were met, except as noted above in the summary section and the following. The initial calibration percent relative standard deviation (%RSD) of vinyl acetate was >30% but <45%. However, all associated sample results were non-detects (NDs) and no other calibration QC acceptance criteria were exceeded. Therefore, no sample data will be qualified as a

result. The CCV %D of 1,2,4-trichlorobenzene was >30% with positive bias. However, all associated sample results were NDs and will not be qualified.

Blanks

No target analytes were detected in the blanks.

Internal Standards (ISs)

All IS area and RT QC acceptance criteria were met.

Surrogates

No surrogate analysis was required by this method.

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

All LCS/LCSD QC acceptance criteria were met. It should be noted that only 16 of the 49 target analytes were analyzed in the LCS/LCSD. No sample data will be qualified as a result.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

No MS/MSD analyses were required by this method. The LCSD analysis was used as a measure laboratory precision. No sample data will be qualified as a result.

Tentatively Identified Compounds (TICs)

Tentatively identified compounds were not requested.

Detection Limits/Dilutions

All detection limits were reported correctly. Samples LRE0138-02 and -03 were diluted 6.9X and 6.4X, respectively, for trichlorofluoromethane due to high concentrations of the target analyte. No other samples required dilution.

Other QC

No equipment blanks (EBs), field blanks (FBs), or field duplicates (FDs) were submitted on the AR/COC.

No other specific issues were identified that affect data quality.

Reviewed by: Kevin A. Lambert, Level I Peer Review, 06/05/08

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Memorandum

DATE: June 5, 2008

TO: File

FROM: David Schwent

SUBJECT: Organic GC Data Review and Validation – SNL
Site: MWL Remediation
AR/COC: 611871
SDG (Work Order): LRE0138
Laboratory: TestAmerica
Project/Task No: 98045.02.02.02

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. This validation was performed according to SNL/NM ER Project AOP 00-03 Rev 2.

Summary

All samples were prepared and analyzed with accepted procedures using method ASTM D1946 (methane by GC/Flame Ionization Detector/Thermal Conductivity Detector). It should be noted that the AR/COC did not request the methane analysis, but the client directed the lab to perform it (see Corrective Action Report in the data package). No problems were identified with the data package that result in the qualification of data.

Data are acceptable. QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times and Preservation

The samples were analyzed within the prescribed holding times and properly preserved.

Calibration

All initial and continuing calibration QC acceptance criteria were met.

Blanks

No target analytes were detected in the method blank.

Surrogates

No surrogate analysis was required by this method.

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

All LCS/LCSD QC acceptance criteria were met.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

No MS/MSD analyses were required by this method. The LCSD analysis was used as a measure laboratory precision. No sample data will be qualified as a result.

Target Compound Identification/Confirmation

No confirmation analysis was required for this method.

Detection Limits/Dilutions

All detection limits were reported correctly. Sample LRE0138-01 was diluted 3.2X, sample -02 was diluted 3.1X, and sample -03 was diluted 2.6X due to the nature of the matrix.

Other QC

No equipment blanks (EBs), field blanks (FBs), or field duplicates (FDs) were submitted on the AR/COC.

No other specific issues were identified that affect data quality.

Reviewed by: Kevin A. Lambert, Level I Peer Review, 06/05/08

Sample Findings Summary

Site: MWL Remediation **AR/COC:** 611871 **Organic**

Sample ID	EPA-21 TO-14A (VOCs):	78-93-3 (2-butanone)	95-63-6 (1,2,4-trimethylbenzene)	ASTM D1946 (methane)
085807-001 MWL-DP3-10-SG		J+,C2	J+,C2	All Acceptance criteria met. No sample data will be qualified.
085807-002 MWL-DP3-30-SG		J+,C2	J+,C2	
085807-003 MWL-DP3-50-SG		J+,C2	J+,C2	

Validated By: David Schwartz **Date:** 06/05/08

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Memorandum

Date: June 3, 2008

To: File

From: Kevin Lambert

Subject: GC/MS Organic Data Review and Validation – SNL
Site: MWL Remediation
COC: 611874
SDG (Work Order): LRE0191
Laboratory: TestAmerica Laboratories, Inc. - Santa Ana, CA
Project/Task No: 98045.02.02.02
Analysis: VOCs

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. Data are evaluated using SNL/NM SMO AOP 00-03 Rev 2.

Summary

Three samples were prepared and analyzed with accepted procedures using method EPA TO-14A (VOCs). Data were reported for all required analytes. No problems were identified with the data package that result in the qualification of data.

Data are acceptable and reported QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times and Preservation

The samples were analyzed within the prescribed holding time and properly preserved.

Instrument Tune

All instrument tune requirements were met.

Calibration

All initial and continuing calibration QC acceptance criteria were met except as follows. The continuing calibration verification (CCV) percent difference (%D) for chloromethane was >30% but ≤45% with a negative bias. All associated sample results were non-detects and no other calibration infractions occurred for this analyte. Therefore, the associated sample results will not be qualified.

Blanks

No target analytes were detected in the method blank.

Surrogates

No surrogate analyses were required by this method.

Internal Standards

All internal standards met QC acceptance criteria.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

No MS/MSD analyses were required by this method. The LCS/LCSD is used to assess accuracy and precision.

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

The LCS/LCSD analyses met all QC acceptance criteria. It should be noted that only 16 of the 49 target analytes were analyzed in the LCS/LCSD. No sample data will be qualified as a result.

Detection Limits/Dilutions

All detection limits were properly reported. The samples were not diluted.

Tentatively Identified Compounds (TICs)

TICs were not requested.

Other QC

No equipment blanks (EBs), field blanks (FBs), or field duplicate pairs were submitted on the AR/COC.

No other specific issues that affect data quality were identified.

Reviewed: David Schwent Level: I 06/04/08

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Memorandum

DATE: June 3, 2008

TO: File

FROM: David Schwent

SUBJECT: GC Organic Data Review and Validation – SNL
Site: MWL Remediation
AR/COC: 611874
SDG (Work Order): LRE0191
Laboratory: TestAmerica Laboratories, Inc. - Santa Ana, CA
Project/Task No: 98045.02.02.02
Analysis: Methane

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. This validation was performed according to SNL/NM ER Project AOP 00-03 Rev 2.

Summary

Three samples were prepared and analyzed with accepted procedures using method ASTM D1946 (methane by GC/Flame Ionization Detector/Thermal Conductivity Detector). It should be noted that the methane analysis was not requested on the AR/COC, but was added by the laboratory in accordance with client instructions (see Corrective Action Report in the data package). No problems were identified with the data package that result in the qualification of data.

Data are acceptable and reported QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times and Preservation

The samples were analyzed within the prescribed holding times and properly preserved.

Calibration

All initial and continuing calibration QC acceptance criteria were met.

Blanks

No target analytes were detected in the method blank.

Surrogates

No surrogate analyses were required by this method.

Sample Findings Summary

Site: MWL Remediation

AR/COC: 611874

Data Type: Organics

VOCs (TO-14A) and Methane analyses met QC acceptance criteria. No data should be qualified.

Validated By:

Kevin A. Lambert

Kevin A. Lambert

Date: 06/03/08

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Memorandum

Date: June 3, 2008

To: File

From: Kevin Lambert

Subject: GC/MS Organic Data Review and Validation – SNL
Site: MWL Remediation
COC: 611876
SDG (Work Order): LRE0192
Laboratory: TestAmerica Laboratories, Inc. - Santa Ana, CA
Project/Task No: 98045.02.02.02
Analysis: VOCs

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. Data are evaluated using SNL/NM SMO AOP 00-03 Rev 2.

Summary

Two samples were prepared and analyzed with accepted procedures using method EPA TO-14A (VOCs). Data were reported for all required analytes. No problems were identified with the data package that result in the qualification of data.

Data are acceptable and reported QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times and Preservation

The samples were analyzed within the prescribed holding time and properly preserved.

Instrument Tune

All instrument tune requirements were met.

Calibration

All initial and continuing calibration QC acceptance criteria were met except as follows. The continuing calibration verification (CCV) percent difference (%D) for chloromethane was >30% but ≤45% with a negative bias. All associated sample results were non-detects and no other calibration infractions occurred for this analyte. Therefore, the associated sample results will not be qualified.

Blanks

No target analytes were detected in the method blank.

Surrogates

No surrogate analyses were required by this method.

Internal Standards

All internal standards met QC acceptance criteria.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

No MS/MSD analyses were required by this method. The LCS/LCSD is used to assess accuracy and precision.

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

The LCS/LCSD analyses met all QC acceptance criteria. It should be noted that only 16 of the 49 target analytes were analyzed in the LCS/LCSD. No sample data will be qualified as a result.

Detection Limits/Dilutions

All detection limits were properly reported. The samples were not diluted.

Tentatively Identified Compounds (TICs)

TICs were not requested.

Other QC

No equipment blanks (EBs), field blanks (FBs), or field duplicate pairs were submitted on the AR/COC.

No other specific issues that affect data quality were identified.

Reviewed: David Schwent Level: I 06/04/08

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Memorandum

DATE: June 3, 2008

TO: File

FROM: David Schwent

SUBJECT: GC Organic Data Review and Validation – SNL
Site: MWL Remediation
AR/COC: 611876
SDG (Work Order): LRE0192
Laboratory: TestAmerica Laboratories, Inc. - Santa Ana, CA
Project/Task No: 98045.02.02.02
Analysis: Methane

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. This validation was performed according to SNL/NM ER Project AOP 00-03 Rev 2.

Summary

Two samples were prepared and analyzed with accepted procedures using method ASTM D1946 (methane by GC/Flame Ionization Detector/Thermal Conductivity Detector). It should be noted that the methane analysis was not requested on the AR/COC, but was added by the laboratory in accordance with client instructions (see Corrective Action Report in the data package). No problems were identified with the data package that result in the qualification of data.

Data are acceptable and reported QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times and Preservation

The samples were analyzed within the prescribed holding times and properly preserved.

Calibration

All initial and continuing calibration QC acceptance criteria were met.

Blanks

No target analytes were detected in the method blank.

Surrogates

No surrogate analyses were required by this method.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

No MS/MSD analyses were required by this method. The LCS/LCSD is used to assess accuracy and precision.

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

The LCS/LCSD analyses met all QC acceptance criteria.

Target Compound Identification/Confirmation

No confirmation analysis was required for this method.

Detection Limits/Dilutions

All detection limits were reported correctly. Sample LRE0192-01 was diluted 3.1X and sample LRE0192-02 was diluted 2.8X due to the nature of the matrix.

Other QC

No equipment blanks (EBs), field blanks (FBs), or field duplicate pairs were submitted on the AR/COC.

No other specific issues that affect data quality were identified.

Reviewed: David Schwent Level: I 06/04/08

Sample Findings Summary

Site: MWL Remediation

AR/COC: 611876

Data Type: Organics

VOCs (TO-14A) and Methane analyses met QC acceptance criteria. No data should be qualified.

Validated By:

Kevin A. Lambert

Kevin A. Lambert

Date: 06/03/08

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Memorandum

DATE: June 5, 2008

TO: File

FROM: David Schwent

SUBJECT: Organic GC/MS Data Review and Validation - SNL
Site: MWL Remediation
AR/COC: 611878
SDG (Work Order): LRE0205
Laboratory: TestAmerica
Project/Task No: 98045.02.02.02

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. This validation was performed according to SNL/NM ER Project AOP 00-03 Rev 2.

Summary

All samples were prepared and analyzed with approved procedures using method EPA-21 TO-14 (VOCs). No problems were identified with the data package that result in the qualification of data.

Data are acceptable. QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times/Preservation

All samples were analyzed within the prescribed holding times and properly preserved.

Instrument Tune

All instrument tune requirements were met.

Calibration

All initial and continuing calibration QC acceptance criteria were met, except the following. The continuing calibration verification (CCV) percent differences (%Ds) of 1,2,4-trimethylbenzene, hexachlorobutadiene, and 1,2,4-trichlorobenzene were >30% with positive bias. However, all associated sample results were non-detects (NDs) and will not be qualified.

Blanks

No target analytes were detected in the blanks.

Internal Standards (ISs)

All IS area and RT QC acceptance criteria were met.

Surrogates

No surrogate analysis was required by this method.

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

All LCS/LCSD QC acceptance criteria were met. It should be noted that only 16 of the 49 target analytes were analyzed in the LCS/LCSD. No sample data will be qualified as a result.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

No MS/MSD analyses were required by this method. The LCSD analysis was used as a measure laboratory precision. No sample data will be qualified as a result.

Tentatively Identified Compounds (TICs)

Tentatively identified compounds were not requested.

Detection Limits/Dilutions

All detection limits were reported correctly. Samples LRE0205-02 and -04 were diluted 3.1X for all target analytes. No other samples required dilution.

Other QC

No equipment blanks (EBs) or field blanks (FBs) were submitted on the AR/COC. All relative percent differences (RPDs) of field duplicate (FD) (sample LRE0205-03 were <30%. All RPDs of FD (sample -04) were <30%, except for the RPDs for the following target analytes: tetrachloroethene (197%); 1,1,1-trichloroethane (80%); trichloroethene (164%); and 1,1,2-trichloro-1,2,2-trifluoroethane (34%). No QC acceptance criteria for the evaluation of FDs are currently in place.

No other specific issues were identified that affect data quality.

Reviewed by: Kevin A. Lambert, Level I Peer Review, 06/06/08

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Memorandum

DATE: June 5, 2008

TO: File

FROM: David Schwent

SUBJECT: Organic GC Data Review and Validation – SNL
Site: MWL Remediation
AR/COC: 611878
SDG (Work Order): LRE0205
Laboratory: TestAmerica
Project/Task No: 98045.02.02.02

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. This validation was performed according to SNL/NM ER Project AOP 00-03 Rev 2.

Summary

All samples were prepared and analyzed with accepted procedures using method ASTM D1946 (methane by GC/Flame Ionization Detector/Thermal Conductivity Detector). No problems were identified with the data package that result in the qualification of data.

Data are acceptable. QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times and Preservation

The samples were analyzed within the prescribed holding times and properly preserved.

Calibration

All initial and continuing calibration QC acceptance criteria were met.

Blanks

No target analytes were detected in the method blank.

Surrogates

No surrogate analysis was required by this method.

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

All LCS/LCSD QC acceptance criteria were met.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

No MS/MSD analyses were required by this method. The LCSD analysis was used as a measure laboratory precision. No sample data will be qualified as a result.

Target Compound Identification/Confirmation

No confirmation analysis was required for this method.

Detection Limits/Dilutions

All detection limits were reported correctly. Sample LRE0205-01 was diluted 3.2X, sample -02 was diluted 3.1X, sample -03 was diluted 2.8X, and sample -04 was diluted 3.1X due to the nature of the matrix.

Other QC

No equipment blanks (EBs) or field blanks (FBs) were submitted on the AR/COC. All relative percent differences (RPDs) of the field duplicates (FDs) (samples LRE0205-03 and -04) were <30%. No QC acceptance criteria for the evaluation of FDs are currently in place.

No other specific issues were identified that affect data quality.

Reviewed by: Kevin A. Lambert, Level I Peer Review, 06/06/08

Sample Findings Summary

Site: MWL Remediation **AR/COC:** 611878 **Organic**

Sample ID	EPA-21 TO-14A (VOCs):	ASTM D1946 (methane):															
	All Acceptance criteria met. No sample data will be qualified.	All Acceptance criteria met. No sample data will be qualified.															

Validated By: David Schmidt **Date:** 06/05/08

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Memorandum

Date: June 10, 2008

To: File

From: Kevin Lambert

Subject: GC/MS Organic Data Review and Validation – SNL
Site: MWL Remediation
COC: 611880
SDG (Work Order): LRE0228
Laboratory: TestAmerica Laboratories, Inc. - Santa Ana, CA
Project/Task No: 98045.02.02.02
Analysis: VOCs

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. Data are evaluated using SNL/NM SMO AOP 00-03 Rev 2.

Summary

Two samples were prepared and analyzed with accepted procedures using method EPA TO-14A (VOCs). Data were reported for all required analytes. No problems were identified with the data package that result in the qualification of data.

Data are acceptable and reported QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times and Preservation

The samples were analyzed within the prescribed holding time and properly preserved.

Instrument Tune

All instrument tune requirements were met.

Calibration

All initial and continuing calibration QC acceptance criteria were met except as follows. The continuing calibration verification (CCV) percent difference (%D) for chloromethane was >30% but ≤45% with a negative bias. All associated sample results were non-detects and no other calibration infractions occurred for this analyte. Therefore, the associated sample results will not be qualified.

Blanks

No target analytes were detected in the method blank.

Surrogates

No surrogate analyses were required by this method.

Internal Standards

All internal standards met QC acceptance criteria.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

No MS/MSD analyses were required by this method. The LCS/LCSD is used to assess accuracy and precision.

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

The LCS/LCSD analyses met all QC acceptance criteria. It should be noted that only 16 of the 49 target analytes were analyzed in the LCS/LCSD. No sample data will be qualified as a result.

Detection Limits/Dilutions

All detection limits were properly reported. The samples were not diluted.

Tentatively Identified Compounds (TICs)

TICs were not requested.

Other QC

No equipment blanks (EBs), field blanks (FBs), or field duplicates (FDs) were submitted on the AR/COC.

No other specific issues were identified that affect data quality.

Reviewed: David Schwent Level: I 06/10/08

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Memorandum

DATE: June 10, 2008

TO: File

FROM: Kevin Lambert

SUBJECT: GC Organic Data Review and Validation – SNL
Site: MWL Remediation
AR/COC: 611880
SDG (Work Order): LRE0228
Laboratory: TestAmerica Laboratories, Inc. - Santa Ana, CA
Project/Task No: 98045.02.02.02
Analysis: Methane

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. This validation was performed according to SNL/NM ER Project AOP 00-03 Rev 2.

Summary

Two samples were prepared and analyzed with accepted procedures using method ASTM D1946 (methane by GC/Flame Ionization Detector/Thermal Conductivity Detector). No problems were identified with the data package that result in the qualification of data.

Data are acceptable and reported QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times and Preservation

The samples were analyzed within the prescribed holding times and properly preserved.

Calibration

All initial and continuing calibration QC acceptance criteria were met.

Blanks

No target analytes were detected in the method blank.

Surrogates

No surrogate analyses were required by this method.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

No MS/MSD analyses were required by this method. The LCS/LCSD is used to assess accuracy and precision.

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

The LCS/LCSD analyses met all QC acceptance criteria.

Target Compound Identification/Confirmation

No confirmation analysis was required for this method.

Detection Limits/Dilutions

All detection limits were reported correctly. Sample LRE0228-01 was diluted 2.2X and sample -02 was diluted 2.6X due to the nature of the matrix.

Other QC

No equipment blanks (EBs), field blanks (FBs), or field duplicate (FDs) were submitted on the AR/COC.

No other specific issues were identified that affect data quality.

Reviewed: David Schwent Level: I 06/10/08

Sample Findings Summary

Site: MWL Remediation

AR/COC: 611880

Data Type: Organics

VOCs (TO-14A) and Methane analyses met QC acceptance criteria. No data should be qualified.

Validated By:

Kevin A. Lambert

Kevin A. Lambert

Date: 06/10/08

6.1 Data Qualifier Definitions

Data qualifiers are commonly used during the validation process to classify sample data as to their conformance to QC requirements. For the purposes of this procedure, the following code letters and associated definitions are provided:

BD	(below detection limit) - Used in radiochemistry to identify results that are not statistically different from zero.
J	The associated value is an estimated quantity.
J+	The associated numerical value is an estimated quantity with a suspected positive bias.
J-	The associated numerical value is an estimated quantity with a suspected negative bias.
N	Presumptive evidence of the presence of the material.
NJ	Presumptive evidence of the presence of the material at an estimated quantity.
NJ+	Presumptive evidence of the presence of the material at an estimated quantity with a suspected positive bias.
NJ-	Presumptive evidence of the presence of the material at an estimated quantity with a suspected negative bias.
R	The data are unusable (compound may or may not be present). Resampling and reanalysis are necessary for verification.
U	The analyte was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.
UJ	The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

Datum is unqualified if the quality parameters indicate the method was appropriate and that the reported result reflects the true value within the expected analytical uncertainty.

9.0 REASON CODES

Programs may require that general validation codes be included in their computer databases or EDDs. The following codes are the default codes used when this is required.

H1 - Holding time exceeded for sample analysis
H2 - Holding time exceeded for sample extraction
H3 - Holding time exceeded by greater than twice the specified holding time

TP1 - Sample improperly preserved
TP2 - Sample not preserved
TP3 - Sample not maintained at required temperature
TP4 - Required sample or extract clean up not performed
TP5 - Sample received unpreserved and preserved at the laboratory

I1 - Initial calibration not reported
I2 - Initial calibration not independently verified
I3 - Slope r^2 or RF %RSD criteria not met
I4 - Minimum RF / Slope not met
I5 - Intercept too large
I6 - Insufficient number of calibration standards used

C1 - Continuing calibration frequency not met
C2 - Continuing calibration %D failed high
C3 - Continuing calibration %D failed low

B - Method blank contamination at concentration greater than PQL
B1 - Trip blank contamination at concentration greater than PQL
B2 - Field/equipment blank contamination at concentration greater than PQL
B3 - Calibration blank contamination at concentration greater than PQL
B4 - Negative value for calibration blank - absolute value greater than the MDL
B5 - Negative value for method blank - absolute value greater than the MDL
B6 - Negative value for field/equipment/trip blank - absolute value greater than the MDL
B7 - Method blank contamination at activity greater than the MDA
B8 - Method blank frequency not met
B9 - Instrument or calibration blank frequency not met

IS1 - Internal standard / tracer recovery failed high
IS2 - Internal standard / tracer recovery failed low but greater than 10%
IS3 - Internal standard / tracer recovery failed low and less than 10%

S1 - Surrogate(s) failed high
S2 - Surrogate(s) failed low
S3 - Multiple random surrogate failures

FR1 - Result exceeds calibration range
FR2 - No result reported - sample lost or damaged
FR3 - Result is less than the MDA / MDL
FR4 - Negative result - absolute value greater than the MDA/MDL
FR5 - Retention time criteria not met
FR6 - Ion mass ratio criteria not met

MS1 - Matrix spike not analyzed or not analyzed on the client's sample
MS2 - Matrix spike analyte(s) recovery failed high
MS3 - Matrix spike analyte(s) recovery failed low
MS4 - Matrix spike analyte(s) recovery failed both high and low
MS5 - MS/MSD relative percent difference failed

RP1 - Replicate not analyzed or not analyzed on the client's sample
RP2 - Replicate relative percent difference failed

L1 - Laboratory control sample frequency not met
L2 - Laboratory control sample analyte(s) recovery failed high
L3 - Laboratory control sample analyte(s) recovery failed low
L4 - Laboratory control sample analyte(s) recovery failed both high and low
L5 - LCS/LCSD relative percent difference failed

DL1 - Reporting limit verification frequency not met
DL2 - Reporting limit verification percent recovery failed high
DL3 - Reporting limit verification percent recovery failed low

CK1 - Interference check sample frequency not met
CK2 - Interference check sample analyte(s) failed high
CK3 - Interference check sample analyte(s) failed low

D1 - Serial dilution failed percent recovery
D2 - Inappropriate initial dilution

V1 - Conformation analysis not done
V2 - Conformation RPD exceeds criteria

X1 - General data quality is suspect - see report
X2 - Analysis failed to meet method requirements - see report
X3 - Required QC documentation missing

Volume II

TAB 9

Notice of Approval: Investigation Report on the Soil-Vapor Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill, August 2008

From: NMED/Bearzi
To: SNL/Wagner

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NEW MEXICO ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

September 26, 2008

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Securities Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: INVESTIGATION REPORT ON THE SOIL-VAPOR VOLATILE ORGANIC COMPOUNDS, TRITIUM, AND RADON SAMPLING AT THE MIXED WASTE LANDFILL, AUGUST 2008
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-08-018

Dear Ms. Wagner and Mr. Nimick:

The New Mexico Environment Department (NMED) has reviewed the subject report and finds that the levels and distributions of tritium, radon, and volatile organic compound (VOC) vapors detected in the investigation are consistent with earlier data used to develop the conceptual model for the MWL. As demonstrated in the risk assessment that is included in the MWL Corrective Measures Study Report, similar levels detected in the past for these constituents were found not to pose unacceptable risk to human health and the environment based on an industrial land-use scenario.

NMED notes that a number of monitoring recommendations are made throughout the subject report. Other than trigger levels that are to be developed as part of the Corrective Measures Implementation Plan, as ordered by the NMED Secretary, the specific requirements for long-term monitoring will be negotiated as part of the Long-Term Monitoring and Maintenance Plan.

If you have any questions regarding this matter, please contact Mr. William Moats of my staff at (505) 222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE OB
J. Cochran, SNL, MS 0719
J. Gould, DOE NNSA/SSO, MS 0184
L. King, EPA Region 6 (6PD-N)
File: Reading and SNL 2008
SNL-08-018

Volume II

Corrective Measures Implementation Plan – Subgrade Preparation

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Volume II

TAB 10

Notification of Current and Planned Field Work

at the Mixed Waste Landfill

From: SNL/Wagner
To: NMED/Curry

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SNL MWL 06

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

JUL 12 2006

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. Ron Curry, Secretary
New Mexico Environment Department
Harold Runnels Building
1190 St. Francis Drive
PO Box 26110
Santa Fe, NM 87502

Dear Secretary Curry,

The purpose of this letter is to provide you with a courtesy notification of current, and planned, field work at the Mixed Waste Landfill (MWL). Currently, borrow pit soils are being screened and stockpiled at the borrow pit area in preparation for grading of the MWL surface and the development of a crown to aid runoff, prevent ponding, and reduce the chance for infiltration.

Field work at the landfill itself is scheduled for early September 2006 when the security fences will be removed and soil piles transported to the vicinity of the MWL in preparation for the surface grading operation. Construction of the cover itself will not begin until formal approval of the MWL Corrective Measures Implementation (CMI) Plan is issued by the New Mexico Environment Department.

Preparatory field work is expected to be completed in early October of 2006. Fencing will be installed, but all further work will be halted pending NMED approval of the CMI Plan, effectively placing the MWL in standby mode.

If you have any questions, please contact me at (505) 845-6036, or John Gould at (505) 845-6089.

Sincerely,

Patty Wagner

Patty Wagner
Manager

cc:
J. Bearzi, NMED-HWB
W. Moats, NMED-HWB
T. Skibitski, NMED-OB
D. Sleeman, NMED-OB
F. Nimick, SNL, Org. 6140, MS 1089
D. Fate, SNL, Org. 6147, MS 1089
M. Martin, NNSA/NA-56

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TAB 11

Fence Removal and Subgrade Preparation, Mixed Waste Landfill

From: NMED/Bearzi
To: SNL/Wagner

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State of New Mexico
ENVIRONMENT DEPARTMENT
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Telephone (505) 428-2500
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BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

September 18, 2006

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Peter B. Davies
Director, Geoscience and Environment
Center (6100)
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185-5400

RE: FENCE REMOVAL AND SUBGRADE PREPARATION
SANDIA NATIONAL LABORATORIES MIXED WASTE LANDFILL
EPA ID# NM5890110518

Dear Ms. Wagner and Mr. Davies:

The New Mexico Environment Department (NMED) has reviewed those portions of the Mixed Waste Landfill (MWL) Corrective Measures Implementation (CMI) Plan relating to removal of the fence and preparation of the subgrade for the cover. Additionally, NMED has not received any public comment comments on this narrow aspect of the CMI Plan.

NMED has determined that the Permittees may proceed with the removal of the fence at the MWL and apply the subgrade cover. This determination does not in any way affect the pending agency action on the MWL CMI Plan.

If you have any questions, please contact William Moats of my staff at (505) 222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

JPB:jek

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
T. Fox, NMED OGC
L. King, EPA Region 6 (6PD-N)
File: SNL MWL 2006 and Reading

Volume II

TAB 12

Notification of Precautionary Measures to Prevent Damage to the Mixed Waste Landfill Subgrade Pending Installation of the Cover

From: SNL/Wagner
To: NMED/Bearzi

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National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

MAR 1 3 2007

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road, East, Bldg. 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

On behalf of Sandia Corporation (Sandia) and the Department of Energy (DOE), DOE is requesting the concurrence of the New Mexico Environment Department (NMED) on our plan to implement several precautionary measures to prevent damage to the Mixed Waste Landfill (MWL) subgrade pending installation of the cover.

The MWL subgrade preparation was completed in December 2006 per the specifications in the Corrective Measures Implementation (CMI) Plan. In January 2007 DOE and Sandia completed the response to the Notice of Deficiency on the MWL CMI Plan and anticipated approval of the Plan by the NMED. The delay in approval of the CMI Plan, along with several other factors beyond our control, resulted in a delay in the construction of the MWL cover. These other factors include: (1) the requirement for soil gas sampling prior to cover installation, and (2) the time required to complete the review process for the soil gas sampling and analysis plan.

The MWL technical team and the Construction Quality Assurance engineer have recommended installation of erosion-control matting to protect the subgrade from erosion during this summer's rainy season. A technical justification for installation of the erosion-control matting is documented in a letter from MKM Engineers, Inc. dated February 27, 2007, and maintained in Sandia's files. To prevent subgrade degradation, DOE and Sandia are planning the following measures:

1. Installation of erosion-control matting (~ 3/16" thick). The matting is biodegradable, is designed to protect the MWL subgrade for up to 12 months and poses no impacts to the cover design.

2. Construction of swales east of the landfill to divert run-on and prevent erosion of the subgrade during heavy rainfall events this summer. The swales will be constructed in the locations proposed in the MWL cover design in the CMI Plan.

3. Periodic inspection/maintenance of the erosion-control matting and subgrade surface.

4. Retesting of the compaction of the MWL subgrade surface prior to cover installation. If necessary, the subgrade surface will be reworked to meet compaction specifications prior to construction of the MWL cover.

DOE and Sandia will proceed with the cover installation only following written approval by the NMED of the MWL CMI Plan.

Please indicate your concurrence by responding to this letter at your earliest convenience, but preferably by March 23, 2007. If you have any questions regarding this submittal, please contact me at (505) 845-6036 or Joe Estrada, Federal Project Director at (505) 845-5326.

Sincerely,

Patty Wagner

Patty Wagner
Manager

cc:
W. Moats, NMED (via Certified Mail)
J. Kieling, NMED, Santa Fe
L. King, USEPA, Region VI (via Certified Mail)
T. Skibitski, NMED-OB
T. Longo, NNSA/NA-56/HQ, GTN
M. Reynolds, NNSA/SSO, MS 0184
K. Agogino, NNSA/SSO, MS 0184
J. Gould, NNSA/SSO, MS 0184
A. Blumberg, SNL/NM, Org. 11100, MS 0141
D. Miller, SNL/NM, Org. 6765, MS 0718
P. Freshour, SNL/NM, Org. 6765, MS 1089
T. Goering, SNL/NM, Org. 6765, MS 1089
M. J. Davis, SNL/NM, Org. 6765, MS 1089
Records, Center, SNL/NM, Org. 6765, MS 1089
Public Reading Room (c/o SNL/NM, Org. 6765)

AOP 95-45, 06

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **NMED Notification of Precautionary Measures at Mixed Waste Landfill, March 2007**

Document authors: **Paul Freshour, 6765**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 3/2/07

Peter B. Davies
Director
Nuclear Energy & Global Security Technologies
Division 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

Date

and

Signature: _____ 3-13-07

Patty Wagner
Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Date

Volume II

TAB 13

Mixed Waste Landfill Corrective Measures Implementation Plan,

Letter of March 13, 2007

From: NMED/Bearzi
To: SNL/Wagner

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State of New Mexico
ENVIRONMENT DEPARTMENT
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
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BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

CINDY PADILLA
DEPUTY SECRETARY

CERTIFIED MAIL -- RETURN RECEIPT REQUESTED

March 23, 2007

Ms. Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P. O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Mr. Les E. Shephard
Vice President
Energy, Information and Infrastructure Surety
Sandia National Laboratories
P. O. Box 5800, MS 0724
Albuquerque, NM 87185

RE: MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION PLAN, LETTER OF MARCH 13, 2007
SANDIA NATIONAL LABORATORIES, EPA ID NM5890110518
SNL-05-025

Dear Ms. Wagner and Mr. Shephard:

The New Mexico Environment Department (NMED) has received the U. S. Department of Energy's (co-Permittee's) letter dated March 13, 2007, concerning the plan to implement precautionary measures to prevent damage to the Sandia National Laboratories' (SNL) Mixed Waste Landfill (MWL) subgrade pending installation of the cover. NMED cannot evaluate the co-Permittee's plans without more detailed information. However, the proposed measures do not require NMED concurrence, as damage to the prepared area would jeopardize successful construction of the cover. Maintenance of the area is therefore inherent in preparation of the subgrade.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

JPB:wpm

cc: J. Kieling, NMED, HWB
W. Moats, NMED, HWB
L. King, EPA-Region 6 (6PD-N)
J. Gould, DOE/NNSA/SSO, MS 0184
P. Freshour, SNL, MS 1087
File: Reading and SNL 2007
SNL-05-025

Volume II

TAB 14

Extension Request for Submittal of Burn Site Corrective Measures Evaluation Report and Mixed Waste Landfill Corrective Measures Implementation Report

From: SNL/Wagner
To: NMED/Bearzi

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National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

AUG 1 0 2007

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. James Bearzi
Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East
Building 1
Santa Fe, New Mexico 87505

Dear Mr. Bearzi:

On behalf of Sandia Corporation (Sandia) and the Department of Energy (DOE), DOE is requesting extensions of time for two deliverables under the Compliance Order on Consent (Consent Order) for Sandia National Laboratories/New Mexico (EPA ID No. NM5890110518). This request is in accordance with Section III.J.2 of the Consent Order, which requires a written submission for schedule changes to the New Mexico Environment Department (NMED) for review and approval.

The following schedule changes are requested:

Deliverable	**Current Due Date**	**Proposed New Due Date**
Burn Site Groundwater Corrective Measures Evaluation (CME) Report	01/08/2008	09/30/2010
Mixed Waste Landfill (MWL) Corrective Measures Implementation (CMI) Report	10/29/2007	Within 180 days after implementation of the remedy is complete*

*estimated date is 09/30/2010

The Burn Site CME Report is delayed pending completion of interim measures, which included the installation of new wells and collection and analysis of additional data. Eight quarters of additional data are required under the interim measures, with data collection ending in December 2007. The new data will be integrated into a revised site conceptual model and a revised CME Work Plan, both of which require approval by NMED. Following approval of the CME Work Plan, the remedy evaluation process will be undertaken and documented as the CME Report.

The MWL CMI Report is delayed pending the approval of the MWL CMI Plan and subsequent implementation of cover construction activities. As part of the CMI Plan review, a Sampling and Analysis Plan (SAP) for soil gas monitoring was issued for public comment in February 2007. NMED is now responding to public comments on the SAP. Following NMED approval of the SAP, soil gas monitoring will be initiated. NMED has indicated that soil gas sampling results must be collected and analyzed prior to approval of the CMI Plan. Upon approval of the CMI Plan, DOE and Sandia will initiate cover construction activities. Within 180 days of completion of the cover, the CMI Report will be submitted to NMED.

If you have any questions, please contact me at (505) 845-6036, or Dan Pellegrino of my staff at (505) 845-5398.

Sincerely,

Patty Wagner for
Manager

cc:
W. Moats, NMED-HWB (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB
A. Blumberg, SNL/NM, Org. 11100, MS 0141
D. Miller, SNL/NM, Org. 6765, MS 0718
P. Freshour, SNL/NM, Org. 6765, MS 1089
M. Skelly, SNL/NM, Org. 6765, MS 1089
T. Goering, SNL/NM, Org. 6765, MS 1089
M. Davis, SNL/NM, Org. 6765, MS 1089
B. Langkopf, SNL/NM Org. 6765, MS 1089
Records Center, SNL/NM, Org.6765, MS 1089
T. Longo, HQ/GTN, NA-56

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Requests for Schedule Extensions for the Burn Site Groundwater Corrective Measures Evaluation Report and the MWL Corrective Measures Implementation Report, July 2007**

Document author: **M. J. Davis, 6765**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 7/26/07
Francis B. Nimick — Date
Deputy to the
Nuclear Energy & Global Security Technologies
Center 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ 8/10/07
Patty Wagner — Date
Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Volume II

TAB 15

Extension Request for Submittal of Burn Site Corrective Measures Evaluation Report and Mixed Waste Landfill Corrective Measures Implementation Report

From: NMED/Bearzi
To: SNL/Wagner

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NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
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BILL RICHARDSON
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DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

CINDY PADILLA
Deputy Secretary

cc:
MS
David M.
Tom G.
Mike Skelly
Brenda
Amy B.
Dan S.
Rebecca
WB

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

August 23, 2007

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Securities Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: EXTENSION REQUEST FOR SUBMITTAL OF BURN SITE CME REPORT AND MIXED WASTE LANDFILL CMI REPORT SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518 HWB-SNL-MISC

Dear Ms. Wagner and Mr. Nimick:

The New Mexico Environment Department (NMED) has received your August 10, 2007 request to change the due dates for submittal of the subject reports under the Sandia National Laboratories Order on Consent, dated April 29, 2004. The Burn Site Corrective Measures Evaluation Report (CME), due January 8, 2008, is delayed due to the need to install new wells and obtain additional groundwater sampling results. The Mixed Waste Landfill (MWL) Corrective Measures Implementation (CMI) Report, due October 29, 2007, is delayed pending approval of the MWL CMI Plan by the NMED.

NMED agrees with the time extension requests for both reports. The new due date for the Burn Site CME Report shall be September 30, 2010. Also, because of the uncertainty associated with the start date of remedy implementation at the MWL, NMED agrees that the MWL CMI Report shall now be due within 180 days after implementation of the remedy is complete. This change in schedule is being made in accordance with Section III.J.2 of the Order on Consent.

AUG 27 200

If you have any questions regarding this matter, please contact Mr. William Moats of my staff at (505) 222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

JPB:wpm

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
T. Fox, NMED OGC
L. King, EPA-6
J. Gould, NNSA/DOE MS 0184
P. Freshour, SNL, MS 1089

File: SNL 2007 and Reading

Sandia National Laboratories

Justification for Class 3 Permit Modification
Corrective Action Complete with Controls
Solid Waste Management Unit 76
Mixed Waste Landfill

October 2014

Volume III of VIII
Corrective Measures Implementation and Report

Environmental Restoration Operations

U.S. DEPARTMENT OF ENERGY

United States Department of Energy
Sandia Field Office

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Justification for Class 3 Permit Modification, Mixed Waste Landfill
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VOLUME II: CORRECTIVE MEASURES IMPLEMENTATION PLAN – SOIL-VAPOR INVESTIGATION AND SUBGRADE PREPARATION						
Corrective Measures Implementation Plan – Soil-Vapor Investigation						
12/21/2006	SNL/Wagner	NMED/Bearzi	Soil-Vapor Sampling and Analysis Plan for Soil-Vapor Volatile Organic Compounds, Tritium, and Radon at the Mixed Waste Landfill	II	1	24
02/05/2007	NMED/Kieling	Interested Citizen	NMED Notice of Public Comment Period on Mixed Waste Landfill Soil-Vapor Sampling and Analysis Plan	II	2	6
04/13/2007	NMED/Kieling	Interested Citizen	Notice of Public Dialogue on the Mixed Waste Landfill Soil-Vapor Sampling and Analysis Plan	II	3	4
02/14/2008	NMED/Bearzi	SNL/Wagner	Response to Public Comment and Approval with Modifications Soil-Vapor Sampling and Analysis Plan for the Mixed Waste Landfill	II	4	4
02/15/2008	NMED/Kieling	Interested Party	Notice of Approval and Response to Public Comment on Soil-Vapor Sampling and Analysis Plan for Mixed Waste Landfill	II	5	24
07/10/2008	SNL/Wagner	NMED/Bearzi	Request for Deadline Extension of Investigation Report Soil-Vapor Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill	II	6	4
07/25/2008	NMED/Bearzi	SNL/Wagner	Time Extension Request to Submit Soil-Vapor Investigation Report Mixed Waste Landfill, Letter of July 10, 2008	II	7	2
08/26/2008	SNL/Wagner	NMED/Bearzi	Investigation Report on the Soil-Vapor Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill, August 2008	II	8	288

Mixed Waste Landfill – Justification Binder Index (Continued)

Date	From	To	Description	Volume	Tab	Number of Pages
09/26/2008	NMED/Bearzi	SNL/Wagner	Notice of Approval: Investigation Report on the Soil-Vapor Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill, August 2008	II	9	2
Corrective Measures Implementation Plan – Subgrade Preparation						
07/12/2006	SNL/Wagner	NMED/Curry	Notification of Current and Planned Field Work at the Mixed Waste Landfill	II	10	2
09/18/2006	NMED/Bearzi	SNL/Wagner	Fence Removal and Subgrade Preparation, Mixed Waste Landfill	II	11	2
03/13/2007	SNL/Wagner	NMED/Bearzi	Notification of Precautionary Measures to Prevent Damage to the Mixed Waste Landfill Subgrade Pending Installation of the Cover	II	12	4
03/23/2007	NMED/Bearzi	SNL/Wagner	Mixed Waste Landfill Corrective Measures Implementation Plan, Letter of March 13, 2007	II	13	2
08/10/2007	SNL/Wagner	NMED/Bearzi	Extension Request for Submittal of Burn Site Corrective Measures Evaluation Report and Mixed Waste Landfill Corrective Measures Implementation Report	II	14	4
08/23/2007	NMED/Bearzi	SNL/Wagner	Extension Request for Submittal of Burn Site Corrective Measures Evaluation Report and Mixed Waste Landfill Corrective Measures Implementation Report	II	15	2
Volume III: Corrective Measures Implementation and Report						
Corrective Measures Implementation						
04/10/2009	SNL/Davis	NMED/Bearzi	Notification of Execution of the Mixed Waste Landfill Corrective Measures Implementation Plan Beginning on May 14, 2009	III	1	4
09/04/2009	SNL/Wagner	NMED/Bearzi	Notification Concerning the Schedule and Approach for Supplemental Watering of the Mixed Waste Landfill ET Cover	III	2	4
09/30/2009	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Quarterly Progress Report ET Cover Project May-July 2009	III	3	80
11/18/2009	NMED/Bearzi	SNL/Davis	NMED Response: Mixed Waste Landfill Quarterly Progress Report ET Cover Construction Project May- July 2009	III	4	2
12/21/2009	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Quarterly Progress Report ET Cover Construction Project August-October 2009	III	5	38
04/08/2010	NMED/Bearzi	SNL/Wagner	NMED Response: Mixed Waste Landfill Quarterly Progress Report ET Cover Project August-October 2009	III	6	2
03/23/2011	SNL/Wagner	NMED/Bearzi	Request for Approval to Implement Supplemental Watering Activities for the Mixed Waste Landfill ET Cover	III	7	4

Mixed Waste Landfill – Justification Binder Index (Continued)

Date	From	To	Description	Volume	Tab	Number of Pages
04/01/2011	NMED/Bearzi	SNL/Wagner	Notice of Approval: Request to Conduct Supplemental Watering and Cover Maintenance Activities Mixed Waste Landfill	III	8	2
04/28/2011	NMED/Moats	SNL/Cochran	Email from William Moats Dated 4/28/11 Notice of Approval Request to Install Access Gate at South End of Mixed Waste Landfill	III	9	2
12/09/2013	SNL/Todd	NMED/ Cobrain	Environmental Restoration Operations Reclamation of the Mixed Waste Landfill Borrow Pit	III	10	12
06/26/2014	NMED/Kieling	SNL/ Beausoleil	Reclamation of the Mixed Waste Landfill Borrow Pit, Letter of December 9, 2013	III	11	2
Corrective Measures Implementation Report						
01/26/2010	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	12	272
11/29/2010	NMED/Kieling	Interested Citizen	Notice of Public Comment Period for Sandia National Laboratories Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	13	6
01/28/2011	NMED/Kieling	Interested Citizen	Extension of Public Comment Period for Sandia National Laboratories Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	14	2
05/20/2011	NMED/Kieling	SNL/Wagner	NOD: Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	15	6
05/20/2011	NMED/Kieling	SNL/Wagner	NMED Response to Public Comments Regarding the Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	16	16
08/11/2011	SNL/Wagner	NMED/Kieling	Responses to NOD: Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	17	48
10/14/2011	NMED/Kieling	SNL/Wagner	Notice of Approval Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	18	2
VOLUME IV: CORRECTIVE MEASURES IMPLEMENTATION REPORT – ATTACHMENTS						
01/26/2010	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Corrective Measures Implementation Report, January 2010 (Appendix A, Volume 2, only)	IV	1	1114
VOLUME V: LONG-TERM MONITORING AND MAINTENANCE PLAN						
09/25/2007	SNL/Wagner	NMED/Bearzi	Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, September 2007	V	1	304
10/31/2007	NMED/Kieling	NMED/Kieling	Notice of Public Comment Period for Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan, September 2007	V	2	6

Mixed Waste Landfill – Justification Binder Index (Continued)

Date	From	To	Description	Volume	Tab	Number of Pages
12/17/2007	NMED/Kieling	SNL/Wagner	Extension of the Public Comment Period on the Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, September 2007	V	3	4
12/07/2011	SNL/Wagner	NMED/Kieling	Withdrawal of the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan Submitted in September 2007	V	4	4
12/21/2011	NMED/Kieling	SNL/Wagner	Withdrawal of Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan, September 2007	V	5	4
03/23/2012	SNL/Sena	NMED/Kieling	Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, March 2012	V	6	278
09/14/2012	NMED/Kieling	Interested Person	Notice of Public Comment Period and Public Dialogue Meeting for the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan, March 2012	V	7	6
11/19/2012	NMED/Kieling	SNL/ Beausoleil	Extension of the Public Comment Period on the Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, March 2012	V	8	4
12/18/2012	NMED/Kieling	SNL/ Beausoleil	Extension of the Public Comment Period on the Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, March 2012	V	9	4
01/08/2014	NMED/Blaine	SNL/ Beausoleil	Notice of Approval: Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan, March 2012	V	10	2
01/15/2014	SNL/ Beausoleil	NMED/Kieling	Work Plan for the Installation of 3 Soil-Vapor Monitoring Wells at the Mixed Waste Landfill	V	11	18
02/14/2014	NMED/Blaine	SNL/ Beausoleil	Notice of Approval: Work Plan for the Installation of 3 Soil-Vapor Monitoring Wells at the Mixed Waste Landfill	V	12	2
06/18/2014	SNL/Todd	NMED/ Cobrain	Mixed Waste Landfill Annual Long-Term Monitoring and Maintenance Report, January - March 2014, June 2014	V	13	68
08/06/2014	NMED/Kieling	SNL/ Beausoleil	Notice of Approval: Mixed Waste Landfill Annual Long-Term Monitoring & Maintenance Report, January - March 2014, June 2014	V	14	2
09/10/2014	SNL/Todd	NMED/Kieling	Mixed Waste Landfill FLUTe™ Soil-Vapor Monitoring Well Installation Report, September 2014	V	15	96
09/25/2014	NMED/Kieling	SNL/ Beausoleil	Notice of Approval: Mixed Waste Landfill FLUTe™ Soil-Vapor Monitoring Well Installation Report, September 2014	V	16	2
VOLUME VI: LONG-TERM MONITORING AND MAINTENANCE PLAN – REFERENCE DOCUMENTS						
03/06/2014	SNL/Todd	NMED/Kieling	Submittal of Reference Documents Cited in the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan	VI	1	780
07/09/2014	SNL/Todd	NMED/Kieling	Submittal of Updated Reference Documents Cited in the Mixed Waste Landfill Long-Term Monitoring & Maintenance Plan	VI	2	310

Mixed Waste Landfill – Justification Binder Index (Continued)

Date	From	To	Description	Volume	Tab	Number of Pages
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VOLUME VII: ANNUAL GROUNDWATER MONITORING REPORTS						
01/30/2006	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Annual Groundwater Monitoring Report, April 2005	VII	1	56
12/13/2006	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Annual Groundwater Monitoring Report, April 2006 Sampling Event	VII	2	50
02/21/2008	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Annual Groundwater Monitoring Report, Spring 2007 Sampling Event	VII	3	80
05/27/2009	SNL/Davis	NMED/Bearzi	Mixed Waste Landfill Annual Groundwater Monitoring Report, Calendar Year 2008	VII	4	112
10/29/2009	NMED/Bearzi	SNL/Davis	NOD: Mixed Waste Landfill Groundwater Monitoring Report, Calendar Year 2008	VII	5	4
12/23/2009	SNL/Wagner	NMED/Bearzi	Responses to NOD: Mixed Waste Landfill Groundwater Monitoring Report, Calendar Year 2008	VII	6	18
06/07/2010	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Groundwater Monitoring Report, Calendar Year 2009	VII	7	144
06/07/2010	NMED/Bearzi	SNL/Wagner	Notice of Approval: Responses to NOD Issued for Mixed Waste Landfill Groundwater Monitoring Report, Calendar Year 2008	VII	8	2
11/09/2010	NMED/Bearzi	SNL/Wagner	Notice of Approval: Mixed Waste Landfill Groundwater Monitoring Report Calendar Year 2009	VII	9	2
09/30/2011	SNL/Wagner	NMED/Kieling	Mixed Waste Landfill Groundwater Monitoring Report, Calendar Year 2010	VII	10	116
08/16/2012	SNL/ Beausoleil	NMED/Kieling	Mixed Waste Landfill Chapter 4 Excerpted from the Annual Groundwater Monitoring Report, Calendar Year 2011	VII	11	102
10/24/2013	SNL/ Beausoleil	NMED/Kieling	Mixed Waste Landfill Chapter 4 Excerpted from the Annual Groundwater Monitoring Report, Calendar Year 2012	VII	12	94
9/24/2014	SNL/ Beausoleil	NMED/Kieling	Mixed Waste Landfill Chapter 4 Excerpted from the Annual Groundwater Monitoring Report, Calendar Year 2013	VII	13	96
VOLUME VIII: GROUNDWATER MONITORING WELL DOCUMENTS AND GROUNDWATER STUDIES						
Groundwater Monitoring Well Documents						
03/23/2007	NMED/Bearzi	SNL/Wagner	Replacement of Mixed Waste Landfill Groundwater Monitoring Well MWL-BW1	VIII	1	2

Mixed Waste Landfill – Justification Binder Index (Continued)

Date	From	To	Description	Volume	Tab	Number of Pages
04/17/2007	SNL/Wagner	NMED/Bearzi	Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2	VIII	2	22
06/19/2007	NMED/Bearzi	SNL/Wagner	NOD: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2	VIII	3	4
07/02/2007	NMED/Bearzi	SNL/Wagner	Replacement of Mixed Waste Landfill Groundwater Monitoring Wells MWL-MW1 and MWL-MW3	VIII	4	2
08/03/2007	SNL/Wagner	NMED/Bearzi	Response to NOD: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1; Installation of Well MWL-BW2, April 9, 2007; and Submittal of Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1; Installation of Well MWL-BW2, Revision 1	VIII	5	32
08/10/2007	SNL/Wagner	NMED/Bearzi	Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Wells MWL-MW1 and MWL-MW-3; Installation of Wells MWL-MW7 and MWL-MW8	VIII	6	24
10/10/2007	NMED/Bearzi	SNL/Wagner	Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2, Revision 1	VIII	7	2
10/12/2007	NMED/Bearzi	SNL/Wagner	Correction for Notice of Approval Dated October 10, 2007 Regarding Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2,	VIII	8	2
10/30/2007	NMED/Bearzi	SNL/Wagner	Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Wells MWL-MW1 and MWL-MW3; Installation of Wells MWL-MW7 and MWL-MW8	VIII	9	2
12/05/2007	SNL/Wagner	NMED/Bearzi	Response to October 30, 2007 Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Wells MWL-MW1 and MWL-MW3; Installation of Wells MWL-MW7 and MWL-MW8	VIII	10	6
02/12/2008	NMED/Bearzi	SNL/Wagner	Location of Monitoring Wells MWL-MW7 and MWL-MW8	VIII	11	2
03/06/2008	SNL/Wagner	NMED/Bearzi	Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-MW2 Installation of Well MWL-MW9	VIII	12	20
03/21/2008	NMED/Bearzi	SNL/Wagner	Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-MW2, Installation of Well MWL-MW9	VIII	13	2
04/23/2008	SNL/Wagner	NMED/Bearzi	Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2	VIII	14	62

Mixed Waste Landfill – Justification Binder Index (Continued)

Date	From	To	Description	Volume	Tab	Number of Pages
08/25/2008	NMED/Bearzi	SNL/Wagner	Notice of Disapproval: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2	VIII	15	4
09/23/2008	SNL/Davis	NMED/Bearzi	Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Wells MWL-MW1, MWL-MW2, MWL-MW3, Installation of Wells MWL-MW7, MWL-MW8, MWL-MW9	VIII	16	150
10/03/2008	SNL/Davis	NMED/Bearzi	Responses to NOD: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2	VIII	17	14
10/31/2008	NMED/Bearzi	SNL/Wagner	Notice of Approval: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2	VIII	18	2
01/15/2009	NMED/Bearzi	SNL/Davis	Notice of Approval: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Wells MWL-MW1, MWL-MW2, MWL-MW3, Installation of Wells MWL-MW7, MWL-MW8, MWL-MW9	VIII	19	2
Groundwater Studies						
04/30/2010	NMED/Bearzi	SNL/Wagner	Toluene Detections in Groundwater Samples from Mixed Waste Landfill	VIII	20	2
05/21/2010	SNL/Wagner	NMED/Bearzi	Extension Request for the Toluene Investigation Report Required for the Mixed Waste Landfill	VIII	21	4
06/04/2010	NMED/Bearzi	SNL/Wagner	Approval of Extension Request for Toluene Investigation Report Mixed Waste Landfill, May 21, 2010	VIII	22	2
08/18/2010	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Toluene Investigation Report, August 2010	VIII	23	236
09/28/2010	NMED/Bearzi	SNL/Wagner	NOD: Mixed Waste Landfill Toluene Investigation Report August 2010	VIII	24	2
10/14/2010	SNL/Wagner	NMED/Bearzi	Response to September 28, 2010, NMED comments on the Mixed Waste Landfill Toluene Investigation Report	VIII	25	142
01/13/2011	NMED/Bearzi	SNL/Wagner	Notice of Approval: Mixed Waste Landfill Toluene Investigation Report, Revised October 2010	VIII	26	2
05/20/2014	SNL/Todd	NMED/Kieling	Mixed Waste Landfill Groundwater Monitoring Report - Monitoring Well MWL -MW4 Metals Data – Calendar Year 2013	VIII	27	44
07/24/2014	NMED/Kieling	SNL/ Beausoleil	Mixed Waste Landfill Groundwater Monitoring Report – Monitoring Well MWL-MW4 Metals Data – Calendar Year 2013, May 2014 (NMED Recommendations Letter)	VIII	28	2

Volume III

Corrective Measures Implementation

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Volume III

TAB 1

Notification of Execution of the Mixed Waste Landfill Corrective Measures Implementation Plan Beginning on May 14, 2009

From: SNL/Davis
To: NMED/Bearzi

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ENTERED

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

APR 10 2009

RECEIVED
APR 2009
NMED Hazardous Waste Bureau

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

Mr. James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Bldg. 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

On behalf of the U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) and Sandia Corporation (Sandia), DOE/NNSA is notifying you that we anticipate executing the Mixed Waste Landfill (MWL) Corrective Measures Implementation Plan (CMIP) beginning on May 14, 2009. Contracting was completed in late March and mobilization to the field is expected in early May, after Sandia's approval of the Contract-Specific Safety Plan. DOE/NNSA and Sandia will adhere to the overall construction schedule originally proposed in the December 15, 2006 Notice of Deficiency Comment Response on the MWL CMIP and approved as condition 1.f. in the New Mexico Environment Department conditional approval letter for the MWL CMIP dated December 22, 2008.

Should you have any questions regarding this submittal, please contact me at (505) 845-6036, or Joe Estrada of my staff at (505) 845-5326.

Sincerely,

Kimberly A. Davis
Acting Manager

cc:

W. Moats, NMED-HWB (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB
B. Birch, NMED-OB
J. Lehr, NA-56, HQ/GTN
Zimmerman Library, UNM

A. Blumberg, SNL/NM, MS-0141
F. Nimick, SNL/NM, MS-0701
D. Miller, SNL/NM, MS-0718
J. Cochran, SNL/NM, MS-0719
M. Mitchell, SNL/NM, MS-0718
B. Langkopf, SNL/NM, MS-1089
C. Daniel, SNL/NM, MS-1089
Records Center, SNL/NM, MS-1089
J. Gould, SSO
J. Estrada, SSO

AOP 95-45, 06

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Notification of Mixed Waste Landfill (MWL) Corrective Measures Implementation Plan (CMIP) Field Work Schedule and Execution Date.**

Document author: **Mike Mitchell, Department 06765**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 4/7/09
Date

Francis B. Nimick
Deputy to the Director
Nuclear Energy & Global Security Technologies
Center 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ 4/9/09
Date

Kimberly A. Davis
Acting Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Volume III

TAB 2

Notification Concerning the Schedule and Approach for Supplemental Watering of the Mixed Waste Landfill ET Cover

From: SNL/Wagner
To: NMED/Bearzi

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National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

SEP - 4 2009

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Bldg 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

On behalf of the U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) and Sandia Corporation (Sandia), DOE/NNSA is submitting this letter to formalize in writing the details of a verbal notification concerning the schedule and approach for supplemental watering of the Mixed Waste Landfill (MWL) Evapotranspirative (ET) Cover. This schedule and approach was discussed with Will Moats of your technical staff on August 13, 2009. Seeding of the ET Cover was completed the week of August 31, 2009. The watering will continue for approximately 3 months to ensure the establishment of a native plant community.

The supplemental watering plan for the MWL ET Cover will be similar to the approach approved by the New Mexico Environment Department on July 31, 2009 for the Chemical Waste Landfill. The amount of water used and the duration of each watering event will be tracked as a precipitation event. This information will be compared to the Cover Performance Modeling presented in the Section 5.3 of the MWL Corrective Measure Implementation Plan (CMIP) (SNL/NM November 2005) to demonstrate that supplemental watering will not result in water percolating downward through the ET Cover and into the waste disposal areas.

Condition 2 of the NMED Conditional Approval of the MWL CMIP (Bearzi December 2008) detailed that supplemental watering information will be included in the revised MWL Long-Term Monitoring and Maintenance Plan (LTMMP). As this supplemental watering of the ET Cover precedes the required submittal of the LTMMP, it is our understanding that this notification prior to completion of the LTMMP is acceptable to the NMED.

Should you have any questions regarding this submittal, please contact me at (505) 845-6036 or Joe Estrada of my staff at (505) 845-5326.

Sincerely,

Patty Wagner

Patty Wagner
Manager

cc:
W. Moats, NMED (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB (2 copies)
J. Lehr, NA-56/HQ/FORS
A. Blumberg, SNL/NM, MS-0141
L. Shephard, SNL/NM, MS-0724
D. Miller, SNL/NM, MS-0718
M.Walck, SNL/NM, MS-0736
J. Cochran, SNL/NM, MS-0719
M. Mitchell, SNL/NM, MS-0718
C. Daniel, Records Center, SNL/NM, MS-1089
Zimmerman Library, UNM (c/o C. Daniel, SNL/NM, MS-0718)
J. Estrada, NNSA/SSO, MS-0184
J. Gould, NNSA/SSO, MS-0184
D. Pellegrino, NNSA/SSO, MS-0184

AOP 95-45, 06

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Notification of Mixed Waste Landfill (MWL) Evapotranspirative (ET) Cover Supplemental Watering Plan, August 2009**

Document author: **Mike Mitchell, Department 06765**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: L E Shephard — 8/26/2009
Date

Les Shephard, Vice President
Energy, Resources and Nonproliferation
Division 6000
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: Patty Wagner — 9-3-09
Date

Ms. Patty Wagner, Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Volume III

TAB 3

Mixed Waste Landfill Quarterly Progress Report ET Cover Project

May-July 2009

From: SNL/Wagner
To: NMED/Bearzi

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ENTERED

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

SEP 30 2009

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

RECEIVED
OCT 2009
NMED Hazardous Waste Bureau

James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Bldg. 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

On behalf of the U. S. Department of Energy/National Nuclear Security Administration (DOE/NNSA), and Sandia Corporation, DOE/NNSA is submitting the "Sandia National Laboratories/New Mexico, Mixed Waste Landfill (MWL) Quarterly Progress Report Evapotranspirative (ET) Cover Construction Project, May–July 2009." This quarterly project report addresses all quarterly reporting requirements required by the New Mexico Environment Department (NMED) Final Order In the Matter of Request for a Class 3 Permit Modification for Corrective Measures for the MWL (Final Order) NMED May 2005) and the NMED conditional approval of the MWL Corrective Measures Implementation Plan (Bearzi December 2008), both requiring the Progress Reports to be submitted to the Department on a quarterly basis during implementation of the remedy. MWL ET Cover construction activities for the period of May through July 2009, are presented in this first quarterly progress report consistent with requirements in the Compliance Order on Consent (NMED April 2004), Section VII.D.5.

Should you have any questions regarding this project quarterly report, please contact me at (505) 845-6036, or Joe Estrada of my staff at (505) 845-5326.

Sincerely,

Patty Wagner
Manager

Enclosure (1)

cc w/enclosure:
W. Moats, NMED-HWB (via Certified Mail)
L. King, EPA, Region 6 (via Certified Mail)
T. Skibitski, NMED-OB, MS-1396
B. Birch, NMED-OB, MS-1396
J. Lehr, NA-56, HQ/FORS
J. Estrada, NNSA/SSO, MS-0184
J. Gould, NNSA/SSO, MS-0184
Zimmerman Library, UNM
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Document title: **Mixed Waste Landfill Quarterly Progress Report Evapotranspirative Cover Construction Project, May – July 2009.**

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I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

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Environmental Restoration Project

MIXED WASTE LANDFILL
QUARTERLY PROGRESS REPORT
EVAPOTRANSPIRATIVE COVER CONSTRUCTION PROJECT
MAY – July 2009

September 2009

United States Department of Energy
Sandia Site Office

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Department 6765
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ABBREVIATIONS AND ACRONYMS

BMP	Best Management Practice
CMI	Corrective Measures Implementation
CMIP	Corrective Measures Implementation Plan
CQA	Construction Quality Assurance
CY	Cubic Yards
DOE	Department of Energy
ET	Evapotranspirative
HWB	Hazardous Waste Bureau
KAFB	Kirtland Air Force Base
K-SAT	Saturated Hydraulic Conductivity
MW	Monitoring Well
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
QA	Quality Assurance
QC	Quality Control
Sandia	Sandia Corporation
SNL/NM	Sandia National Laboratories/New Mexico
SWMU	Solid Waste Management Unit
SWPPP	Storm Water Pollution Prevention Plan
TA	Technical Area

1.0 Introduction

Sandia National Laboratories/New Mexico (SNL/NM) is located within the boundaries of Kirtland Air Force Base (KAFB), immediately south of the city of Albuquerque in Bernalillo County, New Mexico. KAFB occupies 52,233 acres. SNL/NM research and administration facilities are divided into five technical areas (TAs), designated 1 through 5, and several additional test areas, occupying 2,842 acres. TA-1, TA-2, and TA-4 are separate research facilities in the northwestern portion of KAFB. TA-3 and TA-5 are contiguous research facilities forming a 4.5-square-mile, rectangular area in the southwestern portion of KAFB. TA-3 alone occupies 2,000 acres. The Mixed Waste Landfill (MWL) is a 2.6-acre, fenced waste disposal area located in north-central TA-3 at SNL/NM (Figure 1).

1.1 Background

The MWL Corrective Measures Implementation Plan (CMIP) (SNL/NM November 2005) incorporates the final remedy selected by the New Mexico Environment Department (NMED) and details the deployment of the Evapotranspirative (ET) Cover (Chapter 2), the regulatory basis (Chapter 3), MWL characteristics (Chapter 4), the technical basis for the cover (Chapter 5), the MWL ET Cover design (Chapter 6), and cover performance monitoring (Chapter 7). Appendices include construction specifications (Appendix A), and the construction quality assurance plan (Appendix B).

After receiving conditional approval of the CMIP from the New Mexico Environment Department (NMED) (Bearzi December 2008), the MWL ET Cover Construction contracting process was initiated and completed in March 2009. The EDi Team was selected to construct the ET Cover and the URS Corporation was selected to perform independent third party Construction Quality Assurance (CQA) under a separate contract. NMED was notified of the start of ET Cover construction field work on April 10, 2009 (Davis April 2009). The EDi Team mobilized to the field to begin initial site activities on May 11, 2009 after completing an updated Health and Safety Plan that was approved by Sandia.

1.2 Purpose and Scope

Progress reports for ET Cover construction activities are required by the NMED Final Order In the Matter of Request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill (Final Order) (NMED May 2005) during implementation of the remedy. The Conditional Approval for the MWL CMIP (Bearzi December 2008) required the Progress Reports to be submitted to the Department on a quarterly basis during implementation of the

remedy. MWL ET Cover construction activities for the period of May through July 2009 are presented in this first quarterly progress report consistent with requirements in the Compliance Order on Consent (NMED April 2004), Section VII.D.5 specifying that progress reports shall, at a minimum, include the following information.

1. A description of the work completed during the reporting period;
2. A summary of all problems, potential problems, or delays encountered during the reporting period;
3. A description of all actions taken to eliminate or mitigate problems, potential problems, or delays;
4. A discussion of the work projected for the next reporting period, including all sampling events; and
5. Copies of the results of all monitoring, including sampling and analysis, and other data generated during the reporting period; and
6. Copies of all waste disposal records generated during the reporting period.

The construction of the Subgrade Layer was completed in December 2006 during an earlier phase of work. The 2006 Subgrade Layer work is not presented in this quarterly progress report, but will be detailed in the CMI Report. The 2009 Subgrade Layer construction activities were limited to clearing, watering, compacting, field testing, and verification of the surface. No additional fill material was placed on the existing Subgrade Layer.

A CMI Report documenting ET Cover construction will be prepared and submitted to the NMED within 180 days of ET Cover completion as required by the Final Order. The CMI Report will present detailed cover construction documentation, all field and laboratory testing results, CQA documentation, a photo log of construction activities, and final as-built drawings. Sandia and the Department of Energy (DOE) anticipate submitting this report within or shortly after the next quarterly reporting period (August through October 2009). Accordingly, there will be no additional quarterly construction progress report, as the required information will be incorporated within the CMI Report.

1.3 Construction Activity Summary

Construction activities completed during the reporting period are summarized below and in Table 1, which also summarizes activities to be completed in the next reporting period (August through October, 2009). More detailed information is provided in Sections 2.0 through 6.0. A photographic log of ET Cover construction activities is provided in Attachment A. There were

no significant schedule delays or problems encountered during the reporting period, and the ET Cover construction work continues to be ahead of the overall schedule approved by the NMED (Bearzi December 2008). Preliminary soil and rock volume estimates for each layer of the ET Cover (compacted, in-place volumes) are summarized in Table 2. All soil and rock volume estimates and ET Cover layer thickness information presented in this report are preliminary. Final volume and thickness information will be provided in the MWL CMI Report.

Two very small spills occurred during construction activities, both less than one gallon total, and neither spill occurred on the cover. The first spill occurred on June 3, 2009 at the south end of the site and involved a small amount of diesel fuel (less than 1 quart) spilling from the water truck due to a loose fuel cap. The second spill occurred on June 30, 2009 at the Borrow Pit Area. A hydraulic line on an end-dump truck ruptured as gravel was being delivered, releasing approximately 2 to 3 gallons. In both cases site personnel immediately recognized the problem, took corrective action to stop the spill, and then cleaned up the area. All contaminated soil related to the two spills was placed in two 55-gallon drums for disposal (one drum for each spill). One plastic bag of adsorbent materials was also generated from the hydraulic oil spill. All resulting waste was New Mexico Special Waste and was disposed of through the SNL/NM Hazardous Waste Management Facility. Signed waste manifests documenting final disposition are included as Attachment B.

NMED personnel visited the MWL ET Cover construction site on two occasions during the reporting period. On June 26, 2009 NMED/Hazardous Waste Bureau (HWB) representatives visited the site and received a briefing on cover activities completed to date. On July 8, 2009 Will Moats and Bill McDonald of the NMED/HWB conducted a site inspection of both the ET Cover and the Borrow Pit Area operations.

1.3.1 Site and Borrow Pit Area Activities

The 2009 ET Cover construction work included clearing, watering, compacting, field testing, and verification of the Subgrade Layer. Construction of the Bio-intrusion Layer involved the placement and compaction of approximately 6,800 cubic yards (cy) of rock to form an interlocking, approximately 1.3-foot thick layer directly overlying the Subgrade Layer. Approximately 3,060 cy of loose, dry soil was placed, spread, compacted, and then moisture-conditioned immediately above the Bio-intrusion Layer to fill void spaces and create a thin, approximately 3-inch overlying soil layer (hereafter referred to as the meniscus layer) upon which construction of the Native Soil Layer proceeded. Construction of the Native Soil Layer

involved the placement and compaction of approximately 23,300 cy of soil in eight lifts (maximum 8-inch loose, 6-inch compacted) to form a 2.8-foot thick layer (approximate average thickness) over the Bio-intrusion Layer. Two wedge lifts and two polishing lifts (explained in Section 4.1) were installed as Lifts 1 through 4 to establish the 2% east-to-west design slope across the central portions of the landfill. During construction of the Native Soil Layer the side slopes on all sides of the ET Cover were built up and the toe established so at completion of the Top Soil Layer, the final slope would be approximately a 6 to 1 according to the CMIP specifications. The Top Soil Layer will be constructed in early August 2009 and documented in the CMI Report.

Borrow Pit Area activities included loading haul trucks with existing soil fill stockpiled in 2006 at the Borrow Pit and rock stockpiled in 2005 at the nearby Bulk Waste Staging Area; soil sampling of fill material according to CMIP specifications; excavation, screening to 2-inch minus (hereafter referred to as 2-minus), stockpiling, and loading of additional native soil and top soil material; screening and stockpiling berm material hauled to the Borrow Pit from the site for use as fill material; and Pug Mill set up, calibration, and operation to blend 3/8-inch gravel with the top soil fill material. The Borrow Pit Area, Bulk Waste Staging Area, and haul routes used are shown in Figure 2.

1.3.2 Field and Laboratory Testing

Standard Proctor (ASTM 698) soil sampling of Native Soil fill material was conducted at a frequency of 1 sample per 500 cy (loose) as specified in the CMIP. Four samples were also collected from the Top Soil material to support moisture and density testing of the Top Soil Layer after installation (not required by CMIP). Gradation (ASTM C136) and Classification (ASTM D2487 and D4318) soil testing was also preformed on all Native Soil and Top Soil Layer fill material at a frequency of 1 sample per 500 cy (loose) as specified in the CMIP. Saturated hydraulic conductivity (K-SAT, ASTM 5856-95) testing was conducted on all of the Native Soil Layer lifts at a frequency of 1 sample per acre as specified in the CMIP.

Quality control (QC) field moisture and density testing with a Troxler™ Neutron Gauge was conducted by the EDi Team on the Subgrade Layer and all lifts of the Native Soil Layer at a frequency of 5 samples per acre. Additional quality assurance (QA) field testing was performed at specific locations selected by the URS CQA Team as a check to the QC results. A sampling grid comprised of thirteen 100-foot square blocks was used to ensure complete spatial coverage of the landfill surface for the moisture and density field testing effort (Figure 3).

All Standard Proctor test results are presented in Table 3, and shown graphically in Figure 4. The results demonstrate the general consistency of the soil fill material with regards to maximum dry density and optimum moisture. All field moisture and density results for the reporting period are shown in Table 4 for the top of the Subgrade Layer and each individual Native Soil Layer lift. Gradation and Classification soil testing results for the Native Soil and Top Soil Layer fill materials are provided in Tables 5 and 6, respectively. Table 7 presents K-SAT results for the Native Soil Layer soil samples.

1.3.3 Verification Surveys

Topographic surveys of each ET Cover layer system were performed and approved prior to constructing the subsequent layer. QC surveys were performed by the EDi Team and QA surveys were performed by the URS CQA Team as part of the verification process detailed in the CMIP. After the QA survey was performed and approved, construction of the next layer proceeded. Survey verification of the Subgrade Layer, Bio-intrusion Layer, meniscus layer, and Native Soil Layer was performed during the reporting period. Corrective actions were taken as needed based upon these surveys to ensure each layer met the specifications in the CMIP. Any variances were documented and approved by the CQA Engineer prior to proceeding with the next cover layer. All soil and rock volume estimates and ET Cover layer thickness information presented in this report are preliminary. Final QC and QA survey information, as well as final volume and thickness information, will be provided in the MWL CMI Report.

1.3.4 Technical Issues and Resolution

During ET Cover construction engineering decisions were made and documented to address situations where field conditions required changes relative to CMIP specifications, and/or situations where specifications or design elements were not clear or were inconsistent. In all cases where engineering judgment was relied upon, decisions were made in a conservative manner and resulted in an ET Cover that is more protective of human health and the environment. A summary of project technical issues and variances is provided below.

The Subgrade Layer was constructed in 2006. In May 2009 the Subgrade Layer surface was cleared of limited vegetation and remnant erosion matting installed after completion of the 2006 effort. The east-to-west slope across the central portion of the cover was slightly less than the 2% design slope. The decision was made to establish the 2% slope with the Native Soil Layer

instead of adding more material to the Subgrade Layer, by constructing two localized wedge lifts in the east-central part of the Native Soil Layer (i.e., build up the east-central area to increase the slope).

A coarse, angular rock was specified in the CMIP and used for the Bio-intrusion layer. To ensure the minimum thickness of 1 foot was achieved, the rock was placed at a target thickness of 1.25 feet. Based upon the final survey, the average thickness of the rock layer after placement and compaction was approximately 1.3 feet thick. Because of the coarse nature of the rock and the fact that a thicker Bio-intrusion Layer would be more protective, the decision was made to accept the thicker layer. In addition, there were no specifications in the CMIP for filling in void spaces in the Bio-intrusion Layer or how to transition from the rock surface to the Native Soil Layer. Observations of several methods tested in the field led to the decision to spread a layer of loose, dry soil across the surface of the Bio-intrusion Layer with a bulldozer, and then compact it with a vibratory drum roller to an average thickness of approximately 3-inches. After compaction water was added to the dry soil to moisture condition both the overlying layer of soil and the soil that filtered down into the void spaces.

As mentioned above, to establish the east-to-west 2% slope across the main central portion of the ET Cover, the Native Soil Layer was constructed with two wedge lifts. The two wedge lifts raised the elevation of the east-central portion of the cover and resulted in a Native Soil Layer that was slightly thicker than the upper tolerance thickness specified in the CMIP.

Soil volume estimates for each layer of the ET Cover were provided in the CMIP (SNL/NM November 2005) as bank cy, equivalent to compacted, in-place cy. Preliminary estimates of the in-place soil or rock volumes for each cover layer (i.e., as-constructed) exceeded the volume estimates presented in the CMIP and are summarized by cover layer system in Table 2. Additional information will be provided in the CMI Report after further analysis and comparison of the as-built 2009 ET Cover to the 2005 CMIP cover design. In summary, the greater thicknesses of the Bio-intrusion and Native Soil Layers, in comparison to the CMIP design specifications, result in a more protective ET Cover. Additional soil fill and rock material needed to complete the ET Cover was generated (soil fill) or procured (rock) during the reporting period with no adverse schedule impacts.

1.4 Report Structure

MWL site activities are presented in Sections 2.0 through 4.0 of this report as listed below.

- Mobilization and personnel training (Section 2.0)
- Subgrade Layer preparation, field testing, and verification (Section 2.0);
- Bio-intrusion Layer installation and verification (Section 3.0);
- Extension of groundwater monitoring well MW4 casing and protective outer steel casing (Section 3.0); and
- Native Soil Layer installation, field testing, and verification (Section 4.0).

ET Cover construction support activities conducted at the MWL Borrow Pit Area and Bulk Waste Staging Area are presented in Section 5.0. Top Soil Layer work accomplished during the reporting period is presented in Section 6.0, and the construction schedule and remaining ET Cover activities are presented in Section 7.0.

2.0 Mobilization and Subgrade Layer

Mobilization to construct the MWL ET Cover and preparation of the Subgrade Layer surface was conducted from May 11 – 22, 2009. The actual construction of the Subgrade Layer was completed in December 2006 according to the specifications in the CMIP after receiving NMED approval to proceed with Subgrade and fence removal work only (Bearzi September 2006). The side slopes were not constructed to a 6 to 1 ratio as part of the 2006 Subgrade work and around most of the northern and central portion of the cover area they were considerably steeper. Because NMED approval to proceed with the remainder of the ET Cover was not received during 2006, work was stopped after completion of the Subgrade Layer and the administrative fence was re-established. The 2006 Subgrade work will be detailed in the CMI Report, along with the 2009 work summarized in this report.

2.1 2009 Work

Mobilization tasks were completed from May 11-18, 2009 and included office trailer set up, installation of a new perimeter boundary, equipment delivery and inspections, Storm Water Pollution Prevention Plan (SWPPP) best management practices (BMPs) (i.e., perimeter silt fencing and drive-off pad at site entrance for equipment), site grading for staging and administrative areas, completion of personnel training, and removal of the administrative fence around the waste disposal areas.

The Subgrade Layer surface and side slopes were prepared from May 20 - 22, 2009 by using both heavy equipment and manual methods to remove existing vegetation and remnant erosion.

The surface and slopes were then watered using a water truck and rolled with a vibratory compactor. Field moisture and density tests were conducted at 13 locations as specified in the CMIP (5 tests per acre per lift), one location in each of the 13 field testing grid blocks shown in Figure 3. All field tests met CMIP specifications, which are compaction to 90% or greater of maximum dry density at $\pm$ 2% optimum moisture content, as determined by Standard Proctor testing (ASTM D698). Field moisture and density testing results are shown in Table 4.

A 50-foot spaced grid point system was established by the EDI Team over the surface of the ET Cover area for verification topographic surveys. The EDi Team performed a QC survey and URS performed a QA survey of the Subgrade Layer final surface to verify the elevation and slope. The condition the Subgrade Layer was very good almost three years after it was constructed in late 2006, with no signs of erosion, subsidence, or ponding water. Based upon the field testing and verification survey results, the Subgrade Layer was approved by the CQA Engineer.

2.2 Technical Issues and Resolution

The only technical issues associated with the Subgrade Layer were the east-to-west 2% design slope across the central portion of the surface and the side slopes not having a 6 to 1 ratio (they were significantly steeper). After the surface was cleared, watered, compacted, and re-tested the slope was calculated between 50-foot survey grid points to determine specific areas where the slope varied from design. The slope in the east-central portion of the Subgrade surface ranged from 1.8 to 1.9%. Because the slope was only slightly less than 2% the decision was made to proceed with installation of the Bio-intrusion Layer and correct the central east-to-west design slope during construction of the Native Soil Layer. Establishing the side slopes at a 6 to 1 slope was determined to be best accomplished after installation of the Bio-intrusion Layer since the existing Subgrade Layer side slopes already extended well beyond the waste disposal boundary.

3.0 Bio-intrusion Layer

The purpose of the Bio-intrusion Layer is to create a barrier above the MWL to prevent animals from penetrating the cover and compacted subgrade into the waste disposal areas. Placing the Bio-intrusion barrier rock was a challenging construction task with two relatively independent goals. One was to achieve an interlocked, compacted layer of angular rock with good structural integrity. The second goal was to achieve fill in the rock layer voids with native soil.

The thickness, rock type, and specifications of the Bio-intrusion barrier were jointly determined by representatives of the NMED and SNL/NM MWL Project in meetings held at SNL/NM on June 3, 2004 and on February 17, 2005. The desired rock was to be quartzite or comparable siliceous rock, and broken on most or all faces. Hardness, angularity, and chemical and physical stability were the most critical characteristics. Size was to be nominally +4-inches/-6-inches with abundant smaller size fractions to facilitate the filling of the void space. Greater than 50% of the rock fragments by weight were to be larger than the 4-inch size, and the desired largest rock fragment was to be nominally 6-inches. After careful evaluation of five local quarries by SNL/NM staff, the material at San Lazarus Gulch in the San Pedro Mountains was selected. This material was comparable to hornfels, a dense contact metamorphic rock, highly siliceous, and exceedingly tough and durable. This rock exhibited conchoidal fracture and high angularity upon crushing. Approximately 6,000 cy of rock were procured and delivered to the Bulk Waste Staging Area in 2005.

3.1 2009 Work

Loading and hauling of the Bio-intrusion rock material from the Bulk Waste Staging Area occurred from May 26 through June 8, 2009. On May 26 construction tests were performed at the south end of the MWL. On May 27 full-scale construction of the Bio-intrusion Layer started and the well casing and protective outer steel casing of groundwater monitoring well MW4 was extended to accommodate the projected final ET Cover thickness. End-dump trucks were used to haul the rock from the Bulk Waste Staging Area to the site, and the rock was unloaded directly on the cover surface. A bulldozer was used to spread the rock and track/compact it (minimum 4 passes) into an interlocking layer. The target thickness for the initial rock layer was 1.25 feet to make sure the minimum 1-foot thickness specification was achieved. Surveys were continuously performed during construction to control and check thickness. From June 8 through 12, 2009 additional rock material was hauled directly from the San Lazarus Gulch in the San Pedro Mountains to complete the Bio-intrusion Layer over the classified portion of the MWL (northeast part of the MWL). The new rock was hauled directly to the site and placed on

the east side of the MWL. A front end loader was used to place the rock and a bulldozer spread and compacted the material. The additional rock was from a pre-existing stockpile at the San Lazarus Gulch quarry that was generated in 2005 when the original bio-intrusion rock was purchased and delivered to the Bulk Waste Staging Area.

Prior to full-scale construction of the Bio-intrusion Layer, several installation approaches were tested at the south end of the site on May 26, 2009 to determine the most effective way to address the following technical issues: 1) compacting the rock into a structurally sound, interlocking, layer, 2) fill void space within the Bio-intrusion Layer, and 3) create an even surface to begin construction of the Native Soil Layer. Due to the coarse nature of the bio-intrusion rock, there was no way to avoid creating an uneven surface that was problematic relative to construction of the overlying Native Soil Layer. The results of testing demonstrated that the most effective construction method was to: 1) scarify the surface of the Subgrade Layer with the bulldozer tracks (i.e., track over the surface prior to rock placement), 2) place the rock in single +1-foot thick lift or layer, spreading and tracking the rock with a bulldozer a minimum of 4 passes to achieve a compacted, interlocking lattice structure with a relatively even surface, 3) apply loose, dry soil on top of the rock layer, spreading and tracking it with the bulldozer to fill void spaces and create a nominal +3-inch thick soil layer (meniscus layer) , 4) compact the meniscus layer to a nominal 3-inch thickness using a vibratory compactor (minimum of 4 passes), and 5) moisture condition the soil as a final step using a water truck. Surveying was used to determine the thickness of the Bio-intrusion Layer and meniscus layer. A motor grader was used to cut thicker areas of the meniscus layer to achieve nominal +3-inch thick soil layer with a uniform, even surface on top of the Bio-intrusion layer.

The effectiveness of this construction method is summarized as follows. The scarified Subgrade surface allowed the bottom of the rock layer to "settle" into the top of the Subgrade Layer, partially filling the lower-most void spaces. The loose, dry soil spread over the upper surface of the rock layer flowed into interstitial void spaces much like the sand flows through the constriction in an hour glass. Further tracking the surface of the meniscus soil with the bulldozer worked additional soil down into the void spaces and achieved initial compaction, while continuing to facilitate interlocking of the angular rock fragments. Further compaction of the overlying soil layer with a vibratory roller achieved further compaction and interlocking, and may have helped achieve additional void space filling deeper in the rock layer. Surveying the meniscus layer allowed the thickness to be kept to a minimum while creating an even surface to begin construction of the Native Soil Layer. Finally, adding water as the last step hydrated the

soil layer and the soil deeper in the void spaces to complete the process. Not adding water until the final step allowed for maximum penetration of the soil into the rock layer.

3.2 Field Testing

No field testing was required for the Bio-intrusion Layer or the overlying meniscus layer. Standard moisture and density field testing was not feasible due to the minimal thickness of the meniscus layer (average 3-inch thickness) and the presence of rocks immediately beneath it. However, compaction of the meniscus layer was conducted following the same process as used for the overlying Native Soil Layer.

3.3 Verification

The thickness of the Bio-intrusion Layer was verified through both a QC survey performed by EDi Team and a QA survey performed by URS using the previously established 50-foot spaced verification grid. Areas surrounding grid points where thickness corrections were required based upon the CMIP specifications were identified, reworked, and resurveyed. After adjustment, the thickness at all grid points was equal or greater than the 1-foot minimum. The final average thickness of the completed Bio-intrusion Layer was approximately 1.3 feet.

3.4 Technical Issues and Resolution

Construction technical issues and resolution are described above in Section 3.2. The final average thickness of the Bio-intrusion Layer exceeded the upper tolerance thickness of 1.0 foot with a -0.00 feet and +.25 feet tolerance as specified in the CMIP. The layer was approved without further adjustment for the following reasons: 1) the exceedence was only approximately ½-inch, 2) the additional thickness resulted in a more protective layer, and 3) the coarseness of the rock material made fine-tuning the surface to <0.25-foot precision unfeasible without the risk of compromising the already achieved interlocking lattice structure and void filling.

4.0 Native Soil Layer

The Native Soil Layer is the thickest layer of the ET Cover and is designed to hold precipitation moisture, along with the overlying Top Soil Layer, while the processes of evaporation and transpiration remove it to the atmosphere. The Native Soil Layer was constructed with excavated and screened (2-minus) native soil fill material from the Borrow Pit. The CMIP specifications include a minimum thickness of 2.5 feet with a -0.00 foot, +0.25 foot tolerance (CMIP Section 02210), and a construction process employing maximum 8-inch loose, 6-inch

compacted lifts (CMIP Section 02200). Soil fill material sampling requirements are described in Section 1.3.2 and results are provided in Table 3 (Standard Proctor) and Table 5 (Gradation and Classification). K-SAT and moisture/density testing are discussed in Sections 1.3.2 and 4.2.

4.1 2009 Work

Construction of the Native Soil Layer was performed from June 15 through July 27, 2009 and involved the placement and compaction of approximately 23,300 cy of soil (compacted, in-place cy) in eight lifts. Each lift was constructed following the specifications of the CMIP, with a maximum thickness of 8-inches loose, 6-inches compacted. Two wedge lifts (Wedge Lifts 1 and 2) were installed along with two polishing lifts (Lifts 3 and 4) to establish the 2% east-to-west slope across the east-central portion of the landfill. Verification of the Native Soil Layer was completed on July 31, 2009. The thickness of this layer is approximately 2.8 feet, which does not include the thickness of the underlying meniscus layer.

Wedge Lifts 1 and 2 were spatially limited to the east-central portion of the cover and are shown in Figure 3. Lifts 3 and 4 are referred to as polishing lifts because their thickness was variable across the landfill surface, which was necessary to complete the adjustment for the 2% east-to-west design slope. To complete this adjustment after installation of Wedge Lifts 1 and 2, some areas of the cover surface required slightly more than a 6-inch compacted thickness. To achieve this following the CMIP specification, Lifts 3 and 4 were installed as generally thinner than 8-inch loose, 6-inch compacted lifts across the entire surface of the MWL. Grade stakes were used to guide the construction process for these first four lifts.

Lifts 5 through 8 were more standardized lifts that were installed across the entire cover surface as 8-inch loose, 6-inches compacted lifts. Grade stakes were set across the entire cover surface at the 50-foot grid points for each lift to guide the process and allow for visual confirmation that specifications were being followed. The grade stakes locations were shifted periodically to allow uniform compaction. Hubs and whiskers were used instead of grade stakes for the final Lift 8 (blue top approach). QC surveying was performed throughout the installation of each lift to guide, control, and confirm the construction process.

During construction of the Native Soil Layer the side slopes on all sides of the ET Cover were built up and the toe was established so that at completion of the Top Soil Layer, the final slope would be approximately a 6 to 1 according to the CMIP specifications. All side slopes were constructed following the same process and specifications as the Native Soil Layer lifts.

4.2 Field Testing

Moisture and density testing was conducted on every lift according to the frequency specified in the CMIP (5 per acre per lift) using the 13 field testing grid blocks shown in Figure 3. All moisture and density results are presented in Table 4. Because of the limited spatial distribution of Wedge Lifts 1 and 2, only three tests were performed per lift on the cover surface (6 total tests), and one test for each wedge lift (2 additional tests, for a grand total of 8 tests) was performed southeast of (outside) the corner formed by the eastward projection of the classified portion of the MWL (referred to as the Dog Leg Area in Table 4 and shown on Figure 3). Lift 3 was not continuous and thick enough for field testing in all thirteen grid blocks; a total of six grid blocks were tested. All thirteen grid blocks were tested for Lifts 4 through 8.

During the field testing of Lift 5 moisture and density tests failed in grid blocks 2, 3, 5, and 7. The east slope of grid block 7 met specifications after water was added. Grid blocks 1-5 of Lift 5 were ripped to a depth of approximately six inches, moisture conditioned, re-compacted, and re-tested. The re-test results met specifications. The 3-foot perimeter around groundwater monitoring well MW4 (compacted using a manual-operated compactor) was tested in addition to grid block 9 for Lifts 6 through 8. Moisture results failed for Lift 6 and 8 tests, but passed after the application of additional water to the material. Initial tests for Lift 8, grid blocks 8 and 10 also failed for moisture content, but passed re-tests after additional water was applied.

K-SAT sampling is only required for the Native Soil Layer. The results of all samples collected during the reporting period are presented in Table 7. CMIP specifications for K-SAT sampling frequency and results for the Native Soil Layer are as follows:

- frequency of 1 sample per acre per lift
- target maximum value of 4.6×10^{-4}, with a failure tolerance of 5% (i.e., 5% of the test results can exceed the target value).

Twenty K-SAT sample results were collected from the 8 lifts and all results were less than the target value, with an average of 1.62×10^{-4} and a geometric mean of 4.72×-10^{-5}. The average compaction of the 20 samples was 90.2%, with a range of 81.2% to 95.3%.

4.3 Verification

The thickness and slope of the Native Soil Layer was verified through both a QC survey performed by EDi Team and a QA survey performed by URS using the 50-foot spaced verification grid from July 28-31, 2009. During this verification process, nine points were identified by both the QC and QA surveys that were slightly less than the minimum 2.5-foot

thickness, with two of these points falling outside the cover surface on the northern side slope. The range of values falling below the minimum thickness was 2.09 to 2.42 feet, which appear to be related to irregularities (i.e., high spots) in the Bio-intrusion Layer. A thin layer of additional soil was added to these areas to increase the thickness to 2.55 feet, with the thickest fill layer being 0.46 feet. After adjustments the failing grid points were resurveyed and met the 2.5-foot minimum thicknesses specification. The final average thickness of the completed Native Soil Layer was 2.8 feet. The 2% east-to-west design slope was verified across the central portion of the Native Soil Layer surface, and the side slopes were verified to be 6 to 1 or slightly less.

4.4 Technical Issues and Resolution

Establishing the 2% east-to-west design slope across the central portion of the Native Soil Layer surface was accomplished by raising the elevation of the eastern side of the cover surface using two wedge lifts and two polishing lifts as described in Section 4.1. This resulted in a Native Soil Layer that is thicker, on average, than the 2.5-foot minimum, with a -0.000 and +0.25 foot tolerance as specified in the CMIP (i.e., approximately 2.8 feet). This variance in the Native Soil Layer thickness was anticipated after verification of the Subgrade Layer discussed in Section 2.2, and was determined to be the most protective approach to re-establish the 2% design slope. The resulting small increase in the thickness of the Native Soil Layer provides additional protection against surface moisture percolating downward to the waste disposal areas. Maintaining the 2% east-to-west design slope across the central portion of the cover surface is important to ensure adequate drainage off the cover surface over the long-term.

5.0 Borrow Pit Area Activities

Cover construction support activities were conducted at the MWL Borrow Pit Area and Bulk Waste Staging Area (Figure 2). Soil fill for the Native Soil and Top Soil Layers was previously excavated, screened to 2-minus, and stockpiled at the Borrow Pit during 2006; approximately 15,500 cy of native soil fill and 3,400 cy of top soil fill. The Bio-intrusion Layer rock (approximately 6,000 cy) was procured in 2005 and stockpiled in the Bulk Waste Staging Area just south of the Borrow Pit Area.

5.1 2009 Work

Loading and hauling of the Bio-intrusion rock material from the Bulk Waste Staging Area occurred from May 26 to June 8, 2009. End-dump trucks were used to haul the rock from the Bulk Waste Staging Area to the site. On June 15, 2009 loading and hauling activities began at

the Borrow Pit as part of the Native Soil Layer construction. A front end loader was used to load the haul trucks with both the rock and soil fill material. Bottom dump trucks were used to haul and place soil on the cover surface.

To support ongoing cover construction activities additional soil fill material was excavated, screened to 2-minus, and stockpiled at the Borrow Pit from June 12 to July 24, 2009. During this time period the soil berm around the MWL site originally installed as part of the SWPPP was excavated, hauled to the Borrow Pit, and screened for use as native soil fill. A Pug Mill was mobilized to the Borrow Pit Area in late June 2009 and then set up, calibrated, tested, and operated to blend 3/8-inch crushed gravel with the top soil fill material at a 25% by volume specification per the CMIP from July 6 - 24, 2009. The gravel was delivered and stockpiled at the Borrow Pit just prior to and during the Pug Mill operation period. The Pug Mill equipment was being demobilized at the end of the reporting period.

5.2 Technical Issues and Resolution

There were no technical issues and, therefore, no resolution was necessary for activities associated with Borrow Pit Area.

6.0 Top Soil Layer

The Top Soil Layer is the final cover layer and the layer that will directly support the establishment of native plants. It is also the layer that will initially hold all surface moisture that falls on the cover surface as precipitation. As specified in the in the CMIP, the Top Soil Layer is to be minimally compacted (i.e., compacted only as a result of the installation process, not by use of standard compaction equipment such as a vibratory roller) and have a minimum thickness of 8-inches. The Top Soil Layer will be completed in August and documentation will be provided in the CMI Report.

Additional top soil fill material was excavated and screened at the Borrow Pit from June 24 through July 24, 2009. Soil fill material sampling requirements are summarized in Section 1.3.2. Soil sampling for top soil fill material is restricted to Gradation and Classification testing; however, four Standard Proctor samples were also collected to support moisture and density testing. This testing of the Top Soil Layer is not required, but will be performed to support the documentation of this important ET Cover Layer. Results are provided in Table 3 (Standard

Proctor) and Table 6 (Gradation and Classification). No K-SAT sampling requirements apply to the Top Soil Layer.

6.1 Field Testing

There are no field testing requirements for the Top Soil Layer, however; moisture and density testing will be conducted after installation, ripping, tilling and seeding of the layer is accomplished for supporting documentation.

6.2 Technical Issues and Resolution

There were no technical issues associated with the Top Soil Layer during the reporting period. Volume estimates for this layer were revised from those presented in the CMIP (see Table 2) and this additional top soil material was excavated and screened from the Borrow Pit and blended with 3/8 inch crushed gravel as part of the Pug Mill operations. A significant factor in the revised volume estimate is that the actual target thickness of the Top Soil Layer was set at 1-foot and the CMIP estimate was based upon a minimum thickness of 8-inches.

7.0 Construction Schedule and Remaining Work

The construction schedule and remaining activities are described in this section. All work will be completed in August and September 2009. The CMI Report documenting the entire MWL ET Cover Construction Project will be completed within or shortly after the next quarterly reporting period (August through October 2009). Therefore, there will not be additional quarterly construction progress reports, as the required information will be incorporated within the CMI Report.

7.1 Schedule

The MWL ET Cover will be completed before the end of September 2009, ahead of the overall construction timeline schedule originally proposed in the December 15, 2006 Notice of Deficiency Comment Response on the MWL CMIP (SNL/NM December 2006) and approved as condition 1.f. in the NMED CMIP conditional approval (Bearzi December 2008). ET Cover activities that will be completed during the next reporting period include seeding of the Top Soil Layer, installing the final administrative fence, and demobilization of all construction-related equipment. Supplemental watering of the ET Cover and surrounding disturbed/seeded areas is an activity extending beyond completion of the ET Cover that may continue into December 2009 pending weather.

7.2 Soil Vapor Monitoring Points

Two soil vapor monitoring points will be installed through the ET Cover to an approximate depth of 35 feet below the original ground surface as required by condition 1. d. of the NMED conditional approval of the MWL CMIP (Bearzi December 2008). This work will be completed in August 2009.

7.3 Top Soil Layer and Supplemental Watering

Remaining work for the Top Soil Layer includes placement, verification of thickness and slope, ripping and tilling of the surface, drill seeding, and straw-mulch application. This work will be completed in late August or early September 2009. Top Soil Layer construction through seeding will be documented in the CMI Report.

Supplemental watering will be performed immediately after seeding to support seed germination and seedling growth as approved by the NMED (Bearzi December 2008). NMED will be notified by letter of the supplemental watering schedule and approach, which will be documented in the revised MWL Long-Term Monitoring and Maintenance Plan.

7.4 Administrative Fence Installation and Demobilization

The administrative fence surrounding the MWL ET Cover will be installed by early September 2009 according to the specifications in the CMIP. This work will be documented in the CMI Report.

7.5 Corrective Measures Implementation Report

The CMI Report will be completed during the next reporting period (August through October 2009) and submitted to the NMED shortly thereafter.

8.0 References

Davis, K. (U.S. Department of Energy), April 2009. Letter to J. Bearzi (New Mexico Environment Department), notifying the New Mexico Environment Department of the start of Mixed Waste Landfill Evapotranspirative Cover construction field work. April 10, 2009.

Bearzi, J.P. (New Mexico Environment Department), December 2008. Letter to K. Davis (U.S. Department of Energy) and F. Nimick (Sandia Corporation), "Conditional Approval, Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005, Sandia National Laboratories NM5890110518, SNL-05-025." December 22, 2008.

New Mexico Environment Department (NMED) April 2004, "Compliance Order on Consent Pursuant to the New Mexico Hazardous Waste Act 74-4-10: Sandia National Laboratories Consent Order," New Mexico Environment Department, April 24, 2004.

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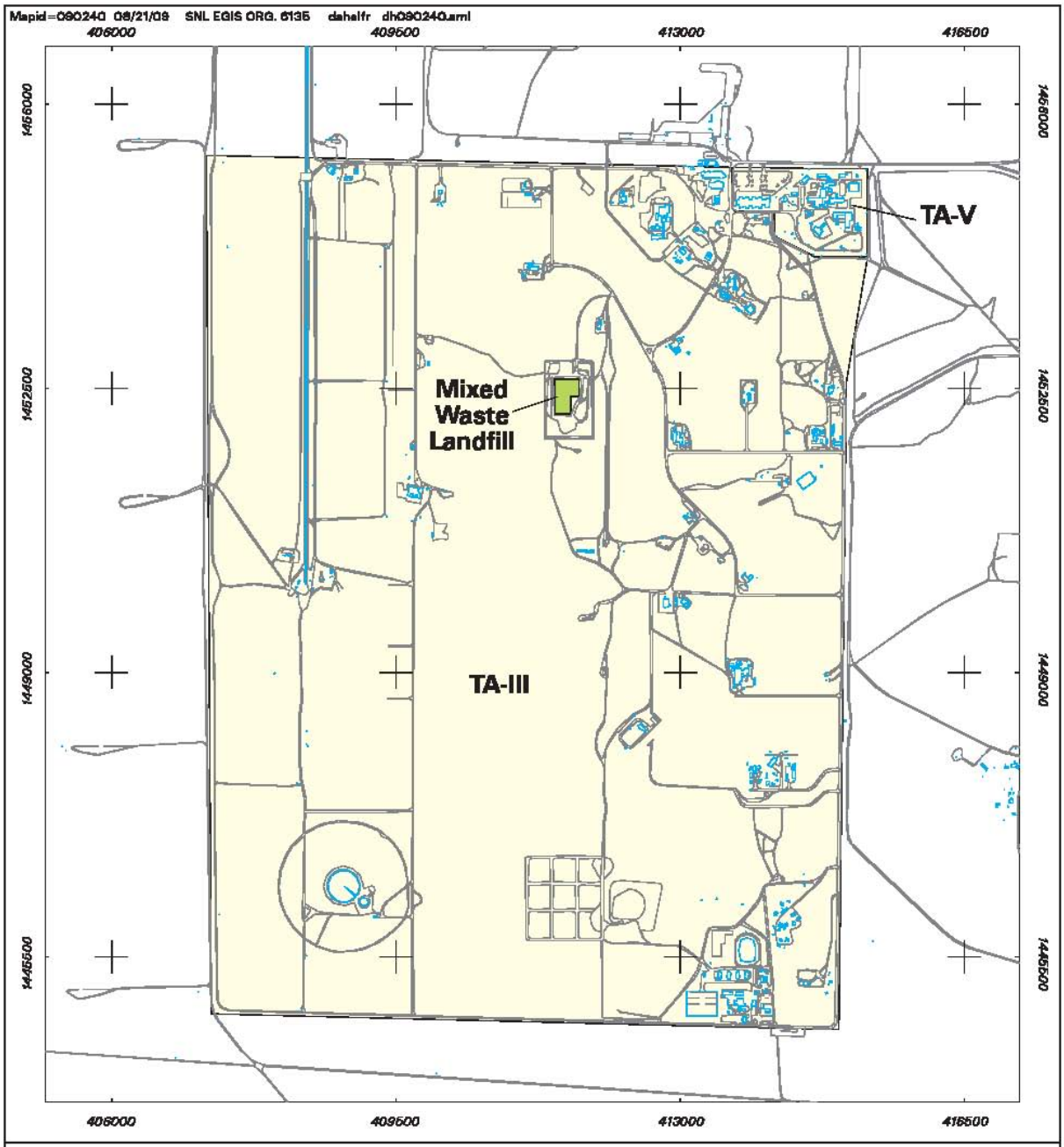
Sandia National Laboratories/New Mexico (SNL/NM), November 2005. "Mixed Waste Landfill Corrective Measures Implementation Plan," Environmental Restoration Project, Sandia National Laboratories, Albuquerque, New Mexico, November 2005.

Sandia National Laboratories/New Mexico (SNL/NM), December 21 2006, "DOE/Sandia Responses to NMED's 'Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Work Plan, November 2005' – Comment Set 1", prepared for US DOE by Sandia National Laboratories Environmental Restoration Project, Albuquerque, New Mexico.

FIGURES



Legend

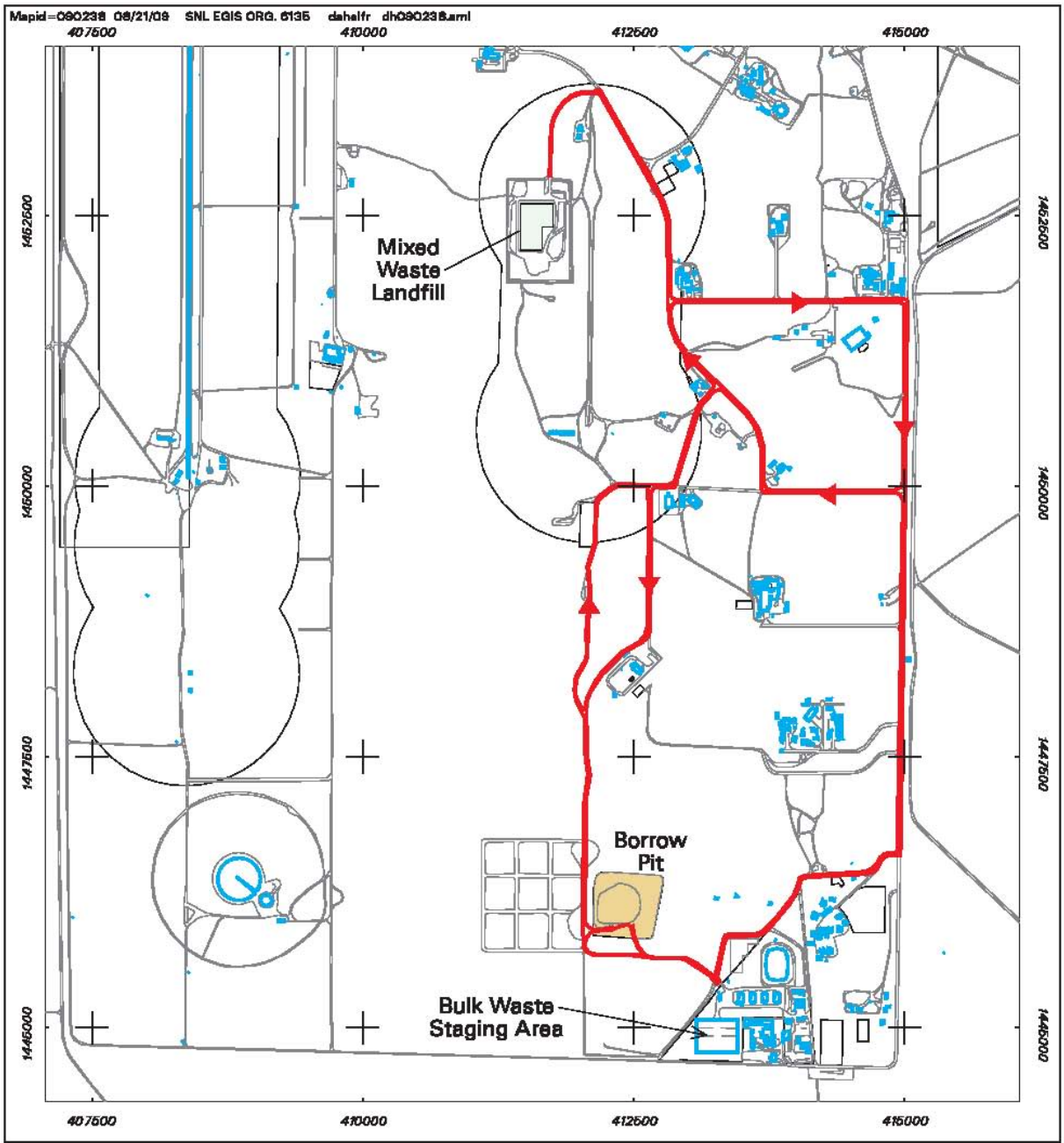
- Building / Structure
- Paved and Unpaved Road
- SNL Technical Area III & V
- Mixed Waste Landfill

Figure 1
Location of Technical Areas III & V and the Mixed Waste Landfill

0 1000 2000
Scale in Feet

0 240 480
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System



Legend

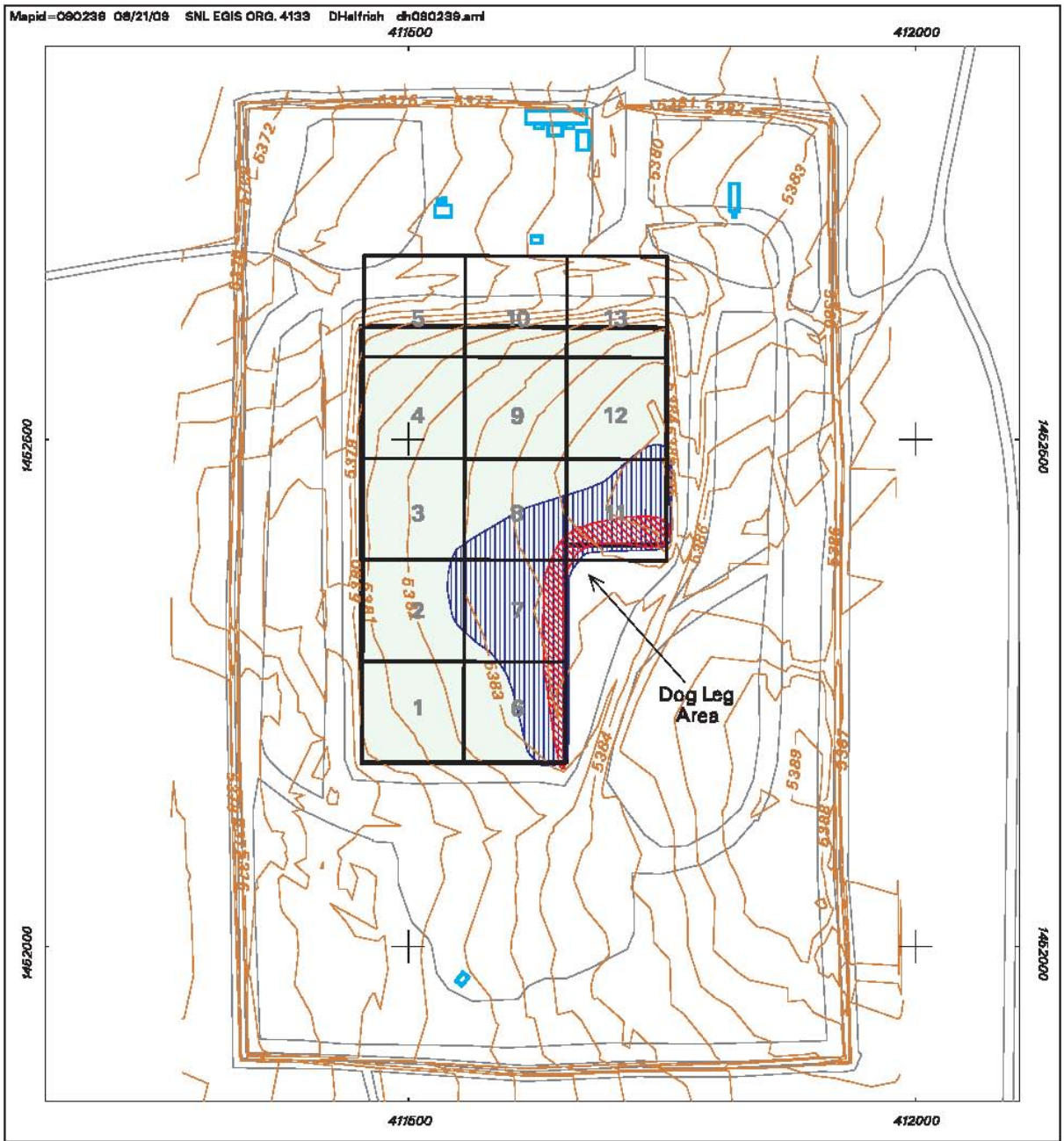
- Building / Structure
- Paved and Unpaved Road
- Haul Route
- Mixed Waste Landfill
- MWL Borrow Pit

Figure 2
Location of the Mixed Waste Landfill, Borrow Pit, Bulk Waste Staging Area and Haul Routes

0 750 1500
Scale in Feet

0 180 360
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System



Legend

- Mobile Office / Shed / Water Tank
- 1-ft. Subgrade Contour Interval
- Edge of unpaved Road
- 100-ft. Sample Grid
- MWL Disposal Area
- Wedge Lift 1
- Wedge Lift 2

Figure 3
Mixed Waste Landfill
Cover Grid Blocks and
Locations of Native Soil
Layer Wedge Lifts 1 & 2

0 80 160
Scale in Feet

0 19.2 38.4
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

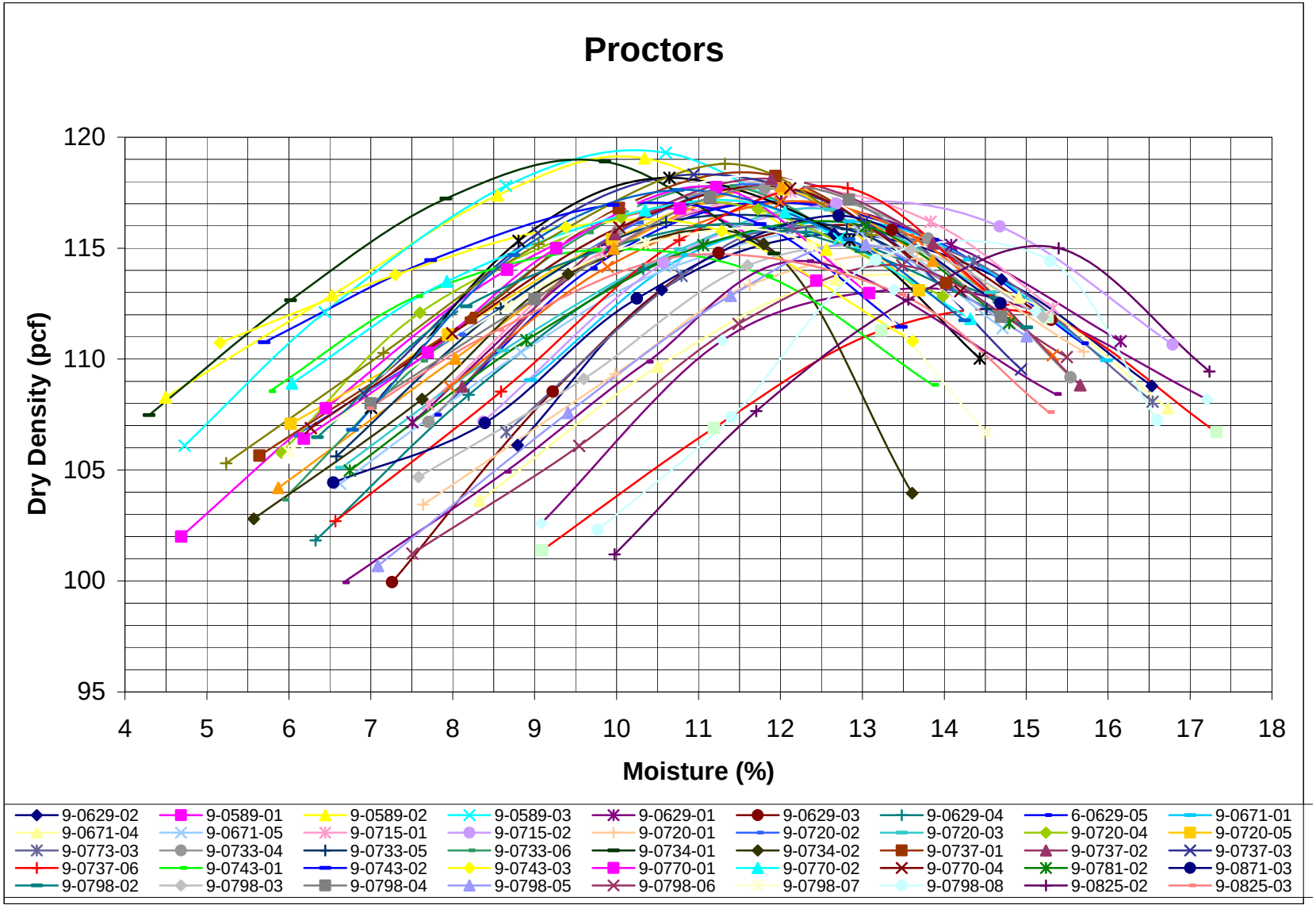


Figure 4 Graphical Representation of all MWL ET Cover Standard Proctor Results

TABLES

Table 1 Mixed Waste Landfill Evapotranspirative Cover Construction Summary

Activity	Start	Finish	Description
Work Completed May through July 2009			
Mobilization and Training	May 11, 2009	May 18, 2009	Resources, equipment, and office trailer mobilized to site and personnel training completed. Installed new perimeter boundary, silt fence, and drive-off pad. Removed administrative fence.
Subgrade Layer	May 20, 2009	May 22, 2009	Cleared vegetation, watered and compacted surface, performed field testing and verification survey.
Bio-intrusion Layer	May 26, 2009	June 16, 2009	Construction method tests conducted on May 26. Hauled and placed rock to create >1 foot thick layer, then placed soil layer on top to fill voids and create a thin soil layer above the rock (~3-inch thickness). New rock material hauled directly to site from vendor June 8-12. Verification surveys for thickness of rock layer and overlying soil layer.
MW4 Extension	May 27, 2009	May 27, 2009	Well casing and protective outer steel casing raised to accommodate surface elevation increase associated with construction of the ET Cover.
Native Soil Layer	June 15, 2009	July 31, 2009	Placed and compacted soil in lifts for cover surface and slopes. Wedge lifts used to establish 2% east-to-west slope. Verification surveys for thickness and slopes.
Borrow Pit Area Activities	June 12, 2009	July 24, 2009	Excavated and screened (2-minus) additional soil fill material, including SWPPP berm soil excavated and hauled to the Borrow Pit from the MWL site. Pug Mill operations set up and calibrated to blend top soil and 3/8-inch crush gravel.
Remaining Work to be completed August through September			
Soil Vapor Monitoring Points	August 2009	August 2009	Two soil vapor monitoring points will be installed through the ET Cover to an approximate depth of 35 feet below the original ground surface.
Top Soil Layer	August 2009	August 2009	Place top soil on cover and side slopes, verification survey for thickness and slopes, and rip/scarify surface.
Seeding and Supplemental Watering	August 2009	August 2009	Set up and test supplemental watering system. Disk and drill seed entire cover surface and disturbed areas.
Supplemental Watering	Immediately after seeding	Through December 2009	System will be operated for up to 3 months (pending weather) to help establish native vegetation.
Administrative Fence	September 2009	September 2009	Perimeter fence will be installed according to the specifications in the CMIP.
Revegetation of the Borrow Pit	To Be Determined	To Be Determined	The MWL Borrow Pit Area will be seeded and reclaimed in the 2010 growing season if it is not transferred to Sandia Facilities for continued use.

Table 2 Preliminary Soil Volume Estimates Comparing CMIP Estimates to As-Constructed Estimates

	Volumes Reflect Placed, Compacted Cubic Yards (cy)		
MWL ET Cover Layer	**CMIP Volume Estimates**	**As-Constructed Volume Estimates**	**Explanation**
Subgrade Layer	6,500	7,400	% compaction achieved in the field may be higher than predicted. The north end of MWL may have required more elevation increase than anticipated in the CMIP design.
Bio-intrusion Layer	4,900	6,800	Average thickness of the installed Bio-intrusion Layer is ~1.29 feet versus "1 foot minimum" as specified in CMIP.
Bio-intrusion Layer - Void filling and overlying 3-inch thick layer	Not Estimated	3,060	Volume estimate based on truck load tallies and represents a "loose" cyd estimate. Not addressed in CMIP.
Native Soil	13,200	23,300	The average thickness of the constructed Native Soil Layer is approximately 2.8 feet due to wedge lifts required to correct the <2% slope in the Subgrade Layer (versus 2.5 feet minimum in the CMIP). The north end elevation of the Subgrade Layer appears to be greater than predicted in the 2005 design, creating a larger cover footprint (i.e., 6 to 1 slopes are larger as a result).
Top Soil	3,900	6,800	Top soil layer is ~12 inches thick, which is ~50% thicker than specified in the CMIP (8-inch minimum thickness).
Total	**28,500**	**44,300**	**15,800 cyd difference (55% increase from original estimate).** 44,300 cyd total does not include the "3,060 cyd loose total" for the Bio-intrusion Layer void filling and overlying soil layer.

Table 3 Standard Proctor Results

Test Number	Date Sampled	Description	Gradation/ Classification Meet Specification	Maximum Dry Density (lb/ft^3)[1]	Optimum Moisture Content (%)	Testing Laboratory
SNL MWL 052009-1	5/20/2009	Native Soil	YES	116.7	10.6	AMEC
SNL MWL 052009-2	5/20/2009	Native Soil	YES	119.1	10.3	AMEC
SNL MWL 052009-3	5/20/2009	Native Soil	YES	119.3	10.3	AMEC
SNL MWL 052909-4	5/29/2009	Native Soil	YES	117.0	12.0	AMEC
SNL MWL 052909-5	5/29/2009	Native Soil	YES	115.7	12.6	AMEC
SNL MWL 052909-6	5/29/2009	Native Soil	YES	116.2	12.8	AMEC
SNL MWL 052909-7	5/29/2009	Native Soil	YES	115.8	12.3	AMEC
SNL MWL 052909-8	5/29/2009	Native Soil	YES	117.0	12.0	AMEC
SNL MWL 060909-9	6/9/2009	Native Soil	YES	116.2	12.5	AMEC
SNL MWL 060909-10	6/9/2009	Native Soil	YES	113.2	13.5	AMEC
SNL MWL 060909-11	6/9/2009	Native Soil	YES	112.2	14.6	AMEC
SNL MWL 060909-12	6/9/2009	Native Soil	YES	113.9	13.6	AMEC
SNL MWL 060909-13	6/9/2009	Native Soil	YES	115.9	12.3	AMEC
SNL MWL 062409-14	6/24/2009	Native Soil	YES	114.7	13.3	AMEC
SNL MWL 062409-15	6/24/2009	Native Soil	YES	117.7	11.8	AMEC
SNL MWL 062409-16	6/24/2009	Native Soil	YES	116.6	12.4	AMEC
SNL MWL 062409-17	6/24/2009	Native Soil	YES	116.9	11.0	AMEC
SNL MWL 062409-18	6/24/2009	Native Soil	YES	117.6	11.6	AMEC
SNL MWL 062909-19	6/29/2009	Native Soil	YES	117.7	12.0	AMEC
SNL MWL 062909-20	6/29/2009	Native Soil	YES	116.9	12.2	AMEC
SNL MWL 062909-21	6/29/2009	Native Soil	NO	115.9	12.7	AMEC
SNL MWL 062909-22	6/29/2009	Native Soil	YES	117.8	11.8	AMEC
SNL MWL 062909-23	6/29/2009	Native Soil	YES	116.6	11.6	AMEC
SNL MWL 062909-24	6/29/2009	Native Soil	YES	117.7	11.3	AMEC
SNL MWL 063009-25	6/30/2009	Native Soil	YES	118.4	11.7	AMEC
SNL MWL 063009-26	6/30/2009	Native Soil	YES	118.0	11.8	AMEC
SNL MWL 063009-27	6/30/2009	Native Soil	YES	118.3	11.2	AMEC
SNL MWL 063009-28	6/30/2009	Native Soil	YES	118.1	10.8	AMEC
SNL MWL 063009-29	6/30/2009	Native Soil	YES	118.2	11.6	AMEC
SNL MWL 063009-30	6/30/2009	Native Soil	YES	117.8	12.5	AMEC
SNL MWL Berm-1	6/30/2009	Native Soil	YES	115.0	10.0	AMEC
SNL MWL Berm-2	6/30/2009	Native Soil	YES	117.0	10.4	AMEC
SNL MWL Berm-3	6/30/2009	Native Soil	YES	116.2	10.2	AMEC
SNL MWL Berm-4	7/10/2009	Native Soil	YES	117.8	11.1	AMEC
SNL MWL Berm-5	7/10/2009	Native Soil	YES	117.0	11.1	AMEC
SNL MWL Berm-6	7/14/2009	Native Soil	YES	116.2	12.3	AMEC
SNL MWL Berm-7	7/14/2009	Native Soil	YES	116.6	12.7	AMEC
SNL MWL Berm-8	7/14/2009	Native Soil	YES	118.6	11.3	AMEC
SNL MWL Berm-9	7/16/2009	Native Soil	YES	114.6	13.0	AMEC

Table 3 Standard Proctor Results

Test Number	Date Sampled	Description	Gradation/ Classification Meet Specification	Maximum Dry Density (lb/ft^3)[1]	Optimum Moisture Content (%)	Testing Laboratory
SNL MWL Berm-10	7/16/2009	Native Soil	YES	116.0	11.2	AMEC
SNL MWL Berm-11	7/16/2009	Native Soil	YES	115.3	13.2	AMEC
SNL MWL Berm-12	7/16/2009	Native Soil	YES	117.7	12.1	AMEC
SNL MWL Berm-13	7/16/2009	Native Soil	YES	115.0	13.0	AMEC
SNL MWL Berm-14	7/16/2009	Native Soil	YES	114.2	13.5	AMEC
SNL MWL Berm-15	7/16/2009	Native Soil	YES	115.9	11.3	AMEC
SNL MWL Berm-16	7/16/2009	Native Soil	YES	116.0	14.4	AMEC
SNL MWL Berm-17	7/23/2009	Native Soil	YES	114.9	15.0	AMEC
SNL MWL Berm-18	7/23/2009	Native Soil	YES	114.7	11.6	AMEC
SNL MWL Berm-19	7/23/2009	Native Soil	YES	117.5	10.9	AMEC
SNL MWL 060209-4	6/2/2009	Top Soil	YES	118.9	9.6	AMEC
SNL MWL 060209-6	6/2/2009	Top Soil	YES	116.2	10.9	AMEC
SNL MWL 071009-8	7/10/2009	Top Soil	YES	117.8	11.8	AMEC
SNL MWL 071409-10	7/14/2009	Top Soil	YES	118.0	11.2	AMEC

Table 4 In-Place Density and Moisture Content Field Results

Test Number	Date of Field Test	Description	Location	Standard Proctor Maximum Density (lb/ft^3)[1]	Standard Proctor Optimum Moisture Content (%)	Percent of Maximum Density Required	Percent Compaction Achieved	Moisture Content Achieved	Meets Density Spec?	Meets Moisture Spec?	Testing Laboratory
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 1	120.1	11.6	90%	97	11.4	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 2	120.1	11.6	90%	99	9.8	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 3	120.1	11.6	90%	100	9.8	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 4	120.1	11.6	90%	100	9.9	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 5	120.1	11.6	90%	98	11.6	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 6	120.1	11.6	90%	98	10.5	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 7	120.1	11.6	90%	100	10.2	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 8	120.1	11.6	90%	98	11.5	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 9	120.1	11.6	90%	98	9.7	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 10	120.1	11.6	90%	96	11.6	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 11	120.1	11.6	90%	99	9.8	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 12	120.1	11.6	90%	97	10.2	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 13	120.1	11.6	90%	98	10.2	YES	YES	AMEC
EDi North Slope Lift 1	6/17/2009	North Slope, Lift 1	North Slope	120.1	11.6	90%	97	11.2	YES	YES	AMEC
EDi North Slope Lift 2	6/17/2009	North Slope, Lift 2	North Slope	120.1	11.6	90%	99	10.8	YES	YES	AMEC
EDi North Slope Lift 3	6/17/2009	North Slope, Lift 3	North Slope	120.1	11.6	90%	97	11.8	YES	YES	AMEC
EDi North Slope Lift 4	6/17/2009	North Slope, Lift 4	North Slope	120.1	11.6	90%	95	12.7	YES	YES	AMEC
EDi North Slope Lift 5	6/18/2009	North Slope, Lift 5	North Slope	120.1	11.6	90%	97	11.8	YES	YES	AMEC
EDi North Slope Lift 6	6/18/2009	North Slope, Lift 6	North Slope	120.1	11.6	90%	99	11.1	YES	YES	AMEC
EDi North Slope Lift 7	6/19/2009	North Slope, Lift 7	North Slope	115.8	12.3	90%	93	14.3	YES	YES	AMEC
EDi North Slope Lift 8	6/19/2009	North Slope, Lift 8	North Slope	115.8	12.3	90%	93	14.2	YES	YES	AMEC
EDi East Slope Lift 1	6/17/2009	East Slope, Lift 1	East Slope	120.1	11.6	90%	97	11.0	YES	YES	AMEC
EDi East Slope Lift 2	6/17/2009	East Slope, Lift 2	East Slope	120.1	11.6	90%	97	11.2	YES	YES	AMEC
EDi East Slope Lift 3	6/17/2009	East Slope, Lift 3	East Slope	120.1	11.6	90%	97	12.2	YES	YES	AMEC
EDi East Slope Lift 4	6/17/2009	East Slope, Lift 4	East Slope	120.1	11.6	90%	98	11.3	YES	YES	AMEC
EDi East Slope Lift 5	6/18/2009	East Slope, Lift 5	East Slope	120.1	11.6	90%	96	11.3	YES	YES	AMEC

Table 4 In-Place Density and Moisture Content Field Results

Test Number	Date of Field Test	Description	Location	Standard Proctor Maximum Density (lb/ft^3)[1]	Standard Proctor Optimum Moisture Content (%)	Percent of Maximum Density Required	Percent Compaction Achieved	Moisture Content Achieved	Meets Density Spec?	Meets Moisture Spec?	Testing Laboratory
EDi East Slope Lift 6	6/18/2009	East Slope, Lift 6	East Slope	120.1	11.6	90%	99	11.7	YES	YES	AMEC
EDi West Slope Lift 1	6/17/2009	West Slope, Lift 1	West Slope	120.1	11.6	90%	96	11.7	YES	YES	AMEC
EDi West Slope Lift 2	6/17/2009	West Slope, Lift 2	West Slope	120.1	11.6	90%	98	11.8	YES	YES	AMEC
EDi West Slope Lift 3	6/17/2009	West Slope, Lift 3	West Slope	120.1	11.6	90%	96	11.1	YES	YES	AMEC
EDi West Slope Lift 4	6/17/2009	West Slope, Lift 4	West Slope	120.1	11.6	90%	97	11.1	YES	YES	AMEC
EDi West Slope Lift 5	6/18/2009	West Slope, Lift 5	West Slope	120.1	11.6	90%	97	11.3	YES	YES	AMEC
EDi West Slope Lift 6	6/18/2009	West Slope, Lift 6	West Slope	120.1	11.6	90%	98	11.9	YES	YES	AMEC
EDi Dog Leg Lift 1	6/18/2009	Lift 1 on Dog Leg	Dog Leg	120.1	11.6	90%	97	11.9	YES	YES	AMEC
EDi Dog Leg Lift 2	6/18/2009	Lift 2 on Dog Leg	Dog Leg	120.1	11.6	90%	97	11.1	YES	YES	AMEC
EDi Wedge Lift 1	6/19/2009	Native Soil Lift 1	Grid Block 7	115.8	12.3	90%	96	11.1	YES	YES	AMEC
EDi Wedge Lift 1	6/19/2009	Native Soil Lift 1	Grid Block 8	115.8	12.3	90%	97	12.4	YES	YES	AMEC
EDi Wedge Lift 1	6/19/2009	Native Soil Lift 1	Grid Block 11	115.8	12.3	90%	94	12.2	YES	YES	AMEC
EDi Wedge Lift 2	6/19/2009	Native Soil Lift 2	Grid Block 7	115.8	12.3	90%	97	11.7	YES	YES	AMEC
EDi Wedge Lift 2	6/19/2009	Native Soil Lift 2	Grid Block 8	115.8	12.3	90%	96	10.6	YES	YES	AMEC
EDi Wedge Lift 2	6/19/2009	Native Soil Lift 2	Grid Block 11	115.8	12.3	90%	96	11.5	YES	YES	AMEC
EDi NS Lift # 3	6/23/2009	Native Soil Lift 3	Grid Block 1	115.8	12.3	90%	100	10.7	YES	YES	AMEC
EDi NS Lift # 3	6/23/2009	Native Soil Lift 3	Grid Block 2	115.8	12.3	90%	100	10.3	YES	YES	AMEC
EDi NS Lift # 3	6/24/2009	Native Soil Lift 3	Grid Block 6	117.0	12.0	90%	97	11.6	YES	YES	AMEC
EDi NS Lift # 3	6/24/2009	Native Soil Lift 3	Grid Block 8	117.0	12.0	90%	95	10.9	YES	YES	AMEC
EDi NS Lift # 3	6/26/2009	Native Soil Lift 3	Grid Block 11 SE	117.0	12.0	90%	99	11.4	YES	YES	AMEC
EDi NS Lift # 3	6/26/2009	Native Soil Lift 3	Grid Block 11 NE	117.0	12.0	90%	91	12.4	YES	YES	AMEC
EDi NS Lift # 4	6/26/2009	Native Soil Lift 4	Grid Block 1	117.0	12.0	90%	100	13.8	YES	YES	AMEC
EDi NS Lift # 4	6/26/2009	Native Soil Lift 4	Grid Block 2	117.0	12.0	90%	98	11.6	YES	YES	AMEC
EDi NS Lift # 4	6/26/2009	Native Soil Lift 4	Grid Block 3	117.0	12.0	90%	94	13.8	YES	YES	AMEC
EDi NS Lift # 4	6/26/2009	Native Soil Lift 4	Grid Block 4	117.0	12.0	90%	97	12.4	YES	YES	AMEC
EDi NS Lift # 4	6/26/2009	Native Soil Lift 4	Grid Block 5	117.0	12.0	90%	97	12.9	YES	YES	AMEC

Table 4 In-Place Density and Moisture Content Field Results

Test Number	Date of Field Test	Description	Location	Standard Proctor Maximum Density (lb/ft^3)[1]	Standard Proctor Optimum Moisture Content (%)	Percent of Maximum Density Required	Percent Compaction Achieved	Moisture Content Achieved	Meets Density Spec?	Meets Moisture Spec?	Testing Laboratory
EDi NS Lift # 4	6/26/2009	Native Soil Lift 4	Grid Block 6	117.0	12.0	90%	100	13.5	YES	YES	AMEC
EDi NS Lift # 4	6/26/2009	Native Soil Lift 4	Grid Block 7	117.0	12.0	90%	99	11.6	YES	YES	AMEC
EDi NS Lift # 4	6/26/2009	Native Soil Lift 4	Grid Block 8	117.0	12.0	90%	100	12.7	YES	YES	AMEC
EDi NS Lift # 4	6/26/2009	Native Soil Lift 4	Grid Block 9	117.0	12.0	90%	100	12.0	YES	YES	AMEC
EDi NS Lift # 4	6/26/2009	Native Soil Lift 4	Grid Block 10	117.0	12.0	90%	97	12.0	YES	YES	AMEC
EDi NS Lift # 4	6/29/2009	Native Soil Lift 4	Grid Block 11	117.0	12.0	90%	98	10.1	YES	YES	AMEC
EDi NS Lift # 4	6/29/2009	Native Soil Lift 4	Grid Block 12	117.0	12.0	90%	96	13.1	YES	YES	AMEC
EDi NS Lift # 4	6/29/2009	Native Soil Lift 4	Grid Block 13	117.0	12.0	90%	97	10.9	YES	YES	AMEC
EDi NS Lift 5	7/7/2009	Native Soil Lift 5	Grid Block 1	117.0	12.0	90%	94	12.3	YES	YES	AMEC
EDi NS Lift 5 Re-Test	7/9/2009	Native Soil Lift 5	Grid Block 1	117.0	12.0	90%	95	10.9	YES	YES	AMEC
EDi NS Lift 5	7/7/2009	Native Soil Lift 5	Grid Block 2	117.0	12.0	90%	91	6.8	YES	**NO**	AMEC
EDi NS Lift 5 Re-Test	7/9/2009	Native Soil Lift 5	Grid Block 2	117.0	12.0	90%	100	10.5	YES	YES	AMEC
EDi NS Lift 5	7/7/2009	Native Soil Lift 5	Grid Block 3	117.0	12.0	90%	89	12.2	**NO**	YES	AMEC
EDi NS Lift 5 Re-Test	7/9/2009	Native Soil Lift 5	Grid Block 3	117.0	12.0	90%	99	12.2	YES	YES	AMEC
EDi NS Lift 5	7/7/2009	Native Soil Lift 5	Grid Block 4	117.0	12.0	90%	95	11.9	YES	YES	AMEC
EDi NS Lift 5 Re-Test	7/9/2009	Native Soil Lift 5	Grid Block 4	117.0	12.0	90%	100	12.1	YES	YES	AMEC
EDi NS Lift 5	7/7/2009	Native Soil Lift 5	Grid Block 5	117.0	12.0	90%	89	6.9	**NO**	**NO**	AMEC
EDi NS Lift 5 Re-Test	7/9/2009	Native Soil Lift 5	Grid Block 5	117.0	12.0	90%	99	13.5	YES	YES	AMEC
EDi NS Lift 5	7/2/2009	Native Soil Lift 5	Grid Block 6	117.0	12.0	90%	100	13.4	YES	YES	AMEC
EDi NS Lift 5	7/1/2009	Native Soil Lift 5	Grid Block 7 East Edge	117.0	12.0	90%	89	7.1	**NO**	**NO**	AMEC
EDi NS Lift 5 Re-Test	7/1/2009	Native Soil Lift 5	Grid Block 7 East Edge	117.0	12.0	90%	96	10.3	YES	YES	AMEC
EDi NS Lift 5	7/1/2009	Native Soil Lift 5	Grid Block 7	117.0	12.0	90%	96	13.6	YES	YES	AMEC
EDi NS Lift 5	7/2/2009	Native Soil Lift 5	Grid Block 8	117.0	12.0	90%	97	10.8	YES	YES	AMEC
EDi NS Lift 5	7/2/2009	Native Soil Lift 5	Grid Block 9	117.0	12.0	90%	98	11.9	YES	YES	AMEC
EDi NS Lift 5	7/2/2009	Native Soil Lift 5	Grid Block 10	117.0	12.0	90%	94	11.1	YES	YES	AMEC
EDi NS Lift 5	7/1/2009	Native Soil Lift 5	Grid Block 11	117.0	12.0	90%	91	10.2	YES	YES	AMEC

Table 4 In-Place Density and Moisture Content Field Results

Test Number	Date of Field Test	Description	Location	Standard Proctor Maximum Density (lb/ft^3)[1]	Standard Proctor Optimum Moisture Content (%)	Percent of Maximum Density Required	Percent Compaction Achieved	Moisture Content Achieved	Meets Density Spec?	Meets Moisture Spec?	Testing Laboratory
EDi NS Lift 5	7/1/2009	Native Soil Lift 5	Grid Block 12	117.0	12.0	90%	96	11.5	YES	YES	AMEC
EDi NS Lift 5	7/1/2009	Native Soil Lift 5	Grid Block 13	117.0	12.0	90%	95	12.1	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 1	117.0	12.0	90%	97	14.0	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 2	117.0	12.0	90%	96	14.0	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 3	117.0	12.0	90%	99	10.2	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 4	117.0	12.0	90%	94	10.1	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 5	117.0	12.0	90%	99	12.5	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 6	117.0	12.0	90%	94	10.7	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 7	117.0	12.0	90%	91	10.0	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 8	117.0	12.0	90%	100	11.6	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 9	117.0	12.0	90%	100	12.4	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 10	117.0	12.0	90%	100	10.5	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 11	117.0	12.0	90%	99	10.9	YES	YES	AMEC
EDi NS Lift 6	7/14/2009	Native Soil Lift 6	Grid Block 12	117.0	12.0	90%	99	12.7	YES	YES	AMEC
EDi NS Lift 6	7/14/2009	Native Soil Lift 6	Grid Block 13	117.0	12.0	90%	99	13.2	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	MW-4	117.0	12.0	90%	94	9.6	YES	**NO**	AMEC
EDi NS Lift 6 Re-Test	7/21/2009	Native Soil Lift 6	MW-4	117.0	12.0	90%	91	10.3	YES	YES	AMEC
EDi NS Lift 7	7/22/2009	Native Soil Lift 7	Grid Block 1	117.0	12.0	90%	94	13.7	YES	YES	AMEC
EDi NS Lift 7	7/22/2009	Native Soil Lift 7	Grid Block 2	117.0	12.0	90%	96	13.6	YES	YES	AMEC
EDi NS Lift 7	7/22/2009	Native Soil Lift 7	Grid Block 3	117.0	12.0	90%	94	11.4	YES	YES	AMEC
EDi NS Lift 7	7/22/2009	Native Soil Lift 7	Grid Block 4	117.0	12.0	90%	94	13.0	YES	YES	AMEC
EDi NS Lift 7	7/22/2009	Native Soil Lift 7	Grid Block 5	117.0	12.0	90%	95	11.8	YES	YES	AMEC
EDi NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 6	117.0	12.0	90%	100	10.6	YES	YES	AMEC
EDi NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 7	117.0	12.0	90%	100	12.2	YES	YES	AMEC
EDi NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 8	117.0	12.0	90%	96.0	11.0	YES	YES	AMEC
EDi NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 9	117.0	12.0	90%	100	12.4	YES	YES	AMEC
EDi NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 10	117.0	12.0	90%	100	12.6	YES	YES	AMEC

Table 4 In-Place Density and Moisture Content Field Results

Test Number	Date of Field Test	Description	Location	Standard Proctor Maximum Density (lb/ft^3)[1]	Standard Proctor Optimum Moisture Content (%)	Percent of Maximum Density Required	Percent Compaction Achieved	Moisture Content Achieved	Meets Density Spec?	Meets Moisture Spec?	Testing Laboratory
EDi NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 11	117.0	12.0	90%	99	11.9	YES	YES	AMEC
EDi NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 12	117.0	12.0	90%	95	13.8	YES	YES	AMEC
EDi NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 13	117.0	12.0	90%	99	11.2	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 1	117.0	12.0	90%	100	10.7	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 2	117.0	12.0	90%	99	11.4	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 3	117.0	12.0	90%	99	12.5	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 4	117.0	12.0	90%	99	11.4	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 5	117.0	12.0	90%	97	13.4	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 6	117.0	12.0	90%	100	10.0	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 7	117.0	12.0	90%	100	10.0	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 8	117.0	12.0	90%	98	8.6	YES	**NO**	AMEC
EDi NS Lift 8 Re-Test	7/28/2009	Native Soil Lift 8	Grid Block 8	117.0	12.0	90%	100	10.3	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 9	117.0	12.0	90%	100	10.1	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 10	117.0	12.0	90%	98	7.6	YES	**NO**	AMEC
EDi NS Lift 8 Re-Test	7/28/2009	Native Soil Lift 8	Grid Block 10	117.0	12.0	90%	100	11.2	YES	YES	AMEC
EDi NS Lift 8	7/24/2009	Native Soil Lift 8	Grid Block 11	117.0	12.0	90%	100	10.5	YES	YES	AMEC
EDi NS Lift 8	7/24/2009	Native Soil Lift 8	Grid Block 12	117.0	12.0	90%	100	11.9	YES	YES	AMEC
EDi NS Lift 8	7/24/2009	Native Soil Lift 8	Grid Block 13	117.0	12.0	90%	100	10.9	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	MW-4	117.0	12.0	90%	98	8.8	YES	**NO**	AMEC
EDi NS Lift 8 Re-Test	7/28/2009	Native Soil Lift 8	MW-4	117.0	12.0	90%	97	10.3	YES	YES	AMEC

[1] lb/ft^3 = pounds per cubic foot
[2] AMEC = AMEC Earth and Environmental, Albuquerque, NM
[3] N/A = not applicable; Maximum Density and Moisture Content specifications and tests do not apply to the topsoil layer

Table 5 Native Soil Layer Gradation Results

Test Number	Date Sampled	Material Description	% Passing Sieve Size						Soil Classification
			3/4 inch	1/2 inch	3/8 inch	#10	#40	#200	
SNL MWL 052009-1	5/20/2009	Native Soil Stock Piled	100	100	100	95	87	34	SC-SM
SNL MWL 052009-2	5/20/2009	Native Soil Stock Piled	100	98	97	90	81	26	SC-SM
SNL MWL 052009-3	5/20/2009	Native Soil Stock Piled	100	98	98	90	82	26	SC-SM
SNL MWL 052909-4	5/29/2009	Native Soil Stock Piled	99	98	98	90	81	31	SM
SNL MWL 052909-5	5/29/2009	Native Soil Stock Piled	98	98	97	92	86	36	SC-SM
SNL MWL 052909-6	5/29/2009	Native Soil Stock Piled	100	100	99	96	90	38	SC
SNL MWL 052909-7	5/29/2009	Native Soil Stock Piled	100	100	100	96	90	37	SC-SM
SNL MWL 052909-8	5/29/2009	Native Soil Stock Piled	99	99	98	94	87	32	SC-SM
SNL MWL 060909-9	6/9/2009	Native Soil Stock Piled	99	99	98	93	87	36	SC
SNL MWL 060909-10	6/9/2009	Native Soil Stock Piled	100	100	99	95	88	38	SC
SNL MWL 060909-11	6/9/2009	Native Soil Stock Piled	99	99	98	94	88	29	SC-SM
SNL MWL 060909-12	6/9/2009	Native Soil Stock Piled	100	100	99	94	87	35	SC-SM
SNL MWL 060909-13	6/9/2009	Native Soil Stock Piled	100	100	99	93	86	27	SC-SM
SNL MWL 062409-14	6/24/2009	Native Soil Stock Piled	100	100	100	95	89	38	SC-SM
SNL MWL 062409-15	6/24/2009	Native Soil Stock Piled	100	100	99	95	89	35	SC-SM
SNL MWL 062409-16	6/24/2009	Native Soil Stock Piled	100	100	99	93	86	33	SM
SNL MWL 062409-17	6/24/2009	Native Soil Stock Piled	100	100	100	95	88	33	SM
SNL MWL 062409-18	6/24/2009	Native Soil Stock Piled	100	100	100	93	86	33	SM
SNL MWL 062909-19	6/29/2009	Native Soil Stock Piled	99	98	97	93	86	33	SC-SM
SNL MWL 062909-20	6/29/2009	Native Soil Stock Piled	100	100	100	96	90	36	SC-SM
SNL MWL 062909-21	6/29/2009	Native Soil Stock Piled	100	99	98	93	86	**41**	SC-SM
SNL MWL 062909-22	6/29/2009	Native Soil Stock Piled	100	100	100	96	90	36	SM
SNL MWL 062909-23	6/29/2009	Native Soil Stock Piled	100	99	99	93	88	36	SM
SNL MWL 062909-24	6/29/2009	Native Soil Stock Piled	100	100	99	94	88	34	SC-SM
SNL MWL 063009-25	6/30/2009	Native Soil Stock Piled	99	98	98	92	86	34	SC-SM
SNL MWL 063009-26	6/30/2009	Native Soil Stock Piled	99	98	97	93	87	36	SC-SM
SNL MWL 063009-27	6/30/2009	Native Soil Stock Piled	98	97	96	91	85	32	SM

Table 5 Native Soil Layer Gradation Results

Test Number	Date Sampled	Material Description	% Passing Sieve Size						Soil Classification
			3/4 inch	1/2 inch	3/8 inch	#10	#40	#200	
SNL MWL 063009-28	6/30/2009	Native Soil Stock Piled	100	100	99	95	88	33	SM
SNL MWL 063009-29	6/30/2009	Native Soil Stock Piled	100	99	99	94	88	33	SM
SNL MWL 063009-30	6/30/2009	Native Soil Stock Piled	100	100	99	96	91	39	SC-SM
SNL MWL Berm-1	6/30/2009	Native Soil Excavated	100	99	99	96	92	30	SM
SNL MWL Berm-2	6/30/2009	Native Soil Excavated	99	98	97	92	86	27	SM
SNL MWL Berm-3	6/30/2009	Native Soil Excavated	99	97	96	91	86	26	SM
SNL MWL Berm-4	7/10/2009	Native Soil Excavated	100	100	100	97	90	28	SC-SM
SNL MWL Berm-5	7/10/2009	Native Soil Excavated	100	98	97	91	85	24	SM
SNL MWL Berm-6	7/14/2009	Native Soil Excavated	100	100	100	95	88	32	SM
SNL MWL Berm-7	7/14/2009	Native Soil Excavated	100	99	99	94	88	32	SC-SM
SNL MWL Berm-8	7/14/2009	Native Soil Excavated	100	100	99	95	89	36	SC-SM
SNL MWL Berm-9	7/16/2009	Native Soil Excavated	100	99	99	97	92	38	SC-SM
SNL MWL Berm-10	7/16/2009	Native Soil Excavated	100	100	99	95	90	30	SM
SNL MWL Berm-11	7/16/2009	Native Soil Excavated	100	100	100	96	91	36	SC-SM
SNL MWL Berm-12	7/16/2009	Native Soil Excavated	100	99	98	94	89	32	SC-SM
SNL MWL Berm-13	7/16/2009	Native Soil Excavated	100	100	99	94	89	37	SC
SNL MWL Berm-14	7/16/2009	Native Soil Excavated	100	99	99	97	92	34	SM
SNL MWL Berm-15	7/16/2009	Native Soil Excavated	100	100	100	97	92	37	SC-SM
SNL MWL Berm-16	7/16/2009	Native Soil Excavated	100	100	99	96	90	34	SC-SM
SNL MWL Berm-17	7/23/2009	Native Soil Excavated	100	98	98	93	87	34	SM
SNL MWL Berm-18	7/23/2009	Native Soil Excavated	97	95	94	91	86	26	SM
SNL MWL Berm-19	7/23/2009	Native Soil Excavated	100	100	100	97	92	34	SM

Table 6 Topsoil Gradation Results

Test Number	Date Sampled	Material Description	% Passing Sieve Size						Soil Classification[1]	Gradation/Classification Meet Specification
			3/4 inch	1/2 inch	3/8 inch	#10	#40	#200		
SNL MWL -060209-1	6/2/2009	Topsoil prior to mixing with crushed 3/8" gravel	100	100	100	98	92	32	SM	YES
SNL MWL -060209-2	6/2/2009	Topsoil prior to mixing with crushed 3/8" gravel	100	100	100	94	86	29	SM	YES
SNL MWL -060209-3	6/2/2009	Topsoil prior to mixing with crushed 3/8" gravel	100	100	100	98	93	33	SM	YES
SNL MWL -060209-4	6/2/2009	Topsoil prior to mixing with crushed 3/8" gravel	100	100	100	98	91	30	SM	YES
SNL MWL -060209-5	6/2/2009	Topsoil prior to mixing with crushed 3/8" gravel	100	100	100	97	90	30	SM	YES
SNL MWL -060209-6	6/2/2009	Topsoil prior to mixing with crushed 3/8" gravel	100	100	99	96	90	31	SM	YES
SNL MWL -071009-7	7/10/2009	Topsoil collected from berm on west side of borrow area	100	100	100	97	92	27	SM	YES
SNL MWL 071009-8	7/10/2009	Topsoil collected from berm on west site of borrow area	100	99	99	95	89	21	SM	YES
SNL MWL 071009-9	7/10/2009	Topsoil collected from berm on west side of borrow area	100	100	99	96	90	26	SM	YES
SNL MWL 071409-10	7/14/2009	Topsoil collected from berm on west side of borrow area	100	99	99	95	89	31	SM	YES
SNL MWL 071609-11	7/16/2009	Topsoil collected from berm on west side of borrow area	100	100	100	98	94	36	SC-SM	YES
SNL MWL 071609-12	7/16/2009	Topsoil collected from berm on south side of borrow area	100	100	100	96	90	29	SM	YES

Table 7 Hydraulic Conductivity Results of Eight Native Soil Lifts

Sample Description	Location	Date Sampled	Compaction	Average Saturated Hydraulic Conductivity[+] (K_{sat}) in cm/s*
Native Soil Wedge Lift 1	Grid Block 8	6/22/2009	90.0%	**4.02E-04**
Native Soil Wedge Lift 2	Grid Block 11	6/22/2009	89.0%	**3.58E-05**
Native Soil Lift 3	Collected Prior to Placement	6/17/2009	90.2%	**1.59E-06**
Native Soil Lift 3	Collected Prior to Placement	6/17/2009	89.7%	**1.81E-06**
Native Soil Lift 3	Collected Prior to Placement	6/17/2009	91.0%	**1.98E-06**
Native Soil Lift 4	Grid Block 2	6/30/2009	84.6%	**2.52E-04**
Native Soil Lift 4	Grid Block 6	6/30/2009	81.2%	**1.87E-04**
Native Soil Lift 4	Grid Block 9	6/30/2009	89.9%	**2.14E-04**
Native Soil Lift 5	Grid Block 1	7/9/2009	90.0%	**2.66E-04**
Native Soil Lift 5	Grid Block 4	7/9/2009	95.3%	**1.46E-04**
Native Soil Lift 5	Grid Block 8	7/9/2009	94.6%	**1.63E-04**
Native Soil Lift 6	Grid Block 3	7/14/2009	90.2%	**3.05E-04**
Native Soil Lift 6	Grid Block 6	7/14/2009	90.3%	**3.51E-04**
Native Soil Lift 6	Grid Block 12	7/14/2009	89.5%	**2.55E-04**
Native Soil Lift 7	Grid Block 1	7/22/2009	94.8%	**2.18E-04**
Native Soil Lift 7	Grid Block 5	7/22/2009	94.8%	**1.87E-04**
Native Soil Lift 7	Grid Block 13	7/22/2009	89.5%	**2.50E-04**
Native Soil Lift 8	Grid Block 2	7/27/2009	90.2%	**1.22E-06**
Native Soil Lift 8	Grid Block 7	7/27/2009	90.0%	**1.23E-06**
Native Soil Lift 8	Grid Block 9	7/27/2009	90.0%	**1.38E-06**
Average			**90.2%**	**1.62E-04**
Geometric Mean			**90.2%**	**4.72E-05**
Median			**90.0%**	**1.87E-04**

[+]Minimum Value is 4.6E-04

*Tests were performed using ASTM standard 5856 Rigid Wall

Attachment A
Photographic Log of ET Cover Construction Activities
May – July 2009

Subgrade Layer surface before the start of 2009 cover construction.
View to the north of the south end of MWL - May 20, 2009.

Subgrade Layer surface before the start of cover construction.
View to the south of the north end of MWL - May 20, 2009.

Subgrade Layer surface cleared, watered and rolled/compacted.
View to the north from the south end of the MWL - May 26, 2009.

Subgrade Layer surface on May 27, 2009. View to the Southeast.

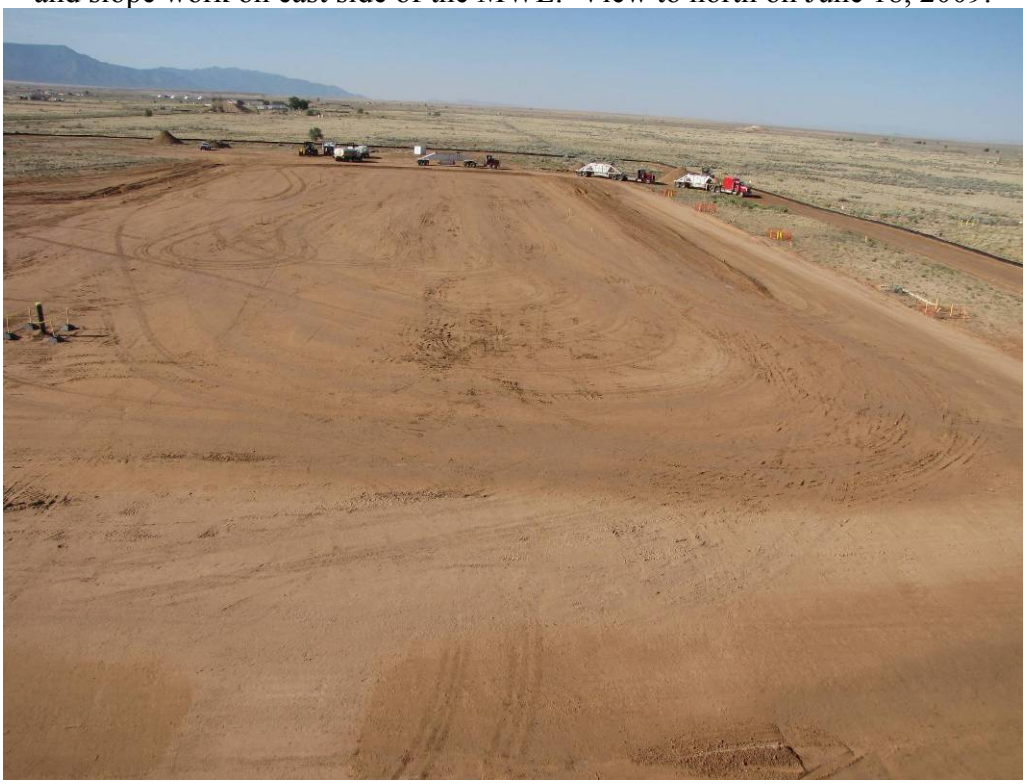
Start of Bio-intrusion Layer test at the south end of landfill.
View to southwest on May 28, 2009.

Spreading rock with bulldozer for Bio-intrusion Layer test.
View to southwest on May 28, 2009.

Bio-intrusion Rock Layer on June 8, 2009. View to north from the south end of the MWL.

Completion of the Bio-intrusion Layer over the Classified Area – northeast end of MWL. View to north on June 12, 2009.

Soil Meniscus Layer (~3 inches thick) covering Bio-intrusion Rock Layer and slope work on east side of the MWL. View to north on June 18, 2009.



North slope completed to 6 to 1 slope and first 2 wedge lifts completed on east side. Lift #3 of Native Soil Layer in progress. View to the south on June 22, 2009.

Bottom dump haul truck placing soil for Lift # 5 at northeast side of the MWL. View to southeast on June 30, 2009.

Borrow Pit Area activities on July 15, 2009. Pug Mill (background) and soil excavation and screening (foreground) operations. View to the south.

Motor grader spreading soil in dog leg area of MWL for Lift # 8.
View to the southwest on July 23, 2009.

Soil being placed to adjust the Native Soil Layer thickness at specific grid points on the west side of the MWL after verification surveys. View to the south on July 31, 2009.

Attachment B

Final Disposition Documentation for the

June 3, 2009 Diesel Spill Waste
and
June 30, 2009 Hydraulic Oil Spill Waste

Attachment B

Final Disposition of the June 3, 2009 Diesel Spill Waste
Waste Manifest 000904423

7 Pages Total
Diesel Spill Waste Represented by
Item #56 on Page 7 of 7

ENTERED JUL 21 2009

Printed: 29-JUN-2009 02:53 PM
Ship Date: 29-JUN-09
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Please print or type. (Form designed for use on elite (12-pitch) typewriter.) Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST	1. Generator ID Number	2. Page 1 of	3. Emergency Response Phone	4. Manifest Tracking Number
	NM5890110518	7	(505)844-4189	000904423 GBF

GENERATOR

5. Generator's Name and Mailing Address
SANDIA NATIONAL LABORATORIES ON BEHALF OF THE U.S. NATIONAL NUCLEAR SECURITY ADMINISTRATION
P.O. BOX 5800, ORG. 04139, MS1117 ALBUQUERQUE, NM 87185
Generator's Phone: 505.844.3470 Attention: ROBERT P. RIVERA

Generator's Site Address (if different than mailing address)
1515 EUBANK BLVD. SE ORG. 04139 / MS1117
ALBUQUERQUE, NM 87123-1117

6. Transporter 1 Company Name
RINCHEM COMPANY, INC.
U.S. EPA ID Number
NMD002208527

7. Transporter 2 Company Name
VEOLIA ES TECHNICAL SOLUTIONS
U.S. EPA ID Number
NJD986631369

8. Designated Facility Name and Site Address
VEOLIA ES TECHNICAL SOLUTIONS L.L.C.
9131 EAST 96TH AVENUE HENDERSON, CO 80640
Facility's Phone: 303 288 4827
U.S. EPA ID Number
COD980591184

9a. HM	9b. U.S. DOT Description (Including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes		
X	1 RQ HAZARDOUS WASTE, SOLID, N.O.S., 9, NA3077, III (LEAD CONTAMINATED MATERIAL)	001	DF	00002	K	D008		
X	2 RQ HAZARDOUS WASTE, SOLID, N.O.S., 9, NA3077, III (D008)(LEAD CONTAMINATED LAB TRASH)	001	DF	00019	K	D008		
X	3 RQ HAZARDOUS WASTE, SOLID, N.O.S., 9, NA3077, III (D008)(LEAD CONTAMINATED MATERIAL)	001	DF	00019	K	D008		
X	4 RQ HAZARDOUS WASTE, SOLID, N.O.S., 9, NA3077, III (D008,D011)(CADMIUM, LEAD CONTAMINATED MATERIAL)	001	BA	00031	K	D008	D008	D011

14. Special Handling Instructions and Additional Information
1 PO# 103014, NEED CD WHEN DISPOSED. PROFILES = 1. HN593141; 2. HN593141; 3. HN593106; 4. HN593106

WEAR GLOVES, GOGGLES, AND PROTECTIVE CLOTHING WHEN HANDLING CONTAINERS

EMERGENCY RESPONSE GUIDE NUMBERS: 1. 171; 2. 171; 3. 171; 4. 171

15. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent.
I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.

Generator's/Offeror's Printed/Typed Name: ROBERT P/ RIVERA
Signature:
Month Day Year: 06 29 09

INTL

16. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter signature (for exports only): Date leaving U.S.:

TRANSPORTER

17. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name: CHAD NELSON
Signature:
Month Day Year: 06 29 09

Transporter 2 Printed/Typed Name
Signature
Month Day Year

DESIGNATED FACILITY

18. Discrepancy

18a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

18b. Alternate Facility (or Generator)
U.S. EPA ID Number
Facility's Phone:

18c. Signature of Alternate Facility (or Generator)
Month Day Year

19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

1.	2.	3.	4.
H141	H141	H141	H141

20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a

Printed/Typed Name
Signature
Month Day Year: 7 9 09

EPA Form 8700-22 (Rev. 3-05) Previous editions are obsolete.

DESIGNATED FACILITY TO GENERATOR

Printed: 22-JUN-2005 12:23 PM
Ship Date: 22-JUN-05
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Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST (Continuation Sheet)

21. Generator ID Number: NM5890110518

22. Page 2 of 7

23. Manifest Tracking Number: 000904423GBF

24. Generator's Name: Emergency Response Phone: (505)844-4189

SANDIA NATIONAL LABORATORIES ON BEHALF OF THE U.S. NATIONAL NUCLEAR SECURITY ADMINISTRATION

P.O. BOX 5800, ORG. 04139, MS1111 ALBUQUERQUE, NM 87185 Phone: 505.844.3470 Attn: ROBERT P. RIVERA

25. Transporter 3 Company Name — U.S. EPA ID Number

26. Transporter 4 Company Name — U.S. EPA ID Number

GENERATOR

27a. HM	27b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	28. Containers No.	28. Containers Type	29. Total Quantity	30. Unit Wt./Vol.	31. Waste Codes		
X	5. RQ WASTE FLAMMABLE LIQUIDS, N.O.S., 3, UN1993, II (D001,D010)(ACETONE, METHANOL MIXTURE)	001	DM	00104	K	D001	F003	D010
X	6. RQ WASTE FLAMMABLE LIQUIDS, TOXIC, N.O.S., 3, (6.1), UN1992, I (D018,D022)(ETHYL ETHER, METHYLENE CHLORIDE MIXTURE)	001	DF	00032	K	D001 F002 F003 F005 D018 D022		
X	7. RQ WASTE FLAMMABLE LIQUIDS, TOXIC, N.O.S., 3, (6.1), UN1992, II (D004)(ACETONE, GALLIUM ARSENIDE MIXTURE) DOT-SP 13937	001	CF	00035	K	D001	F003	D004
X	8. RQ WASTE FLAMMABLE LIQUIDS, TOXIC, N.O.S., 3, (6.1), UN1992, II (D007,D008)(ACETONE, LEAD ZIRCONIUM TITANATE MIXTURE)	001	DM	00154	K	D001 D008	F003	D007
X	9. RQ WASTE FLAMMABLE LIQUIDS, TOXIC, N.O.S., 3, (6.1), UN1992, II (D022)(ACETONE, CADMIUM SELENIDE MIXTURES)	001	DF	00017	K	D001 D006	F003 D010	F005 D022
X	10. RQ WASTE TOXIC SOLID, INORGANIC, N.O.S., 6.1, UN3288, II (D004)(GALLIUM ARSENIDE, HYDROFLUORIC ACID CONTAMINATED MATERIAL)	001	DF	00081	K	D004		
X	11. RQ WASTE TOXIC SOLID, INORGANIC, N.O.S., 6.1, UN3288, II (D004)(GALLIUM ARSENIDE, INDIUM ANTIMONIDE CONTAMINATED MATERIAL) DOT-SP 13937	001	CF	00023	K	D004		
X	12. RQ WASTE TOXIC SOLID, INORGANIC, N.O.S., 6.1, UN3288, II (D007,D011)(BARIUM, LEAD ZIRCONIUM TITANATE CONTAMINATED MATERIAL)	001	DM	00123	K	D005 D008	D006 D011	D007
X	13. RQ WASTE TOXIC SOLID, INORGANIC, N.O.S., 6.1, UN3288, II (D008)(LEAD ZIRCONIUM TITANATE CONTAMINATED MATERIAL)	002	DM	00204	K	D008		
X	14. RQ WASTE TOXIC SOLID, INORGANIC, N.O.S., 6.1, UN3288, II (D011)(SILVER VANADATE CONTAMINATED MATERIAL)	001	DF	00004	K	D011		

32. Special Handling Instructions and Additional Information

PROFILES = 5. HN593132; 6. HN593141; 7. HN593141; 8. HN593132; 9. HN593141, 10. HN593138; 11. HN593141, 12. HN593138; 13. HN593105, 14. HN593141

WEAR GLOVES, GOGGLES AND PROTECTIVE CLOTHING WHEN HANDLING CONTAINERS.

ERGN's: 5. 128; 6. 131, 7. 131; 8. 131, 9. 131; 10. 151; 11. 151, 12. 151, 13. 151, 14. 151

TRANSPORTER

33. Transporter 3 Acknowledgment of Receipt of Materials

Printed/Typed Name | Signature | Month | Day | Year

34. Transporter 4 Acknowledgment of Receipt of Materials

Printed/Typed Name | Signature | Month | Day | Year

DESIGNATED FACILITY

35. Discrepancy

36. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

H061 H141 H141 H061 H141

H141 H141 H141 H141 H141

EPA Form 8700-22A (Rev. 3-05) Previous editions are obsolete.

DESIGNATED FACILITY TO GENERATOR

Printed: 29-JUN-2009 09:52 PM
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Ship Tag: WEOR30 29 JUN 2009

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Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST (Continuation Sheet)	21. Generator ID Number	22. Page 3 of 7	23. Manifest Tracking Number
	NM5890110518		000904423GBF

24. Generator's Name — Emergency Response Phone (505)844-4189

SANDIA NATIONAL LABORATORIES ON BEHALF OF THE U.S. NATIONAL NUCLEAR SECURITY ADMINISTRATION

P.O. BOX 5800 ORG 04139, MS11 ALBUQUERQUE, NM 87185 Phone: 505.844.3470 Attn: ROBERT P/ RIVERA

25. Transporter 5 Company Name — U.S. EPA ID Number

26. Transporter 6 Company Name — U.S. EPA ID Number

GENERATOR

27a. HM	27b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	28. Containers No.	28. Containers Type	29. Total Quantity	30. Unit Wt./Vol.	31. Waste Codes		
X	15. RQ WASTE TOXIC SOLIDS, ORGANIC, N.O.S., 6.1, UN2811, II (D004)(GALLIUM ARSENIDE CONTAMINATED MATERIAL)	001	DF	00055	K	D004		
X	16. RQ WASTE TOXIC SOLIDS, SELF-HEATING, N.O.S., 6.1, (4.2), UN3124, II (D001,D004)(ARSENIC, ACTIVATED CARBON MIXTURE)	003	DM	00282	K	D001	D004	
X	17. RQ WASTE TOXIC, LIQUIDS, ORGANIC, N.O.S., 6.1, UN2810, III (F039)(LEACHATE CONTAMINATED WITH METHYLENE CHLORIDE)	003	DF	00558	K	F039		
X	18. WASTE AEROSOLS, FLAMMABLE, N.O.S., 2.1, UN1950, LIMITED QUANTITY	001	DF	00028	K	D001	D018	D035
X	19. WASTE AEROSOLS, FLAMMABLE, N.O.S., 2.1, UN1950, LIMITED QUANTITY (AEROSOL CANS WITH TRACE BERYLLIUM CONTAMINATION)	001	DF	00010	K	D001		
X	20. WASTE CADMIUM COMPOUNDS, 6.1, UN2570, II (CADMIUM SELENIDE)	001	DF	00003	K	D006	D010	
X	21. WASTE FLAMMABLE LIQUIDS, N.O.S., 3, UN1993, II (ACETONE, METHANOL MIXTURE) DOT-SP 12327	001	CF	00073	K	D001 D035	F003	F005
X	22. WASTE FLAMMABLE LIQUIDS, N.O.S., 3, UN1993, II (ACETONE, METHANOL MIXTURE) DOT-SP 13037	002	CF	00049	K	D001	F003	
X	23. WASTE FLAMMABLE LIQUIDS, N.O.S., 3, UN1993, II (ACETONE, METHANOL MIXTURE) DOT-SP 13037	001	CF	00024	K	D001	F003	D011
X	24. WASTE FLAMMABLE LIQUIDS, N.O.S., 3, UN1993, II (ACETONE, METHANOL MIXTURES) DOT-SP 12327	001	CF	00078	K	D001 D021	F002	F003

32. Special Handling Instructions and Additional Information — PROFILES = 15. HN593141; 16. HN593177; 17. HN593484; 18. HN593138; 19. HN592157; 20. HN593141; 21. HN593141; 22. HN593141; 23. HN593141; 24. HN593141

WEAR GLOVES, GOGGLES, AND PROTECTIVE CLOTHING WHEN HANDLING CONTAINERS — ERGN's: 15. 154; 16. 135; 17. 153; 18. 126; 19. 126; 20. 154; 21. 128; 22. 128; 23. 128; 24.

TRANSPORTER

33. Transporter 5 Acknowledgment of Receipt of Materials

Printed/Typed Name: CHAD NELSON — Signature — Month Day Year

34. Transporter 6 Acknowledgment of Receipt of Materials

Printed/Typed Name — Signature — Month Day Year

DESIGNATED FACILITY

35. Discrepancy

36. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

H141 H141 H141 H141 H141

H141 H141 H141 H141

EPA Form 8700-22A (Rev. 3-05) Previous editions are obsolete.

DESIGNATED FACILITY TO GENERATOR

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UNIFORM HAZARDOUS WASTE MANIFEST (Continuation Sheet)

21. Generator ID Number: NM5890110518

22. Page 4 of 7

23. Manifest Tracking Number: 000904423GBF

24. Generator's Name: SANDIA NATIONAL LABORATORIES ON BEHALF OF THE U.S. NATIONAL NUCLEAR SECURITY ADMINISTRATION

Emergency Response Phone: (505)844-4189

P.O. BOX 5800, ORG. 04139, MS11, ALBUQUERQUE, NM 87185 Phone: 505.844.3470 Attn: ROBERT P. RIVERA

25. Transporter 7 Company Name — U.S. EPA ID Number

26. Transporter 8 Company Name — U.S. EPA ID Number

GENERATOR

27a. HM	27b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	28. Containers No.	28. Containers Type	29. Total Quantity	30. Unit Wt./Vol.	31. Waste Codes		
X	25. WASTE FLAMMABLE LIQUIDS, N.O.S., 3, UN1993, II (ACETONE, METHANOL MIXTURES) DOT-SP 13937	001	CF	00020	K	D001	F002	F003
						D021		
X	26. WASTE FLAMMABLE LIQUIDS, N.O.S., 3, UN1993, II (ACETONE, METHANOL MIXTURES) DOT-SP 13937	001	CF	00040	K	D001	D003	F003
						F005		
X	27. WASTE FLAMMABLE LIQUIDS, N.O.S., 3, UN1993, II (ACETONE, METHANOL) DOT-SP 13937	001	CF	00012	K	D001	F003	
X	28. WASTE FLAMMABLE LIQUIDS, N.O.S., 3, UN1993, II (ACETONE, TOLUENE)	001	DF	00019	K	D001	F003	F005
X	29. WASTE FLAMMABLE LIQUIDS, N.O.S., 3, UN1993, II (ACETONITRILE, TOLUENE)	001	DF	00022	K	D001	F005	D011
X	30. WASTE FLAMMABLE LIQUIDS, N.O.S., 3, UN1993, II (ETHYL ACETATE, METHANOL MIXTURE)	001	CF	00026	K	D001	F003	
X	31. WASTE FLAMMABLE LIQUIDS, N.O.S., 3, UN1993, II (METHANOL, TOLUENE MIXTURES)	001	DF	00038	K	D001	F003	F005
X	32. WASTE FLAMMABLE LIQUIDS, TOXIC, N.O.S., 3, (6.1), UN1992, I (ACETONE, CARBON DISULFIDE MIXTURE)	001	DF	00032	K	D001	F002	F003
						F005	D022	D027
X	33. WASTE FLAMMABLE LIQUIDS, TOXIC, N.O.S., 3, (6.1), UN1992, II (ACETONE, 2-CHLOROETHYL PHENYL SULFIDE MIXTURES) DOT-SP 13937	001	CF	00024	K	D001	F002	F003
						F005	D007	D008
X	34. WASTE FLAMMABLE SOLID, TOXIC, INORGANIC, N.O.S., 4.1, (6.1), UN3179, II (SILVER, LEAD LANTHANUM ZIRCONATE TITANATE MIXTURE)	001	DF	00002	K	D001	D008	D011

32. Special Handling Instructions and Additional Information PROFILES = 25. HN593141, 26. HN593141, 27. HN593141, 28. HN593141, 29. HN593141, 30. HN593141, 31. HN593141, 32. HN593141, 33. HN593141, 34. HN593141

WEAR GLOVES, GOGGLES, AND PROTECTIVE CLOTHING WHEN HANDLING CONTAINERS ERGN's: 25. 128, 26. 128, 27. 128, 28. 128, 29. 128, 30. 128, 31. 128, 32. 131, 33. 131, 34.

TRANSPORTER

33. Transporter 7 Acknowledgment of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year
CHAD NELSON				

34. Transporter 8 Acknowledgment of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year

DESIGNATED FACILITY

35. Discrepancy

36. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

H 1 0 | H 1 0 | H 1 0 | H 1 0

H 1 0 | H 1 0 | H 1 0 | H 1 0

EPA Form 8700-22A (Rev. 3-05) Previous editions are obsolete.

DESIGNATED FACILITY TO GENERATOR

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UNIFORM HAZARDOUS WASTE MANIFEST (Continuation Sheet)	21. Generator ID Number NM5890110518	22. Page 5 of 7	23. Manifest Tracking Number 000904423GBF

24. Generator's Name: SANDIA NATIONAL LABORATORIES ON BEHALF OF THE U.S. NATIONAL NUCLEAR SECURITY ADMINISTRATION
Emergency Response Phone (505)844-4189
P.O. BOX 5800, ORG 04139, MS1117 ALBUQUERQUE, NM 87185 Phone: 505.844.3470 Attn: ROBERT P. RIVERA

25. Transporter 9 Company Name — U.S. EPA ID Number

26. Transporter 10 Company Name — U.S. EPA ID Number

GENERATOR

27a. HM	27b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	28. Containers No.	28. Containers Type	29. Total Quantity	30. Unit Wt./Vol.	31. Waste Codes		
X	35 WASTE MAGNESIUM POWDER, 4.3, (4.2), UN1418, I	001	DF	00009	K	D001	D003	
X	36 WASTE ORGANOMETALLIC SUBSTANCE, LIQUID, PYROPHORIC, WATER-REACTIVE, 4.2, (4.3), UN3394, I (METHYLALUMINOXANE SOLUTION IN TOLUENE)	001	DM	00013	K	D001	D003	
X	37 WASTE ORGANOMETALLIC SUBSTANCE, SOLID, PYROPHORIC, WATER-REACTIVE, 4.2, (4.3), UN3393, I (LITHIUM DIMETHYLAMIDE)	001	DM	00011	K	D001	D003	
X	38 WASTE PROPANE, 2.1, UN1978	001	DF	00003	K	D001		
X	39 WASTE TOXIC SOLID, INORGANIC, N.O.S., 6.1, UN3288, III (FLUORESCENT LAMPS BROKEN, CONTAMINATED WITH TRACE BERYLLIUM)	001	DF	00011	K	D009		
X	40 WASTE TOXIC SOLIDS, ORGANIC, N.O.S., 6.1, UN2811, III (THIOUREA)	001	DF	00003	K	U219		
X	41 WASTE WATER-REACTIVE SOLID, FLAMMABLE, N.O.S., 4.3, (4.1), UN3132, I (9-BORABICYCLO(3.3.1)NONANE DIMER)	001	DF	00005	K	D001	D003	
X	42 WASTE WATER-REACTIVE SOLID, FLAMMABLE, N.O.S., 4.3, (4.1), UN3132, II (GALLIUM PHOSPHIDE)	001	DF	00002	K	D001	D003	
X	43 WASTE WATER-REACTIVE SOLID, TOXIC, N.O.S., 4.3, (6.1), UN3134, II (ALUMINUM, ANTIMONY MIXTURE)	001	DF	00003	K	D001	D003	
X	44 WASTE ZIRCONIUM POWDER, DRY, 4.2, UN2008, II	001	DF	00014	K	D001	D003	

32. Special Handling Instructions and Additional Information PROFILES = 35. HN593141; 36. HN593141; 37. HN593141; 38. HN593141; 39. HN593141; 40. HN593141; 41. HN593141; 42. HN593141; 43. HN593141; 44. HN593141

WEAR GLOVES, GOGGLES, AND PROTECTIVE CLOTHING WHEN HANDLING CONTAINERS. ERGN's: 35. 138, 36. 135, 37. 135, 38. 115, 39. 151, 40. 154, 41. 138, 42. 138, 43. 138, 44.

TRANSPORTER

33. Transporter 9 Acknowledgment of Receipt of Materials
Printed/Typed Name — Signature — Month Day Year

34. Transporter 10 Acknowledgment of Receipt of Materials
Printed/Typed Name — Signature — Month Day Year

DESIGNATED FACILITY

35. Discrepancy

36. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

H141 H141 H141 H141 H141 H141 H141 H141

EPA Form 8700-22A (Rev. 3-05) Previous editions are obsolete.

DESIGNATED FACILITY TO GENERATOR

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST (Continuation Sheet)

21. Generator ID Number: NM5890110518

22. Page 6 of 7

23. Manifest Tracking Number: 000904423GBF

24. Generator's Name: SANDIA NATIONAL LABORATORIES ON BEHALF OF THE U.S. NATIONAL NUCLEAR SECURITY ADMINISTRATION

Emergency Response Phone: (505)844-4189

P.O. BOX 5800, ORG. 04139, MS1117 ALBUQUERQUE NM 87185 Phone: 505.844.3470 Attn: ROBERT P. RIVERA

25. Transporter 11 Company Name — U.S. EPA ID Number

26. Transporter 12 Company Name — U.S. EPA ID Number

GENERATOR

27a. HM	27b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	28. Containers No.	28. Containers Type	29. Total Quantity	30. Unit Wt./Vol.	31. Waste Codes
X	45. AEROSOLS, 2.2, UN1950, LIMITED QUANTITY	001	DF	00012	K	
X	46. COMBUSTIBLE LIQUID, N.O.S., NA1993, III (DIPROPYLENE GLYCOL METHYL ETHER, N-METHYL PYRROLIDINONE)	001	DM	00095	K	
X	47. COMBUSTIBLE LIQUID, N.O.S., NA1993, III (DIPROPYLENE GLYCOL METHYL ETHER, N-METHYL PYRROLIDINONE)	001	DF	00191	K	
X	48. TOXIC LIQUID, INORGANIC, N.O.S., 6.1, UN3287, II (DILUTE HYDROFLUORIC ACID, NICKEL CHLORIDE) DOT-SP 13937	001	CF	00008	K	
X	49. TOXIC SOLID, INORGANIC, N.O.S., 6.1, UN3288, III (HYDROFLUORIC ACID CONTAMINATED MATERIAL) DOT SP 12927	001	CF	00018	K	
X	50. TOXIC SOLID, INORGANIC, N.O.S., 6.1, UN3288, III (TRACE BERYLLIUM CONTAMINATED MATERIAL)	002	DF	00156	K	
X	51. TOXIC SOLID, INORGANIC, N.O.S., 6.1, UN3288, III (TRACE BERYLLIUM CONTAMINATED MATERIAL)	002	BA	00366	K	
X	52. TOXIC SOLID, INORGANIC, N.O.S., 6.1, UN3288, III (TRACE BERYLLIUM CONTAMINATED MATERIAL) DOT SP 13937	001	CF	00012	K	
X	53. TOXIC SOLIDS, ORGANIC, N.O.S., 6.1, UN2811, III (2,2'-DIPYRIDYL)	001	DF	00003	K	
	54. NON REGULATED LIQUID WASTE	002	DF	00198	K	

32. Special Handling Instructions and Additional Information: PROFILES = 45. HN593179; 46. HN593132; 47. HN593134; 48. HN593141; 49. HN593141; 50. HN593194; 51. HN590198; 52. HN593141; 53. HN593141; 54. HN593131

WEAR GLOVES, GOGGLES, AND PROTECTIVE CLOTHING WHEN HANDLING CONTAINERS

ERGN's. 45. 126, 46. 128, 47. 128, 48. 151, 49. 151, 50. 151, 51. 151, 52. 151, 53. 154

TRANSPORTER

33. Transporter 11 Acknowledgment of Receipt of Materials — Printed/Typed Name — Signature — Month Day Year

34. Transporter 12 Acknowledgment of Receipt of Materials — Printed/Typed Name — Signature — Month Day Year

DESIGNATED FACILITY

35. Discrepancy

36. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

H141 H061 H141 H141

H141 H101 H141 H141 H061

EPA Form 8700-22A (Rev. 3-05) Previous editions are obsolete.

DESIGNATED FACILITY TO GENERATOR

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST (Continuation Sheet)

21. Generator ID Number: NM5890110518

22. Page 7 of 7

23. Manifest Tracking Number: 000904423GBF

24. Generator's Name: SANDIA NATIONAL LABORATORIES ON BEHALF OF THE U.S. NATIONAL NUCLEAR SECURITY ADMINISTRATION

Emergency Response Phone: (505)844-4189

P.O. BOX 5800 ORG 04139, MS 1177 ALBUQUERQUE, NM 87185 Phone: 505.844.3476 Attn: ROBERT P. RIVERA

25. Transporter 13 Company Name — U.S. EPA ID Number

26. Transporter 14 Company Name — U.S. EPA ID Number

GENERATOR

27a. HM	27b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	28. Containers No.	28. Containers Type	29. Total Quantity	30. Unit Wt./Vol.	31. Waste Codes
	55 NON REGULATED LIQUID WASTE DOT SP 13037	002	CF	00072	K	
	56 NON REGULATED SOLID WASTE	001	DM	00180	K	
	57 NON REGULATED SOLID WASTE	001	DF	00005	K	
	58 NON REGULATED SOLID WASTE	002	DF	00165	K	
	59 NON REGULATED SOLID WASTE DOT-SP 13037	001	CF	00005	K	

32. Special Handling Instructions and Additional Information: PROFILES : 55. HN593141 56. HN593179 57. HN593141, 58. HN593179 59. HN593141

WEAR GLOVES, GOGGLES, AND PROTECTIVE CLOTHING WHEN HANDLING CONTAINERS.

TRANSPORTER

33. Transporter 13 Acknowledgment of Receipt of Materials

Printed/Typed Name — Signature — Month Day Year

34. Transporter 14 Acknowledgment of Receipt of Materials

Printed/Typed Name — Signature — Month Day Year

DESIGNATED FACILITY

35. Discrepancy

36. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

H141 H141 H141 H141 H141

EPA Form 8700-22A (Rev. 3-05) Previous editions are obsolete.

DESIGNATED FACILITY TO GENERATOR

Attachment B

Final Disposition of the June 30, 2009 Hydraulic Oil Spill Waste Bill of Lading and Shipment Record

3 Pages Total
Hydraulic Oil Spill Waste Represented by Highlighted Item on Page 1

RINCHEM COMPANY, INC.
6133 EDITH BOULEVARD NE
ALBUQUERQUE, N.M. 87107
PHONE (505) 345-3655

BILL OF LADING

Date: 01 SEP 2009
Number: BL1786

Ship to: RIO RANCHO SANITARY LANDFILL
33RD & NORTHERN BLVD.
P.O. BOX 15700
RIO RANCHO, NM 87174
505.892.2055

EPA # NONE

Ship From: SANDIA NATIONAL LABORATORIES ON BEHALF OF THE U.S. NATIONAL NUCLEAR SECURITY ADMINISTRATION
P.O. BOX 5800, ORG. 04139, MS1117
ALBUQUERQUE, NM 87185
505.844.3470

EPA # NM5890110518

Ship Via: RINCHEM COMPANY, INC.

Due Date: 01 SEP 2009

nits			Quantity		
ntained	HM Package	Description	Net	Gross	
001	BA	NON REGULATED SOLID WASTE	148	148	Kilograms
001	DM	NON REGULATED SOLID WASTE	238	238	Kilograms
004	BA	NON REGULATED SOLID WASTE	533	533	Kilograms

Emergency Response Numbers

Special Handling Instruction and Additional Information
.PROFILE# 100048NM. SHIPMENT# 58689. PO# 109022. NEED CD WHEN DISPOSED.
.PROFILE# 08037B. SHIPMENT# 58390.
.PROFILE# ~~07798.00~~ 04779B SHIPMENT# 58693.

R. Morales 9-1-09
Transporter Date

Avoid contact with material.
Wear gloves, goggles, and protective clothing when handling material.
If unable to deliver, return to Generator.

For Emergencies Contact:
Sandia National Labs at
505.844.4169

09-1-09

THIS IS TO CERTIFY THAT THE ABOVE NAMED MATERIALS ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELED AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATION OF THE DEPARTMENT OF TRANSPORTATION.

SIGNATURE Robert Rivera 9-1-09
DELIVERED RETURNED
Deposit Drums Deposit Drum
RECEIVED BY

SPECIAL WASTE SHIPMENT RECORD

Rio Rancho Sanitary Landfill / Valencia Regional Landfill & Recycling Facility Shipment № 58690

Mailing Address:	❑ Physical Address:	❑ Physical Address:	
P.O. Box 15700	33rd St. & Northern Blvd.	1600 W. Highway 6	
Rio Rancho, NM 87174	Rio Rancho, NM 87144	Los Lunas, NM 87031	
505/892-2055	SWM #231402	SWM #013230 (sp)	Profile # 08037B

1. Generator's work site name and address
Sandia National Laboratories, 1515 Eubank Blvd. S.E., Albuquerque, NM 87123-1117

2. Generator's name and address
Sandia National Laboratories on behalf of the U.S. National Nuclear Security Administration
1515 Eubank Blvd. SE
Albuquerque, NM 87123-1117

Generator's Telephone no. (505) 844 - 3470

3. Authorized Agent's name and mailing address (if different from #2)

Agent's Telephone no.

4. Proper name and type of waste	5. Containers No.	Type	6. Total quantity (yd3) (tons)
Soil Contaminated With > 1000 PPM TPH	1	Drums	233 Kilograms

7. Special handling instructions: **SEE BILL OF LADING 1786**

8. GENERATOR'S OR AUTHORIZED AGENT'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway in accordance with applicable international and government regulations.

I hereby certify that the above named material does not contain free liquid as defined by 40CFR Part 258.28 and is not a hazardous waste as defined by 40CFR 261 or any applicable state law.

Generator's or Authorized Agent's printed/typed name	Signature	Month / Day / Year
Robert P. Rivera	[signature]	09 / 01 / 09

9. Transporter 1 (Acknowledgement of receipt of materials)

Printed/typed name, address, telephone no.	Signature	Month / Day / Year
Rinchem Company Inc 6133 Edith Blvd NE (505) 345-3655 Albuquerque, NM 87107	[signature]	09 / 01 / 09

10. Transporter 2 (Acknowledgement of receipt of materials)

Printed/typed name, address, telephone no.	Signature	Month / Day / Year
		/ /

11. Discrepancy indication space

12. Waste disposal site location coordinates
N 35° 16.' 70" W 106° 38' 40.7"

Received By (printed/typed name):	Signature	Month / Day / Year
Cynthia Deal	[signature]	09 2 09

White/GEN Yellow/CUSTOMER Pink/LANDFILL

SNL CONTAINER CONTENT FORM
Sandia National Laboratories/New Mexico
NM Hazardous Waste Management Facility

Cntnr Barcode / ID: **SNLA091275** / 1424934 Pack Type: N Container Type: DM55X Approval Number: 08037B Waste Accum Start Date: 15 JUL 2009 Gross Weight: 233KG

DOT Shipping Name: NON REGULATED SOLID WASTE

Drum EPA Codes NCR

UDM: D81

Package No.	DR-Line	Waste ID	Solid Stream Name	Weight	EPA Codes
P1423217	DR2061435-1	A50672	SOIL CONTAMINATED WITH HYDRAULIC OIL	233 KG	NCR

Volume III

TAB 4

NMED Response: Mixed Waste Landfill Quarterly Progress Report

ET Cover Construction Project May-July 2009

From: NMED/Bearzi
To: SNL/Davis

Back of Tab 4

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

November 18, 2009

Kimberly A. Davis
Acting Manager
U.S. Department of Energy
NNSA / Sandia Site Office
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Security Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: MIXED WASTE LANDFILL QUARTERLY PROGRESS REPORT EVAPOTRANSPIRATIVE COVER CONSTRUCTION PROJECT, MAY-JULY 2009, SEPTEMBER 2009
SANDIA NATIONAL LABORATORIES
EPA ID# NM5890110518
HWB-SNL-09-014

Dear Ms. Davis and Mr. Nimick:

The New Mexico Environment Department (NMED) has reviewed the subject quarterly progress report, dated September 2009, and its transmittal letter of September 30, 2009. NMED has no concerns at this time; however, this letter does not constitute approval of construction completed to date or any of the other required corrective measures for the Mixed Waste Landfill.

If you have any questions regarding this matter, please contact Mr. William Moats of my staff at (505) 222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
J. Cochran, SNL, MS 0719
J. Gould, SNL, MS 0184
File: SNL 2009 and Reading
SNL-09-014

Volume III

TAB 5

Mixed Waste Landfill Quarterly Progress Report ET Cover Construction Project August-October 2009

From: SNL/Wagner
To: NMED/Bearzi

Back of Tab 5

ENTERED

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

DEC 21 2009

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Bldg. 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

On behalf of the U. S. Department of Energy/National Nuclear Security Administration (DOE/NNSA), and Sandia Corporation (Sandia), DOE/NNSA is submitting the "Mixed Waste Landfill (MWL) Quarterly Progress Report Evapotranspirative (ET) Cover Construction Project, August–October 2009." This quarterly project report addresses all quarterly reporting requirements required by the New Mexico Environment Department (NMED) Final Order In the Matter of Request for a Class 3 Permit Modification for Corrective Measures for the MWL (Final Order) (NMED May 2005) and the NMED conditional approval of the MWL Corrective Measures Implementation Plan (Bearzi December 2008), both requiring the Progress Reports to be submitted to NMED on a quarterly basis during implementation of the remedy. MWL ET Cover construction activities for the period of August through October 2009 are presented in this second quarterly progress report consistent with requirements in the Compliance Order on Consent (NMED April 2004), Section VII.D.5.

Should you have any questions regarding this project quarterly report please contact me at (505) 845-6036, or Joe Estrada of my staff at (505) 845-5326.

Sincerely,

Patty Wagner
Manager

Enclosure (1)

cc w/enclosure:
W. Moats, NMED-HWB (via Certified Mail)
L. King, EPA, Region 6 (via Certified Mail)
T. Skibitski, NMED-OB, MS-1396
B. Birch, NMED-OB, MS-1396
J. Estrada, SSO, MS-0184

DEC 21 2009

J. Gould, SSO, MS-0184
Zimmerman Library, UNM
SNL ES&H Records Center, SNL/NM, Org.6765, MS-0718

cc w/o enclosure:
J. Lehr, NA-56, HQ/FORS
T. Longo, NA-56, HQ/GTN
A. Blumberg, SNL/NM, Org. 11100, MS-0141
M. Walck, SNL/NM, Org. 6700, MS-0701
D. Miller, SNL/NM, Org. 6765, MS-0718
T. Cooper, SNL/NM, Org. 4133, MS-0729
J. Cochran, SNL/NM, Org. 6765, MS-0719
M. Skelly, SNL/NM, Org 6765, MS-0718
C. Daniel, SNL/NM, Org. 10667, MS-0718

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Mixed Waste Landfill Quarterly Progress Report Evapotranspirative Cover Construction Project, August - October 2009.**

Document author: **Mike Mitchell, Department 06765**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: Marianne C Walck 12/14/09

Marianne Walck, Director
Nuclear Energy & Global Security Technologies
Center 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

Date

and

Signature: Kimberly A Davis for 12/21/09

Ms. Patty Wagner, Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Date

Sandia National Laboratories

Sandia National Laboratories, New Mexico (SNL/NM)

Environmental Restoration Project

MIXED WASTE LANDFILL
QUARTERLY PROGRESS REPORT
EVAPOTRANSPIRATIVE COVER CONSTRUCTION PROJECT
AUGUST – OCTOBER 2009

DECEMBER 2009

United States Department of Energy
Sandia Site Office

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

MIXED WASTE LANDFILL
QUARTERLY PROGRESS REPORT
EVAPOTRANSPIRATIVE COVER CONSTRUCTION PROJECT
AUGUST – OCTOBER 2009

Sandia National Laboratories/New Mexico
Environmental Restoration Project
Department 6765
Albuquerque, New Mexico 87185

December 2009

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ABBREVIATIONS AND ACRONYMS

ASTM	American Society of Testing Materials
CMIP	Corrective Measures Implementation Plan
CQA	Construction Quality Assurance
CY	Cubic Yards
DOE	U.S. Department of Energy
EDi	Environmental Dimensions, Inc.
ET	Evapotranspirative
KAFB	Kirtland Air Force Base
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
QA	Quality Assurance
QC	Quality Control
Sandia	Sandia Corporation
SNL/NM	Sandia National Laboratories/New Mexico
TA	Technical Area

1.0 Introduction

Sandia National Laboratories/New Mexico (SNL/NM) is located within the boundaries of Kirtland Air Force Base (KAFB), immediately south of the city of Albuquerque in Bernalillo County, New Mexico. KAFB occupies 52,233 acres. SNL/NM research and administration facilities are divided into five technical areas (TAs), designated 1 through 5, and several additional test areas, occupying 2,842 acres. TA-1, TA-2, and TA-4 are separate research facilities in the northwestern portion of KAFB. TA-3 and TA-5 are contiguous research facilities forming a 4.5-square-mile, rectangular area in the southwestern portion of KAFB. TA-3 alone occupies 2,000 acres. The Mixed Waste Landfill (MWL) is a 2.6-acre, fenced waste disposal area located in north-central TA-3 at SNL/NM (Figure 1).

1.1 Background

The MWL Corrective Measures Implementation Plan (CMIP) (SNL/NM November 2005) incorporates the remedy selected by the New Mexico Environment Department (NMED) and details the deployment of the MWL Alternative Evapotranspirative (ET) Cover (Chapter 2), the regulatory basis (Chapter 3), MWL characteristics (Chapter 4), the technical basis for the cover (Chapter 5), the MWL ET Cover design (Chapter 6), and cover performance monitoring (Chapter 7). Appendices include construction specifications (Appendix A), and the construction quality assurance plan (Appendix B).

After receiving conditional approval of the CMIP from the NMED (Bearzi December 2008), the MWL ET Cover Construction contracting process was initiated and completed in March 2009. The Environmental Dimensions, Inc. (EDi) Team was selected to construct the ET Cover and the URS Corporation was selected to perform independent third party Construction Quality Assurance (CQA) under a separate contract. NMED was notified of the start of ET Cover construction field work on April 10, 2009 (Davis April 2009). The EDi Team mobilized to the field to begin initial site activities on May 11, 2009 after completing an updated Health and Safety Plan that was approved by Sandia.

1.2 Purpose and Scope

Progress reports for ET Cover construction activities are required by the NMED Final Order In the Matter of Request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill (Final Order) (NMED May 2005) during implementation of the remedy. The Conditional Approval for the MWL CMIP (Bearzi December 2008) required the Progress Reports to be submitted to the Department on a quarterly basis during implementation of the

remedy. The Compliance Order on Consent (NMED April 2004), Section VII.D.5 specifies that progress reports shall, at a minimum, include the following information.

1. A description of the work completed during the reporting period;
2. A summary of all problems, potential problems, or delays encountered during the reporting period;
3. A description of all actions taken to eliminate or mitigate problems, potential problems, or delays;
4. A discussion of the work projected for the next reporting period, including all sampling events; and
5. Copies of the results of all monitoring, including sampling and analysis, and other data generated during the reporting period; and
6. Copies of all waste disposal records generated during the reporting period.

MWL ET Cover construction activities for the period May through July 2009 are presented in the first quarterly progress report that was submitted to the NMED in September 2009 (SNL/NM September 2009). This first progress report presented ET Cover construction activities from initial mobilization to the site (May 2009) to construction of the Native Soil Layer (completed in late July 2009). All laboratory and field testing results associated with ET Cover construction were included in this first quarterly progress report, with the exception of Topsoil Layer field testing that was performed early September 2009. All waste disposition documentation associated with the MWL ET Cover construction occurred in the previous reporting period and was addressed in the first quarterly progress report.

This second quarterly progress report documents the final ET Cover construction activities completed from August 3 – September 3, 2009, including installation of the Topsoil Layer and re-vegetation. Two soil vapor monitoring wells were installed through the Topsoil Layer prior to seeding and mulching activities to minimize the impact to re-vegetation efforts (i.e., minimize damage to plants). These soil vapor monitoring wells are required by NMED (Bearzi December 2008, referred to as soil-vapor sampling points) but are not part of cover construction as defined by the CMIP, and will be documented in a separate report that will be submitted to the NMED for approval.

A CMI Report documenting ET Cover construction will be prepared and submitted to the NMED within 180 days of ET Cover completion as required by the Final Order. The CMI Report will present detailed cover construction documentation, all field and laboratory testing results, CQA

documentation, a photographic log of construction activities, and final as-built drawings. Sandia Corporation (Sandia) and the U.S. Department of Energy (DOE) anticipate submitting this report in early calendar year 2010.

1.3 Construction Activity Summary

MWL ET Cover construction was completed on September 3, 2009. Table 1 provides a summary of construction activities completed this reporting period (August – October 2009) as well as the activities completed during the previous reporting period. More detailed information for ET Cover construction activities completed this reporting period is provided in Section 2.0. A photographic log covering all ET Cover construction activities will be included in the CMI Report.

There were no significant schedule delays or problems encountered during the reporting period, and the ET Cover construction work was completed ahead of the overall schedule approved by the NMED (Bearzi December 2008). Preliminary soil and rock volume estimates for each layer of the ET Cover (compacted, in-place volumes) are summarized in Table 2 and have been updated from the May-July Quarterly Progress Report. Final volume and thickness information will be provided in the MWL CMI Report. Figure 2 shows the ET Cover in profile view and presents the as-designed (minimum specifications) and as-constructed (average) cover layer thicknesses.

NMED personnel visited the MWL ET Cover construction site on August 6, 2009 to oversee the installation of the two soil vapor monitoring wells. This was the only NMED site visit during the reporting period. There was one NMED visit and one NMED inspection during the previous reporting period.

1.4 Report Structure

The 2009 ET Cover construction work completed this reporting period includes installation of the Topsoil Layer, re-vegetation, supplemental watering, and project demobilization. In addition, preparation of the MWL CMI Report and MWL Alternative Cover CQA Report was ongoing throughout the reporting period. These activities are presented in Section 2.0. The construction schedule and remaining work are presented in Section 3.0, and a reference list is provided in Section 4.0.

2.0 MWL ET Cover Completion Activities

Activities completed during this reporting period include Topsoil Layer installation, soil vapor monitoring well installation, seeding and mulching, administrative security fence installation, and supplemental watering. Installation of the two soil vapor monitoring wells will be documented in a separate installation report.

2.1 Topsoil Layer

The Topsoil Layer is the final cover layer and the layer that will directly support the establishment of native plants. It is also the layer that will initially hold all surface moisture that falls on the cover surface as precipitation. As specified in the CMIP, the Topsoil Layer is to be minimally compacted (i.e., compacted only as a result of the installation process, not by use of standard compaction equipment such as a vibratory roller) and have a minimum thickness of 8 inches.

Construction of the Topsoil Layer was conducted from August 3 through August 12, 2009. Topsoil material consisted of topsoil (upper 6 inches of the in situ Borrow Pit Area soil) and native soil (soil excavated below 6 inches) excavated from the Borrow Pit, screened to 2-inch minus, then admixed with 3/8-inch crushed gravel (25 percent by volume). A total of approximately 7,300 cubic yards (cy) (loose) of topsoil material with 25 percent by volume, 3/8-inch crushed gravel was hauled from the Borrow Pit in 20 cy dump trucks and unloaded directly onto the landfill surface. The material was spread with a John Deere (JD) 670 motor grader in a single, approximately 12-inch loose lift. The 2 percent east-to-west surface design slope established on the Native Soil Layer surface was maintained on the Topsoil Layer surface during final construction, and the side slopes were established at a 6 (horizontal) to 1 (vertical) or flatter angle.

Due to the larger footprint of the as-constructed ET Cover (versus the 2005 CMIP design), the toe of the cover slope on the west side encroached on the MWL groundwater monitoring well pads. Soil drainage diversions immediately east of the three monitoring well locations were constructed to create a localized east-west ridge (i.e., localize high point) parallel to the slope angle. These small ridges or high points divert water to the north and south of the monitoring well pads, protecting them from surface run-off. These features represent a minor design change that was approved by the CQA Engineer as part of the Topsoil Layer.

Visual inspection of the topsoil fill containing 25 percent by volume 3/8 inch crushed gravel was conducted throughout the installation process by the CQA Inspector to verify the topsoil fill conformed to the CMIP specifications. No organic matter, rubble, trash, rocks, or deleterious material greater than 2 inches in dimension was identified.

Following QC and QA verification surveying that confirmed proper layer thickness and slope angles, the Topsoil Layer surface was ripped to loosen the soil and then tilled to break up larger soil clumps in preparation for seeding. The initial ripping was accomplished using scarifier shanks on the JD670 motor grader. Additional surface preparations were conducted as part of the re-vegetation activity discussed in Section 5.6.

2.1.1 Field Testing

Gradation (American Society for Testing and Materials [ASTM] C136) and Classification (ASTM D2487 and D4318) soil testing was performed on the Topsoil Layer fill material at a frequency of 1 sample per 500 cy (loose) as specified in the CMIP. Gradation and Classification results for all samples were included in the previous quarterly progress report (SNL/NM September 2009) and verified the topsoil fill material met the CMIP specifications.

Four soil samples were also collected from the topsoil material for Standard Proctor (ASTM 698) testing to support in-place density and moisture testing of the Topsoil Layer after installation. The Standard Proctor and in-place density and moisture tests were not required by the CMIP. The Standard Proctor results for all samples were included in the previous quarterly progress report (SNL/NM September 2009). The Topsoil Layer in-place density and moisture test results are provided in Table 3.

Four grid block locations on the ET Cover surface were tested at two depths per location, for a total of eight in-place density and moisture tests ranging in depth from 4 to 10 inches. Field testing grid blocks are shown in Figure 3. Percent of maximum dry density achieved (i.e., compaction) ranged from 75 percent (at a 4 inch testing depth) to 96 percent (at an 8-inch testing depth), and the moisture content ranged from 3.7 to 5.4 percent of optimum moisture content.

2.1.2 Verification

The thickness, surface slope, and side slopes of the Topsoil Layer were verified through both the quality control (QC) survey and the quality assurance (QA) survey using the established 50-foot

spaced verification grid shown in Figure 3. Hubs and whiskers were used instead of grade stakes for the Topsoil Layer (blue top approach).

The 2 percent east-to-west surface design slope and 6 to 1 side slopes were verified by both the QC and QA surveys. The average thickness of the Topsoil Layer after placement was 1.02 feet, and the thickness at each grid point exceeded the minimum CMIP specification of 8 inches. The final QC and QA survey data, including the thickness and slopes (surface design and side slopes), were approved by the CQA Engineer on August 12, 2009.

2.2 Re-vegetation

Activities related to re-vegetation were initiated on August 13, 2009, with the installation of an above-ground sprinkler irrigation system that covered the entire landfill surface. All re-vegetation activities except for supplemental watering were completed by September 3, 2009. Tilling, seeding and crimping operations were conducted using a Kubota M7040 agricultural tractor. The tiller was towed by the tractor to till the soil on the cover, slopes, and surrounding area, which broke up the larger soil clumps present after the surface was ripped using scarifier shanks on the JD670 motor grader. Tilling on side slopes was conducted perpendicular to the slope direction to prevent or minimize surface erosion. After tilling, personnel walked the site to break up clumps near irrigation piping that the tiller did not reach.

Seeding operations began on August 25, 2009. Based on recommendations from the SNL/NM Staff Biologist that were approved by the CQA Engineer, the following modifications were implemented to the Reclamation Seeding and Mulching Specification of the CMIP (Section 02930):

- Uniform seeding rate of 80 pounds of seed mix per acre (4 times the original rate);
- No fertilizer added due to timing of seeding; and
- Supplemental watering to assist seed germination and root development.

The seed drill equipment set at the maximum output rate was capable of applying 20 pounds of seed mix per acre. At this rate, the seed drill equipment would have required a minimum of 4 passes to achieve the 80 pounds per acre requirement. This approach would have resulted in an unacceptable amount of compaction to the topsoil, so the decision was made and approved by the CQA Engineer to spread half of the seed by hand. The remaining seed was installed using 2 passes with the seed drill equipment. Following placement of seed, straw was blown over the site at the rate of 2 tons per acre and crimped in.

2.3 Administrative Security Fence

As seeding and mulching activities were being completed, the three strand barbed wire administrative security fence was installed around the cover as specified in the CMIP (Specification 02445). One access gate was placed at the north end. Due to the slightly larger footprint of the as-constructed cover, the fence is positioned on the 6 to 1 side slope on the west side of the ET Cover, just east of three groundwater monitoring wells located on this side of the MWL.

2.4 Supplemental Watering

Supplemental watering of the seeded Topsoil Layer is not addressed in the CMIP and is not considered part of the alternative cover construction scope. The NMED was verbally notified of the supplemental watering schedule and approach on August 13, 2009, and a notification letter was submitted in September 2009 (Wagner September 2009).

On September 3, 2009 seeding and mulching activities were completed and supplemental watering began using the above-ground irrigation system. Watering continued through October 20, 2009 to facilitate the establishment of a native plant community. Consistent with the NMED conditional approval of the CMIP (Bearzi December 2008) and the Sandia/DOE notification letter, detailed supplemental watering information will be included in the revised Long-Term Monitoring and Maintenance Plan.

2.5 Technical Issues and Resolution

The main technical issue associated with the Topsoil Layer is the larger cover footprint, which is the result of the cover being thicker than the minimum thickness specifications in the CMIP. This is graphically summarized in Figure 2, which shows the average thickness of the as-constructed cover is 1.2 feet greater than the minimum thickness in the CMIP. The thicker as-constructed ET Cover is the result of each cover layer being constructed with at thickness exceeding the minimum specification. Although this required more biointrusion rock and soil fill material than estimated in the CMIP, the final result was achievable within the estimated project budget and schedule. The as-designed versus as-constructed soil and rock volumes for each cover layer are provided in Table 2 along with a brief summary of the main reasons additional materials were needed. In summary, the increase in soil and rock material volumes resulted in a thicker, larger, more protective ET Cover that was achieved within budget and schedule.

Note: A page numberinging error occurred in the original document that was submitted to the NMED. This page is followed by Page 9; no content was lost.

3.0 Construction Schedule and Remaining Work

The ET Cover construction was completed ahead of the overall construction timeline schedule originally proposed in the December 15, 2006 Notice of Deficiency Comment Response on the MWL CMIP (SNL/NM December 2006) and approved as condition 1.f. in the NMED CMIP conditional approval (Bearzi December 2008). ET Cover activities that will be completed during the next reporting period include demobilization of the temporary irrigation system and the field office trailer.

Preparation of the MWL CMI Report and the Alternative Cover CQA Report started this reporting period and will be completed within or shortly after the next quarterly reporting period (November through January). The Cover CQA Report will be a stand-alone appendix to the CMI Report and will address all CMI Report cover construction documentation requirements.

4.0 References

Bearzi, J.P. (New Mexico Environment Department), December 2008. Letter to K. Davis (U.S. Department of Energy) and F. Nimick (Sandia Corporation), "Conditional Approval, Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005, Sandia National Laboratories NM5890110518, SNL-05-025." December 22, 2008.

Davis, K. (U.S. Department of Energy), April 2009. Letter to J. Bearzi (New Mexico Environment Department), notifying the New Mexico Environment Department of the start of Mixed Waste Landfill Evapotranspirative Cover construction field work. April 10, 2009.

New Mexico Environment Department (NMED), May 2005. "Final Order, State of New Mexico Before the Secretary of the Environment in the Matter of Request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill, Sandia National Laboratories, Bernalillo County, New Mexico," EPA ID #5890110518," New Mexico Environment Department, May 26, 2004.

New Mexico Environment Department (NMED) April 2004, "Compliance Order on Consent Pursuant to the New Mexico Hazardous Waste Act 74-4-10: Sandia National Laboratories Consent Order," New Mexico Environment Department, April 24, 2004.

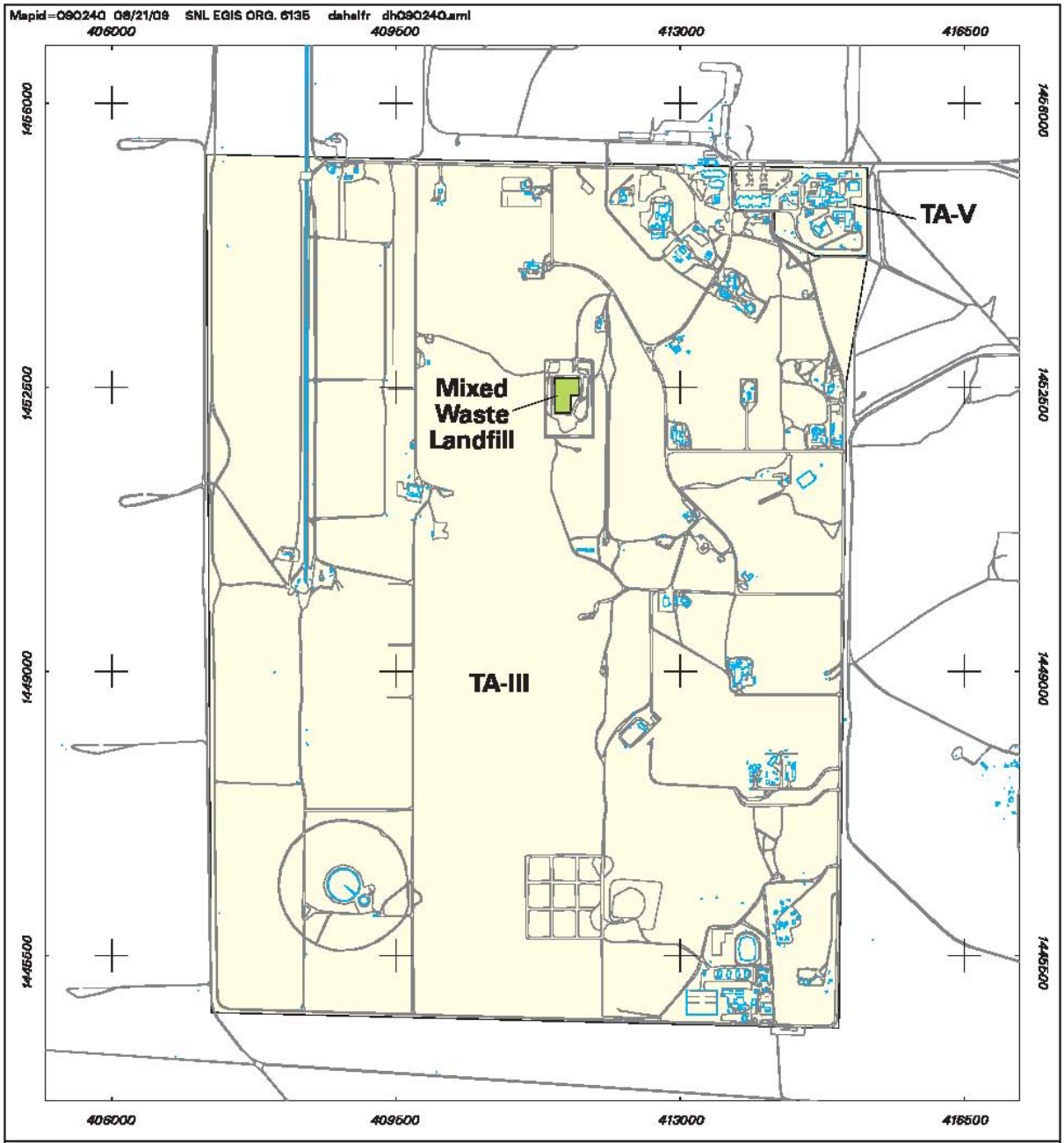
Sandia National Laboratories/New Mexico (SNL/NM), September 2009. "Mixed Waste Landfill Quarterly Progress Report Evapotranspirative Cover Construction Project, August – October 2009," Environmental Restoration Project, Sandia National Laboratories, Albuquerque, New Mexico, November 2005.

Sandia National Laboratories/New Mexico (SNL/NM), December 21 2006, "DOE/Sandia Responses to NMED's 'Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Work Plan, November 2005' – Comment Set 1," prepared for US DOE by Sandia National Laboratories Environmental Restoration Project, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), November 2005. "Mixed Waste Landfill Corrective Measures Implementation Plan," Environmental Restoration Project, Sandia National Laboratories, Albuquerque, New Mexico, November 2005.

Wagner, Patty (U.S. Department of Energy), September 4, 2009. Letter to J. Bearzi (New Mexico Environment Department), notifying the New Mexico Environment Department of the start of Mixed Waste Landfill Evapotranspirative Cover supplemental watering. September 4, 2009.

FIGURES



Legend

- Building / Structure
- Paved and Unpaved Road
- SNL Technical Area III & V
- Mixed Waste Landfill

Figure 1
Location of Technical Areas III & V and the Mixed Waste Landfill

0 1000 2000
Scale in Feet

0 240 480
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

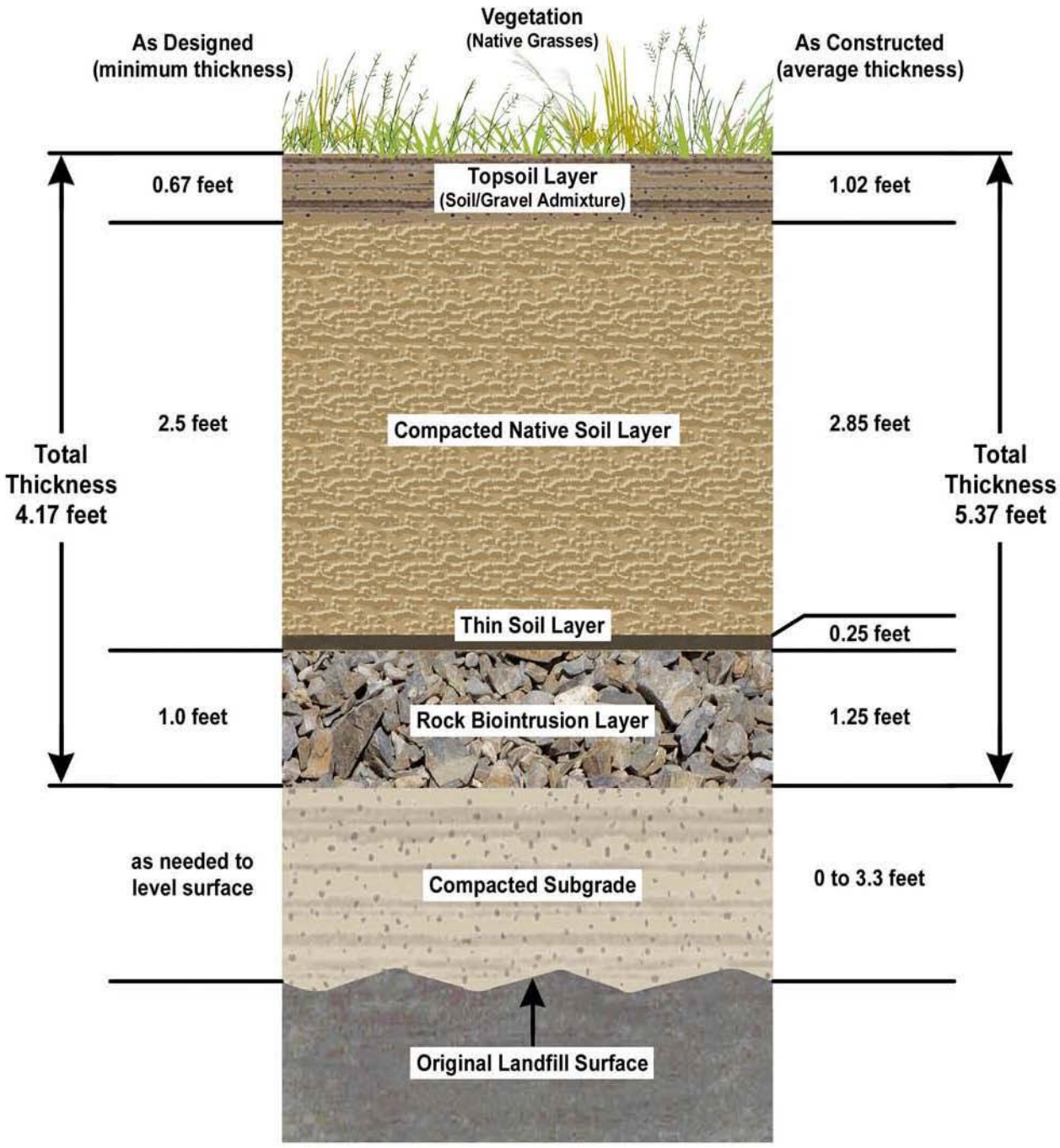


Figure 2

Schematic Diagram of the Mixed Waste Landfill Alternative Evapotranspirative Cover

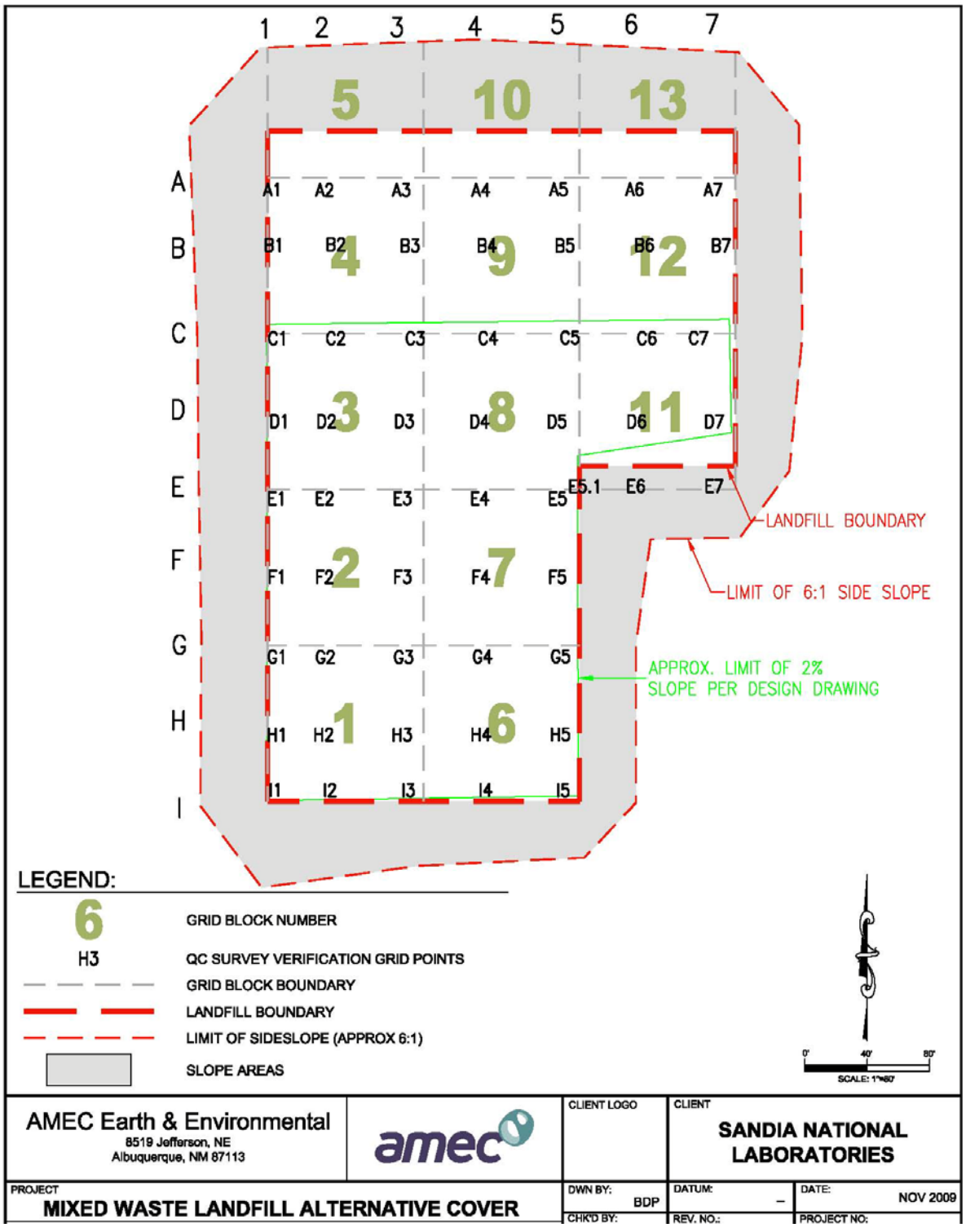


Figure 3

Survey Verification Grid Points and Field Testing Grid Blocks

TABLES

Table 1 Mixed Waste Landfill Evapotranspirative Cover Construction Summary

Activity	Start	Finish	Description
Work Completed August through October 2009			
Soil Vapor Monitoring Wells	August 5, 2009	August 7, 2009	Two soil vapor monitoring wells were installed through the ET Cover to an approximate depth of 35 feet below the original ground surface.
Topsoil Layer	August 3, 2009	August 12, 2009	Placed topsoil on cover and side slopes, verification survey for thickness and slopes, and ripped/scarified surface.
Seeding and Supplemental Watering	August 13, 2009	September 3, 2009	Set up and test supplemental watering system. Disk and drill seeded entire cover surface and disturbed areas. Approximately ½ the seed hand-broadcasted to minimize compaction caused by multiple passes with the tractor.
Supplemental Watering	September 3, 2009	October 20, 2009	System will be operated for up to 3 months (pending weather) to help establish native vegetation.
Administrative Fence	August 31, 2009	September 2, 2009	Perimeter fence was installed according to the specifications in the CMIP.
Revegetation of the Borrow Pit	To Be Determined	To Be Determined	The MWL Borrow Pit Area will be seeded and reclaimed in the 2010 growing season if it is not transferred to Sandia Facilities for continued use.
Work Completed May through July 2009			
Mobilization and Training	May 11, 2009	May 18, 2009	Resources, equipment, and office trailer mobilized to site and personnel training completed. Installed new perimeter boundary, silt fence, and drive-off pad. Removed administrative fence.
Subgrade Layer	May 20, 2009	May 22, 2009	Cleared vegetation, watered and compacted surface, performed field testing and verification survey.
Biointrusion Layer	May 26, 2009	June 16, 2009	Construction method tests conducted on May 26. Hauled and placed rock to create >1 foot thick layer, then placed soil layer on top to fill voids and create a thin soil layer above the rock (~3-inch thickness). New rock material hauled directly to site from vendor June 8-12. Verification surveys for thickness of rock layer and overlying soil layer.
MW4 Extension	May 27, 2009	May 27, 2009	Well casing and protective outer steel casing raised to accommodate surface elevation increase associated with construction of the ET Cover.
Native Soil Layer	June 15, 2009	July 31, 2009	Placed and compacted soil in lifts for cover surface and slopes. Wedge lifts used to establish 2% east-to-west slope. Verification surveys for thickness and slopes.
Borrow Pit Area Activities	June 12, 2009	July 24, 2009	Excavated and screened (2-minus) additional soil fill material, including SWPPP berm soil excavated and hauled to the Borrow Pit from the MWL site. Pug Mill operations set up and calibrated to blend top soil and 3/8-inch crush gravel.

Table 2 Preliminary Soil and Rock Volume Estimates Comparing CMIP Estimates to As-Constructed Estimates

MWL ET Cover Layer	Volume Estimates Reflect Placed, Compacted Cubic Yards (cy)		Explanation
	CMIP Volume	As-Constructed Volume	
Subgrade	6,500	7,700	The MWL existing surface required more elevation increase than anticipated in the CMIP design.
Biointrusion Layer	4,900	5,800	The average thickness of the installed Biointrusion Layer is 0.25 feet greater than the CMIP design. Estimate does not account for volume of rock penetrating down into the Subgrade due to installation method.
Biointrusion Layer - Void filling and overlying 3-inch thick soil layer	Not Estimated	3,100	Volume estimate based on truck load tallies and represents a loose un-compacted estimate. Volume cannot be accurately estimated due to some soil moving down into rock void space.
Native Soil	13,200	17,300	The average thickness of the constructed Native Soil Layer is approximately 2.85 feet (versus 2.5 feet minimum in the CMIP) due to wedge lifts required to correct the <2% slope in the Subgrade and Biointrusion Layer. The north end elevation of the Subgrade Layer appears to be greater than predicted in the 2005 design, creating a larger cover footprint (i.e., 6 to 1 slopes are larger as a result).
Topsoil	3,900	5,400	The average thickness of the Topsoil Layer is approximately 0.33 feet greater than the CMIP design.
Total	**28,500**	**36,200**	**7,700 cy difference (27% increase from original estimate).** 36,200 cy total does not include the 3,100 cy for the void filling and thin soil layer above the Biointrusion Layer.

1) The CMIP estimates were based on minimum thickness specifications for each cover layer. The greater cover layer thicknesses resulted in a larger cover footprint, increasing the volume of soil material needed for the side slopes.
2) The increase in soil and rock material volumes results in a thicker, larger, more protective Evapotranspirative Cover.

Table 3

Topsoil Layer In-Place Density and Moisture Content Field Results

Test Number	Date of Field Test	Description	Location	Standard Proctor Maximum Density (lb/ft^3)[1]	Standard Proctor Optimum Moisture Content (%)	Percent of Maximum Density Required	Percent Compaction Achieved	Moisture Content Achieved	Meets Density Spec?	Meets Moisture Spec?	Testing Laboratory[2]
EDi NS Top Soil[3]	9/03/2009	Topsoil	Grid Block 12 4" depth	118.9	9.6	NA[3]	89	4.7	NA[4]	NA[4]	AMEC
EDi NS Top Soil[3]	9/03/2009	Topsoil	Grid Block 12 10" depth	118.9	9.6	NA[3]	94	4.9	NA[4]	NA[4]	AMEC
EDi NS Top Soil[3]	9/03/2009	Topsoil	Grid Block 8 4" depth	118.9	9.6	NA[3]	75	3.9	NA[4]	NA[4]	AMEC
EDi NS Top Soil[3]	9/03/2009	Topsoil	Grid Block 8 6" depth	118.9	9.6	NA[3]	82	3.9	NA[4]	NA[4]	AMEC
EDi NS Top Soil[3]	9/03/2009	Topsoil	Grid Block 2 4" depth	118.9	9.6	NA[3]	89	3.8	NA[4]	NA[4]	AMEC
EDi NS Top Soil[3]	9/03/2009	Topsoil	Grid Block 2 8" depth	118.9	9.6	NA[3]	96	3.7	NA[4]	NA[4]	AMEC
EDi NS Top Soil[3]	9/03/2009	Topsoil	Grid Block 5 4" depth	118.9	9.6	NA[3]	88	5.4	NA[4]	NA[4]	AMEC
EDi NS Top Soil[3]	9/03/2009	Topsoil	Grid Block 5 8" depth	118.9	9.6	NA[3]	94	3.8	NA[4]	NA[4]	AMEC

[1] lb/ft^3 = pounds per cubic foot
[2] AMEC = AMEC Earth and Environmental, Albuquerque, NM
[3] N/A = not applicable; Maximum Density and Moisture Content specifications and tests do not apply to the topsoil layer.
[4] Topsoil Layer density and moisture testing was performed but not required. These test locations were not surveyed.

Volume III

TAB 6

NMED Response: Mixed Waste Landfill Quarterly Progress Report

ET Cover Project August-October 2009

From: NMED/Bearzi
To: SNL/Wagner

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NEW MEXICO
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Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

SARAH COTTRELL
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

April 8, 2010

Patty Wagner
Manager
U. S. Department of Energy
NNSA/Sandia Site Office
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Dr. Marianne C. Walck
Director
Nuclear Energy & Global Security Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185-0701

RE: MIXED WASTE LANDFILL QUARTERLY PROGRESS REPORT
EVAPOTRANSPIRITIVE COVER CONSTRUCTION PROJECT
AUGUST-OCTOBER 2009, DECEMBER 2009
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-10-002

Dear Ms. Wagner and Dr. Walck:

The New Mexico Environment Department (NMED) has reviewed the subject quarterly progress report, dated December 2009, and transmittal letter of December 21, 2009. Although the NMED has no concerns at this time, this letter does not constitute approval of construction completed to date or any of the other required corrective measures for the Mixed Waste Landfill.

If you have any questions regarding this matter, please contact Mr. William Moats of my staff at (505) 222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
J. Cochran, SNL, MS 0719
J. Gould, SNL, MS 0184
File: SNL 2010 and Reading
SNL-10-002

Volume III

TAB 7

Request for Approval to Implement Supplemental Watering Activities for the Mixed Waste Landfill ET Cover

From: SNL/Wagner
To: NMED/Bearzi

Back of Tab 7

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

ENTERED

MAR 23 2011

MAR 2011

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

James Bearzi, Chief
New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Road East, Building 1
Santa Fe, NM 87505

Subject: Request for Approval to Implement Supplemental Watering Activities for the Mixed Waste Landfill (MWL) Evapotranspirative (ET) Cover

Dear Mr. Bearzi:

On behalf of the Department of Energy/National Nuclear Security Administration (DOE/NNSA) and Sandia Corporation (Sandia), DOE/NNSA is submitting this letter to formalize in writing recent discussions with your technical staff and to request approval to implement supplemental watering activities for the MWL ET Cover. In addition, this letter provides information to the New Mexico Environment Department (NMED) in advance of the revised MWL Long-Term Monitoring and Maintenance Plan (LTMMP) of other ET Cover maintenance activities that may be performed during Calendar Year (CY) 2011 through CY 2013. The purpose of supplemental watering and other ET cover maintenance activities is to establish healthy, self-sustaining native vegetation on the MWL ET Cover.

Initial supplemental watering was conducted immediately after completion of ET Cover construction and seeding in September and October 2009, as authorized by Condition 2 of the NMED Conditional Approval of the MWL Corrective Measures Implementation Plan (CMIP) (Bearzi December 2008). The approach agreed to by NMED stipulated that all water applied to the MWL ET Cover, both natural precipitation and supplemental, be tracked as precipitation (i.e., inches of rain) and the sum of all "precipitation" for the CY shall not exceed the maximum annual precipitation (i.e., 16.5 inches) used in the Cover Performance Modeling effort presented in the Section 5.3 of the MWL CMIP (Sandia National Laboratories /New Mexico [SNL/NM] November 2005). Based upon modeling, annual precipitation of 16.5 inches will not result in water percolating downward through the ET Cover far enough to reach the waste disposal areas, especially given the greater as-built thickness of the ET Cover (average cover thickness above the compacted subgrade is 5.37 feet versus the design thickness of 4.17 feet). As stipulated in the September 4, 2009, DOE MWL Supplemental Watering Notification Letter (Wagner September 2009), all supplemental watering activities would be tracked and reported to NMED.

Additional limited supplemental watering is necessary for the CY 2011 growing season to promote healthy growth of native perennial grass seedlings, and may also be necessary for CY 2012 and CY 2013. The growth of native grasses that were seeded in September 2009 progressed slowly during the 2010 growing season and is currently not robust enough to ensure a future self-sustaining native grass community with foliar coverage approximately equivalent to the surrounding east mesa ecosystem. It may take two or more additional growing seasons to achieve this goal. Once the native vegetation is established in a self-sustaining manner, no additional supplemental watering should be needed.

The requested supplemental watering approach will be similar to the approach approved by NMED on July 31, 2009, for the Chemical Waste Landfill (CWL) and used in 2009 on the MWL ET Cover after discussions and formal notification to NMED (Wagner September 2009). As stated previously, the amount of water used and the duration of each watering event will be tracked as a precipitation event, along with all natural precipitation in the vicinity of the MWL (SNL meteorological monitoring station). Supplemental watering will be performed in a flexible manner to augment natural precipitation. No more than three inches of supplemental water will be applied over a 30-day period and no more than 0.5 inches will be applied during any one daily supplemental watering event. The total water applied to any portion of the MWL ET Cover over the CY shall not exceed 16.5 inches and will be reported to NMED as discussed above.

ET Cover maintenance activities for CY 2011 through CY 2013 will include invasive annual weed species removal (i.e., Russian thistle and others), erosion repair as necessary, and may include seeding bare areas (not the entire ET Cover surface) with the native grass seed mixture specified in the CMIP (SNL/NM November 2005). Seeding activities could include the addition of gravel mulch and commercially available, weed-free top soil to augment the existing top soil. Gravel mulch specifications and application will follow the approach documented in the NMED-approved CWL ET Cover Plan (Bearzi July 2009). This approach has been successful at both the Corrective Action Management Unit and CWL ET Covers. If performed, this cover maintenance work will be documented and reported to NMED along with supplemental watering activities.

The overall schedule and approach for supplemental watering and additional cover maintenance activities were discussed with Mr. William Moats and Mr. John Kieling of your technical staff on February 17, 2011, and during a MWL ET Cover field visit by Mr. Moats and Mr. McDonald on February 25, 2011. Preparations for supplemental watering are ongoing, and will likely be implemented quickly after receiving NMED approval due to the dry winter and the need to maximize native seedling growth on the MWL ET Cover in 2011.

Should you have any questions or need additional information regarding this correspondence, please feel free to contact me at (505) 845-6036 or John Gould of my staff at (505) 845-6089.

Sincerely,

Patty Wagner

Patty Wagner
Manager

MAR 2 3 2011

cc:
W. Moats, NMED (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB
B. Birch, NMED-OB
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A. Blumberg, SNL/NM, Org. 11100, MS-0141
C. Byrd, SNL/NM, Org. 04142, MS-0730
P. Freshour, SNL/NM, Org. 04142, MS-0730
D. Schofield, SNL/NM, Org. 04142, MS-1126
J. Payne, SNL/NM, Org. 04143, MS-0729
B. Reavis, SNL/NM, Org. 04143, MS-1126
J. Cochran, SNL/NM, Org. 06234, MS-0719
C. Daniel, SNL/NM, Org. 06234, MS-0718
D. Miller, SNL/NM, Org. 06234, MS-0718
M. Mitchell, SNL/NM, Org. 06234, MS-0718
SNL Records Center, SNL/NM, Org. 06234, MS-0718
K. Davis, SSO/MO, MS-0184
M. Reynolds, SSO/MO, MS-0184
C. Wimberly, SSO/MO, MS-0184
S. Mondy, SSO/MO, MS-0184
D. Pellegrino, SSO/ESH, MS-0184
S. Lacy, SSO/ESH, MS-0184
J. Gould, SSO/ESH, MS-0184

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Supplemental Watering and Additional Maintenance Activities on the Mixed Waste Landfill Evapotranspirative Cover, March 2011**

Document author: **Mike Mitchell, Department 06234**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 3/21/11
Date

S. Andrew Orrell, Director
Nuclear Energy & Fuel Cycle Programs
Center 6200
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ 3-22-11
Date

Ms. Patty Wagner, Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Volume III

TAB 8

Notice of Approval: Request to Conduct Supplemental Watering and Cover Maintenance Activities Mixed Waste Landfill

From: NMED/Bearzi
To: SNL/Wagner

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Lieutenant Governor

DAVE MARTIN
Secretary

RAJ SOLOMON, P.E.
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

April 1, 2011

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P.O. Box 5800, MS 0771
Albuquerque, NM 87185-0771

RE: REQUEST TO CONDUCT SUPPLEMENTAL WATERING AND COVER MAINTENANCE ACTIVITIES
MIXED WASTE LANDFILL
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-MISC

Dear Ms. Wagner and Mr. Orrell:

The New Mexico Environment Department (NMED) has reviewed the request to conduct supplemental watering and cover maintenance activities at the Mixed Waste Landfill (MWL) dated March 23, 2011, submitted by the U. S. Department of Energy on behalf of itself and Sandia Corporation (collectively, the Permittees). NMED hereby approves the request as specified in the request letter. This approval shall remain in effect through calendar year 2013 or until such time that the Long-Term Monitoring and Maintenance Plan for the MWL is approved by the NMED, whichever comes first.

If you have any questions regarding this matter, please contact Mr. William Moats of my staff at (505) 222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
J. Cochran, SNL, MS 0719
J. Gould, DOE, MS 0184
File: SNL 2011 and Reading

Volume III

TAB 9

Email from William Moats Dated 4/28/11 Notice of Approval Request to Install Access Gate at South End of Mixed Waste Landfill

From: NMED/Moats
To: SNL/Cochran

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Daniel, Carolyn

Subject: FW: Request to install access gate at south end of Mixed Waste Landfill

From: Moats, William, NMENV [mailto:Williams.Moats@state.nm.us]
Sent: Thursday, April 28, 2011 8:37 AM
To: Cochran, John R
Cc: Kieling, John, NMENV
Subject: RE: Request to install access gate at south end of Mixed Waste Landfill

Hi John,

NMED has no concerns regarding the installation of another gate at the MWL that matches the specifications for the existing gate. Please feel free to install the new gate, and thanks for consulting with us on this matter.

- Will

From: Cochran, John R [mailto:jrcochr@sandia.gov]
Sent: Wednesday, April 27, 2011 4:34 PM
To: Moats, William, NMENV
Cc: Mitchell, Mike M
Subject: Request to install access gate at south end of Mixed Waste Landfill

Hi Will

s we discussed on the phone on April 21, 2011, we are requesting e-mail approval to install an access gate at the south end of the MWL perimeter fence.

Per that discussion, we are conducting a number of activities to maintain the MWL ET Cover. These activities include supplemental watering, tumbleweed removal, and supplemental seeding activities (i.e., seeding, gravel mulching, and top soil augmentation); as approved by NMED on April 1, 2011.

Due to the location of the perimeter fence, it is not possible to transport materials or remove stockpiled weeds at the south end of the site without driving over the cover surface. This is because the perimeter fence is immediately adjacent to the cover side slopes along the east and west boundary and the only access gate is at the north end. To minimize vehicle traffic on the cover, we are requesting e-mail permission to install an access gate at the south end of the MWL perimeter fence. The gate will be constructed to the same specifications approved by the NMED for the northern gate, as detailed in the CMIP and CMI Report. A revised as-built site plan depicting this minor change to the existing perimeter security fence will be submitted to NMED in the revised LTMMP.

Thanks for your help
John

ER Project Manager
Organization 06765
andia National Laboratories
Albuquerque, NM 87185-0719
Telephone: 505.844.5256

Volume III

TAB 10

Environmental Restoration Operations Reclamation of the

Mixed Waste Landfill Borrow Pit

From: SNL/Todd
To: NMED/Cobrain

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MWL

ENTERED

Department of Energy
National Nuclear Security Administration
Sandia Field Office
P. O. Box 5400
Albuquerque, NM 87185

DEC 0 9 2013

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

RECEIVED

DEC 16 2013

NMED
Hazardous Waste Bureau

Mr. David Cobrain
Manager
Permits Management Program
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505

Subject: Department of Energy/National Nuclear Security Administration, Sandia National Laboratories Environmental Restoration Operations, Reclamation of the Mixed Waste Landfill Borrow Pit

Dear Mr. David Cobrain:

The Department of Energy/National Nuclear Security Administration and Sandia Corporation are submitting a brief summary describing the reclamation work performed at the Mixed Waste Landfill (MWL) Borrow Pit from May through August 2013. This reclamation effort addresses the only remaining MWL Corrective Measures Implementation (CMI) Plan requirement, Condition 1.g., of the New Mexico Environment Department/Hazardous Waste Bureau (NMED/HWB) Conditional Approval, Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005 (Bearzi December 2008). Condition 1.g. states:

> *"The Permittees must implement the change to the CMI Plan under comment response 10 of Comment Response Set #1 concerning the seeding of borrow pits that are no longer needed."*

Response 10 of MWL CMI Plan Comment Response Set #1 states the following:

> *"Once the MWL cover has been constructed and the TA-3 borrow pits are no longer required ... they will be seeded and reclaimed as described in Appendix A, Construction Specifications, Section 02930, Reclamation Seeding and Mulching."*

This wording was incorporated into the CMI Plan (Appendix A Construction Specifications, Section 02930 Reclamation Seeding and Mulching, Part 3.2.2, page 02930-4) through replacement pages that were submitted to the NMED/HWB on February 12, 2009.

Although several borrow sites were identified in Technical Area 3 to support MWL evapotranspirative cover construction, use of only one site was necessary. Reclamation work on this borrow site was completed from May 8 through August 2, 2013 and is summarized in the enclosure.

See Page 2

SCANNED

If you should have questions, please contact me at (505) 845-5398 or John Weckerle of my staff at (505) 845-6026.

Sincerely,

James W. Todd
Assistant Manager

Enclosure

cc w/enclosure **(Certified Mail):**
William Moats, NMED-HWB
5500 San Antonio Dr., NE
Albuquerque, NM 87109

Laurie King, EPA, Region 6
1445 Ross Ave., Ste. 1200
Dallas, TX 75202

cc w/enclosure:
Thomas Skibitski, NMED-OB, MS-1396
SNL/NM Customer Funded Records Center, MS-0718
Zimmerman Library, UNM
MSC05 3020
1 University of New Mexico
Albuquerque, NM 87101-0001

cc w/o enclosure:
Joanna Serra, NA-173, HQ/FORS
Amy Blumberg, SNL/NM, MS-0141
John Cochran, SNL/NM, MS-0718
Peter Davies SNL/NM, MS-0721
David Miller, SNL/NM, MS-0718
Mike Mitchell, SNL/NM, MS-0719
Joe Estrada, SFO/ENG, MS-0184
Jeanette Norte SFO/ENG, MS-0184
John Weckerle, SFO/ENG, MS-0184
14-126-550682

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Department of Energy/National Nuclear Security Administration, Sandia National Laboratories Environmental Restoration Operations, Reclamation of the Mixed Waste Landfill Borrow Pit, November 2013**

Document author: **Michael Mitchell, Department 06234**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ Date 11/13/13

Peter B. Davies, Director
Nuclear Energy & Fuel Cycle Programs
Center 6200
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ Date 12/7/13

James W. Todd, Assistant Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Enclosure

Summary of Mixed Waste Landfill Borrow Pit Reclamation
May – August 2013

Summary of Mixed Waste Landfill Borrow Pit Reclamation
May – August 2013

Background

The Mixed Waste Landfill (MWL) Borrow Pit was created as a source of soil material for the construction of an evapotranspirative (ET) cover over the MWL in Technical Area 3 (TA-3) at Sandia National Laboratories/New Mexico (SNL/NM). Although several borrow sites were identified in TA-3, use of only one site was necessary. Beginning in 2006, soils at the Borrow Pit were excavated, screened, and transported to the MWL until the ET cover was completed in 2009. Planned construction activities at the Borrow Pit were to be covered under the Construction General Permit and addressed in a Storm Water Pollution Prevention Plan (SWPPP). In May 2006, prior to the commencement of construction activities, a SWPPP was submitted to the U.S. Environmental Protection Agency (EPA). When construction activities were completed in 2009, the Borrow Pit had been excavated to a depth of approximately three feet across nine acres, down to a caliche/alkali salt-rich horizon. In preparation for termination of construction activities, SNL/NM personnel began evaluating strategies for restoration of the site in 2011. This planning began after a determination that the Borrow Pit was not necessary for future use.

Based on experience in establishing native vegetation on ET covers at the Chemical Waste Landfill, the Corrective Action Management Unit (CAMU), and the MWL, project staff realized that the traditional seeding and mulching approach specified in the MWL Corrective Measure Implementation (CMI) Plan would likely fail at the Borrow Pit due to site conditions as summarized below.

- The site is characterized by surface soils that are highly alkaline with very low organic content;
- The site is large (i.e., nine acres), making supplemental watering infeasible; and,
- The climate is arid, with unpredictable precipitation.

To address these challenges, project personnel developed a reclamation approach involving native plant species that are best suited for the existing site conditions. Key to the overall revegetation strategy was amending the soil to offset its high alkalinity/low organic content, grading and ripping the Borrow Pit floor to maximize storm water infiltration, and timing the restoration activities to coincide with the monsoonal rains. This approach was developed incorporating over 10 years of ET Cover experience and is intended to achieve final stabilization criteria of the Construction General Permit. Final stabilization is considered to be complete when the groundcover of the disturbed areas is a minimum of 70 percent of the original native vegetation density, and dispersed in a manner that does not result in large barren areas.

The Borrow Pit reclamation field work was completed from May 8 through August 2, 2013. The integrated reclamation approach utilized current site conditions and incorporated best management practices (BMPs) to facilitate long-term restoration. The restoration efforts are intended to achieve conditions that meet EPA Construction General Permit final stabilization criteria.

Restoration Activities

Borrow Pit restoration included three main activities. 1) Grading, including ripping and contouring the site to maximize local infiltration of storm water to facilitate revegetation efforts and create a gradual transition between the Borrow Pit and the surrounding undisturbed areas. 2) Adding soil amendments to facilitate revegetation. 3) Seeding of carefully-selected, alkali-tolerant, native grass and shrub species. Each of these activities is described in more detail below.

Grading, Ripping, and Contouring of the Site

A soil balance approach to grading the site was used that was designed to enhance storm water infiltration across the site without requiring any imported soil fill. As part of this approach, four distinct shallow depressions less than 2.5 feet deep were established across the Borrow Pit floor (i.e., Basins 1, 2, 3, and 4)

to collect storm water that does not immediately infiltrate into the surface soils. The term "basin" is used to describe these four shallow depressions; it is not intended to denote a specific regulated storm water feature. The areas between and surrounding the basins have a very gentle slope and were ripped to create windrows perpendicular to the main wind direction for the capture of soil and seed. Grading work involved improvements to the perimeter BMP (i.e., soil berm) that minimize the boundary slopes to create a gradual, stabilized transition between the surrounding undisturbed areas and the Borrow Pit. Grading operations were guided by topographic surveys that included an initial survey with placement of grade stakes to establish the desired topography, and a final survey to verify the achieved grade.

Soil Amendments

Once the grading and ripping operations were completed, the soils were amended before seeding to maximize the native vegetative cover. Different soil amendments were tailored for the basin areas versus non-basin area. Because of increased soil moisture anticipated in the four basin areas, the soil amendment approach was more aggressive in these areas and included the application of ferrous sulfate, compost, and humates. These amendments help to reduce and buffer soil pH, improve the organic content of the soil, and to provide needed nutrients for seed germination and plant growth. In the non-basin area humates and a Helena Chemical Company 5-0-5 fertilizer were applied to the surface of the Borrow Pit floor. Key 5-0-5 ingredients include 5% ammoniacal nitrogen, 5% soluble potash, 7% sulfur, 14% iron, and 17% humic acid. The application of the 5-0-5 fertilizer in addition to the humic substances provides added benefit to the revegetation effort. Materials applied to the basins and non-basin areas are summarized in the table below.

Area Designation	Total Area (acres)	Ferrous Sulfate (lbs)	Compost (cy)	Humates (lbs)	Seed Mix (lbs, PLS)	Gravel Mulch (cy)	5-0-5 Amendment (lbs)	Hydro Mulch (lbs)
Basin 1	0.82	3300	174	520	31	90	0	0
Basin 2	0.27	1100	105	165	9	30	0	0
Basin 3	0.27	1100	72	165	9	30	0	0
Basin 4	0.18	750	48	120	6	21	0	0
Non-Basin	7.42	0	0	0	119	0	3235	0
Perimeter BMP and Side Slopes	1.13	0	0	0	19	0	0	1500

Seeding

The restoration effort is completely dependent on natural precipitation for moisture and was planned to coincide with the 2013 monsoon rains. The basin and non-basin areas were seeded with native grass species specifically selected for their tolerance to alkali soil. In the basins three native grass species were selected that can tolerate temporary standing water. In the non-basin and perimeter slope areas a grass and shrub species were selected that can tolerate dryer conditions. Seed application was accomplished using a drill seeder that created small furrows and ensured shallow burial of the seed in the surface soil. For the perimeter BMP and side slopes seeding was accomplished using a hydroseeding approach. The seed-mulch-water mixture included straw fiber mulch with a high strength polymer binder and a tackifier that was prepared in a trailer-mounted tank and applied via a pump and

hose. Quantities of seed and other materials were measured and then applied to a specific area of the site to ensure that the desired application rate was achieved. The seed mixes and application rates used are summarized in the table below.

Seed Variety (Common Name)	Pure Live Seed (Pounds per Acre)
Basin Areas	
"Viva" Galleta grass	12
"Hatchita" Blue grama	17
Alkali sacaton	4
Total	**33**
Areas of Borrow Pit Floor Outside Basins	
Four-wing (de-winged seeds) saltbush	8
"Paloma" Indian rice grass	8
Total	**16**
Perimeter BMP	
Four-wing (de-winged seeds) saltbush	8
"Paloma" Indian rice grass	8
Total	**16**

Gravel mulch was applied to the surface area of the basins after seeding to promote establishment of the native grasses. The gravel mulch helps retain soil moisture and moderate extreme summertime temperatures.

Conclusion

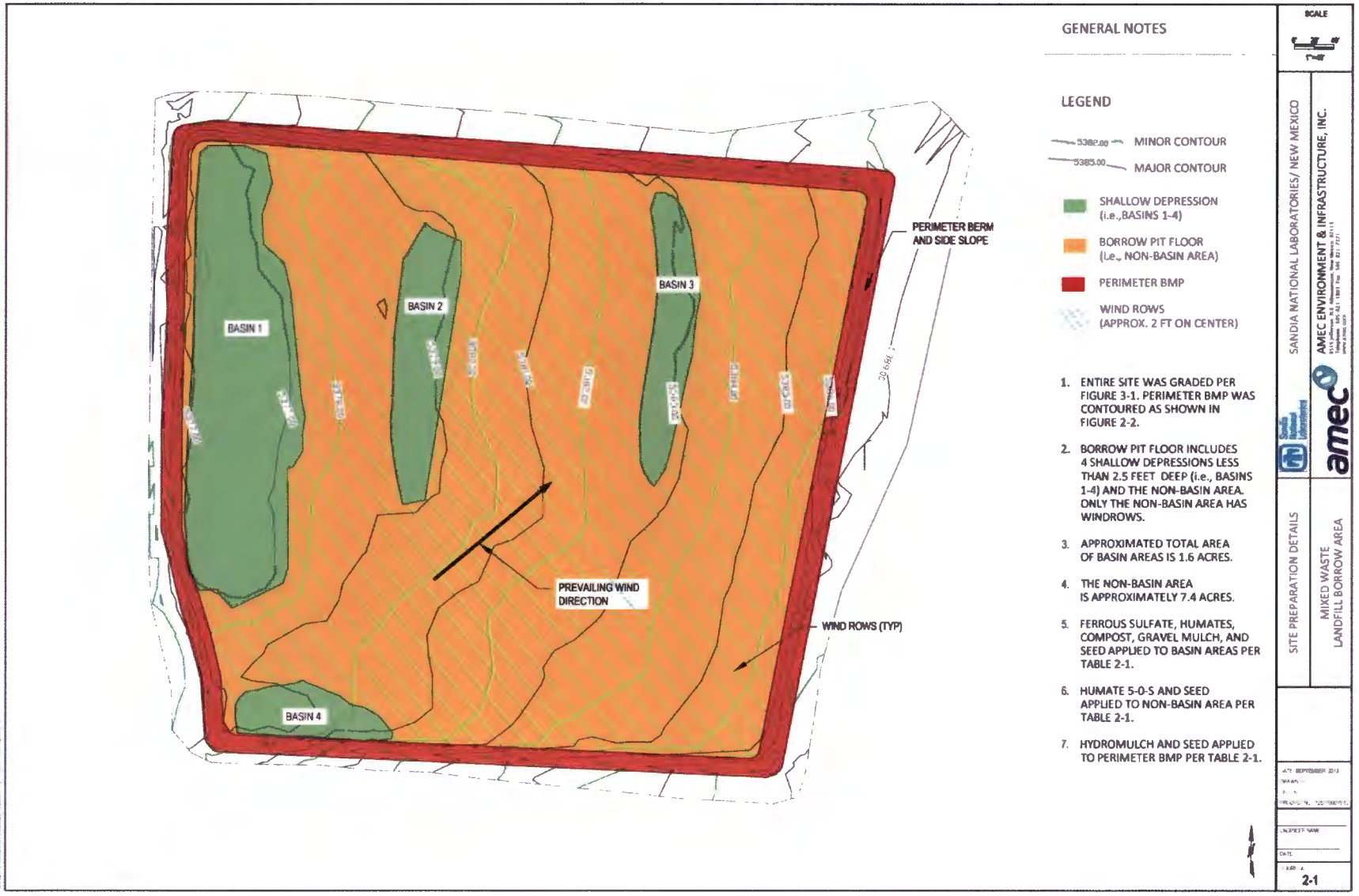
Reclamation field activities started on May 8 and were completed on August 2, 2013. During this period there were nine rain events recorded using a rain gauge at the site, totaling approximately four inches. All but 0.5 inches of this monsoonal precipitation fell after seeding was completed in both the basin and non-basin areas. Grass growth was established in the basin areas by the end of August. Pre- and Post-Restoration photographs of the Borrow Pit are provided on the next page. These photographs show the transformation of the site and the current conditions. The final as-built topographic map of the site is provided after the photographs.

The restoration effort went beyond the requirements of the CMI Plan (Appendix A *Construction Specifications*, Section 02930 *Reclamation Seeding and Mulching*) and demonstrate a commitment to restore the site despite challenging conditions not anticipated when the CMI Plan was written (i.e., excavation across the entire nine acre site down to the pervasive caliche, alkali-rich soil horizon). Site grading, application of soil amendments, site-specific native seed mix, and the application of gravel mulch in the basin areas were not required per the CMI Plan reclamation specifications but recommended actions based upon past experience and lessons learned from similar sites and ET covers.

The SNL/NM Storm Water Program will continue routine SWPPP inspections and maintenance of the site until final stabilization criteria are met. While many factors will affect the rate at which this occurs, SNL/NM personnel have incorporated relevant past experience to increase the potential for success in the least amount of time.

Borrow Pit in May 2013 at the start of the reclamation effort. View from northwest corner to southeast.

Borrow Pit in August after completion of the reclamation effort. View from northwest corner to southeast.



Final As-Built Topographic Map of the MWL Borrow Pit – Post Reclamation

Volume III

TAB 11

Reclamation of the Mixed Waste Landfill Borrow Pit,

Letter of December 9, 2013

From: NMED/Kieling
To: SNL/Beausoleil

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NEW MEXICO
ENVIRONMENT DEPARTMENT

SUSANA MARTINEZ
Governor
JOHN A. SANCHEZ
Lieutenant Governor

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

RYAN FLYNN
Secretary
BUTCH TONGATE
Deputy Secretary

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

June 26, 2014

Geoffrey L. Beausoleil
Manager
U.S. Department of Energy
P.O. Box 5400, MS-0184
Albuquerque, NM 87185-5400

Peter B. Davies
Director,
Nuclear Energy & Fuel Cycle Programs
P.O. Box 6200, MS-0721
Albuquerque, NM 87185

RE: RECLAMATION OF MIXED WASTE LANDFILL BORROW PIT, LETTER OF DECEMBER 9, 2013
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-MISC

Dear Mr. Beausoleil and Mr. Davies:

The New Mexico Environment Department (NMED) has received a cover letter and enclosure concerning the reclamation of the Mixed Waste Landfill (MWL) Borrow Pit submitted by the U.S. Department of Energy (DOE) on behalf of itself and Sandia Corporation (collectively, the Permittees). The subject borrow pit was used as a source of soil for construction of the MWL cover. NMED staff inspected the borrow pit reclamation work on June 4, 2014. The NMED considers the reclamation work to be complete and acceptable.

If you have any questions regarding this matter, please contact Mr. William Moats of my staff at (505) 222-9551. If necessary, you may also contact me by mail at the address shown in the letterhead of this correspondence.

Sincerely,

John E. Kieling
Chief
Hazardous Waste Bureau

cc: D. Cobrain, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE OB
L. King, EPA-6
J. Cochran, SNL/NM, MS-0719
J. Weckerle, SFO/ENG MS-0184

File: SNL 2014 and Reading

Volume III

Corrective Measures Implementation Report

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Volume III

TAB 12

Mixed Waste Landfill Corrective Measures Implementation Report,

January 2010

From: SNL/Wagner
To: NMED/Bearzi

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Notes for Volume III, Tab 12:

1. The "Mixed Waste Landfill Corrective Measures Implementation Report" included herein is Revision 1 of the report submitted to NMED on January 26, 2011. Revision 1 was part of the DOE/SNL response to comments that were received in the NMED Notice of Disapproval (NOD) dated May 20, 2011. The August 11, 2011 response to comment can be found in Justification Binder Volume III, Tab 17.

2. Due to the size of the report, only Appendix A, Volume 1 of the "Mixed Waste Landfill Corrective Measures Implementation Report" is included here with the main report. The remainder of the report "Appendix A, Volume 2, Corrective Measures Implementation Report Attachments", can be found in Justification Binder Volume IV, Tab 1.

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

ENTERED

JAN 26 2010

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

RECEIVED
JAN 2010
NMED Hazardous Waste Bureau

James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Bldg. 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

On behalf of the U. S. Department of Energy/National Nuclear Security Administration (DOE/NNSA), and Sandia Corporation (Sandia), DOE/NNSA is submitting the Mixed Waste Landfill (MWL) Corrective Measures Implementation (CMI) Report. The MWL CMI Report provides the data and documentation that demonstrate the deployment of the MWL alternative Evapotranspirative (ET) Cover that was performed in accordance with the requirements presented in the MWL Corrective Measures Implementation Plan (CMIP) Sandia National Laboratories/New Mexico (SNL/NM November 2005). Construction of the MWL ET Cover was completed on September 3, 2009. Consistent with the SNL/NM Resource Conservation and Recovery Act (RCRA) Permit, this CMI Report is being submitted for approval by the New Mexico Environment Department (NMED) within 180 days after implementation of the remedy.

Appendix A of the MWL CMI Report is the MWL Alternative Cover Construction Quality Assurance (CQA) Report, which is a two volume report prepared by the independent third-party CQA Contractor. The MWL Alternative Cover CQA Report is certified by a New Mexico registered Professional Engineer and provides all construction quality control and CQA data and documentation. Volume 1 contains tables, figures, as-built drawings, etc. Volume 2 of this report provides supporting documentation in the form of attachments and is provided electronically on a compact disc at the end of the report. A separately bound hard copy of Volume 2 is provided for the NMED Hazardous Waste Bureau document library as previously discussed with Mr. William Moats of your staff. Additional hardcopies of the MWL Alternative Cover CQA Report Volume 2 will be maintained at the DOE/Sandia Document Repository (Public Reading Room, Zimmerman Library at the University of New Mexico) and the SNL/NM Customer Funded Records Center, formerly known as the SNL/NM Environment, Safety & Health and Security Records Center.

Should you have any questions regarding this MWL CMI Report please contact me at (505) 845-6036, or Joe Estrada of my staff at (505) 845-5326.

Sincerely,

Kimberly A Davis for

Patty Wagner
Manager

Enclosures (2)

cc w/enclosure:
W. Moats, NMED-HWB (via Certified Mail)
L. King, EPA, Region 6 (via Certified Mail)
T. Skibitski, NMED-OB, MS-1396
B. Birch, NMED-OB, MS-1396
Zimmerman Library, UNM
SNL ES&H Records Center, SNL/NM, Org.6765, MS-0718

cc w/o enclosure:
T. Longo, NA-56, HQ/GTN
J. Lehr, NA-56, HQ/GTN
J. Gould, NNSA/SSO, MS-0184
C. Wimberly, NNSA/SSO, MS-0184
A. Blumberg, SNL/NM, Org. 11100, MS-0141
M. Walck, SNL/NM, Org 6700, MS-0701
S. Saltzstein, SNL/NM, Org 6702, MS-0701
D. Miller, SNL/NM, Org 6765, MS-0718
J. Cochran, SNL/NM, Org. 6765, MS-0719
D. Schofield, SNL/NM, Org. 4133, MS-1126
G. Peace, SNL.NM, Org. 1525, MS-0372
C. Daniel, SNL/NM, Org. 10677, MS-0718

AOP 95-45, 06

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Mixed Waste Landfill Corrective Measures Implementation Report, January 2010.**

Document author: **Mike Mitchell, Department 06765**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: Marianne C Walck 1-20-10

Marianne Walck, Director
Nuclear Energy & Global Security Technologies
Center 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: Kimberly A Davis 1/25/10

Ms. Patty Wagner, Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Sandia National Laboratories

Sandia National Laboratories/New Mexico Environmental Restoration Project

MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION REPORT

JANUARY 2010
Revision 1

United States Department of Energy
Sandia Site Office

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

EXECUTIVE SUMMARY

This document represents a revision to the January 2010 Mixed Waste Landfill Corrective Measures Implementation Report in response to the New Mexico Environment Department Notice of Disapproval dated May 20, 2011.

Sandia National Laboratories/New Mexico (SNL/NM) is located within the boundaries of Kirtland Air Force Base, immediately south of the city of Albuquerque in Bernalillo County, New Mexico. Sandia Corporation (Sandia), a wholly owned subsidiary of Lockheed Martin Corporation, manages and operates SNL/NM for the U.S. Department of Energy (DOE). Sandia performs research and development in support of various energy, weapons, and national security programs. It also performs work for the U.S. Department of Defense, the U.S. Nuclear Regulatory Commission, and other government agencies.

The Mixed Waste Landfill (MWL) is located 4 miles south of SNL/NM central facilities and 5 miles southeast of the Albuquerque International Sunport. The MWL is a fenced, 2.6-acre Solid Waste Management Unit in the north-central portion of Technical Area 3 that was a disposal area for low-level radioactive and minor amounts of mixed waste from March 1959 through December 1988. Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies of activity (in 1988) were disposed of in the MWL. The New Mexico Environment Department (NMED) is authorized by the U.S. Environmental Protection Agency to implement and enforce the corrective action requirements for the MWL.

In this MWL Corrective Measures Implementation (CMI) Report, the DOE and Sandia demonstrate that the deployment of the MWL alternative evapotranspirative (ET) cover (hereafter referred to as the ET Cover) was performed in accordance with the requirements, specifications, and design drawings presented in the MWL Corrective Measures Implementation Plan (CMIP) (SNL/NM November 2005). The MWL ET Cover was deployed from October 2006 through September 2009 and consists of four main layers: compacted subgrade, biointrusion barrier, compacted native soil, and topsoil. The Subgrade varies in thickness from 0 to 3.3 feet, and the combined average thickness of the overlying ET Cover layers (Biointrusion, Native Soil, and Topsoil Layers) is 5.37 feet. The overall footprint of the ET Cover is 4.1 acres including side slopes. The ET Cover was constructed with approximately 33,000 cubic yards of soil fill and 6,800 cubic yards of rock (in-place, compacted volumes) that meet CMIP specifications based upon 113 laboratory tests (Standard Proctor, Gradation, Classification, and Saturated Hydraulic Conductivity), 271 field tests (in-place density and moisture), and visual inspections. All MWL ET Cover construction activities were observed, inspected, and documented by an independent third-party Construction Quality Assurance (CQA) contractor.

This MWL CMI Report meets the requirements stipulated in the NMED Final Order In the Matter of Request for a Class 3 Permit Modification for Corrective Measures for the MWL (Final Order) (NMED May 2005); the CMIP (SNL/NM November 2005); the SNL/NM Resource Conservation and Recovery Act Permit (as modified for the MWL after the Final Order); the Compliance Order on Consent (NMED April 2004); and the NMED conditional approval for the MWL CMIP (Bearzi December 2008). The MWL Alternative Cover CQA Report (Appendix A of this CMI Report) is certified by a New Mexico-registered Professional Engineer and provides all construction quality control and CQA data and documentation required to verify that the MWL ET Cover meets NMED requirements and the specifications of the CMIP.

On May 26, 2005, the Secretary of the NMED selected a vegetative soil cover with a biointrusion barrier (i.e., the ET cover) as the remedy for the MWL. The remedy selection was documented in the NMED Final Order for the MWL (NMED May 2005) that also required submittal within 180 days of a CMIP incorporating the selected remedy. The MWL CMIP (SNL/NM November 2005) was submitted to the NMED in November 2005 and outlines the deployment of the MWL ET Cover (Chapter 2.0), the regulatory basis (Chapter 3.0), MWL characteristics (Chapter 4.0), the technical basis for the cover (Chapter 5.0), the MWL alternative cover design (Chapter 6.0), and cover performance monitoring (Chapter 7.0). Appendices include Construction Specifications (Appendix A), a CQA Plan (Appendix B), and other supporting documentation. The MWL CMIP was conditionally approved by the NMED in December 2008 (Bearzi December 2008), and all conditions related to construction of the MWL ET Cover were addressed and incorporated into the CMIP through replacement pages (Davis February 2009).

Deployment of the MWL alternative ET Cover was conducted in two main phases. During the first phase in 2006, MWL Borrow Pit and Subgrade construction activities were conducted in preparation for ET Cover construction. Soil fill material was excavated, screened to 2-inch minus, and stockpiled at the MWL Borrow Pit from June through July 2006. Following the NMED approval in September 2006, Subgrade construction was performed from October through December 2006, and protective measures installed on the completed Subgrade surface in April 2007. After NMED conditional approval of the CMIP in December 2008 (Bearzi December 2008), the MWL ET Cover was constructed during the second phase, which took place from May through September 2009.

The MWL Alternative Cover CQA Report (Appendix A) is the comprehensive report that documents all aspects of MWL ET Cover deployment and addresses all CMI Report data and documentation requirements. All ET Cover materials and layers were approved by the CQA Engineer as specified in the CQA Plan in Appendix B of the CMIP (SNL/NM November 2005) prior to starting construction of the next layer. All nonconformances and design changes were identified; documented; resolved in consultation between the Sandia Project Staff, the Construction Team, and the CQA Team; and approved by the CQA Engineer. The design changes were implemented and resulted in a thicker, more conservative and protective MWL ET Cover.

Longer-term aspects of site revegetation, monitoring and maintenance, and institutional controls will be addressed in a revised MWL Long-Term Monitoring and Maintenance Plan that will be prepared and submitted to the NMED within 180 days of approval of this MWL CMI Report.

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A Mixed Waste Landfill Alternative Cover Construction Quality Assurance Report, January 2010

Volume 1 – Main Text and Tabbed Sections
Volume 2 – Attachments (provided electronically on a CD at the end of the report)

Separately bound hard copies of Volume 2 are available in the NMED Hazardous Waste Bureau document library (Santa Fe, New Mexico); the DOE/Sandia document repository (Public Reading Room, Zimmerman Library at the University of New Mexico, Albuquerque, New Mexico); and the SNL/NM Customer Funded Records Center (formerly known as the ES&H and Security Records Center).

ACRONYMS AND ABBREVIATIONS

CMI	Corrective Measures Implementation
CMIP	Corrective Measures Implementation Plan
CMS	Corrective Measures Study
CQA	Construction Quality Assurance
CQC	Construction Quality Control
cy	cubic yard(s)
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ES&H	Environment, Safety, and Health
ET	Evapotranspirative
KAFB	Kirtland Air Force Base
LTMMP	Long-Term Monitoring and Maintenance Plan
MKM	MKM Engineers, Inc.
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
NOD	Notice of Disapproval
RCRA	Resource Conservation and Recovery Act
Sandia	Sandia Corporation
SNL/NM	Sandia National Laboratories/New Mexico
SWMU	Solid Waste Management Unit
TA	Technical Area
URS	URS Group, Inc.

1.0 INTRODUCTION

Sandia National Laboratories/New Mexico (SNL/NM) is located within the boundaries of Kirtland Air Force Base (KAFB), immediately south of the city of Albuquerque in Bernalillo County, New Mexico (Figure 1-1). SNL/NM includes five Technical Areas (TAs), designated 1 through 5, occupying approximately 2,842 acres. Additional SNL/NM remote test areas total approximately 12,200 acres located on KAFB and adjacent land withdrawn from the U.S. Forest Service. TA-1, TA-2, and TA-4 are separate research facilities in the northwestern portion of KAFB. TA-3 and TA-5 are contiguous research facilities forming a 4.5-square-mile, rectangular area in the southwestern portion of KAFB (Figure 1-2). TA-3 alone occupies 2,000 acres. The Mixed Waste Landfill (MWL) is a 2.6-acre, fenced Solid Waste Management Unit (SWMU) located in north-central TA-3 at SNL/NM (Figure 1-2).

Sandia Corporation (Sandia), a wholly owned subsidiary of Lockheed Martin Corporation, has a Management and Operating Contract with the U.S. Department of Energy (DOE) for SNL/NM. SNL/NM is owned by the DOE. Sandia performs research and development in support of various energy and weapons programs. It also performs work for the U.S. Department of Defense, the U.S. Nuclear Regulatory Commission, and other government agencies.

In this MWL Corrective Measures Implementation (CMI) Report, the DOE and Sandia demonstrate that the deployment of the MWL alternative Evapotranspirative (ET) Cover (hereafter referred to as the ET Cover) was performed in accordance with the requirements, specifications, and design drawings presented in the MWL Corrective Measure Implementation Plan (CMIP) (SNL/NM November 2005). The MWL CMIP was conditionally approved by the New Mexico Environment Department (NMED) in December 2008 (Bearzi December 2008), and all NMED conditions related to construction of the MWL ET Cover were addressed and incorporated into the CMIP through replacement pages (Davis February 2009).

The MWL ET Cover was deployed from October 2006 through September 2009 and consists of four main layers: compacted subgrade, biointrusion barrier, compacted native soil, and topsoil. The Subgrade varies in thickness from 0 to 3.3 feet, and the combined average thickness of the overlying ET Cover layers (Biointrusion, Native Soil, and Topsoil Layers) is 5.37 feet. The overall footprint of the ET Cover is 4.1 acres including side slopes. The ET Cover was constructed with approximately 33,000 cubic yards (cy) of soil fill and 6,800 cy of rock (in-place, compacted volumes) that meet CMIP specifications (SNL/NM November 2005) based upon 113 laboratory tests (Standard Proctor, Gradation, Classification, and Saturated Hydraulic Conductivity), 271 field tests (in-place density and moisture), and visual inspections. All MWL ET Cover construction activities were observed, inspected, and documented by an independent third-party Construction Quality Assurance (CQA) contractor.

The MWL Alternative Cover CQA Report is a stand-alone document prepared by the CQA contractor responsible for independent third-party oversight of MWL ET Cover deployment, and is incorporated as Appendix A of this CMI Report. The MWL Alternative Cover CQA Report contains all construction quality control (CQC) and CQA data and documentation required to provide a comprehensive, integrated report for the deployment of the MWL ET Cover. This stand-alone report verifies that the MWL ET Cover was installed in a manner that meets the CMIP specifications and requirements (SNL/NM November 2005) and is certified by a New Mexico-registered Professional Engineer.

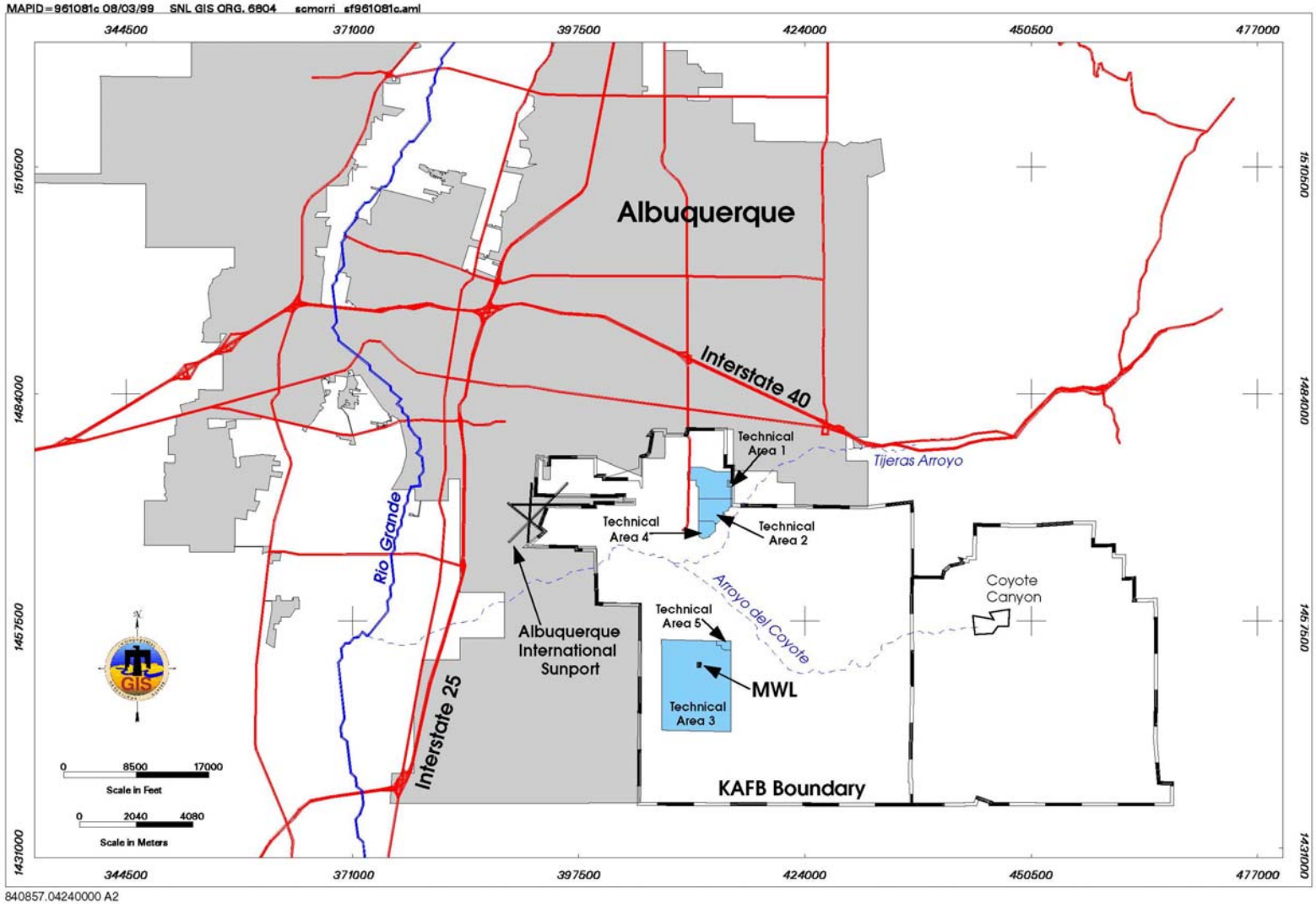

Figure 1-1
Location of Kirtland Air Force Base and Sandia National Laboratories, New Mexico

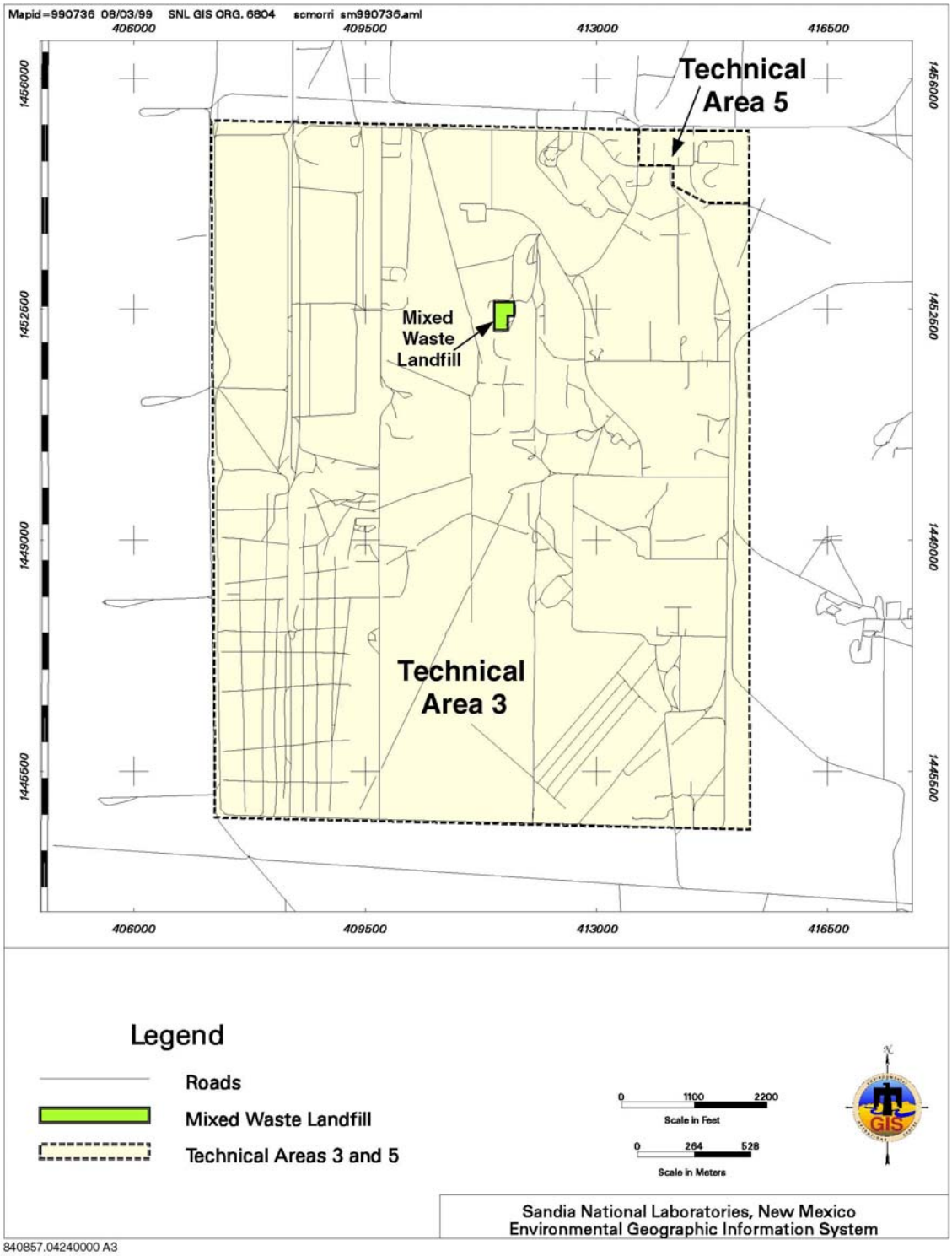

Figure 1-2
Location of Technical Areas 3 and 5 and the Mixed Waste Landfill

In this CMI Report, regulatory background information and a summary of ET Cover deployment are presented in Sections 1.2 and 1.3, respectively. All CMI Report data and documentation requirements defined in the NMED Final Order for the MWL (NMED May 2005); the CMIP (SNL/NM November 2005); the SNL/NM Resource Conservation and Recovery Act Permit (RCRA) Permit (as modified for the MWL after the Final Order); the Compliance Order on Consent (NMED April 2004); and the NMED conditional approval of the MWL CMIP (Bearzi December 2008) are presented in Chapter 2.0 (Sections 2.1 and 2.2). In addition, Sections 2.1 and 2.2 provide cross-walk information indicating where these requirements are addressed in the MWL Alternative Cover CQA Report (Appendix A). Section 2.3 briefly summarizes NMED oversight and DOE/Sandia quarterly progress reporting during ET Cover deployment, and a summary of the cover deployment safety program is provided in Section 2.4. Chapters 3.0 and 4.0 provide conclusions and references cited, respectively.

The MWL is located 4 miles south of SNL/NM central facilities and 5 miles southeast of Albuquerque International Sunport (Figure 1-1). The MWL is a fenced, 2.6-acre SWMU in the north-central portion of TA-3 that was a disposal area for low-level radioactive and minor amounts of mixed waste generated by SNL/NM research facilities from March 1959 through December 1988. Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies of activity (in 1988) were disposed of in the MWL.

The MWL consists of two distinct disposal areas. The classified area occupies 0.6 acres and the unclassified area occupies 2.0 acres (Figure 1-3). Low-level radioactive and minor amounts of mixed waste were disposed of in each of these areas. Classified wastes were buried in unlined, cylindrical pits in the classified area. Unclassified wastes were buried in shallow, unlined trenches in the unclassified area. The MWL is designated as an Underground Radioactive Materials Area under DOE requirements and a Hazardous and Solid Waste Amendments SWMU subject to NMED corrective action regulations as delegated by the U.S. Environmental Protection Agency (EPA). The NMED is authorized by the EPA to implement and enforce the corrective action requirements for the MWL.

1.1 Purpose and Scope

The purpose of this MWL CMI Report is to provide the required data and documentation to demonstrate that the deployment of the MWL ET Cover was performed in accordance with the construction and design specifications detailed in the MWL CMIP (SNL/NM November 2005). The scope includes all required CQC and CQA documentation to provide a comprehensive, integrated report for the deployment of the MWL ET Cover. This CMI Report presents background information, regulatory requirements, and conclusions; the required CQC and CQA data and documentation are provided in the stand-alone MWL Alternative Cover CQA Report incorporated as Appendix A. Chapter 2.0 presents more specific information regarding data and documentation requirements and how these are addressed in the MWL Alternative Cover CQA Report (Appendix A).

1.2 Regulatory Background

On October 11, 2001, the NMED directed the DOE and Sandia to conduct a Corrective Measures Study (CMS) for the MWL. The MWL CMS Report was submitted to the NMED on

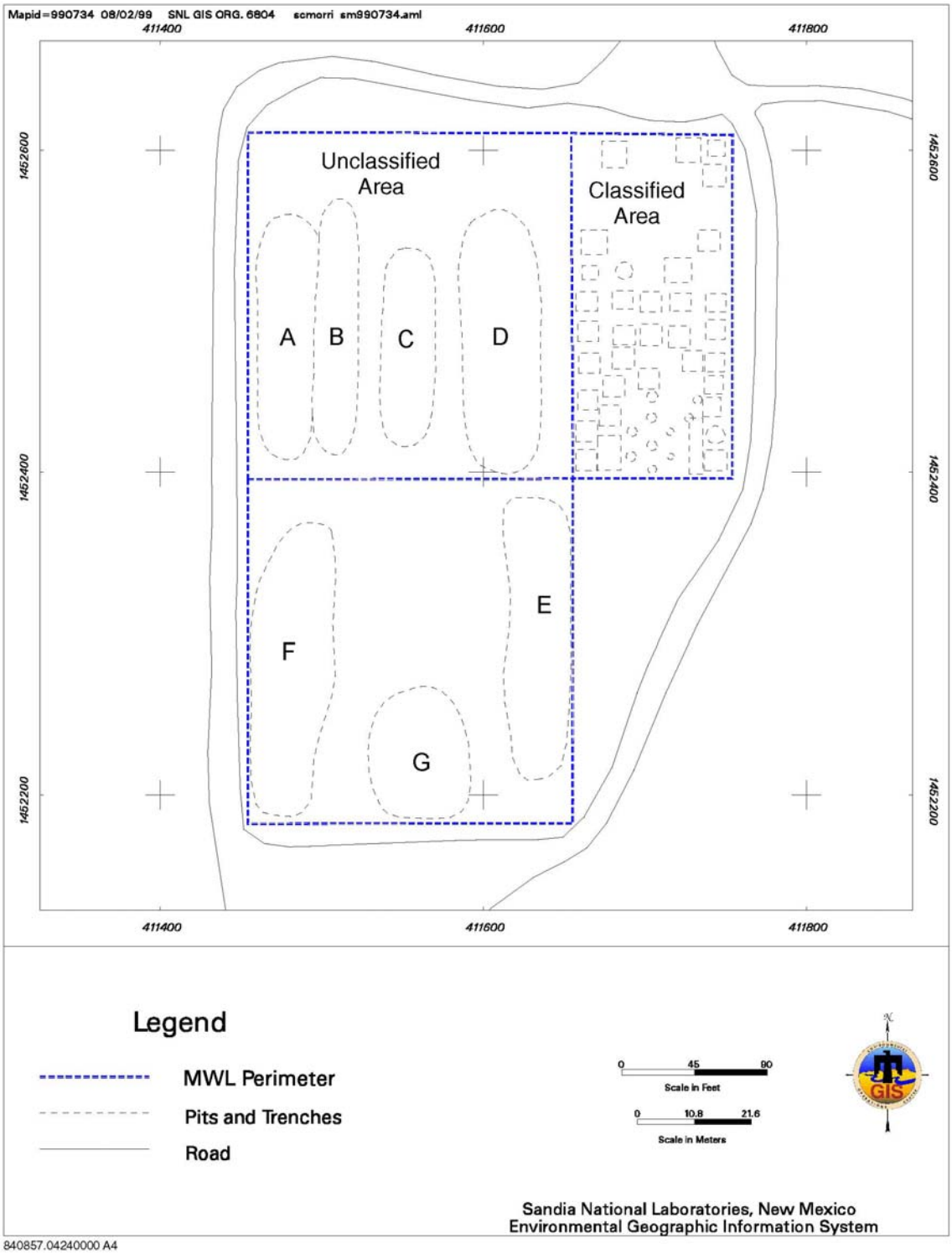

Figure 1-3
Map of the Mixed Waste Landfill

May 21, 2003, for technical review and comment (SNL/NM May 2003). The purpose of the CMS was to identify, develop, and evaluate corrective measures alternatives and recommend the corrective measure(s) to be taken at the MWL. Based upon detailed evaluation and risk assessment using guidance provided by the EPA and NMED, the DOE and Sandia recommended that an alternative vegetative soil cover (i.e., ET Cover) be deployed as the preferred corrective measure for the MWL.

The NMED held a public comment period on the MWL CMS from August 11 to December 9, 2004. A public hearing was held for the MWL CMS from December 2 to December 3 and December 8 to December 9, 2004. On May 26, 2005, the Secretary of the NMED selected a vegetative soil cover with a biointrusion barrier as the remedy for the MWL. The selection was based upon the administrative record, including the Hearing Officer's report, and was documented in the NMED Final Order In the Matter of Request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill (Final Order) (NMED May 2005). The Secretary requested that a CMIP incorporating the selected remedy be developed within 180 days following the selection of the remedy. The draft permit modification issued by the NMED in the matter prior to the hearing was revised by the NMED in accordance with the Secretary's final decision.

The MWL CMIP (SNL/NM November 2005) was submitted to the NMED in November 2005 and incorporates the remedy selected by the NMED. The CMIP outlines the deployment of the ET Cover (Chapter 2.0), the regulatory basis (Chapter 3.0), MWL characteristics (Chapter 4.0), the technical basis for the cover (Chapter 5.0), the MWL alternative cover design (Chapter 6.0), and cover performance monitoring (Chapter 7.0). Appendices include Construction Specifications (Appendix A), a CQA Plan (Appendix B), identification and qualifications of key persons implementing the remedy (Appendix C), a health and safety plan (Appendix D), and a comprehensive fate and transport model with triggers for monitoring (Appendix E).

In September 2006, approval to proceed with MWL security fence removal and Subgrade construction was received from the NMED (Bearzi September 2006). The NMED issued the first of two Notices of Disapproval (NODs) on the CMIP in November 2006 (Bearzi November 2006). Sandia responded to the first NOD in two parts (Wagner December 2006 and January 2007). The majority of the second NOD comments (Bearzi October 2008) were holdover issues from the first NOD. The response to the second NOD (Davis November 2008) resolved these remaining comments, and the CMIP was conditionally approved by the NMED (Bearzi December 2008). Comments related to construction of the ET Cover were incorporated into the CMIP through replacement pages that were submitted to the NMED (Davis February 2009). The MWL ET Cover construction began in May 2009 after the NMED was notified of the start of ET Cover construction fieldwork on April 10, 2009 (Davis April 2009).

1.3 Mixed Waste Landfill Evapotranspirative Cover Deployment Summary

Deployment of the MWL ET Cover was conducted during two main construction phases consisting of the 2006 Subgrade Construction and the 2009 ET Cover Construction. The MWL Alternative Cover CQA Report (Appendix A) documents both phases of ET Cover deployment.

In preparation for the ET Cover Construction phase, rock needed to construct the Biointrusion Layer was selected and delivered to the Bulk Waste Staging Area in TA-3. Approximately 6,000 cy of crushed, angular rock were delivered from October 4 through November 14, 2005. From June 14 through July 17, 2006, Storm Water Pollution Prevention Plan surface water and site controls were implemented at the MWL Borrow Pit in TA-3, and soil fill material needed for construction of the Subgrade and ET Cover layers was excavated, screened to 2-inch minus, and stockpiled following the specifications provided in the CMIP (SNL/NM November 2005). Screened soil fill was hauled and stockpiled at the MWL for the Subgrade Construction phase from July 31 through November 5, 2006.

After receiving NMED approval (Bearzi September 2006), the Subgrade Construction phase began on October 2, 2006, and was completed on April 11, 2007. This phase involved preparation of the existing MWL surface, construction of the Subgrade, and installation of protective measures on the completed Subgrade surface. Subgrade construction was performed from October 2 through December 21, 2006, and measures to protect the completed Subgrade surface while awaiting final NMED approval of the CMIP (SNL/NM November 2005) were completed on April 11, 2007 (i.e., installation of erosion control straw mats). The ET Cover Construction phase was performed from May 20 to September 3, 2009, and involved the construction of the ET Cover layers (Biointrusion, Native Soil, and Topsoil Layers), revegetation of the Topsoil Layer, and installation of the final administrative security fence around the perimeter of the MWL. Third-party CQA services were provided by MKM Engineers, Inc. (MKM) during the 2006 Subgrade Construction phase (under subcontract to URS Group, Inc. [URS]), and by URS during the 2009 ET Cover Construction phase.

The completed ET Cover is shown schematically in Figure 1-4. The Subgrade varies in thickness from 0 to 3.3 feet and is the base layer that established the broad, central crown and 2-percent east-to-west surface design slope. The combined average thickness of the overlying ET Cover layers (Biointrusion, Native Soil, and Topsoil Layers) is 5.37 feet, which is 1.2 feet thicker than the minimum specifications provided in the CMIP (SNL/NM November 2005). The ET Cover overlies the 2.6-acre disposal area, with an overall footprint of 4.1 acres including side slopes. The Subgrade and ET Cover layers were constructed with approximately 33,000 cy of soil fill and 6,800 cy of rock (in-place, compacted volumes) that meet CMIP specifications based upon 113 laboratory tests (Standard Proctor, Gradation, Classification, and Saturated Hydraulic Conductivity), 271 field tests (in-place density and moisture), and visual inspections. The approximate in-place compacted soil and rock volumes for each component of the ET Cover are as follows:

- Subgrade (soil) – 7,700 cy
- Biointrusion Layer (rock) – 6,800 cy
- Biointrusion Layer void space and thin overlying soil layer (soil) – 2,600 cy
- Native Soil Layer (soil) – 17,300 cy
- Topsoil Layer (soil) – 5,400 cy

All MWL ET Cover construction activities were observed, inspected, and documented by an independent third-party CQA contractor.

A Subgrade CQA Report was prepared as a draft in 2007 by MKM and included certification by the CQA Engineer that the Subgrade Construction conformed to the CMIP construction and design specifications (SNL/NM November 2005). This draft report was completed in August 2007 (MKM August 2007) and updated in 2009 and 2010 to incorporate the ET Cover

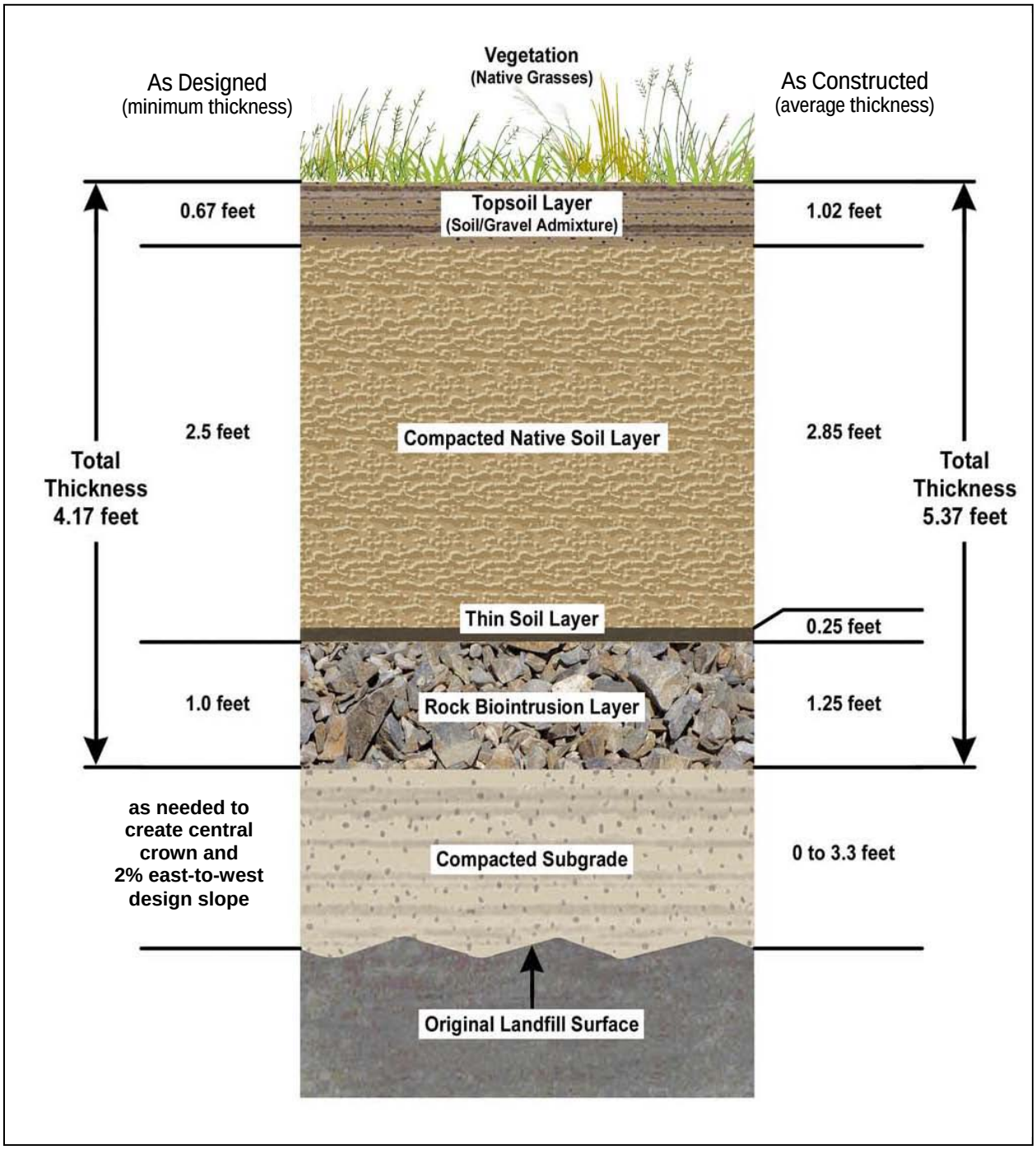

Figure 1-4
Schematic Diagram of the Mixed Waste Landfill Alternative Evapotranspirative Cover

Construction phase CQA and CQC information. The resulting MWL Alternative Cover CQA Report (Appendix A) integrates NMED requirements, including a detailed summary of the construction activities, laboratory and field testing results, land surveying results, as-built drawings, quality assurance verification survey plates, a photographic record of the construction activities, and other CQA documentation (i.e., meetings, daily reports, inspection forms, and data and cover layer approvals).

For both the 2006 and 2009 construction phases, a representative of the CQA Team was at the construction site each workday to inspect and oversee construction activities, laboratory and field testing, and land surveying. The CQA inspections and oversight are documented in daily reports, inspection checklists/forms, and approval forms provided in the MWL Alternative Cover CQA Report (Appendix A). All ET Cover layers were approved by the CQA Engineer as stipulated by the CQA Plan in Appendix B of the CMIP (SNL/NM November 2005) prior to starting construction of the next layer. All nonconformances and design changes were identified, documented, and resolved in consultation between the Sandia Project Staff, the Construction Team, and the CQA Team. Overall, the design changes resulted in a thicker, more protective ET Cover and there were no adverse impacts to ET Cover quality as a result of the nonconformances and design changes.

2.0 ALTERNATIVE COVER DOCUMENTATION

All required MWL ET cover deployment data and documentation are provided in the MWL Alternative Cover CQA Report (Appendix A). Section 2.1 presents an overview of MWL CMI Report data and documentation requirements as defined in various regulatory source documents. More specific information on data and documentation requirements as detailed in the CMIP (SNL/NM November 2005), and how CQC and CQA data are delineated for each phase of ET Cover construction (2006 Subgrade and 2009 ET Cover Construction), is presented in Section 2.2. The location of required CQC and CQA data and documentation in the MWL Alternative Cover CQA Report (Appendix A) is provided in the cross-walk tables presented in Sections 2.1 and 2.2. Section 2.3 provides information on regulatory oversight and quarterly reporting. Section 2.4 briefly summarizes the ET Cover deployment health and safety program.

2.1 Requirements Cross-Walk

The NMED Final Order for the MWL (NMED May 2005) required the submittal of this MWL CMI Report within 180 days after completion of the MWL ET Cover. Data and documentation requirements for this MWL CMI Report are defined in the NMED-approved CMIP (SNL/NM November 2005); the SNL/NM RCRA Permit (as modified for the MWL after the Final Order); the NMED conditional approval of the MWL CMIP (Bearzi December 2008); and the Compliance Order on Consent (NMED April 2004). Table 2-1 lists the requirements for the MWL CMI Report as compiled from these source documents and provides the location where the related information can be found in the MWL Alternative Cover CQA Report (Appendix A).

The MWL CMI Report requirements are divided into two broad categories: data and documentation. Data requirements include both CQC (data collected to verify ET Cover construction meets CMIP construction and design specifications) and CQA (data collected to verify the CQC data, if required). Both data and documentation requirements are more specifically defined in the NMED-approved CMIP (SNL/NM November 2005) and in Section 2.2, which also provides cross-walk tables mapping the locations where each requirement is addressed in the MWL Alternative Cover CQA Report (Appendix A).

2.2 Data and Documentation Requirements

As part of the MWL Subgrade Construction and ET Cover deployment, CQC data were collected to verify that construction and design specifications provided in the CMIP (SNL/NM November 2005) were met. CQA documentation was collected to establish and verify construction methods and processes, as well as CQC and CQA data collection procedures and field and laboratory testing methods. All data and documentation requirements are defined in the Construction Specifications in Appendix A and CQA Plan in Appendix B of the CMIP (SNL/NM November 2005).

During the 2006 Subgrade Construction phase, the CQA Team was responsible for all CQC data and CQA documentation requirements. CQA Team personnel either performed or coordinated all CQC laboratory sampling and testing, field testing, and land surveying. They also provided oversight and documentation of all construction activities and prepared a Draft

Table 2-1
MWL CMI Report Requirements Cross-Walk Table

Requirement	Comment/Location in CQA Report Appendix A
CMIP Appendix B, Construction Quality Assurance Plan (SNL/NM November 2005)	
Quality control data generated by the construction contractor	Described in Sections 2.4, 2.5, 2.7, and 4.3–4.5; data presented in Tables 5–10, 12, 13, and Attachment 7
Quality assurance data generated by the CQA contractor	Described in Sections 2.5, 2.6, 2.7, and 4.1–4.5; see below for information regarding specific CQA documentation and data
Daily summary reports	Section 4.1 and Attachment 3
Inspection checklists	Section 4.2 and Attachments 4–6
Nonconformance and corrective action reports	There were no nonconformances – all design changes are documented in Chapter 7.0 and Table 14
Field test results (in-place density and moisture tests)	Section 4.3.2 and Table 11 and Attachment 7
Laboratory test results (Standard Proctor, Gradation, Classification, and Saturated Hydraulic Conductivity)	Section 4.3.1 and Tables 4–8, and Attachment 7 (CQC data collected and/or overseen by CQA Contractor)
Photographs and photograph logbook	Section 4.5; Photographic logs included in tabbed section at end of report
As-built drawings	Section 4.4; As-built drawings included in tabbed section at end of report
Internal CQA memoranda or reports with data interpretation or analysis	Chapter 3.0; Quality Resolution Meeting minutes in Attachment 1; data submittals and Cover Layer Approval Forms in Attachment 2
Design changes	Chapter 7.0, Table 14
SNL/NM Part B Permit, Section V, Corrective Measures for the Mixed Waste Landfill	
A summary of the work completed	Chapter 5.0
A statement signed by a registered professional engineer, that the remedy has been completed in full satisfaction of the specifications in the CMIP	Chapter 9.0
As-built drawings and specifications signed and stamped by a registered professional engineer	As-built drawings included in tabbed sections at end of report
Copies of the results of all monitoring, including sampling and analysis, and other data generated during the remedy implementation, if not already submitted in a progress report	Chapter 4.0, Tables 4–12, and Attachment 7
A certification, signed by a responsible Permittee official stating: "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations"	Included as part of formal submittal package to NMED
SNL/NM Compliance Order On Consent, Section VII (NMED April 2004)	
Items 1, 2, 3, 4, and 6 are identical to requirements of the Part B Permit presented above.	
5. Copies of all waste disposal records, if not already submitted in a progress report	The only waste disposal records associated with cover construction were presented in the MWL Quarterly Progress Report, May–July, 2009 (SNL/NM September 2009)

CMI Corrective Measures Implementation
CMIP Corrective Measures Implementation Plan
CQA Construction Quality Assurance
MWL Mixed Waste Landfill
NMED New Mexico Environment Department
SNL/NM Sandia National Laboratories/New Mexico

CQA Subgrade Report (MKM August 2007) according to the requirements of the CQA Plan presented in Appendix B of the CMIP (SNL/NM November 2005) to document the effort.

For the 2009 ET Cover Construction phase, the Construction Team was responsible for all required CQC laboratory sampling and field testing, as well as land surveying. Independent CQA field testing and surveying were performed under the direction of the CQA Team to verify CQC results. CQA field testing was performed at approximately 50 percent of the locations tested by the Construction Team. Independent CQA surveys were conducted on the surface of each ET Cover layer (Biointrusion, Native Soil, and Topsoil Layers). CQA Team personnel also conducted oversight of all construction activities, including CQC laboratory sampling, field testing, and surveying, and were responsible for all project documentation, including preparation of the MWL Alternative Cover CQA Report (Appendix A). Detailed information for data and documentation requirements are provided in the following sections.

2.2.1 Data Requirements

Data requirements defined in the CMIP include laboratory testing, field testing, and surveying results. Laboratory and field testing were performed to verify that the materials used met specifications and that the existing surface (pre-Subgrade Construction MWL site surface), Subgrade, and ET Cover layers met the construction and design specifications (i.e., compaction, thickness, and slope) provided in the CMIP (SNL/NM November 2005). Laboratory testing included Standard Proctor, Gradation, Classification, and Saturated Hydraulic Conductivity analyses of fill material soil samples. Field testing consisted of in-place density and moisture testing of the fill material after installation and compaction. The frequency and methods for laboratory and field testing are addressed in the CMIP Construction Specifications, Appendix A, Specification 02200 (*Earthwork)*, Table 3.1 (SNL/NM November 2005). Land surveys were performed to guide and control the construction process and to verify that the Subgrade and ET Cover layers met CMIP design specifications (i.e., thickness and slope specifications). Surveying specifications are addressed in the CMIP Construction Specifications, Appendix A, Specification 02210 (*Grades, Lines, and Levels)* and in the CMIP design drawings (SNL/NM November 2005).

Table 2-2 lists the data requirements and provides specific information regarding where these are addressed in the MWL Alternative Cover CQA Report (Appendix A). Both CQC and CQA data are delineated in the center columns, which provide references to sections of the report, tables, tabbed sections at the end of the report, and attachments that specifically address each data requirement. Additional information is provided in the comment column on the far right-hand side of the table.

2.2.2 Documentation Requirements

Documentation requirements defined in the CMIP include daily reports of construction activities; equipment used; materials receiving, construction, and testing/inspection checklists/forms; backup laboratory documentation for laboratory and field testing; as-built drawings; and photographic records (SNL/NM November 2005). In addition, for the 2009 ET Cover Construction phase, all laboratory and field testing CQC data were approved by the CQA Engineer through a formal submittal process, and each ET Cover layer was approved through Quality Resolution Meetings documented on Cover Layer Approval Forms (documentation was

Table 2-2
MWL CMI Report Requirements – Data Requirements Summary and Cross-Walk

Data Requirement	Location in the MWL Alternative Cover CQA Report (Appendix A)		Comments
	CQA Data	CQC Data	
Laboratory Testing Data Standard Proctor (ASTM D698)	NA	Described in Section 4.3.1 Results in Tables 4–5	For 2006 Subgrade Construction phase, all CQC laboratory testing was performed by the CQA Team. For 2009 ET Cover Construction phase, all laboratory testing was performed by the Construction Team, with oversight by the CQA Team.
Laboratory Testing Data Gradation (ASTM C136) and Classification (ASTM D2487 and D4318)	NA	Described in Section 4.3.1 Results in Table 4 (4th column), Tables 6–7, and Attachment 7	For 2006 Subgrade Construction phase, all CQC laboratory testing was performed by the CQA Team. For 2009 ET Cover Construction phase, all laboratory testing was performed by the Construction Team with oversight by the CQA Team.
Laboratory Testing Data Saturated Hydraulic Conductivity (ASTM D5856-95 [2007])	NA	Described in Section 4.3.1 Results in Table 8	Saturated Hydraulic Conductivity testing was only required for the Native Soil Layer. CQC testing was performed by the Construction Team with oversight by the CQA Team.
Field Testing Data In-place density and moisture (ASTM D2922 and D3017)	CQA field testing for 2009 Subgrade surface and Native Soil Layer only Described in Section 4.3.2 Results in Table 11	Described in Section 4.3.2 Results in Tables 9–10	For 2006 Subgrade Construction phase, all CQC field testing was performed by the CQA Team. For 2009 ET Cover Construction phase, field testing was performed by the Construction Team and the CQA Team. CQA testing was performed at approximately 50% of the locations tested by the Construction Team.
Land Survey Data	Described in Sections 2.5 and 4.4 Only 2009 CQA verification surveys considered CQA data – results in QA Verification Plates in tabbed section at end of report	Described in Sections 2.5 and 4.4 2006 results in Subgrade As-Built Drawing 2009 results in Table 12 and 2009 As-Built Drawings All As-Built Drawings in tabbed section at end of report	For 2006 Subgrade Construction phase, all surveying was for CQC, performed by CQA Team, and documented in the 2006 Subgrade As-Built Drawing. For 2009 ET Cover Construction phase, the Construction Team performed CQC surveying and the CQA Team performed CQA verification surveys on the surface of each cover layer to confirm and support the CQC surveys. CQA surveys are documented in QA Verification Plates in tabbed section at end of report.

ASTM American Society for Testing and Materials (ASTM International)
CMI Corrective Measures Implementation
CQA Construction Quality Assurance
CQC Construction Quality Control
ET Evapotranspirative
MWL Mixed Waste Landfill
NA Not applicable
QA Quality assurance

prepared for both the Quality Resolution Meetings and the Cover Layer Approval, the latter on project-specific approval forms).

Table 2-3 lists the documentation requirements and provides specific information regarding where they are addressed in the MWL Alternative Cover CQA Report (Appendix A). Documentation for CQC and CQA are delineated in the center columns, which provide references to sections of the report, tables, tabbed sections at the end of the report, and attachments that specifically address each documentation requirement. Additional information is provided in the comment column on the far right-hand side of the table.

2.3 Regulatory Oversight Quarterly Reporting

NMED personnel visited the MWL ET Cover construction site on three occasions during ET Cover deployment in 2009. On June 26, 2009, NMED representatives visited the site and received a briefing on cover activities completed to date. On July 8, 2009, William Moats and Bill McDonald of the NMED conducted a site inspection of both the ET Cover and the MWL Borrow Pit Area operations. During this NMED inspection, a review of laboratory and field-testing data was conducted, as well as a complete walk-down of ongoing site activities at the MWL (Native Soil Layer installation) and Borrow Pit (soil excavation, screening, stockpiling, loading, hauling, and Pug Mill operations to blend topsoil fill with 3/8-inch gravel). On August 6, 2009, NMED personnel also visited the MWL ET Cover construction site to oversee the installation of the two soil-vapor monitoring wells.

In accordance with the SNL/NM RCRA Permit and Compliance Order on Consent requirements, quarterly progress reports were submitted to the NMED during the construction period (e.g., SNL/NM September 2009). Periodic updates, including photographs of construction activities, were also provided to the NMED during the construction period.

2.4 Cover Deployment Health and Safety Program

The MWL ET Cover was constructed without a single loss-time injury or accident resulting in property damage. There were two minor incidents during June 2009 that involved small amounts of spilled diesel fuel or hydraulic oil. In both cases the spill occurred on the site perimeter (i.e., no spills occurred on the ET Cover or side slopes) and involved very small quantities of material (less than 1 quart of diesel fuel and 2 to 3 gallons of hydraulic oil). Site personnel immediately recognized the problem, took corrective action to stop the spill, and then cleaned up the affected area. All contaminated soil related to the spills was placed into two 55-gallon drums for disposal (one drum for each spill). One plastic bag of absorbent materials was also generated as part of the hydraulic oil spill on June 30, 2009. All resulting waste was New Mexico Special Waste and disposed of through the SNL/NM Hazardous Waste Management Facility. For each minor incident, Incident Reports were completed, and final waste disposition documentation was provided to the NMED as required in the MWL Cover Construction Quarterly Progress Report, May–July 2009 (SNL/NM September 2009).

Table 2-3
MWL CMI Report Requirements – Documentation Requirements Summary and Cross-Walk

Documentation Requirement	Location in the MWL Alternative Cover CQA Report (Appendix A)		Comments
	CQA Data	CQC Data	
Daily reports of construction activities	Described in Section 4.1 Reports in Attachment 3	NA	Daily Reports were the responsibility of the CQA Team. For 2009 ET Cover Construction phase, daily reports were completed by the Construction Team but not included in the CQA Report.
Documentation of equipment used	Described in Chapter 5.0, Table 13, and Daily Reports See comments for additional information	NA	Documentation of equipment used for the 2006 Subgrade Construction phase is documented in Daily Reports (Attachment 3) and Section 5.2.1. For 2009 ET Cover Construction phase, equipment used is documented in Daily Reports and Table 13, and described in Sections 5.2.2, 5.3.2, 5.3.3, 5.4, 5.5, and 5.6.
Inspection checklists/forms[1]	Described in Section 4.2 Forms in Attachments 4-6	NA	Receiving, Construction, and Testing Inspection Forms and related documentation were completed by the CQA Team.
Supporting documentation for laboratory and field testing[1]	Described in Section 4.3 Supporting documentation in Attachment 7	Described in Section 4.3 Supporting documentation in Attachment 7	Supporting documentation for all 2006 Subgrade and 2009 ET Cover laboratory and field testing is included in Attachment 7 and represents CQA documentation. See Table 2-2 for additional information on CQA and CQC laboratory and field testing.
As-Built Drawings	Described in Sections 2.5 and 4.4	Described in Section 2.5 and 4.4 Results in Table 12 and 2006 Subgrade As-Built Drawing and 2009 As-Built Drawings in tabbed section at end of report	For 2006 Subgrade Construction phase, all surveying was for CQC and documented in the 2006 Subgrade As-Built Drawing. For 2009 ET Cover Construction phase, the Construction Team performed all required field control and final surveying and prepared the final as-built drawings. The 2009 as-built drawings are complete, final drawings documenting the MWL ET Cover. See Table 2-2, "Land Survey Data," for more information.
Photographic records	Described in Section 4.5	NA	Photographic Logs for both 2006 and 2009 phases included in a tabbed section at end of the CQA Report.
CQA Engineer Approval of all Cover Layers, Design Changes, and Final Construction	Described in Sections 3.4, Chapters 7 and 9, and Tables 3 and 14	NA	Table 3 documents approval of all Cover Layers. Chapter 7.0 and Table 14 document all nonconformances and design changes. Attachment 2 provides approval documentation. MWL ET Cover construction is certified by a New Mexico-registered Professional Engineer in Chapter 9.0.

[1] All construction materials and the completed Subgrade and ET Cover Layers were approved by the CQA Engineer as documented in Section 3.4, Chapter 7.0, and Table 3; with supporting documentation in Attachments 1, 2, and 7.

CMI Corrective Measures Implementation
CQA Construction Quality Assurance
CQC Construction Quality Control
ET Evaporatranspirative
MWL Mixed Waste Landfill
NA Not applicable

3.0 CONCLUSIONS

This CMI Report for the MWL meets all requirements stipulated in the NMED Final Order for the MWL (NMED May 2005); the CMIP (SNL/NM November 2005); the SNL/NM RCRA Permit (as modified for the MWL after the Final Order); the Compliance Order on Consent (NMED April 2004); and the NMED conditional approval for the MWL CMIP (Bearzi December 2008). All required CQC and CQA data and documentation have been included in the MWL Alternative Cover CQA Report, incorporated as Appendix A of this CMI Report, to provide a comprehensive, integrated report for the deployment of the MWL ET Cover. The information contained in the MWL Alternative Cover CQA Report is certified by a New Mexico-registered Professional Engineer and verifies that the MWL existing surface, Subgrade, and ET Cover layers (Biointrusion, Native Soil, and Topsoil Layers) were prepared and installed in a manner that meets the CMIP construction and design specifications.

Longer-term aspects of site revegetation, monitoring, maintenance, and institutional controls will be addressed in a revised MWL Long-Term Monitoring and Maintenance Plan (LTMMP) that will be prepared and submitted to the NMED within 180 days of approval of this CMI Report. The MWL LTMMP that the DOE and Sandia submitted to the NMED in September 2007 (SNL/NM September 2007) will be revised to incorporate changes requested by the NMED as part of the CMIP NOD process (Bearzi November 2006 and October 2008).

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APPENDIX A

Mixed Waste Landfill Alternative Cover Construction Quality Assurance Report January 2010 Revision 1

Volume 1 Main Text and Tabbed Sections

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Mixed Waste Landfill
Alternative Cover Construction
Quality Assurance Report

Submitted to

Sandia National Laboratories
P.O. Box 5800
Albuquerque, NM 87185

January 2010

Revision 1

Submitted by

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MIXED WASTE LANDFILL
ALTERNATIVE COVER
CONSTRUCTION QUALITY ASSURANCE REPORT

JANUARY 2010
Revision 1

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2006 Subgrade As-Built Drawing (11 x 17 Drawing)

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Appendix A – MWL Alternative Cover CQA Report – Volume 2

Separately bound hard copies of the attachments in Volume 2 are available in the NMED Hazardous Waste Bureau document library (Santa Fe, New Mexico); the DOE/Sandia document repository (Public Reading Room, Zimmerman Library at the University of New Mexico, Albuquerque, New Mexico); and the SNL/NM Customer Funded Records Center (formerly known as the ES&H and Security Records Center).

List of Attachments

(provided electronically on a CD at the end of the report)

Attachment	***Title***
1	Record of Meetings and Approvals
	2006 Meetings
	2009 Meetings
2	CQA Submittals and Approvals
	2009 QA Submittal Cover Pages
	2009 Cover Layer Approval Forms
3	Daily Quality Control Reports
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8	Summary Report for the Extension of Monitoring Well MWL-MW4 at the Mixed Waste Landfill

End of Appendix A – MWL Alternative Cover CQA Report – Volume 2

List of Abbreviations/Acronyms

AMEC	AMEC Earth and Environmental, Inc.
ASTM	American Society for Testing and Materials (ASTM International)
CD	compact disc
CMI	Corrective Measures Implementation
CMIP	Corrective Measures Implementation Plan
cm/s	centimeter(s) per second
CQA	Construction Quality Assurance
CQC	Construction Quality Control
cy	cubic yard(s)
DOE	U.S. Department of Energy
EDi	Environmental Dimensions, Inc.
EPA	U.S. Environmental Protection Agency
ES&H	Environment, Safety, and Health
ET	Evapotranspirative
IR	Ingersoll-Rand
JD	John Deere
KAFB	Kirtland Air Force Base
LTMMP	Long-Term Monitoring and Maintenance Plan
MKM	MKM Engineers, Inc.
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
Sandia	Sandia Corporation
SCR	Sandia Construction Representative
Shaw	Shaw Environmental, Inc.
SNL/NM	Sandia National Laboratories/New Mexico
SWPPP	Storm Water Pollution Prevention Plan
TA	Technical Area
URS	URS Group, Inc.

Executive Summary

This document represents a revision to the January 2010 Mixed Waste Landfill Alternative Cover Construction Quality Assurance Report in response to the New Mexico Environment Department Notice of Disapproval dated May 20, 2011.

Sandia National Laboratories/New Mexico (SNL/NM) is located within the boundaries of Kirtland Air Force Base (KAFB), immediately south of the city of Albuquerque in Bernalillo County, New Mexico. SNL/NM is owned by the U.S. Department of Energy (DOE) and managed and operated by Sandia Corporation (Sandia), a wholly owned subsidiary of Lockheed Martin Corporation. Sandia performs research and development in support of various energy, weapons, and national security programs. Sandia also performs work for the U.S. Department of Defense, the U.S. Nuclear Regulatory Commission, and other government agencies.

The Mixed Waste Landfill (MWL) at SNL/NM is designated as an Underground Radioactive Materials Area under DOE requirements and a Hazardous and Solid Waste Amendments Solid Waste Management Unit subject to New Mexico Environment Department (NMED) corrective action regulations as delegated by the U.S. Environmental Protection Agency (EPA). The NMED is authorized by the EPA to implement and enforce the corrective action requirements for the MWL. The MWL is located within the boundaries of KAFB on federal land controlled by the DOE. The MWL consists of two distinct disposal areas; the classified area in the northeast portion occupies 0.6 acres and the unclassified area occupies 2.0 acres. Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies of activity (at the time of disposal) were disposed of in the MWL from March 1959 through December 1988.

The MWL alternative evapotranspirative (ET) cover (hereafter referred to as the ET Cover) was deployed from October 2006 through September 2009 and consists of four main layers: compacted subgrade, biointrusion barrier, compacted native soil, and topsoil (Figure ES-1). The Subgrade varies in thickness from 0 to 3.3 feet, and the combined average thickness of the overlying ET Cover layers (Biointrusion, Native Soil, and Topsoil Layers) is 5.37 feet. The overall footprint of the ET Cover is 4.1 acres including side slopes. The ET Cover was constructed with approximately 33,000 cubic yards (cy) of soil fill and 6,800 cy of rock (in-place, compacted volumes) that meet the specifications provided in the MWL Corrective Measures Implementation Plan (CMIP) (SNL/NM, November 2005) based upon 113 laboratory tests (Standard Proctor, Gradation, Classification, and Saturated Hydraulic Conductivity), 271 field tests (in-place density and moisture), and visual inspections. All MWL ET Cover construction activities were observed, inspected, and documented by an independent third-party Construction Quality Assurance (CQA) contractor.

This MWL Alternative Cover CQA Report documents the implementation of the MWL CMIP (SNL/NM, November 2005) that was conditionally approved by the NMED (Bearzi, December 2008) and addresses all requirements for the MWL Corrective Measures Implementation Report as defined in the NMED Final Order for the MWL (NMED, May 2005); the CMIP (SNL/NM, November 2005); the SNL/NM Resource Conservation and Recovery Act Permit (as modified for the MWL after the Final Order); the Compliance Order on Consent (NMED, April 2004); and the NMED conditional approval of the MWL CMIP (Bearzi, December 2008). The CMIP contains the Construction Specifications (Appendix A) and CQA Plan (Appendix B) that define the construction, design, and quality assurance requirements for construction of the MWL Alternative Cover (i.e., MWL ET Cover).

Deployment of the MWL ET Cover was conducted in two main construction phases, the 2006 Subgrade Construction and 2009 ET Cover Construction. The 2006 Subgrade Construction phase began on October 2, 2006, following the NMED approval received in September 2006 (Bearzi, September 2006), and was completed on April 11, 2007. This phase involved MWL Borrow Pit activities to generate soil fill material for cover construction, preparation of the existing disposal area surface, construction of the Subgrade, and installation of erosion control measures to protect the Subgrade surface while awaiting final NMED approval of the CMIP. The 2009 ET Cover Construction phase was performed from May 20 through September 3, 2009, and involved preparation of the Subgrade surface, construction of the ET Cover layers (Biointrusion, Native Soil, and Topsoil Layers) and site drainage features, installation of the administrative security fence, and site revegetation activities. Minor variances in construction and/or design specifications that did not adversely affect the quality of the cover were documented as nonconformances or design changes and approved by the CQA Engineer. Overall, the final MWL ET Cover as constructed provides a thicker, more protective ET Cover relative to the CMIP minimum design specifications. The completed ET Cover is shown schematically in Figure ES-1.

Third-party CQA services were provided by MKM Engineers, Inc. during the 2006 Subgrade Construction phase (under subcontract to URS Group, Inc. [URS]), and by URS during the 2009 ET Cover Construction phase. This report and the attachments provide the construction quality control and CQA data and documentation required to verify that the MWL ET Cover meets the construction and design specifications of the NMED-approved CMIP (SNL/NM, November 2005). All aspects of the MWL ET Cover deployment are addressed in this stand-alone report and have been certified by a New Mexico-registered Professional Engineer.

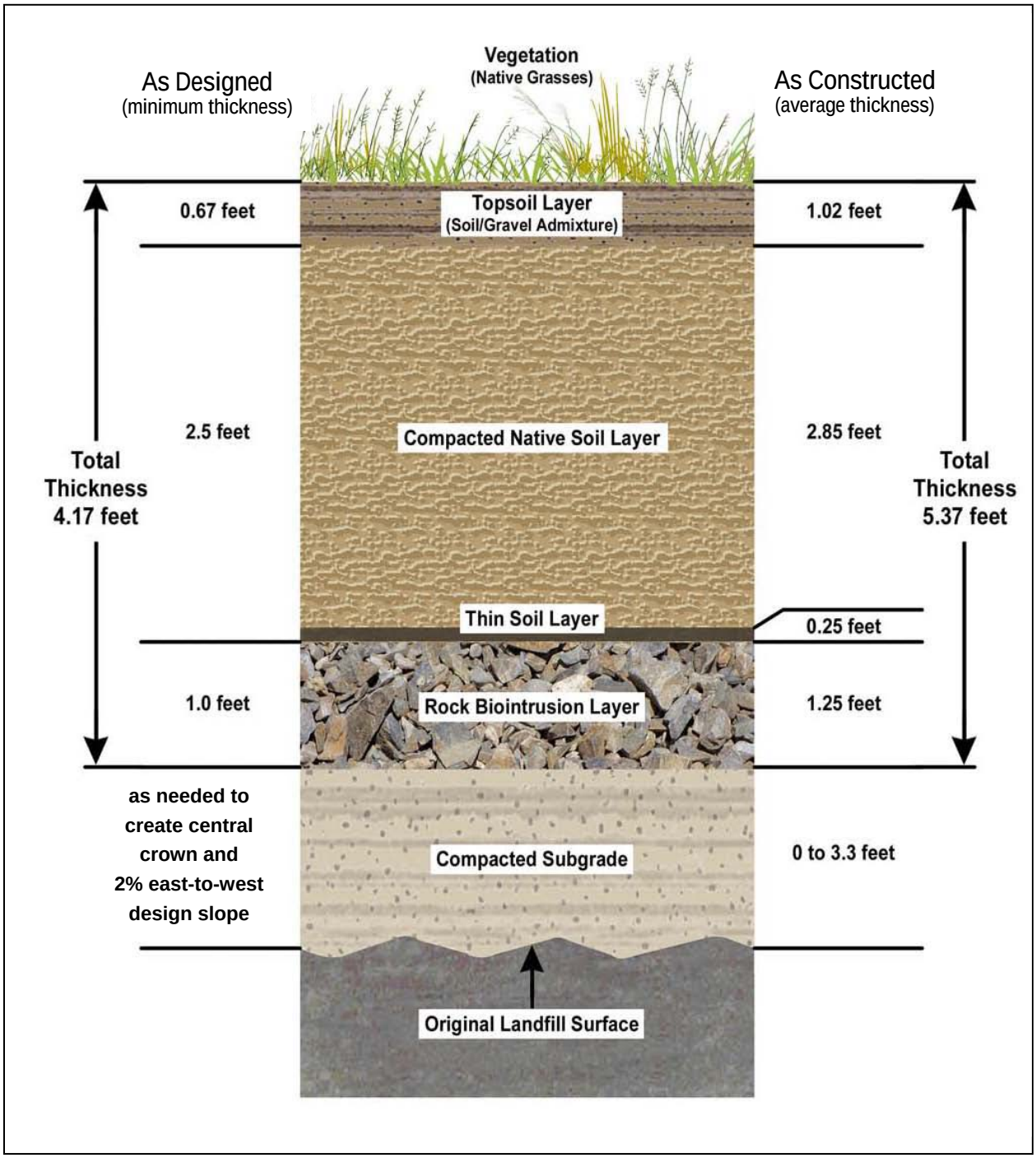

Figure ES-1
Schematic Profile of the Mixed Waste Landfill Alternative Evapotranspirative Cover

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1.0 Introduction

The Mixed Waste Landfill (MWL) at Sandia National Laboratories/New Mexico (SNL/NM) is designated as an Underground Radioactive Materials Area under U.S. Department of Energy (DOE) requirements and a Hazardous and Solid Waste Amendments Solid Waste Management Unit subject to New Mexico Environment Department (NMED) corrective action regulations as delegated by the U.S. Environmental Protection Agency (EPA). The NMED is authorized by the EPA to implement and enforce the corrective action requirements for the MWL. The MWL is located approximately 4 miles south of SNL/NM central facilities and 5 miles southeast of Albuquerque International Sunport within Technical Area (TA)-3. SNL/NM facilities and TA-1 through TA-5 are located within the boundaries of Kirtland Air Force Base (KAFB) on federal land controlled by the DOE. The location of KAFB, TA-3, TA-5, and the MWL are shown in Figures 1 and 2.

The MWL Corrective Measures Implementation Plan (CMIP) (SNL/NM, November 2005) was submitted to the NMED in November 2005 and incorporates the remedy selected by the Secretary of the NMED on May 26, 2005 (NMED, May 2005). It was conditionally approved by the NMED in December 2008 (Bearzi, December 2008), and conditions related to construction of the remedy were incorporated into the CMIP through replacement pages submitted to the NMED (Davis, February 2009). The MWL CMIP details the deployment of the selected remedy, which is the MWL Alternative Evapotranspirative (ET) Cover with a biointrusion barrier (hereafter referred to as the ET Cover). The MWL ET Cover construction specifications are provided in Appendix A of the CMIP, and the Construction Quality Assurance (CQA) Plan is presented in Appendix B (SNL/NM, November 2005).

The MWL ET Cover was deployed from October 2006 through September 2009 and consists of four main layers: compacted subgrade, biointrusion barrier, compacted native soil, and topsoil. The Subgrade varies in thickness from 0 to 3.3 feet and is the base layer that established the broad, central crown and 2-percent east-to-west surface design slope. The combined average thickness of the overlying ET Cover layers (Biointrusion, Native Soil, and Topsoil Layers) is 5.37 feet, and the overall cover footprint is 4.1 acres including side slopes. The ET Cover was constructed with approximately 33,000 cubic yards (cy) of soil fill and 6,800 cy of rock (in-place, compacted volumes) that meet CMIP specifications (SNL/NM, November 2005) based upon 113 laboratory tests (Standard Proctor, Gradation, Classification, and Saturated Hydraulic Conductivity), 271 field tests (in-place density and moisture), and visual inspections.

All MWL ET Cover construction activities were observed, inspected, and documented by an independent third-party CQA contractor.

Deployment of the MWL ET Cover is detailed in this MWL Alternative Cover CQA Report (Volumes 1 and 2), which incorporates all construction quality control (CQC) and CQA data and documentation requirements for the MWL Corrective Measures Implementation (CMI) Report as defined in the NMED Final Order for the MWL (NMED, May 2005); the CMIP (SNL/NM, November 2005); the SNL/NM Resource Conservation and Recovery Act (RCRA) Permit (as modified for the MWL after the Final Order); the Compliance Order on Consent (NMED, April 2004); and the NMED conditional approval of the MWL CMIP (Bearzi, December 2008).

Volume 1 includes the main text (Chapters 1.0 through 10.0) and tabbed sections located at the end of this report. Chapter 1.0 provides background information and the purpose and scope of this report. Chapter 2.0 presents the roles and responsibilities of the organizations, contractor teams, and key personnel. Chapter 3.0 presents project communications, the construction approval process, and related CQA documentation. The CQC and CQA programs that were implemented to test, control, and verify construction of the ET Cover according to the specifications and design drawings in the CMIP are presented in Chapter 4.0, along with the associated CQC and CQA data. Chapter 5.0 provides a detailed summary of the 2006 Subgrade and 2009 ET Cover Construction earthwork. Chapter 6.0 discusses the extension of groundwater monitoring well MWL-MW4 and the installation of two required soil-vapor monitoring wells; these tasks were completed in 2009 during installation of the ET Cover. Chapter 7.0 summarizes nonconformances and design changes (i.e., minor variances in construction and/or design specifications that do not affect the quality of the cover) to the CMIP specifications and design drawings. Chapters 8.0 and 9.0 provide the conclusions and CQA Engineering Certification of ET Cover construction, respectively. Report references are provided in Chapter 10.0. Tabbed sections at the end of Volume 1 include all tables, figures, as-built drawings, quality assurance (QA) verification survey plates, and photographic logs. Volume 2 contains Attachments 1 through 8 that include supporting CQC and CQA documentation. Volume 2 is provided in electronic format (PDF files) on a compact disc (CD) at the end of this report. Separately bound hard copies of the attachments in Volume 2 are available in the NMED Hazardous Waste Bureau document library (Santa Fe, New Mexico), the DOE/Sandia document repository (Public Reading Room, Zimmerman Library at the University of New Mexico, Albuquerque, New Mexico), and the SNL/NM Customer Funded Records Center (formerly known as the ES&H [Environment, Safety, and Health] and Security Records Center).

1.1 Subgrade and ET Cover Construction Background

The MWL consists of two distinct disposal areas that include the classified area (northeast portion of the MWL occupying 0.6 acres) and the unclassified area (occupying 2.0 acres). The waste was buried in pits and trenches that were backfilled with the excavated soil and capped with more soil at the completion of operation. This capped condition was the existing surface prior to the 2006 Subgrade Construction phase. A complete summary of all MWL construction preparation, 2006 Subgrade, and 2009 ET Cover Construction activities is provided in Table 1 and in the following discussion.

Prior to the 2006 Subgrade Construction phase, rock needed to construct the Biointrusion Layer was selected in consultation with NMED representatives and delivered to the Bulk Waste Staging Area located near the MWL Borrow Pit from October 4 through November 14, 2005. In addition, from June 14 to July 17, 2006, surface water and site controls were implemented at the MWL Borrow Pit (hereafter referred to as the Borrow Pit), and soil fill material needed for construction of the Subgrade and ET Cover layers was excavated, screened to 2-inch minus, and stockpiled following the specifications in the CMIP (SNL/NM, November 2005). Screened soil fill was hauled and stockpiled at the MWL for the Subgrade Construction phase from July 31 through November 5, 2006. The location of the Bulk Waste Staging Area, Borrow Pit, and the haul routes used to transport materials to the MWL site are shown in Figure 3.

In September 2006, the NMED approved the portions of the CMIP that addressed removal of the administrative security fence and subgrade construction (i.e., ET Cover preparation work) (Bearzi, September 2006). Subgrade construction was performed from October 2 through December 21, 2006, and consisted of clearing and grubbing, grading, and compacting the existing surface followed by placement and compaction of subgrade soil lifts to establish a surface over the MWL that mirrored the final CMIP design surface (i.e., a broad, central crown or high area with a 2-percent east-to-west slope across most of the disposal area). Subgrade construction was completed on April 11, 2007, after finishing installation of erosion control matting (i.e., straw blankets) on the completed Subgrade surface and verifying that the completed drainage swale on the east side of the Subgrade diverted run-on surface water around the perimeter as intended.

After receiving conditional approval of the CMIP from the NMED in December 2008 (Bearzi, December 2008), the MWL ET Cover Construction contracting process was initiated by Sandia Corporation (Sandia) and completed in March 2009. The Environmental Dimensions, Inc. (EDi) Team was selected as the Construction Contractor for the MWL ET Cover and URS Group, Inc. (URS) was selected to perform independent third party CQA under a separate contract. The

NMED was notified of the start of ET Cover Construction fieldwork on April 10, 2009 (Davis, April 2009). The EDi Construction Team and the URS CQA Team mobilized to the field to begin initial site activities in mid-May 2009 after an updated Health and Safety Plan was completed and approved by Sandia. A schematic profile of the completed MWL Subgrade and ET Cover layers is shown in Figure 4.

1.2 Purpose and Scope

The purpose of this report is to provide the required data and documentation that demonstrates the deployment of the MWL ET Cover was performed in accordance with the CMIP (SNL/NM, November 2005) requirements, specifications, and design drawings. This report presents details of construction activities as well as CQA activities associated with the 2006 Subgrade Construction phase (October through December 2006) and the 2009 ET Cover Construction phase (May through September 2009).

The scope includes all required CQC and CQA data and documentation to provide a comprehensive, integrated report that addresses all requirements for the MWL CMI Report as defined in the NMED Final Order for the MWL (NMED, May 2005); the CMIP (SNL/NM, November 2005); the SNL/NM RCRA Permit (as modified for the MWL after the Final Order); the Compliance Order on Consent (NMED, April 2004); and the NMED conditional approval of the MWL CMIP (Bearzi, December 2008). All required Subgrade and ET Cover Construction deployment data and documentation are presented in Volume 1 of this MWL Alternative Cover CQA Report, including all laboratory and field test results, QA verification survey results, as-built drawings, and photographic logs provided in tabbed sections at the end of this report. Volume 2 of this report contains supporting CQC and CQA documentation in Attachments 1 through 8 and is provided in electronic format on a CD in a tabbed section at the end of this report.

1.3 2006 and 2009 CQA Teams and CQA Report Progression

Third-party CQA services were provided by MKM Engineers, Inc. (MKM), under subcontract to URS for the 2006 Subgrade Construction phase, and by URS for the 2009 ET Cover Construction phase. The CQA personnel were responsible for the following activities:

- Ensuring the design drawings and specifications were followed during the construction effort
- Inspecting and observing material preparation and placement
- Accepting materials used in the construction process
- Verifying testing in the field and laboratory

- Maintaining team communication of construction sequence, progress, and changes
- Documenting any nonconformances affecting cover quality in a Corrective Action Report and verifying implementation of corrective action(s)
- Evaluating and approving design changes (i.e., minor variances in construction and/or design specifications that do not affect the quality of the cover)
- Preparing and maintaining documentation related to achieving performance requirements
- Preparing the final CQA Report

For the 2006 Subgrade Construction only, the CQA Engineer was responsible for the preparation of an independent CQA Plan (SNL/NM, May 2006) that incorporated the CMIP construction and design specifications and requirements for the MWL Subgrade, essentially duplicating and building upon the CQA Plan included as Appendix B in the CMIP (SNL/NM, November 2005). The CQA Plan was based upon guidance from the EPA, NMED, and CMIP. The CMIP CQA Plan was used for the 2009 ET Cover Construction phase.

Following the NMED approval received in September 2006 (Bearzi, September 2006), the 2006 Subgrade Construction phase began on October 2, 2006, and was completed on April 11, 2007. This phase involved the generation of soil fill material, preparation of the existing surface, construction of the Subgrade, and installation of the east-side drainage swale and erosion control matting on the Subgrade surface. At that time, the DOE and Sandia were awaiting final NMED approval of the CMIP and ET Cover design. Construction of the ET cover did not proceed because final CMIP approval was not received from the NMED until December 2008.

The MWL Alternative Cover Subgrade CQA Report (MKM, August 2007) was prepared as a draft and included the documentation required by the CQA Plan (SNL/NM, May 2006) and CMIP (SNL/NM, November 2005) and the certification by the MKM CQA Engineer that the Subgrade construction conformed to the CMIP specifications and design drawings. The draft Subgrade CQA Report was completed in August 2007 (MKM, August 2007) and has been revised to incorporate the 2009 ET Cover Construction activities conducted from May 20 through September 3, 2009. This MWL Alternative Cover CQA Report, Volumes 1 and 2, represents the final CQA report for all MWL ET Cover construction activities, which are summarized in Table 1.

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2.0 Responsibility, Authority, and Qualifications

The principal organizations involved in construction of the Subgrade and ET Cover are listed below, along with the Construction and CQA Teams for both the 2006 Subgrade and 2009 ET Cover Construction phases of the project. Information concerning their roles and responsibilities is presented in Sections 2.1 through 2.7.

Principal Organizations

- NMED – Lead Regulatory Agency
- DOE – Owner
- Sandia – Designer and Operator, Construction Oversight

2006 Subgrade Construction and CQA Contractors

- Shaw Environmental, Inc. (Shaw)/GRAM, Inc. – Construction Team
- MKM – CQA Contractor
  - URS – Field Surveyor
  - AMEC Earth & Environmental, Inc. (AMEC) – Testing Laboratory

2009 ET Cover Construction and CQA Contractors

- EDi – Construction Team, Prime Construction Contractor (hereafter referred to as the EDi Team or Construction Team) – The main EDi Team subcontractors and their roles are listed as follows:
  - North Wind, Inc – Heavy Equipment, Soil Moving and Placement
  - AMEC – Project CQC and Testing Laboratory
  - Albuquerque Surveying – CQC Field Surveyor
  - Pioneer Industries – Pug Mill Equipment and Operations
  - Lee Landscapes – Revegetation
  - ACME Fencing Company, Inc. – Administrative Fence Installation

- URS – CQA Contractor
  - AMEC – Testing Laboratory
  - URS – CQA Field Surveyor

The responsibilities of the principal organizations, Construction Teams, and CQA Teams and team members are summarized in the following sections.

2.1 Review/Permitting Agency

The NMED is the Administrative Authority overseeing corrective action at the MWL. The NMED is responsible for reviewing and approving this MWL Alternative Cover CQA Report as part of the MWL CMI Report.

2.2 U.S. Department of Energy (Owner)

The DOE has the authority to accept or reject the construction of the MWL cover. Based upon DOE oversight during the two construction phases and review of this report, the DOE accepts the construction of the MWL ET Cover.

2.3 Sandia Corporation (Designer and Operator)

Sandia Environmental Restoration Project Staff designed the MWL ET Cover that fulfills the closure needs of the Owner and the regulatory requirements of the NMED, as confirmed by the NMED conditional approval of the CMIP. Sandia has the responsibility and authority for implementation of the CMIP (SNL/NM, November 2005), oversight of construction, and review of related documentation. The Sandia Construction Representative (SCR) has the responsibility and authority for all project-related contracting and formal approval of all aspects of Subgrade and ET Cover Construction phases, including modifications to the construction specifications and design drawings and corrective actions (if needed) for any deviations from the design. The DOE and Sandia are responsible for the long-term monitoring and maintenance of the site, which will be formalized and documented in the MWL Long-Term Monitoring and Maintenance Plan (LTMMP). The LTMMP will be prepared and submitted to the NMED for approval within 180 days after approval of the MWL CMI Report, which includes this MWL Alternative Cover CQA Report as Appendix A.

2.4 Construction Contractor Team

The Construction Team was responsible for Subgrade preparation and construction (Shaw/GRAM, Inc.) and ET Cover construction (EDi Team) in accordance with the construction specifications, design drawings, and CQA Plan (SNL/NM, November 2005–Appendix B). For the 2006 Subgrade Construction phase, all CQC laboratory testing, field testing, and surveying were performed by the CQA Team. For the 2009 ET Cover Construction phase, the EDi Team performed all CQC laboratory testing, field testing, and surveying.

2.5 Surveying Contractor

The Surveying Contractor was responsible for performing land surveys to guide, control, and verify the Subgrade and ET Cover Construction process, as well as providing the survey data

used to prepare the Subgrade and ET Cover as-built drawings. For the 2006 Subgrade Construction phase, one Surveying Contractor was part of the CQA Team and responsible for all land surveying and preparation of the as-built drawing. For the 2009 ET Cover Construction phase, both a CQC (Albuquerque Surveying – part of the EDi Team) and a CQA (URS – part of the CQA Team) Surveying Contractor participated in the project. The EDi Team surveyor was responsible for all surveying performed to guide, control, and verify the construction process, as well as all final Subgrade and ET Cover layer surface surveys used to prepare the 2009 as-built drawings. The CQA Team surveyor performed QA verification surveys on the surface of each ET Cover layer (Biointrusion, Native Soil, and Topsoil Layers) to validate the more extensive CQC survey data. Additional information on surveying is provided in Section 4.4.

2.6 CQA Contractor

The responsibility of the CQA personnel was to perform the activities specified in the CQA Plan (SNL/NM, November 2005–Appendix B), consisting of oversight, inspection, sampling/testing, and documentation. The CQA personnel roles and responsibilities were generally the same for both the 2006 and 2009 construction phases. However, some differences reflect a more robust CQC and CQA program for the 2009 ET Cover Construction phase (i.e., construction of the Biointrusion, Native Soil, and Topsoil Layers).

During the 2006 Subgrade Construction phase, the CQA Team was responsible for all CQC laboratory testing (i.e., Standard Proctor, Gradation, and Classification soil data), field testing (i.e., in-place density and moisture testing), as well as associated oversight of the testing laboratory.

During the 2009 ET Cover Construction phase, the CQA Team was responsible for oversight and approval of the CQC laboratory testing (i.e., Standard Proctor, Gradation, Classification, and Saturated Hydraulic Conductivity) performed by the EDi Team, as well as performing independent CQA in-place field density and moisture tests to confirm the CQC testing (minimum 5 percent frequency) specified in the CQA Plan (SNL/NM, November 2005–Appendix B). A similar approach was implemented for surveying, as explained in Section 2.5. This approach provided additional CQA data and documentation that supported and verified the ET Cover Construction phase CQC results.

Table 2 presents the CQA personnel and summarizes their qualifications and their responsibilities are presented in the following sections.

2.6.1 CQA Inspection Personnel

The CQA inspectors were responsible for daily independent oversight and inspection of the work in progress to assess compliance with design criteria and to attend progress meetings. They were on site daily, attended daily tailgate safety and project meetings, and worked closely with Sandia Oversight personnel and the Construction Contractor as part of an integrated team approach. Their work was documented through Daily Quality Control (QC) Reports supplemented with inspection forms/checklists, testing forms, photographs, and other supporting documentation. The Daily QC Reports and inspection forms are discussed in Sections 4.1 and 4.2, and photographic documentation is discussed in Section 4.5.

2.6.2 CQA Certifying Engineer

The CQA Certifying Engineer also served as the CQA Engineer. The CQA Engineer reviewed the CQA inspectors' documentation for clarity and completeness and observed the field-testing procedures. He met with the inspectors, the SCR, Sandia Oversight personnel, and the Construction Team to discuss progress, testing and survey results, technical issues, and any deviations from specifications and/or design drawings (i.e., design changes). In conjunction with the SCR, the CQA Certifying Engineer was responsible for final approval of all construction work for the Subgrade, each ET Cover layer, and the completed ET Cover. He was also responsible for CQA documentation until it was submitted to Sandia. A certifying statement and Professional Engineer Seal are provided in Chapter 9.0 of this report for both the Subgrade and overall ET Cover construction.

2.7 Testing Laboratory

The testing laboratory was responsible for its own QC Plan and the assurance that the tests were performed in accordance with the applicable American Society for Testing and Materials (ASTM International) (ASTM) standards and chain-of-custody requirements for the samples. The testing laboratory was also responsible for maintaining equipment calibration and operating information to ensure all results are defensible. The laboratory and field testing performed to verify MWL Subgrade and ET Cover construction are discussed in Section 4.3. The results are summarized in the referenced tables, and supporting laboratory and field documentation are provided in attachments to this report.

For the 2006 Subgrade Construction phase, there was only one CQC laboratory and field-testing program, performed by the CQA Team, that utilized one testing laboratory. The 2009 ET Cover Construction phase also used one testing laboratory but had two independent field-testing programs that included a CQC (Construction Team) and CQA (CQA Team) testing program.

Although only one testing laboratory was used, the laboratory set up internal procedures to ensure that the CQC and CQA results were independent. This approach was implemented by using separate personnel and different equipment to perform the CQC and CQA field tests. Internal processing and reporting of the field measurement data were also performed separately to create a "firewall" between the CQC and CQA testing programs.

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3.0 Project Communications

Project communication was an important component of ET Cover construction and was facilitated through a team approach. Project communications were maintained with the entire project team on a daily basis. Field operations were centralized in one field office trailer used by Sandia Oversight, CQA Team, and Construction Team personnel. Meetings were held at the start of every workday and throughout the project to ensure effective communication, coordination of activities, and safe implementation of all construction tasks. These meetings addressed plans, progress, specific construction issues, and CQC and CQA data related to ET Cover layer approval as described in the following sections. The daily reports prepared by the CQA Team document these meetings, team interactions, and the overall team approach. Notes and agendas from preconstruction, weekly progress (2006 Subgrade Construction phase), and quality resolution meetings (2009 ET Cover Construction phase) were documented on project forms and/or in daily reports and project log books.

3.1 Preconstruction Meeting

The Preconstruction Meeting for the 2006 Subgrade Construction phase was held on June 5, 2006, with representatives from Sandia, the Construction Team, and the CQA Team present. A record of this meeting is included in Attachment 1. The following major items were reviewed:

- Project organization and responsibilities
- Design drawings
- Soil testing requirements and specifications
- Fugitive emissions permit and excavation permit
- Construction plan and schedule
- Health and safety requirements
- CQA Plan review

The 2009 ET Cover Construction phase of the project included three Preconstruction Meetings conducted on April 30 (Project Kickoff), May 6 (Project Readiness Review), and May 19, 2009 (Project Operational Readiness). Records of these meetings are included in Attachment 1. The first meeting included Sandia Project Staff, SNL/NM ES&H personnel, the SCR, and project personnel as well as representatives from the CQA and Construction Teams. Topics addressed at this meeting consisted of the team approach, roles and responsibilities, permitting and premobilization requirements, construction scope, and technical approach for the Biointrusion Layer void space filling. Biointrusion Layer void space filling was not addressed in the CMIP (SNL/NM, November 2005). The second meeting, held on May 6, 2009, involved all key project

personnel, including SNL/NM ES&H representatives, and addressed a complete Readiness Review agenda for project mobilization and fieldwork startup, including the recently approved Project Health and Safety Plan and associated requirements. The third meeting was attended by Construction Team and Sandia Oversight personnel and addressed the completion of all project-required training, documentation, and mobilization tasks (i.e., Operational Readiness for the start of construction). The 2009 ET Cover Construction activities started on May 20, 2009, after completion of the Project Operational Readiness meeting on May 19, 2009.

3.2 Progress Meetings

Weekly Construction Progress Meetings were held to discuss progress, plans, safety, and Subgrade construction issues during the 2006 Subgrade Construction phase. Any issues were resolved at the meeting and/or assigned actions. The agendas for these meetings are part of the CQA project record maintained in the SNL/NM Customer Funded Records Center.

As part of the 2009 ET Cover Construction phase, progress was discussed every day during the morning Daily Tailgate Meetings. The Daily Tailgate Meetings were documented by the Construction Team on a standard form that included a sign-in sheet listing all personnel working on the site. These forms are maintained in the Customer Funded Records Center along with other supporting project documentation.

3.3 Quality Resolution Meetings

During the 2006 Subgrade Construction phase, QC issues were discussed with the SCR and Sandia Oversight personnel, the Construction Team Supervisor, and CQA Team personnel. The discussions and resolutions typically occurred in the field. If a meeting were required, the CQA Engineer initiated the meeting, invited the attendees, and documented the meeting. Documentation of the meetings and issue resolution are provided in Attachment 1 and in the daily reports and/or CQA personnel logbooks.

During the 2009 ET Cover Construction phase, Quality Resolution Meetings were held and documented for the following two main reasons:

- To evaluate data, discuss and resolve issues, and obtain CQA Engineer and SCR approval of each ET Cover Layer
- To evaluate, resolve, and obtain CQA Engineer and SCR approval of specific QC issues, including technical issues and design changes to the CMIP specifications and/or design drawings

The 2009 Quality Resolution Meetings were held in the field office trailer and attended by the SCR and Sandia Oversight, CQA Team, and Construction Team representatives. These meetings are summarized in Table 3 and documented in Attachment 1. Additional discussion of these meetings is provided in Section 3.4 and Chapter 7.0.

3.4 Approvals and Submittals

The CQA Engineer approval of the 2006 Subgrade Construction phase activities is documented in Chapter 9.0 (*Engineering Certification).* For the 2009 ET Cover Construction phase, all field and laboratory test results were conveyed to the CQA Engineer for approval in the form of Submittals. Throughout the project, 42 Submittals were generated. The Submittal cover pages are included in Attachment 2. Individual test results are presented in Section 4.3 and have been removed from the Submittals and organized into a separate attachment by the type of test for ease of access and review (see Sections 4.3.1 and 4.3.2 for more information).

Each ET Cover layer constructed in 2009 was approved by the CQA Engineer through Quality Resolution Meetings prior to the construction of the next cover layer as required by the CQA Plan in Appendix B of the CMIP (SNL/NM, November 2005). This process allowed the construction of the subsequent ET Cover layer to proceed with minimal delay. In addition, construction was often approved in phases for some layers to allow construction to proceed on the next layer in one area while final verification and/or adjustments were implemented and confirmed in another area. An example of this phased approach is documented in Table 3 for approval of the Biointrusion Layer, which was approved in three phases or areas (i.e., south, northwest, and northeast portions of the MWL). This allowed installation of the thin soil layer to proceed while the Biointrusion Layer was being completed.

Table 3 provides a detailed chronological summary of the Quality Resolution Meetings and Cover Layer Approval. Cover layer approval involved the approval of associated laboratory and field-testing data (preliminary laboratory testing and in-place field density and moisture results) and final CQC and CQA verification survey data (layer thickness and slope information). The Quality Resolution Meetings are documented in Attachment 1, and approval forms for each cover layer are provided in Attachment 2. Approval of the Native Soil Layer laboratory and field-testing data through the formal Submittal process occurred after Native Soil Layer approval due to the time lag between receipt of preliminary and final laboratory results. However, all preliminary results were confirmed by final laboratory results. Both CQC and CQA surveying activities are discussed in more detail in Section 4.4.

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4.0 Observations, Inspections, Tests and Surveys

The CQC and CQA observations, inspections, testing (laboratory and field), surveying, and photographic reporting performed to control, verify, and document that the materials and earthwork for the MWL Subgrade and ET Cover Construction phases conformed to the CMIP construction and design specifications are presented in this chapter. This documentation supports the detailed summary of the Subgrade and ET Cover Construction phases presented in Chapter 5.0 and forms the basis for the ET Cover layer approval (Section 3.4) and the engineering certification for the Subgrade and ET Cover Construction phases (Chapter 9.0). All required CQC and CQA documentation is included in the tables, figures, as-built drawings, QA verification survey plates, photographic record, and Attachments 1 through 8 of this report. Additional supporting documentation is retained in the SNL/NM Customer Funded Records Center. The CQA documentation of project meetings and 2009 CQC data submittals and CQA cover layer approval documentation are presented in Chapter 3.0.

Daily QC reporting and inspection forms are discussed in Sections 4.1 and 4.2, respectively. The CQC data (collected to verify that ET Cover construction meets CMIP construction and design specifications), CQA data (collected to verify the CQC data), and associated documentation are presented in Section 4.3. Data and documentation associated with CQC and CQA surveying are discussed in Section 4.4, and photographic reporting is presented in Section 4.5.

In general, CQC and CQA data and documentation can be collected by either the Construction Team or the CQA Team or a combination of both. However, for the MWL Subgrade and ET Cover deployment, CQA data and documentation were exclusively the responsibility of the independent third party CQA Team.

4.1 Daily Quality Control Reports

The CQA Inspectors prepared the Daily QC Reports consistent with the information requirements itemized in the CQA Plan in Appendix B of the CMIP (SNL/NM, November 2005). The CQA Engineer reviewed and approved the reports on a regular basis. Each report provided the date, summary of weather conditions, location of construction activities, list of on-site personnel, summary of meetings and attendees, description of materials/equipment used, references to testing or sampling performed, and inspection forms completed. For the 2009 ET Cover Construction phase, some of this information was addressed through cross-referencing other project documentation, such as Daily Tailgate Meeting Forms for on-site personnel. Other information, such as field maps of in-place density and moisture test locations, are not included because the information is superseded by maps provided in this report. The Daily QC Reports

for the 2006 Subgrade and 2009 ET Cover Construction phases are included in Attachment 3. The Construction Team also completed daily reports during the 2009 ET Cover Construction phase, which are maintained in the SNL/NM Customer Funded Records Center.

4.2 Inspection Forms

All CQA inspection forms are provided in the CQA Plan in Appendix B of the CMIP (SNL/NM, November 2005) and were developed to include checklists to ensure consistent documentation for all ET Cover construction activities. The testing inspection forms documented the inspections performed by the CQA Inspectors for the samples collected and tests performed by the testing laboratory. Each form was signed by the CQA Inspector, reviewed and signed by the CQA Engineer, and contained the following information.

- Date and time of each inspection
- Location
- Weather conditions
- Type of inspection
- Procedure used for testing
- Test data
- Results of the activity
- Personnel involved in the inspection and sampling activities
- Signature of the inspector indicating approval

The inspection forms discussed in Sections 4.2.1 through 4.2.3 were completed as applicable during construction of the Subgrade and ET Cover to document daily activities and supplement the Daily QC Reports.

4.2.1 Receiving Inspection Forms

No Receiving Inspection Forms were used during the 2006 Subgrade Construction phase as no materials were received from outside vendors during this phase of the project. Approximately 8,100 tons (6,000 cy) of angular crushed rock for the Biointrusion Layer were delivered to SNL/NM from October 4 through November 4, 2005, and stockpiled in the TA-3 Bulk Waste Staging Area (Figure 3) by the 2006 Subgrade Construction Team. Approximately 1,100 tons (800 cy) of additional biointrusion rock from the same source were delivered directly to the MWL site from June 8 through June 12, 2009, to complete construction of the Biointrusion Layer in the northeast, classified disposal area of the MWL. Approximately 2,400 tons of aggregate (3/8-inch crushed gravel) were delivered to the Borrow Pit (Figure 3) from June 29

through July 22, 2009, to be admixed with the topsoil fill using the Pug Mill in accordance with the specifications in the CMIP (SNL/NM, November 2005). Delivery ticket information for the biointrusion rock and aggregate is summarized in tables provided in Attachment 4. A Receiving Inspection Form for the seed and copies of the seed bag labels are also included in Attachment 4. The CQA Engineer's approval of the biointrusion rock and 3/8-inch crushed gravel is documented in Table 3 and Attachment 2.

4.2.2 Construction Inspection Forms

Construction Inspection Forms were completed during daily field inspection activities as required by the CQA Plan in Appendix B of the CMIP (SNL/NM, November 2005). The appropriate forms were used for the inspection of the existing surface and perimeter area, the Subgrade, and the erosion control matting installation activities completed as part of the 2006 Subgrade Construction phase. Similar project-specific forms were completed in 2009 for the Subgrade surface (the "existing surface form" was used for the 2009 Subgrade surface inspection), Biointrusion Layer, Native Soil Layer, Topsoil Layer, and Reclamation Seeding and Mulching. The activities for each of the construction tasks were determined to be acceptable based upon the inspections conducted during the activities. The Construction Inspection Forms are presented in Attachment 5.

4.2.3 Testing Inspection Forms

Testing Inspection Forms were completed during in-place density and moisture testing of the compacted existing disposal area surface and Subgrade and for the laboratory analyses of the Subgrade soil fill during the 2006 Subgrade Construction phase. All of this testing was performed by the CQA Team. The 2009 ET Cover Construction phase included both CQC and CQA in-place field density and moisture testing (i.e., field testing). Testing Inspection Forms were completed for the in-place density and moisture tests performed by the CQA Team (i.e., CQA field tests). All CQC laboratory and field tests conducted by the Construction Team were submitted to the CQA Engineer for approval (Section 3.4). All 2006 and 2009 Testing Inspection Forms are presented in Attachment 6.

4.3 Laboratory and Field Testing

Laboratory and field testing were performed throughout construction to verify that the materials used met specifications and that the existing surface, Subgrade, and installed ET Cover layers met the construction and design specifications in the CMIP (SNL/NM, November 2005). Stockpiled fill material was sampled and analyzed in the laboratory to document that the fill materials used met gradation and classification specifications and to develop Proctors for field

testing. Field testing included in-place density and moisture content measurements of the compacted soil layers. Native Soil Layer fill material was also sampled and tested for saturated hydraulic conductivity. The frequency of all required testing was performed in accordance with the construction specification (Section 02200) in Table 3.1 of the CMIP (SNL/NM, November 2005–Appendix A).

The CQC data are the laboratory and field-testing results that are used to verify the materials meet specifications. The CQA data is generally used to spot-check and verify the CQC data.

For the 2006 Subgrade Construction phase, all CQC laboratory and field testing was performed and documented by the CQA Team. For the 2009 ET Cover Construction phase a more robust program was implemented. The Construction Team was responsible for all CQC laboratory and field testing, and the CQA Team performed oversight and CQA verification field testing to supplement and confirm the CQC data generated by the Construction Team.

Consistent with this approach, all 2006 Subgrade Construction phase laboratory and field-testing data are considered CQC data. All 2009 ET Cover Construction phase laboratory and field-testing results generated by the Construction Team are CQC data that were reviewed and approved by the CQA Engineer through Submittals, Quality Resolution Meetings, and Cover Layer Approval Forms (Section 3.4 and Attachments 1 and 2). The CQA field-testing data were collected at a frequency greater than 5 percent, as stipulated by the CQA Plan in Appendix B of the CMIP (SNL/NM, November 2005) to confirm the CQC results (typically 50 percent). The following sections present the laboratory and field-testing activities that were performed to verify that each phase of Subgrade and ET Cover Construction met the CMIP construction and design specifications.

4.3.1 Laboratory Testing

The laboratory testing of soil fill material was performed according to the following methods:

- Standard Proctor, ASTM Method D698-07 (ASTM, 2007a)
- Gradation, ASTM Method C136-06 (ASTM, 2006a)
- Classification, ASTM Methods D2487 (ASTM, 2006b) and D4318 (ASTM, 2005)
- Saturated hydraulic conductivity, ASTM Method D5856-95 (ASTM, 2007b)

Standard Proctor (ASTM Method D698)

At the start of the 2006 Subgrade Construction phase, one composite sample of the existing surface was collected to support field density and moisture testing of the existing MWL surface (MWL-ES-001). Three additional Proctor samples (MWL-ES-002 through MWL-ES-004) were collected from different areas of the existing surface within the disposal area boundary to compare with the original sample. There were no significant differences in the Proctor results.

Standard Proctor (ASTM Method D698) soil sampling of Subgrade and Native Soil fill material was conducted at a frequency of 1 sample per 500 cy (loose) as specified in the CMIP (SNL/NM, November 2005). Four samples were also collected from the topsoil material to support moisture and density testing of the Topsoil Layer after installation, which was not required by the CMIP.

Standard Proctor results are summarized for the existing MWL surface and Subgrade in Table 4, and for the Native Soil Layer and Topsoil Layer in Table 5. Complete Standard Proctor laboratory testing supporting documentation is included in Attachment 7.

Gradation (ASTM Method C136) and Classification (ASTM Methods D2487 and D4318)

Gradation (ASTM Method C136) and Classification (ASTM Methods D2487 and D4318) soil testing was performed on all Subgrade, Native Soil Layer, and Topsoil Layer fill material at a frequency of 1 sample per 500 cy (loose) as specified in the CMIP (SNL/NM, November 2005). Gradation and Classification results for all samples are included on laboratory testing forms provided in Attachment 7 and summarized in Tables 4 and 5 for the 2006 Subgrade and 2009 ET Cover Construction phases, respectively. Native Soil Layer and Topsoil Layer results are summarized in Tables 6 and 7, respectively. Complete laboratory results are included in Attachment 7 on the same cover sheet that presents the Standard Proctor results, with the exception of the topsoil fill samples that were analyzed for only Gradation and Classification; separate forms are provided for these sample results in Attachment 7. All Gradation and Classification results met the associated specifications (Tables 4 through 7).

Saturated Hydraulic Conductivity (ASTM Method D5856-95 [2007])

Saturated hydraulic conductivity (ASTM Method D5856-95 [2007]) testing was conducted on all of the Native Soil Layer lifts at a frequency of 1 sample per acre per lift as specified in the CMIP (SNL/NM, November 2005). Samples of the soil fill used to construct each Native Soil Layer lift were collected, compacted in a mold at the testing laboratory, and then tested for saturated hydraulic conductivity following ASTM Method D5856 procedures (ASTM, 2007b). The CMIP

specification (Section 02200 in Appendix A) referenced a target maximum value of 4.6×10^{-4} centimeters per second (cm/s) with an acceptable failure rate of 5 percent. A total of 20 saturated hydraulic conductivity sampling results were collected from the eight Native Soil Layer lifts. The results are summarized in Table 8, and complete laboratory results are provided in Attachment 7. Most results are less than the target value (i.e., met specifications); however, four samples (20 percent) did not pass initially. These samples were recompacted to a density of approximately 95 percent to reflect actual field compaction results and retested. The results for the recompacted samples, which are more representative of the in-place compacted lift as determined by in-place density and moisture testing, met specifications (i.e., are less than the target value). The passing samples have an average of 1.62×10^{-4} cm/s and a geometric mean of 4.72×-10^{-5} cm/s. The average compaction of all 20 samples is 90.2 percent, with a range of 81.2 to 95.3 percent.

4.3.2 Field Testing

The CMIP (SNL/NM, November 2005) required in-place density and moisture testing by nuclear methods according to ASTM Methods D2922 ("Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods") and D3017 ("Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods [Shallow Depth]) using a Troxler™ Gauge at the rate of five tests per acre per lift for the Subgrade and Native Soil Layer. These ASTM methods were superseded in 2007 and combined into the new standard, ASTM D6938-08a (ASTM, 2008); however, the methods did not change. Field-testing results were used to demonstrate compliance with Section 02200 in Appendix A of the CMIP, which requires compaction of not less than 90 percent of the maximum dry density at +/- 2 percent of optimum moisture content, as determined by ASTM D698 (Standard Proctor testing) (ASTM, 2007a). Field density and moisture content of compacted soil were determined by comparing field measurements to a specified, representative Proctor that has a theoretical maximum dry density and optimum moisture content. Following standard construction industry practices, if any field-testing results indicated that compaction and/or moisture content specifications were not achieved, additional compaction and/or moisture conditioning of the soil material was performed until testing results met specifications. The 2006 Subgrade and 2009 ET Cover Construction field-testing programs are discussed in the following sections.

4.3.2.1 2006 Subgrade Construction Phase

Field density and moisture testing were performed on both the existing surface and each lift during the 2006 Subgrade Construction phase at the required frequency of five tests per acre per lift. The existing surface was graded and compacted with a vibratory roller and then field

density and moisture readings were obtained to verify compaction of not less than 90 percent of the maximum dry density. After discussions with the SCR and Sandia Oversight, Construction Team, and CQA Team personnel, this approach was approved by the CQA Engineer for verification of a stable surface, rather than counting the number of passes over an area using a roller with a ballasted weight of 25 tons, as stipulated in Section 02200 in Appendix A of the CMIP (SNL/NM, November 2005). Due to moisture being added to the surface rather than mixed into the soil prior to placement, the optimum moisture content goal of +/- 2 percent could not be attained using either compaction method. However, the field-testing results provided a more quantitative method and verified adequate compaction of the existing surface.

The spatial extent of most Subgrade Construction phase lifts was highly variable due to the uneven existing surface, so many of the lifts were significantly smaller than 1 acre. Therefore, the number of tests per lift was generally less than five. The field test locations were selected to be representative of each lift and were surveyed, recorded on an inspection checklist, and plotted on maps. The actual in-place density and moisture testing performed during Subgrade construction exceeded CMIP specifications of 5 CQC tests per acre per lift plus at least 5% additional confirmatory CQA tests. Based upon the aerial extent of the twelve Subgrade lifts, only 48 CQC and 3 CQA tests were required based upon the CMIP requirements (total of 51 tests). However, a total of 71 field tests were performed. Figures 5 through 17 show the locations of all existing surface and Subgrade field tests, Table 9 summarizes the results, and Attachment 7 provides the associated field and laboratory documentation. Testing inspection forms completed in the field are included in Attachment 6.

For the 2006 Subgrade Construction phase field-testing program, the native soil fill material was tracked as it was sampled, hauled, and placed. The associated Proctor result for every 500 cy was used to support the in-place density and moisture field tests of that 500 cy of fill material as it was placed and tested. The Subgrade lifts were relatively small making this approach feasible, although verifying the Proctor result characterizing each 500 cy of fill material that was placed, compacted, and tested was challenging. In one situation, this approach could not be followed due to laboratory reporting delays. The CQA Engineer approved proceeding with the previous Proctor results because the physical properties of the native soil fill were consistent. As more Standard Proctor results became available it was evident that the Borrow Pit fill material was relatively uniform in terms of its geotechnical characteristics, especially after screening and stockpiling.

4.3.2.2 2009 Evapotranspirative Cover Construction Phase

Field density and moisture testing were performed on the existing Subgrade surface and each lift of the Native Soil Layer during the 2009 ET Cover Construction phase at the required frequency of five tests per acre per lift. To ensure a representative spatial distribution of in-place density and moisture tests, the 2.6-acre cover surface was divided into thirteen 100-foot-square grid blocks (Figure 18). For each lift that extended over the entire cover surface, one in-place density and moisture test was conducted at a randomly selected location within each of the 13 grid blocks. For lifts that were spatially limited or of variable thickness (i.e., Native Soil Layer Wedge Lifts 1 and 2 and Lift 3, respectively), density and moisture tests were performed for each grid block where the compacted soil was thick enough for testing (i.e., nominally 4 inches). Figure 19 shows the extent of Native Soil Layer Wedge Lifts 1 and 2 with respect to the grid blocks. Lift 3 was placed across the entire cover surface, but the thickness of this lift was variable and not adequate for testing in some grid blocks (i.e., less than a nominal 4-inch thickness). All 13 grid blocks were tested for Lifts 4 through 8. Testing of the side slopes, which extended beyond the 2.6-acre cover surface, was conducted following the same procedure used for the Native Soil Layer lifts.

In-place density and moisture tests performed on the Subgrade in 2009 to confirm that it still met compaction specifications were compared with a Proctor sample from the soil excavated, screened, and stockpiled during the 2006 Subgrade Construction phase (MWL-SG-018, Table 4). This 2006 Proctor was selected by the CQA Engineer after review of the 30 results characterizing soil fill material excavated from the Borrow Pit in 2006 (Table 4). Initial tests indicated that the soil was similar to the selected 2006 Proctor and within an acceptable compaction and moisture range.

As shown in Tables 4 and 5 and Figure 20, the Standard Proctor results for all of the fill material sampled in 2006 and 2009 are generally consistent, with a relatively narrow range of maximum dry density and optimum moisture content. For this reason, the CQA Engineer approved the use of three representative Proctor results throughout the 2009 Subgrade and Native Soil Layer field-testing program, with one of the samples being the 2006 MWL-SG-018. This decision by the CQA Engineer was based on experience gained during 2006 Subgrade Construction phase, a review of all available data (2006 and incoming 2009 results), ongoing field-testing results, field Proctor compaction tests, and visual inspections of the fill material during placement and testing. The method used to change the Proctor used for in-place density and moisture testing is described as follows.

During placement of Native Soil Layer Wedge Lift 1, the soil appeared to contain higher amounts of clay and silt than the materials previously tested in 2006 based upon visual inspection. Moisture and density readings confirmed slight variations in soil composition and, as a result, the Proctor was revised to more accurately reflect density and moisture percentage of the fill material being used. The revised Proctor was determined by collecting a sample of soil from the area of Wedge Lift 1 where the change was noted. This soil was then compacted using a Proctor mold in the field in accordance with ASTM standards (ASTM, 2007b). The compacted sample provided a theoretical maximum wet density at current moisture levels. The theoretical maximum density and moisture was plotted on a graph with all available Proctor curves (i.e., Figure 20). The plotted point lined up on a Proctor curve that indicated which Proctor was most appropriate for that specific fill material.

The field-molded compactions were not used as a single point Proctor but were used to identify the most representative Proctor curve for the given soil from the already established data set. Because of the overall general consistency of the native soil fill material, most of which came from the same source (i.e., Borrow Pit), the Proctor result used for field testing changed only three times during the 2009 ET Cover Construction field activities.

The 2009 ET Cover Construction field-testing program included both CQC and CQA field testing. All CQC in-place moisture and density tests are summarized in Table 10. Approximately 50 percent of the CQC field tests were duplicated by independent CQA field tests performed under the direction of the CQA Contractor, although only a 5-percent testing frequency was specified in the CQA Plan in Appendix B of the CMIP (SNL/NM, November 2005; Section 2.6.2). CQA tests were typically performed within 3 feet of the CQC test location for the purpose of checking and confirming the CQC results. The CQA field test results are summarized in Table 11 and confirmed the CQC results. Complete testing reports are included in Attachment 7 for both the CQC and CQA field tests. Figures 21 through 29 illustrate the surveyed locations of each CQC and CQA field test. Topsoil Layer field testing was not required by the CMIP, but was conducted to support revegetation efforts. The results are included in Table 10; however, the locations were neither surveyed nor included in a figure.

4.4 Surveys and As-Built Drawings

Surveys were performed to guide, control, and verify the Subgrade and ET Cover Construction fieldwork. For the 2006 Subgrade Construction phase, one Surveying Contractor (URS) was integrated as part of the CQA Team and responsible for all CQC land surveying and preparation

of the final Subgrade Construction phase as-built drawing. The as-built drawing for the 2006 Subgrade (Drawing No. 1) is provided in a tabbed section at the end of this report.

For the 2009 ET Cover Construction phase, Albuquerque Surveying (part of the EDi Team) served as the CQC Surveying Contractor, and URS (part of the URS CQA Team) served as the CQA Surveying Contractor. CQC surveys were performed throughout the ET Cover Construction phase to support the following objectives:

- Check and control layer and lift thickness
- Install grade staking for the Native Soil and Topsoil Layer construction
- Record final elevations, surface slope, and side slopes of each lift and layer
- Record side slopes and drainage features around the perimeter of the cover
- Record the location of field density tests, fencing installation, and other miscellaneous site features

The CQC survey data were more extensive, performed for the purpose of documenting the entire ET Cover construction process, and were used as the basis for the ET Cover as-built drawings. Final CQC elevation surveys were conducted for each layer system to verify layer thickness and slope as required by Section 02210 in Appendix A of the CMIP (SNL/NM, November 2005) and for each lift of the Native Soil Layer. A 50-foot-spaced verification grid was established for collection of elevation measurements during the final CQC and CQA surveys. The verification grid map is illustrated in Figure 18 in relation to the grid blocks established for field density testing. The approximate limit of the 2-percent east-to-west cover surface design slope, the original disposal area boundary, and the 6 (horizontal) to 1 (vertical) side slopes surrounding the disposal area are also shown in Figure 18. The final CQC elevation survey data for each layer and the thin soil layer above the Biointrusion Layer are provided in Table 12. The final MWL surface and ET Cover cross-sections, which include the existing surface, Subgrade, drainage features, fencing installation, and other site features; are illustrated in the 2009 ET Cover As-Built Drawings (Figures No. 1 through 4) in a tabbed section at the end of this report.

All Construction Team CQC surveys were performed by Albuquerque Surveying and conducted using GPS [global positioning system]/RTK [real-time kinematic]-capable TOPCON GR-3 systems with GEODIMETER 600 SERIES Total Stations. Specifications for the survey equipment are on file in the SNL/NM Customer Funded Records Center. All elevation measurements were obtained as static measurements. Accuracy for static measurements is estimated at approximately ± 3 millimeters horizontal and ± 5 millimeters vertical.

The CQA surveys were more limited and performed on the surface of each ET Cover layer (Biointrusion, Native Soil, and Topsoil Layers). The purpose of the CQA surveys was to verify the precision and accuracy of the CQC survey results and confirm that the cover layers complied with the design specifications (i.e., thickness, surface slope, and side slope). The CQA verification surveys are documented in Plates No. 1 through 3 in a tabbed section at the end of this report. These plates provide all CQA survey information, including tabular data (elevation and layer thickness) and a QA verification survey grid map, and are certified by a New Mexico Professional Surveyor.

4.5 Photographic Reporting

A digital camera was used to compile comprehensive photographic logs of the 2006 Subgrade and 2009 ET Cover Construction phases. A man lift or scissors lift was maintained on site to facilitate aerial photographic documentation of the construction effort. Each photo was identified with the following information:

- The date, time, and location of the photograph
- The name of the photographer
- A brief description of the activity

The photographic logs for the 2006 Subgrade (Log No. 1) and 2009 ET Cover Construction (Log No. 2) phases represent CQA documentation and are presented in a tabbed section at the end of this report.

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5.0 Earthwork

This chapter provides a detailed summary of all MWL construction preparation, 2006 Subgrade, and 2009 ET Cover Construction activities. The CQC and CQA programs implemented to control and verify the Subgrade and ET Cover earthwork are documented in Chapters 3.0 and 4.0 and only briefly summarized in this chapter. The information presented in Chapters 3.0 through 5.0 documents that the 2006 Subgrade and 2009 ET Cover Construction earthwork conforms to the specifications and requirements of the NMED-approved CMIP (SNL/NM, November 2005). Table 1 summarizes all activities related to both phases of the MWL ET Cover construction project.

Deployment of the MWL ET Cover was conducted in two main phases consisting of the 2006 Subgrade Construction phase and the 2009 ET Cover Construction phase. The main earthwork activities associated with the two phases of construction are summarized as follows:

2006 Subgrade Construction Phase Earthwork

- Clearing, grubbing, grading, moisture-conditioning, compacting, and testing of the existing MWL surface and perimeter
- Placing, moisture-conditioning, compacting, and testing screened soil fill in lifts to create the Subgrade for the ET Cover layers with a central crown and 2-percent east-to-west design slope over the MWL disposal area
- Surveying to control and guide the construction process and verify final cover layer thickness and slope angles
- Constructing a partial drainage swale on the east side of the Subgrade
- Final surveying and installing erosion control matting to protect the Subgrade surface until ET Cover Construction was approved by the NMED

2009 ET Cover Construction Phase Earthwork

- Clearing, moisture-conditioning, compacting, and testing of the 2009 Subgrade surface
- Placing and compacting the Biointrusion Layer
- Placing loose, dry soil in Biointrusion Layer voids and compacting a thin soil layer on the rock surface to create a relatively smooth surface upon which the Native Soil Layer was constructed
- Placing, moisture-conditioning, compacting, and testing screened soil fill in lifts to create the Native Soil Layer

- Placing and minimal compacting of the Topsoil Layer
- Surveying to control and guide the construction process and verify final cover layer thickness and slope angles
- Constructing the final drainage swale on the east perimeter of the ET Cover
- Performing revegetation activities (ripping, tilling, seeding, mulching, and crimping) for the Topsoil Layer

Equipment used during the 2006 Subgrade Construction phase and 2006 supporting activities at the Borrow Pit are summarized below and in Sections 5.1 and 5.2.1. Equipment used for the 2009 ET Cover Construction phase is summarized in Table 13, and 2009 supporting activities at the Borrow Pit are summarized below and in Sections 5.4 and 5.5. For all dust suppression and soil moisture-conditioning activities performed during both phases of construction, potable water without supplementary chemicals or additives from a local TA-3 source was used. The Borrow Pit, Bulk Waste Staging Area, and associated haul routes to the MWL are shown in Figure 3.

In preparation for 2006 Subgrade and 2009 ET Cover Construction phases, rock needed to construct the Biointrusion Layer was selected and delivered to the Bulk Waste Staging Area. Rock delivery occurred from October 4 through November 14, 2005. In addition, from June 14 through July 17, 2006, Storm Water Pollution Prevention Plan (SWPPP) surface water and site controls were implemented at the Borrow Pit in TA-3 (i.e., soil berm was installed around the perimeter of the site and a cobble drive-off pad for equipment was installed at the site entrance) and soil fill material needed for construction of the Subgrade and ET Cover layers was excavated, screened to 2-inch minus, and stockpiled following the specifications of Section 02200 in Appendix A of the CMIP (SNL/NM, November 2005). Screened soil fill was hauled and stockpiled at the MWL for the Subgrade Construction phase from July 31 through November 5, 2006. This preconstruction preparation work was completed by the same Construction Contractor Team that performed the 2006 Subgrade Construction.

To support the 2009 ET Cover construction phase, Borrow Pit Area activities were performed that included loading haul trucks with existing soil fill stockpiled at the Borrow Pit in 2006 and rock stockpiled at the nearby Bulk Waste Staging Area in 2005; soil sampling of fill material according to CMIP specifications; excavation, screening to 2-inch minus, stockpiling, and loading of additional native soil and topsoil material; screening and stockpiling berm material hauled to the Borrow Pit from the MWL for use as fill material; and Pug Mill setup, calibration, and operation to blend 3/8-inch gravel with the topsoil fill material.

5.1 Existing Mixed Waste Landfill Surface

Preparation of the existing MWL surface was conducted as the first part of the 2006 Subgrade Construction phase. From October 2 through October 26, 2006, the security fence was removed and the MWL surface was cleared of vegetation. After clearing, the existing surface was graded, watered, compacted, and tested in preparation for the Subgrade Construction phase. As part of site preparation work, an area immediately south of the MWL was cleared and used as the staging area for the soil stockpile, the roll-off containers for waste and recyclable metal, the container for shredded vegetation, and equipment storage. The work area boundary was marked with a rope and signs to designate the radiation control area that was in effect for the 2006 Subgrade Construction phase. After completion of the Subgrade Construction phase, which involved placement of clean soil fill over the disposal area surface, the radiological posting of the MWL was changed to an Underground Radioactive Materials Area. This allowed the 2009 ET Cover Construction phase to proceed without formal radiological controls, although SNL/NM Radiological Control Technicians continued to be involved in the early construction phases to confirm clean operations.

Soil berms were constructed around the perimeter work area as a best management practice required by the project SWPPP for the control of storm water run-on and to control runoff from the site. The berms were inspected after each significant rainfall event (i.e., more than 0.5 inches) or semimonthly at a minimum, according to the project SWPPP requirements, and repairs were made as necessary. The existing administrative security fencing was removed and stockpiled on site for radiological clearance before disposal or recycling. The vegetation removed from the existing MWL surface and the perimeter area was shredded and containerized for future disposition. The material was sampled for radiological contamination, approved for reuse, and disposed of at the KAFB Landfill. Any material on the surface larger than 2 inches was removed and stockpiled. One remaining concrete pad pit cover was reduced to rubble in place and backfilled with stockpiled soil.

The existing surface was uneven due to the previously backfilled disposal trenches. The surface was graded, compacted with a vibratory roller, and water was added using a water truck to complete existing surface preparation activities.

5.1.1 Existing Surface Laboratory and Field Testing

After the surface was graded and compacted, in-place field density and moisture testing were performed to verify compaction of not less than 90 percent of the maximum dry density. Standard Proctor soil testing to support the in-place density and moisture field testing was

performed and is discussed in Section 4.3.2. This approach was used for verification of a stable surface rather than counting the number of passes over the surface using a roller with a ballasted weight of 25 tons, as stipulated by Section 02200 in Appendix A of the CMIP (SNL/NM, November 2005). Due to moisture being added to the surface rather than mixed into the soil prior to placement, the optimum moisture content goal of +/- 2 percent could not be attained. This approach and the results verified adequate compaction of the existing surface, and both were approved by the CQA Engineer as a design change. Laboratory results are presented in Table 4 and field-testing results are presented in Table 9.

5.1.2 Existing Surface Survey

A survey of the existing disposal area surface was performed on May 10, 2006, prior to construction activities. This survey was used to document the existing (preconstruction) MWL surface (i.e., construction starting datum) for as-built drawings, and documentation is maintained in the SNL/NM Customer Funded Records Center.

5.2 Subgrade Construction

After receiving NMED approval (Bearzi September 2006), the Subgrade Construction phase began on October 2, 2006, and was completed on April 11, 2007. Because of the delay between completion of the Subgrade Construction phase in December 2006 and the start of the ET Cover Construction in May 2009, erosion control matting was installed over the Subgrade surface as a protective measure. This activity was completed on April 11, 2007. In addition, some final Subgrade activities were required as part of the ET Cover Construction phase in May 2009. The 2006 and 2009 Subgrade construction and preparation activities are discussed in the following sections.

5.2.1 2006 Subgrade Construction

From June 14 through July 17, 2006, the soil fill material used for the Subgrade was excavated and screened to 2-inch minus according to the CMIP specifications (SNL/NM, November 2005). The soil fill material was loaded and hauled to the site from July 31 through November 5, 2006, where it was stockpiled for use in constructing the Subgrade lifts. The CQA Inspector performed visual inspections during placement of the soil at the MWL to ensure the absence of debris and material (primarily rocks) greater than 2 inches.

The following equipment was used for 2006 Subgrade Construction phase earthwork:

- Dump trucks to haul the soil (Volvo WG 64)
- Two front-end loaders to haul and spread the soil in lifts (John Deere 644G)
- An excavator at the soil stockpile to mix the soil with water before placing it on the MWL surface (John Deere 240)
- A grader (John Deere 670) to spread the soil to the required thickness (grader later replaced with a tracked bulldozer [John Deere 650G])
- One water truck (2,000 gallon Ford F650) to moisture-condition the soil and to control dust in the work area
- One vibratory roller for compacting the soil lifts (Ingersoll Rand SD 70D, 8 ton gross weight, maximum centrifugal force 32,100 pounds)
- A skid steer to spread the soil in tight areas and around groundwater monitoring well MWL-MW4 (Caterpillar 246B)

The Subgrade was installed on top of the prepared existing surface using approximately 11,000 cy (loose) of native soil fill placed in a total of 12 lifts. The subgrade soil was placed in 8-inch loose, 6-inch compacted lifts beginning with the topographically lowest areas. In general, the lower northern side of the MWL was augmented to match the higher southern grade. The goal of the Subgrade Construction phase was to establish a surface over the MWL that mirrored the final CMIP design surface of the ET Cover (i.e., a broad, central crown or high area with a 2-percent east-to-west slope across most of the MWL).

The initial seven lifts were spatially limited and largely placed to bring depressions across the site to a level grade. Lifts 8 through 12 were placed in increasingly larger areas across the MWL. A total of 12 lifts were applied, with the total depth varying from a few inches to 40 inches (approximately 3.3 feet) at the lowest spots. To guide and control lift thickness across the area, the surveyors installed grade stakes marked in 8-inch thickness levels for each lift. Each lift was compacted to meet the CMIP specification of compaction of not less than 90 percent of the maximum dry density at +/- 2 percent of optimum moisture content, as determined by ASTM D698 (Standard Proctor testing) (ASTM, 2007a). Compaction with the vibratory roller resulted in an approximate 6-inch lift. The in-place, compacted volume of the Subgrade is approximately 7,700 cy indicating a compaction factor of approximately 30 percent.

The quantity of soil was tracked by the volume per loader bucket and the number of loads per day. A total volume of soil was recorded for each lift and the locations of each laboratory and

field test were surveyed. The CQA Inspector oversaw the spreading and compaction of the soil and noted observations on the inspection forms. A loader moved the soil from the stockpile to the work area, and the grader or bulldozer leveled the soil to the lift mark on the survey stake. The vibratory roller made several passes over the work area to achieve the required compaction, which was verified through in-place field density and moisture testing.

5.2.1.1 2006 Laboratory and Field Testing

The laboratory and field-testing activities performed for the Subgrade Construction phase are discussed in Sections 4.3.1 and 4.3.2. The CQC results verified that the fill material and the constructed Subgrade met CMIP specifications and were approved by the CQA Engineer. Laboratory results are presented in Table 4 and field-testing results are presented in Table 9.

5.2.1.2 2006 Survey Verification

A final survey was performed in April 2007 to locate the corners of the Subgrade footprint, the final topographical slope, and the protective drainage swales on the southeast and northeast corners of the Subgrade perimeter. The final data is reflected in the as-built drawing provided in a tabbed section at the end of this report (2006 Subgrade As-Built Drawing No. 1).

5.2.1.3 2006 Subgrade Layer Protection

The construction delay resulting from not receiving NMED approval to proceed with the ET Cover Construction phase in late-2006/early-2007 resulted in the DOE/Sandia decision to protect the Subgrade surface from erosion as a best management practice. Sandia Oversight, Construction Team, and CQA Team personnel met to discuss the Subgrade protection alternatives, which included no action, a rock layer, and erosion control matting (i.e., straw blankets). The decision to install erosion control matting was based upon the capability of this alternative to accomplish the following objectives:

- Absorb the impact of raindrops and reduce soil loosening
- Minimize runoff and the resulting soil displacement and transport
- Absorb shear forces of overland flow
- Trap soil particles beneath straw blanket
- Reduce potential wind erosion

The CMIP design (SNL/NM, November 2005) requires an earthen swale along the eastern perimeter of the site to divert storm water run-on around the cover. The swale collects the water from the east and diverts it around the MWL to the north and south ends of the Subgrade, and then westward toward the surrounding landscape. A portion of the swale (i.e., partial drainage

swales on the east side of the Subgrade) was constructed in the locations specified in the CMIP design drawing to protect the Subgrade surface until construction of the ET Cover in 2009. The CQA Team inspected the installation of the erosion control matting and the eastern perimeter drainage swale on April 11, 2007. The matting was installed in accordance with the manufacturer's instructions. The mats were placed from west to east, and the ends and sides were anchored in an earthen trench to reduce the effects of the prevailing winds. The swale was constructed to collect water from the east of the site and direct it around the MWL with discharges to the west. The flow in the partial swale was observed to split directions from north and south approximately at the middle of the MWL. The inspection forms are provided in Attachment 5.

5.2.1.4 2006 Subgrade Approval

After completion of all construction activities, the CQA Team surveyor completed a final survey of the Subgrade surface and surrounding area in April 2007. The CQA Team documented the 2006 Subgrade Construction phase activities in a Draft Subgrade CQA Report (MKM, August 2007). Based upon a review of all construction data and documentation, the CQA Engineer approved and certified all aspects of the 2006 Subgrade Construction on August 31, 2007 (Chapter 9.0). The Draft Report was used as the starting point for this MWL Alternative Cover CQA Report.

5.2.2 2009 Subgrade Preparation

The 2009 ET Cover Construction phase began with preparation of the Subgrade surface on May 20, 2009. Mobilization activities conducted prior to the cover construction fieldwork included completing personnel training, mobilizing equipment and materials to the site, site grading and setting up temporary office/storage trailers and a water tower, rebuilding the drive-off pad and installing a silt fence as detailed in the SWPPP, and removing the existing perimeter security fence (installed after completion of the 2006 Subgrade Construction phase). Care was taken to minimize disturbance to the Subgrade surface; some of the erosion control matting remaining from 2006 and vegetation were removed by hand. Specific areas of the surface (including all of the side slopes and areas within the MWL footprint only where needed) were "back-dragged" with a John Deere (JD) 644 wheel loader to remove vegetation and remnants of the erosion control matting and to repair minor surface erosion. A 4,000-gallon water truck was used for dust suppression and to add moisture for compaction. An Ingersoll-Rand (IR) SD100 vibratory smooth drum roller was then used to compact the existing Subgrade surface.

5.2.2.1 2009 Laboratory and Field Testing

The laboratory and field testing for the 2009 Subgrade construction activities were performed in accordance with CMIP specifications (SNL/NM, November 2005–Appendix A, Section 02200) and are discussed in Sections 4.3.1 and 4.3.2. The results verified that the 2009 existing Subgrade met the CMIP specifications and were approved by the CQA Engineer. Laboratory results are presented in Table 4, and field-testing results are presented in Tables 10 (CQC) and 11 (CQA).

5.2.2.2 2009 Survey Verification

The 2009 survey approach is discussed in Section 4.4. A CQC survey was performed on the Subgrade surface to establish a baseline for subsequent cover surveys to establish thicknesses and slope according to design specifications. The survey revealed that the Subgrade surface did not meet the 2-percent east-to-west surface design slope across the eastern side of the cover from the central to the southern end of the MWL (the slope ranged from 1.8 to 1.9 percent in this area). Also, the side slopes around the northern end of the MWL were steeper than the 6 to 1 ratio specified in the CMIP (SNL/NM, November 2005). Because the side slopes of the Subgrade extend beyond the original MWL boundary and provide adequate protection of the disposal areas, at the Quality Resolution Meeting held on May 22, 2009, the decision was made to proceed with the Biointrusion Layer installation and adjust both the surface design and side slopes during construction of the overlying layers. This path forward and the Subgrade surface were approved by the CQA Engineer on May 22, 2009 (Section 3.4 and Tables 3 and 14).

5.3 Biointrusion Layer

The Biointrusion Layer was constructed from May 26 through June 17, 2009, and consisted of nominal 4- to 6-inch crushed; angular, highly siliceous, dense contact, metamorphic rock (i.e., hornfels) from the San Lazarus Gulch located in the San Pedro Mountains. This rock was selected by Sandia Project Staff after completing an evaluation of several potential rock sources and consulting with NMED representatives in 2005. Approximately 6,000 cy of rock (8,100 tons) were delivered to the Bulk Waste Staging Area from October 4 through November 14, 2005.

5.3.1 Biointrusion Layer Construction Field Tests

Prior to full-scale installation, a series of small-scale construction tests were performed at the southern end of the MWL to determine the installation method that would be most effective in achieving the following goals:

- Compacting the rock into a structurally sound, interlocking layer
- Filling void space within the Biointrusion Layer with native soil fill
- Creating an even surface to begin construction of the Native Soil Layer
- Creating an even surface to measure and verify Native Soil Layer thickness

Although filling of the void space and creation of a relatively even surface to construct the Native Soil Layer were not addressed in the CMIP, the Sandia Project Staff, Construction Team, and CQA Team identified these issues prior to construction. All parties agreed to a field-testing approach, to be approved by the CQA Engineer based upon engineering judgment, at the preconstruction meeting held on April 30, 2009 (Section 3.1 and Attachment 1).

5.3.1.1 Biointrusion Test Area I

The first test area was designed to evaluate an approach for filling the void space that consisted of placing a loose lift of native soil fill on the Subgrade surface and then placing and compacting the biointrusion rock down into the loose soil. Two truckloads of dry, loose soil were placed over an approximate 20- by 20-foot area to create a 6- to 8-inch layer prior to placing the rock. The soil was initially spread using a JD 670 motor grader, but this was later switched to a JD 650 bulldozer in an attempt to reduce the soil compaction.

The biointrusion rock was then placed on top of the 6- to 8-inch loose soil layer. Using the JD 650 bulldozer, the biointrusion rock was spread to an approximate thickness of 1 foot and compacted by tracking over the layer with the bulldozer in an attempt to push the rock down into the soil layer. After several passes with the bulldozer, it was clear that the biointrusion rock was not being pressed down through the loose soil layer to the existing Subgrade surface as intended. Instead, the rock appeared to be "free-floating" on the loose soil layer and not fully interlocking. It was determined this procedure was not adequate to meet the stated goals and CMIP specifications (SNL/NM, November 2005–Appendix A, Section 02115).

5.3.1.2 Biointrusion Test Area II

A second test area was created and the process was changed. Instead of applying a 6- to 8-inch loose soil layer on the surface of the Subgrade prior to placing the rock, the Subgrade surface was scarified using the tracks of the JD 650 bulldozer. This created a rough texture on the Subgrade surface and a thin, irregular layer of loose soil (approximately 1 to 2 inches), which was ideal for filling some of the lower void space in the rock layer without causing the rock to free-float. The final outcome was a stable, interlocking rock structure at the base of the Biointrusion Layer. The rock was compacted using a minimum of four passes with the JD 650

bulldozer. Loose, dry, soil was then placed on top of the rock layer, spread with the JD 650 bulldozer, and worked into the voids through initial spreading and tracking with the bulldozer.

Field observations revealed that the dry, loose soil flowed into the upper rock void space similar to the way sand flows through the restriction in an hourglass. The final two steps after spreading the dry, loose soil involved first compacting a thin (nominally 3-inch) layer of soil over the rock layer with a minimum of four passes with the IR SD100 vibratory roller, and then adding water to the surface of the compacted thin layer to moisture-condition it and the underlying soil that penetrated into the rock void space. After the test, part of the test area was excavated and removed, and soil could be observed penetrating all the way through the 1-foot thick rock layer. Based upon visual inspections and engineering judgment, this second method proved to be the most effective at achieving the stated goals. The revised procedure for the installation of the Biointrusion Layer was approved on May 26, 2009 (Section 3.4 and Table 3). Both test areas were reworked using the approved installation method.

5.3.2 Biointrusion Layer Construction

Loading and hauling of the biointrusion rock material from the Bulk Waste Staging Area occurred from May 26 through June 8, 2009. The Construction Team utilized 12-cy tandem dump trucks to haul material and unload it directly onto the scarified Subgrade surface. A JD 650 bulldozer was used to spread and compact the rock with a target thickness of 1.25 feet to ensure that the 1-foot minimum thickness was achieved.

The biointrusion rock was placed and compacted with a minimum of four passes by the JD 650 bulldozer to ensure compaction and interlocking of the rock. Surveys were performed continually to control and verify thickness. Due to a biointrusion rock volume shortfall, an additional 800 cy (1,100 tons) of rock material were purchased from the original quarry (material still remained from the 2005 stockpiles) and delivered directly to the east side of the site from June 8 through June 12, 2009. This rock was inspected by the CQA Engineer and approved prior to completing the Biointrusion Layer over the northeast, classified portion of the MWL (Section 3.4 and Table 3). A JD 644 wheel loader was used to place the material onto the scarified cover surface and side slopes and the JD 650 bulldozer was used to spread and compact the material.

Visual inspections of the biointrusion crushed rock and loose, dry soil were conducted throughout installation by the CQA Inspector to verify that the biointrusion rock and soil conformed to the CMIP specifications and that no organic matter, rubble, trash, or deleterious

material was identified. Only hand-operated compaction equipment was used within 3 feet of groundwater monitoring well MWL-MW4.

The Biointrusion Layer was completed, surveyed, and approved in three phases by area (South, Northwest, and Northeast). Each individual area of the Biointrusion Layer thickness was verified and approved by the CQA Engineer prior to the placement of any soil on the layer. As each area was surveyed and approved; the installation steps of dry loose soil placement, spreading, and compaction proceeded. All construction was performed in accordance with the revised Biointrusion Layer installation procedure.

5.3.3 Void Space Filling and Thin Soil Layer

After each area of the Biointrusion Layer was compacted, surveyed, and approved, dry, loose soil was placed on the surface and spread and worked into rock void space using a JD 650 bulldozer (minimum four passes to spread and track the soil into the void space). After this step was completed and the overlying soil layer thickness was approximately 3 to 4 inches, an IR SD100 vibratory drum roller was then used (minimum of four passes) to compact the remaining soil on the surface of the rock to form a smooth surface for the construction of the Native Soil Layer. Only hand-operated compaction equipment was used within 3 feet of groundwater monitoring well MWL-MW4.

Water was applied to moisture-condition the applied soil (thin layer and soil in the rock void space). All construction was performed in accordance with the revised Biointrusion Layer installation procedure.

Approximately 3,100 cy of dry, loose soil were used; the majority of which was worked into the Biointrusion Layer voids, while the remaining soil created a nominal 3-inch-thick (average) soil layer on the surface of the Biointrusion Layer. The thin soil layer created a stable surface and reference datum upon which to build and measure thickness of the Native Soil Layer. This approach was important due to the unavoidable irregularities of the biointrusion rock surface caused by the coarse (predominantly 4- to 6-inch) and angular nature of the rock material.

5.3.4 Laboratory and Field Testing, Survey Verification, and Approval

There are no laboratory or field-testing requirements for the Biointrusion Layer and overlying thin soil layer. However, compaction of the thin soil layer was performed following the same process used for Subgrade and Native Soil lifts (except the loose soil layer was thinner than a typical 8-inch loose Subgrade or Native Soil lift).

The rock material was selected in consultation with representatives of the NMED and approved by Sandia Project Staff and the CQA Engineer based upon visual observations and material measurements made in the field. Small-scale field tests and engineering judgment were used to develop a structurally sound approach to filling rock void space and to create an even surface upon which the Native Soil Layer could be constructed and its thickness determined. In-place density and moisture testing of the thin soil layer was not feasible due to the thinness of the soil layer (i.e., less than 4 inches thick) and the presence of rocks immediately below the surface.

The primary specification was Biointrusion Layer thickness of 1 foot minimum with a + 0.25-foot upper tolerance level. This was verified through both the final CQC and CQA verification surveys. The Biointrusion Layer was constructed, surveyed, and approved by the CQA Engineer in three phases by area as previously discussed (Section 5.3.2). The CQC and CQA surveys were performed for each phase/area and used to determine any grid point locations where adjustments were required to meet the thickness specification. Identified grid point locations requiring adjustment were reworked (i.e., additional rock was added and compacted following the same construction process or rock was removed if it was too thick) and resurveyed to verify corrections. After adjustment, the thickness at all grid points was equal to or greater than the 1-foot minimum requirement. The final average thickness of the completed Biointrusion Layer was 1.25 feet (Table 12). This average thickness equals the CMIP upper tolerance thickness of 1.25 feet, although the thickness at some grid points exceeds the 1.25-foot maximum.

In addition, the 2-percent east-to-west surface design slope along the eastern boundary and the side slopes around the northern end of the MWL did not meet specifications. The entire Biointrusion Layer was approved by the CQA Engineer on June 15, 2009 (Section 3.4 and Table 3). No further adjustments were required for the following reasons:

- The maximum thickness resulted in a more protective layer.
- The coarseness of the rock material made fine-tuning the surface to more than 0.25-foot precision very difficult without the risk of compromising the already achieved interlocking lattice structure and void filling.
- The decision had already been made after completion of the Subgrade to correct the 2-percent surface design slope and 6 to 1 side slopes as part of construction of the Native Soil Layer.

A CQC survey was performed on the thin soil layer overlying the Biointrusion Layer to verify the thickness, determine the surface slope, and establish a datum from which to measure the

thickness of the Native Soil Layer. The thickness of this soil layer is not considered part of the Biointrusion Layer or the Native Soil Layer, both of which meet minimum thickness specifications of the CMIP without including this layer. Grid points and surrounding areas where the thin soil layer exceeded 3 inches were rechecked and adjusted using the JD 670 motor grader where feasible. If the soil layer could not be scraped and thinned without encountering the underlying rock, no further adjustment was made.

All grid points that were altered were resurveyed, and the final average thickness of the thin soil layer overlying the Biointrusion Layer was 0.25 feet (Table 12). Final approval of the thin soil layer occurred on June 17, 2009 (Section 3.4 and Table 3).

The final average thickness of the completed Biointrusion Layer was 1.25 feet, which equals the CMIP upper tolerance thickness. The complete volume of rock used for the Biointrusion Layer is estimated at 6,800 cy. The in-place surveyed volume is approximately 5,800 cy. The 1,000-cy discrepancy (approximately 15 percent reduction) is most likely attributable to the fact that the Subgrade surface elevation was lowered approximately 1 to 2 inches during the scarification process prior to installing the Biointrusion Layer rock material. Initial volume estimates of the received rock may have also been biased slightly high.

5.4 Native Soil Layer

Construction of the Native Soil Layer was conducted from June 16 through August 4, 2009. Construction started on the side slopes around the northern end of the MWL, which were built up in lifts to meet the 6 to 1 slope requirement from June 16 through June 22, 2009. Construction of the Native Soil Layer on the surface of the MWL started on June 18, 2009, after the thin soil layer overlying the Biointrusion Layer was approved on June 17, 2009 (Table 3). Construction of the side slopes around the northern end of the MWL and the first Native Soil lift (Wedge Lift 1) on the MWL surface proceeded concurrently from June 18 through June 22, 2009.

To support construction of the Native and Topsoil Layers, additional soil fill material was excavated, screened to 2-inch minus, and stockpiled at the Borrow Pit from June 12 to July 24, 2009. During this time period, the soil berm around the MWL site originally installed as part of the 2006 Subgrade Construction phase SWPPP was excavated, hauled to the Borrow Pit, and screened for use as native soil fill (a perimeter silt fence had been installed around the berm in late May 2009). The quantity of soil fill stockpiled at the Borrow Pit in 2006 based on CMIP estimates was not sufficient to complete construction of the Native Soil and Topsoil Layers. During the Quality Resolution Meeting held on July 14, 2009, estimates were finalized for

additional soil fill needed for Native Soil and Topsoil Layer construction (Table 3). All required native and topsoil fill was excavated from the Borrow Pit, screened to 2-inch minus, and stockpiled by July 24, 2009.

The CMIP side slope specification and design required that the side slopes extend out from the MWL boundary at a 6 to 1 slope. During initial construction of the Native Soil Layer, the side slopes around the northern end of the MWL were built up using a wedge lift approach, and the final cover toe-of-slope catch points were established, so that at completion of the Topsoil Layer the final side slopes would meet the 6 to 1 CMIP specification (SNL/NM, November 2005– Appendix A, Section 02200). The soil placed and compacted to provide the appropriate side slopes was identified as 'slope lifts' and installed following the same procedure as the Native Soil Layer lifts (maximum 8-inch loose, 6-inch compacted lifts). Because the slope thickness tapered toward the toe, the thickness of each lift was also tapered, and therefore these lifts are referred to as "wedge lifts" with the maximum compacted thickness not exceeding 6 inches.

Native soil fill material was hauled from the Borrow Pit in 20-cy dump trucks and unloaded directly onto the MWL surface from June 18 through August 4, 2009. The material was placed, spread, and graded with a JD 670 motor grader; and then compacted using an IR SD100 vibratory roller (minimum four passes). The Native Soil Layer involved the placement and compaction of approximately 17,300 cy of soil (compacted, in-place cy) in eight lifts. Each lift was constructed following the specifications of the CMIP, with a maximum thickness of 8-inch loose, 6-inch compacted. Two wedge lifts (Wedge Lifts 1 and 2) were installed along with two polishing lifts (Lifts 3 and 4) to establish the 2-percent east-to-west surface design slope across the eastern side of the cover from the central to southern end of the MWL. This was necessary because neither the Subgrade nor Biointrusion Layers had the required 2-percent east-to-west surface slope in this part of the MWL (Sections 5.2.2.2 and 5.3.4).

Wedge Lifts 1 and 2 were spatially limited to the eastern side of the cover, as shown in Figure 19. Lifts 3 and 4 are referred to as polishing lifts because, although they extended across the disposal area surface, their thickness was variable, which was necessary to complete the adjustment for the 2-percent east-to-west surface design slope. After installation of Wedge Lifts 1 and 2, some areas of the cover surface required slightly more than a 6-inch compacted thickness. In order to meet the CMIP lift thickness specifications, Lifts 3 and 4 were constructed as generally thinner than 8-inch loose, 6-inch compacted lifts across the entire surface of the MWL. Survey grade stakes were used to guide the construction process for these first four lifts.

Lifts 5 through 8 were more standardized lifts that were installed across the entire cover surface as 8-inch loose, 6-inch compacted lifts. Grade stakes were set across the entire cover surface at or near the 50-foot grid points for each lift to guide the process and allow for visual confirmation that specifications were being followed.

5.4.1 Laboratory and Field Testing

The laboratory and field-testing activities for the Native Soil Layer side slopes and lifts were performed in accordance with CMIP specifications (SNL/NM, November 2005) and are discussed in Sections 4.3.1 and 4.3.2. The results verified that the Native Soil Layer met the CMIP specifications and were approved by the CQA Engineer. Laboratory results are presented in Tables 5 and 6, and field-testing results are presented in Tables 10 and 11.

Because of the limited spatial distribution of Wedge Lifts 1 and 2, only three CQC and two CQA in-place field density moisture tests were performed on Wedge Lift 1, and two CQC tests and one CQA test were performed on Wedge Lift 2 (total of eight tests for Wedge Lifts 1 and 2). Lift 3 was not thick enough across the surface for field testing in all 13 grid blocks. Four CQC tests and two CQA tests were conducted for Lift 3. All 13 grid blocks were tested for Lifts 4 through 8 as discussed in Section 4.3.2. Figures 21 through 29 show all CQC and CQA field-testing locations for the Native Soil Layer side slopes (Figure 21) and lifts (Figures 22 through 29).

During field testing of Lift 5, Grid Blocks 2, 3, 5, and the east edge of Grid Block 7 failed moisture and density tests. The east slope of Grid Block 7 met specifications after water was added. Grid Blocks 1 through 5 of Lift 5 were ripped using the scarifier shanks on the JD 670 motor grader to a depth of approximately 6 inches, moisture-conditioned, recompacted, and retested. The retest results met specifications. The 3-foot perimeter around groundwater monitoring well MWL-MW4 was compacted using a manually operated compactor and tested in addition to Grid Block 9 for Lifts 6 through 8. Lifts 6 and 8 failed the moisture content tests, so additional water was applied to the material. The area was retested and met specifications. Lift 8 and Grid Blocks 8 and 10 also failed initial tests for moisture content, so the same procedure was followed (i.e., additional water was applied) and passing results were obtained from the repeated tests.

5.4.2 Survey Verification and Approval

The thickness, surface slope, and side slopes of the Native Soil Layer were verified through both CQC and CQA surveys using the 50-foot-spaced verification grid (Figure 18). The CQC survey

data is provided in Table 12. During this verification process, nine points were identified by both the CQC and CQA surveys that were slightly less than the minimum 2.5-foot thickness, with two of these points falling outside the cover surface on the northern side slope. The range of values below the minimum thickness was 2.09 to 2.42 feet, which appears to be related to irregularities (i.e., high spots) in the Biointrusion Layer. A thin layer of additional soil was placed and compacted in these areas to increase the thickness to 2.55 feet, with the thickest fill layer being 0.46 feet (compacted). After adjustments, the corresponding grid points were resurveyed and all grid points met the specification of 2.5-foot minimum thicknesses.

The final average thickness of the completed Native Soil Layer was 2.85 feet, which reflects the buildup on the eastern side of the cover to correct the 2-percent east-to-west surface design slope inherited from the Subgrade and Biointrusion Layer (Table 12; Sections 5.2.2.2 and 5.3.4). Eleven grid points exceeded 3 feet in thickness (D7, E1, E4–E7, F5, G5, H5, I5, and G4); all of these grid points are located at or near the eastern boundary of the MWL where Wedge Lifts 1 and 2 were installed (Table 12; Figures 18 and 19). The two grid points with the thickest measurements, E6 and E7 at 3.66 and 3.98 feet, respectively, are located just south of the MWL boundary (Figure 18). The Native Soil Layer thickness at these two points is greater because they are located over the side slope. The 2-percent east-to-west surface design slope was verified across the central and southern portion of the Native Soil Layer surface, and the side slopes were verified to be 6 to 1 or slightly flatter, with the exception of the northwestern corner where the side slope was 4.4 to 1 (Native Soil Layer QA Verification Survey Plate No. 2 in tabbed section at end of report). No adjustment was required at this one location; final adjustment was made during installation of the Topsoil Layer. Final approval of the Native Soil Layer occurred on August 4, 2009 (Section 3.4 and Table 3).

Based on the final survey data, the final in-place compacted volume of the Native Soil Layer is estimated at 17,300 cy.

5.5 Topsoil Layer

Construction of the Topsoil Layer was conducted from August 3 through August 12, 2009. Topsoil material consisted of topsoil (upper 6 inches of the in situ Borrow Pit Area soil) and native soil (soil from below 6 inches) excavated from the Borrow Pit, screened to 2-inch minus, then admixed with 3/8-inch crushed gravel, 25 percent by volume according to the specifications of Section 02200 in Appendix A of the CMIP (SNL/NM, November 2005). A Pug Mill was mobilized to the Borrow Pit Area in late June 2009 and then set up, calibrated, tested, and operated to blend 3/8-inch crushed gravel with the topsoil fill material. Pug Mill operations were

conducted from July 6 through July 24, 2009. The gravel was delivered and stockpiled at the Borrow Pit just prior to and during the Pug Mill operation period.

Approximately 7,300 cy (loose) of topsoil material with 25 percent by volume, 3/8-inch crushed gravel were hauled from the Borrow Pit in 20-cy dump trucks and unloaded directly onto the MWL surface (approximately 5,500 cy of topsoil and 1,800 cy of 3/8 inch gravel). The material was spread with a JD 670 motor grader in a single, approximately 12-inch loose lift. Hubs and whiskers were used instead of grade stakes for the Topsoil Layer (blue top approach). No compaction was performed on the loose lift beyond that accomplished by the equipment placing the material to facilitate seedling growth and root development.

Visual inspections of the topsoil fill containing 25 percent by volume 3/8-inch crushed gravel were conducted throughout the installation by the CQA Inspector to verify that the topsoil fill conformed to the CMIP specifications. No organic matter, rubble, trash, rocks, or deleterious material greater than 2 inches in dimension was identified.

Due to the larger footprint of the as-constructed ET Cover (versus the 2005 CMIP design [SNL/NM, November 2005]), the toe of the cover slope on the west side extended to the three MWL groundwater monitoring well pads (MW-7 through MW-9) and two shallow vadose zone moisture monitoring access tube pads (MWL-VZ-1 and VZ-2). Soil drainage diversions immediately east (i.e., upslope) of the three monitoring well locations were constructed to create a localized east-west ridge (i.e., localize high point) parallel to the slope angle. These small ridges or high points divert water to the north and south of the monitoring well/access tube pads, protecting them from surface runoff. These features are shown in the 2009 as-built drawing (Figure No. 2, Mixed Waste Landfill Alternative Evapotranspirative Cover Site Plan, provided in a tabbed section at the end of this report) and represent a design change that was approved by the CQA Engineer as part of the Topsoil Layer.

The eastern perimeter boundary drainage swale that was designed to divert surface water run-on around the northern and southern ends of the final ET Cover was completed during Topsoil Layer installation and is shown in the 2009 as-built drawing (Figure No. 2, Mixed Waste Landfill Alternative Evapotranspirative Cover Site Plan, provided in a tabbed section at the end of this report).

Following CQC and CQA verification surveying that confirmed proper layer thickness and slope angles, the Topsoil Layer surface was ripped to loosen the soil and then tilled to break up larger

soil clumps in preparation for seeding. The initial ripping was accomplished using scarifier shanks on the JD 670 motor grader. Additional surface preparations were conducted as part of the revegetation activities discussed in Section 5.6.

5.5.1 Laboratory and Field Testing

The laboratory and field-testing activities performed for the Topsoil Layer are discussed in Sections 4.3.1 and 4.3.2. The Gradation and Classification results verified that the topsoil fill material met the CMIP specifications (SNL/NM, November 2005) and were approved by the CQA Engineer. Laboratory results are presented in Tables 5 and 7 and field-testing results (not required by the CMIP) are presented in Table 10.

Although there were no in-place field density and moisture testing requirements for the Topsoil Layer, field tests were performed for the layer to document the compaction achieved prior to the revegetation effort. Four topsoil Standard Proctor samples were collected to support field testing. Four grid block locations were tested (CQC tests only) at two depths per location, for a total of eight in-place density and moisture tests ranging in depth from 4 to 10 inches. Percent of maximum dry density achieved ranged from 75 percent (at a 4-inch testing depth) to 96 percent (at an 8-inch testing depth), and the moisture content ranged from 3.7 to 5.4 percent.

5.5.2 Survey Verification and Approval

The thickness, surface slope, and side slopes of the Topsoil Layer were verified through both the CQC and CQA surveys using the 50-foot-spaced verification grid (Figure 18). The average thickness of the Topsoil Layer after placement was 1.02 feet, and the thickness at each grid point exceeded the minimum CMIP specification of 8 inches (Table 12). Correction of the side slope at the northwestern corner was verified by both the CQC and CQA surveys. The final CQC and CQA survey data, including the thickness and slopes (surface design and side slopes), were approved by the CQA Engineer on August 12, 2009 (Section 3.4 and Table 3).

Based on the final survey data, the final in-place volume of the Topsoil Layer is 5,400 cy.

5.6 Revegetation Activities and Administrative Security Fence Installation

Revegetation activities were initiated on August 12, 2009, with the installation of an aboveground sprinkler irrigation system that covered the entire surface of the MWL. Tilling, seeding, and crimping operations were conducted from August 19 through September 2, 2009, using a Kubota M7040 agricultural tractor. The tiller was towed by the tractor to till the soil on the cover, slopes, and surrounding area, which broke up the larger soil clumps present after the

surface was ripped using scarifier shanks on the JD 670 motor grader. Tilling on side slopes was conducted perpendicular to the slope direction to minimize surface erosion and was completed on August 20, 2009. After tilling, personnel walked the site to break up clumps near irrigation piping that the tiller did not reach.

After rain delays, seeding operations began on August 25, 2009, and were completed on September 2, 2009. Based on recommendations from the SNL/NM Staff Biologist that were approved by the CQA Engineer on August 25, 2009 (Section 3.4 and Table 3), the following modifications were implemented to the Reclamation Seeding and Mulching Specification of the CMIP (SNL/NM, November 2005–Appendix A, Section 02930):

- Uniform seeding rate of 80 pounds of seed mix per acre (4 times the minimum specified rate of 20 pounds per acre)
- No fertilizer added due to timing of seeding
- Supplemental watering to assist seed germination and root development

The seed drill equipment set at the maximum output rate was capable of applying 20 pounds of seed mix per acre. At this rate, the seed drill equipment would have required a minimum of four passes to achieve the 80-pounds-per-acre requirement. This approach would have resulted in an unacceptable amount of compaction to the topsoil, so the decision was made and approved by the CQA Engineer to spread half of the seed by hand. The remaining seed was applied using two passes with the seed drill equipment. Following placement of seed, straw was blown over the site at the rate of 2 tons per acre and crimped in. Seed and mulch placement were approved by the CQA Engineer on September 2, 2009 (Section 3.4 and Table 3).

Supplemental watering of the seeded Topsoil Layer is not addressed in the CMIP and is not considered part of the alternative cover construction scope. The NMED was notified of the supplemental watering schedule and approach on August 13, 2009. On September 3, 2009, supplemental watering began using the aboveground irrigation system. Watering continued through October 20, 2009, to facilitate the establishment of a native plant community. Consistent with the NMED conditional approval of the CMIP (Bearzi, December 2008), detailed supplemental watering information will be included in the revised LTMMP for the MWL.

As seeding and mulching activities were being completed, the three-strand barbed wire administrative security fence was installed around the cover as specified in the CMIP (SNL/NM, November 2005–Appendix A, Section 02445) from August 31 through September 2, 2009. One access gate was placed at the northern end. Due to the slightly larger footprint of the

as-constructed cover, the fence is positioned on the 6 to 1 side slope on the west side of the ET Cover, just east of three groundwater monitoring wells located on this side of the MWL. The location of the administrative security fence is shown in the 2009 As-Built Drawing No. 2 in a tabbed section at the end of this report.

The final CQA Engineer approval of revegetation occurred on September 2, 2009 (Section 3.4 and Table 3).

The Borrow Pit Area was graded for proper drainage from August 18 to August 24, 2009. It will be seeded and reclaimed during the 2010 growing season if it is not transferred to the SNL/NM Facilities organization for continued use as required by the CMIP. Documentation will be provided in the MWL LTMMP.

6.0 Monitoring Well (MWL-MW4) Extension

The outer protective casing and the well casing of groundwater monitoring well MWL-MW4 were raised on May 27, 2009, prior to installation of the ET Cover layers, as specified in the CMIP (SNL/NM, November 2005). The two casings were extended to a height approximately 3 feet above the estimated completion surface of the ET Cover assuming the overlying ET cover layers would meet the minimum thickness specifications. Because the three ET Cover layers were constructed with a thickness greater than the minimum specifications (Sections 5.3 through 5.5), the final height of the MWL-MW4 well casing above the surface of the completed ET Cover is approximately 1 foot, 4 inches, which is less than the minimum specification in the CMIP of 2 feet, 6 inches above the final grade of the constructed cover. The final height of the well casing was approved by the CQA Engineer as a design change instead of extending the well casings an additional 1 foot, 2 inches to meet the minimum specification because there were no adverse impacts to the cover quality or performance of the monitoring well. A new concrete well pad and protective bollards were installed around MWL-MW4 on August 13, 2009, after completion of the Topsoil Layer installation. A report summarizing the extension of monitoring well MWL-MW4 is provided in Attachment 8.

Two soil-vapor monitoring wells, required by the NMED and referred to as "soil-vapor sampling points" (Bearzi, December 2008), were installed from August 5 to August 7, 2009, during construction of the Topsoil Layer. The wells were installed through the Topsoil Layer prior to seeding and mulching activities to eliminate damage to both the surface and plants that would result from driving the drilling equipment over the Topsoil Layer surface after having seeded and mulched it. Although required by the NMED, installation of these soil-vapor monitoring wells is not part of cover construction requirements as defined in the CMIP (SNL/NM, November 2005); therefore, the soil-vapor monitoring well installation will be documented in a separate report to be submitted to the NMED for approval.

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7.0 Cover Layer Approvals, Nonconformances, and Design Changes

Documentation associated with the 2009 Quality Resolution Meetings and ET Cover layer approval is summarized in Sections 3.3 and 3.4, Table 3, and Attachments 1 and 2. Based upon the final CQC survey data (Table 12) and 2009 as-built drawings (Figures No. 2 and 3 in tabbed section at the end of this report), the final ET Cover surface meets the 2-percent east-to-west surface design slope, and all side slopes meet or exceed (i.e., are flatter) than the 6 to 1 specification. All cover layers were approved prior to starting construction of the next layer as stipulated in the CMIP CQA Plan (SNL/NM, November 2005–Appendix B).

Consistent with the CMIP CQA Plan, nonconformances are defined as deviations or changes to construction and/or design specifications. If it is determined by the CQA Engineer that a nonconformance has an adverse impact on quality of the ET Cover, a corrective action plan and documentation of corrective action implementation are also required. Design changes are minor variances from construction and/or design specifications that do not have an adverse impact on quality and therefore do not require corrective action. However, nonconformances and design changes must be documented.

Two nonconformances were identified. During the 2006 Subgrade construction phase, CQC versus CQA in-place density and moisture field tests were not clearly distinguished and the CQA Team directed/performed all of the field testing instead of the construction team performing/directing the required CQC tests. The actual in-place density and moisture testing performed during Subgrade construction exceeded the CMIP specifications of 5 CQC tests per acre per lift plus at least 5% additional confirmatory CQA tests. Based upon the aerial extent of the 12 Subgrade lifts, 48 CQC and 3 CQA field tests were required; however, a total of 71 field tests were performed. In the judgment of the CQA Engineers, the testing performed exceeded requirements and there was no quality impact to the Subgrade of the MWL ET Cover.

The second nonconformance occurred during the 2009 ET Cover construction phase and involved saturated hydraulic conductivity tests performed using the ASTM D-5856 rigid wall (remolded) method on the Native Soil Layer fill material. Although the term “rigid wall” is used twice in the CMIP construction specifications (Appendix A, Section 02200 Earthwork) and is a valid method for determining the saturated hydraulic conductivity in these types of soils, the intent of the CMIP specification appears to indicate the use of the ASTM D-5084 flexible wall (undisturbed) method. After discussion at the June 16, 2009 Quality Resolution Meeting, the

project team agreed that the ASTM D5856-95 rigid wall method was the best method for two main reasons: 1) samples could be collected without compromising the integrity of the installed Native Soil Layer lift (i.e., without punching holes in the lift surface), and 2) compaction of the sample in the laboratory could be controlled to accurately simulate compaction achieved in the field. In the judgment of the CQA Engineer there was no impact on the quality of the ET Cover and a corrective action plan was not required.

All design changes are summarized in Table 14, along with a brief explanation of why they had no adverse quality impact. For both the 2006 Subgrade and 2009 ET Cover Construction phases, all technical issues and design changes were addressed by the respective project teams and resolved through a team approach in documented meetings and project-specific approval forms as discussed in Chapter 3.0. The project teams included Sandia Oversight, CQA Team, and Construction Team representatives. The design changes were approved by the CQA Engineer and did not result in an adverse impact on the quality of the final cover. In all instances, the implemented design changes had a neutral or positive impact on ET Cover quality.

For the 2006 Subgrade construction activities, the compaction and in-place density and moisture field-testing approach for the existing MWL surface, supported by Standard Proctor results, provided a more quantitative approach for verifying adequate compaction than the CMIP-specified approach of "counting 10 passes of a roller with ballasted weight of 25 tons and a minimum tire pressure of 90 psi." The overall relative uniformity of the Borrow Pit soil fill material, particularly after screening and stockpiling procedures, is demonstrated by the large number of Standard Proctor, Gradation, and Classification results collected throughout the 2006 and 2009 construction phases (Tables 4, 5, 6, and 7; Figure 20). These data support the conclusion that the existing MWL surface soil is very similar to the Borrow Pit soil. In addition, the data support the use of relatively few Proctors for the 2009 in-place density and moisture field-testing program, as well as the use of one Proctor to cover approximately 1,500 cy of soil fill during the 2006 Subgrade Construction phase field-testing program, as approved by the respective CQA Engineers.

On May 22, 2009, a Quality Resolution Meeting was held to discuss the 2009 existing Subgrade surface, which did not meet the 2-percent east-to-west surface design slope across the eastern side of the cover from the central portion to the southern end of the MWL (slopes ranged from 1.8 to 1.9 percent in this area). After evaluating the CQC survey data and discussing possible solutions, Sandia Oversight, Construction Team, and CQA Team representatives determined that

the most technically sound and protective engineering solution was to make the surface slope correction (i.e., increase the elevation of the eastern side of the ET Cover surface) during construction of the Native Soil Layer.

Although it was recognized that adjusting the surface slope as part of Native Soil Layer construction would result in an exceedence of the upper tolerance thickness of 2.75 feet, the resulting layer and overall thicker ET Cover would be more protective, both as a physical barrier (between the surface and the waste) and a water storage layer (greater water storage capacity above the waste). The main design purpose of this layer is to act as a water storage reservoir retaining water until it can be removed by evapotranspiration. The thicker Native Soil Layer has a larger capacity for holding water. In addition to these advantages, establishing and/or maintaining the 2-percent surface design slope on the Biointrusion Layer surface would have been difficult due to the coarse, angular nature of the material (predominantly 4- to 6-inch crushed rock). Although the goal was to maintain the 2-percent surface design slope on each ET Cover layer, this slope is most important on the surface of the ET Cover (i.e., the Topsoil Layer) for the purpose of surface water drainage. After careful consideration, the project team agreed that making the 2-percent east-to-west surface design slope correction during Native Soil Layer construction was the best approach.

The issue of the Subgrade side slopes around the northern end of the MWL being steeper than the 6 to 1 ratio specified in the CMIP was also addressed at the Quality Resolution Meeting held on May 22, 2009. Because the side slopes of the Subgrade extend beyond the original MWL boundary, the decision was made and approved by the CQA Engineer to proceed with the Biointrusion Layer installation and correct both the surface design and northern end side slopes during the construction of the overlying layers. Adjusting the side slope angles to 6 to 1 as part of the Subgrade would have extended the overall ET Cover footprint well beyond the design footprint and required a considerable amount of additional biointrusion rock, as well as native soil and topsoil fill material. The groundwater monitoring wells on the west side of the MWL would have been significantly impacted, creating additional design change issues.

Table 15 compares the CMIP in-place, compacted soil and rock volume estimates to the as-constructed estimates based on the final CQC survey data (Table 12) and 2009 as-built drawings (Figures No. 2 and 3 in tabbed section at the end of this report). The as-constructed rock and soil volumes are approximately 27 percent greater than the CMIP estimates, in large part due to the final average thickness of each cover layer exceeding the minimum thickness specified in the CMIP (SNL/NM, November 2005), as discussed in Sections 5.2 through 5.5.

The CMIP cover layer volume estimates are based upon the minimum thickness specifications and assumed a compaction factor (i.e., reduction in volume from loose to compacted soil fill) of approximately 25 percent. The percent compaction achieved during construction appears to be approximately 30 percent instead of 25 percent as estimated in the CMIP based upon comparing loose volume estimates to compacted, in-place volume estimates. The main points related to this design change (i.e., thicker ET Cover that required more materials than estimated in the CMIP) are summarized as follows:

- The thicker overall ET Cover with a larger footprint was necessary to achieve the 2-percent east-to-west cover surface design slope and the 6 to 1 side slopes in accordance with the CMIP specifications and drawings.
- In all cases, the ET Cover layers were constructed to exceed the minimum thickness specifications to ensure a protective final ET Cover (i.e., a conservative construction approach).
- The as-constructed ET Cover is approximately 1.2 feet thicker than the CMIP design minimum thickness specifications, as shown schematically in Figure 4.
- The thicker, more protective final ET Cover was achievable within the estimated project budget and schedule.

The final as-constructed ET Cover meets or exceeds the CMIP (SNL/NM, November 2005) construction and design specifications. Although a higher cover profile does increase cover exposure to wind and water erosion, these factors are mitigated by the design surface and side slopes, as well as the long-term monitoring and maintenance requirements for the ET Cover that will be formalized in the MWL LTMMP.

8.0 Conclusions

For the 2006 Subgrade Construction phase only, an independent MWL CQA Plan (SNL/NM, May 2006) was prepared that incorporated the regulatory guidance and design and specification requirements for the construction of the MWL cover as defined in the CMIP (SNL/NM, November 2005). For the 2009 ET Cover Construction phase, the CQA Plan in Appendix B of the CMIP (SNL/NM, November 2005) was used directly.

For both the 2006 and 2009 phases, a representative of the CQA team was at the site each workday to inspect and oversee construction activities and the field and laboratory testing. The results of the inspections and oversight are provided on the inspection forms, daily reports, and approval forms attached to this report. This report also presents a summary of the construction activities, CQC and CQA laboratory and field-testing results, CQC and CQA survey results, as-built drawings documenting cover construction, and photographic records of the activities.

All nonconformances and design changes are documented and were made in consultation between the Construction Team, Sandia Project Staff, and the CQA Team. These changes did not result in an adverse impact on the quality of the final cover and did not require corrective action. All cover layers were approved as stipulated by the CQA Plan in Appendix B of the CMIP (SNL/NM November 2005) prior to starting construction of the next layer, and all cover-related design changes resulted in a more protective cover. This report and the attachments provide the required documentation to verify that the MWL existing surface, Subgrade, ET Cover layers (Biointrusion, Native Soil, and Topsoil Layers), and site drainage features were prepared and installed in accordance with the CMIP (SNL/NM, November 2005) construction and design specifications. A New Mexico-registered Professional Engineer has certified that the MWL alternative cover construction was performed in accordance with the plans and specifications (Chapter 9.0).

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9.0 Engineering Certification

During construction of the subgrade, I have performed tasks required of the CQA Engineer in accordance with the CQA Plan for the MWL Alternative Cover construction at Sandia National Laboratories, New Mexico. I certify that the MWL subgrade has been prepared and constructed in accordance with construction plans and specifications and the MWL Cover Construction Quality Assurance Plan. I certify that to the best of my knowledge the CQA subgrade preparation draft report accurately documents the CQA activities conducted under my responsible charge as the CQA Engineer.

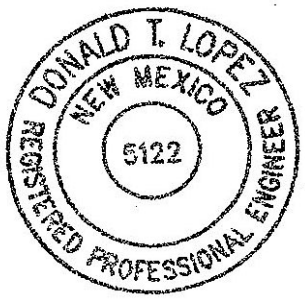
Kelly M. Peil

Kelly M. Peil, PhD, P.E. Title: CQA Certifying Engineer
MKM Engineers, Inc. Date: August 31, 2007

State: New Mexico Registration No. 9718

Note: The certification statement above pertains to the 2006 Subgrade Construction effort only. The CQA subgrade preparation draft report referenced in the statement above was incorporated into this January 2010 CQA Report as explained in Section 1.3

During the construction of the 2009 ET Cover, I have performed tasks required of the CQA Engineer in accordance with the CQA Plan in Appendix B of the MWL CMIP (SNL/NM, November 2005). I was also involved in an oversight role during the 2006 Subgrade Construction phase and have reviewed the associated CQC and CQA data and documentation. I certify that both the 2006 Subgrade and the 2009 ET Cover for the MWL have been prepared and constructed in accordance with the construction plans, drawings, and specifications contained in the MWL CMIP (SNL/NM, November 2005), including Appendix A (MWL Landfill Alternative Cover Construction Specifications Revision 2 [July 29, 2005]) and Appendix B (CQA Plan). I certify that to the best of my knowledge this MWL Alternative Cover CQA Report, as revised to address NMED comments provided on May 20, 2011, accurately documents the construction, CQC, and CQA activities conducted under my responsible charge as the CQA Certifying Engineer.



Donald T. Lopez, PE
URS Group. Inc.

Title: CQA Certifying Engineer
Date: July 12, 2011

State: New Mexico

Registration No. 5122

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Tables

Table 1
Summary of Mixed Waste Landfill Subgrade and ET Cover Construction Activities

Activity	Start	Finish	Description
2005 and 2006 Preparation Activities			
Biointrusion Rock Delivery	October 4, 2005	November 14, 2005	Approximately 8,100 tons (6,000 cubic yards) of biointrusion rock delivered to the Bulk Waste Staging Area.
Preconstruction Land Survey	May 10, 2006	May 10, 2006	Existing MWL site surface surveyed to document the preconstruction existing land surface. This survey used to construct the Subgrade and ET Cover as-built drawings.
MWL Borrow Pit Activities	June 14, 2006	July 17, 2006	Surface water and site controls were implemented and soil fill material for construction of the Subgrade and ET Cover layers was excavated, screened to 2-inch minus, and stockpiled.
Hauling Soil for Subgrade	July 31, 2006	November 5, 2006	Screened soil fill stockpiled at the MWL Borrow Pit was hauled and stockpiled at the MWL site for Subgrade construction.
2006 Subgrade Construction Activities			
Existing Land Surface Preparation	October 2, 2006	October 26, 2006	Site security fence was removed, MWL site surface water controls were implemented, and the existing MWL surface was cleared of vegetation, graded, watered, compacted, and field tested.
Subgrade Construction	October 27, 2006	December 21, 2006	Subgrade constructed in 12 lifts to create the central crown and 2% east-to-west design slope over the MWL. Laboratory and field testing conducted for each lift. Final survey completed in April 2007.
Subgrade Protective Measures	April 3, 2007	April 11, 2007	Erosion matting installed over the completed Subgrade surface as a protective measure due to delay in NMED-approval of CMIP and ET Cover implementation. Eastern surface drainage swale and erosion control matting inspected and approved by the CQA Engineer on April 11.
2009 ET Cover Construction Activities			
Mobilization and Training	May 11, 2009	May 18, 2009	Resources, equipment, and office trailer mobilized to site and personnel training completed. Installed new perimeter boundary, silt fence, and drive-off pad. Removed administrative fence.
Subgrade Layer	May 20, 2009	May 22, 2009	Cleared vegetation, watered and compacted surface, and performed field testing and verification survey. Subgrade approved on May 22.

Table 1 (cont'd.)
Summary of Mixed Waste Landfill Subgrade and ET Cover Construction Activities

Activity	Start	Finish	Description
2009 ET Cover Construction Activities (cont'd.)			
Biointrusion Layer	May 26, 2009	June 16, 2009	Construction tests conducted on May 26. Hauled and placed existing rock to create 1.25-foot-thick layer, then placed dry, loose soil on top to fill voids and create a thin soil layer above the rock (~3 inches). New rock material hauled directly to site from vendor June 8-12 to complete installation. Verification surveys for thickness of rock layer performed in 3 phases (South, Northwest, Northeast) to allow installation of the overlying thin soil layer to proceed concurrently with Biointrusion Layer installation. Entire Biointrusion Layer approved on June 15, and thin soil layer approved on June 17.
MW4 Extension	May 27, 2009	August 13, 2009	Well casing and protective outer steel casing extended to accommodate surface elevation increase associated with construction of the cover. Concrete pad and well bollards installed on August 13.
Native Soil Layer	June 15, 2009	August 4, 2009	Placed and compacted soil in lifts for side slopes (June 16-22) and cover surface (June 18-August 4). Constructed side slopes to 6 to 1 ratio around north end June 16-22. Construction of Native Soil Layer on cover surface did not proceed until thin soil layer approval on June 17. Wedge lifts used to establish 2% east-to-west surface design slope on cover surface. Verification surveys performed for thickness and slopes – Native Soil Layer approved on August 4.
Borrow Pit Area Activities	June 12, 2009	July 24, 2009	Excavated and screened (2-inch minus) additional soil fill material, including SWPPP berm soil excavated and hauled to the Borrow Pit from the MWL site. Pug Mill operations set up and calibrated to blend topsoil and 3/8-inch crushed gravel – blending performed July 6-24.
Soil-Vapor Monitoring Points	August 6, 2009	August 7, 2009	Two soil-vapor monitoring points (MWL-SV1 and -SV2) installed through the ET Cover to an approximate depth of 35 feet below the original ground surface. Concrete pad and well bollards installed on August 13, 2009.
Topsoil Layer	August 3, 2009	August 12, 2009	Placed topsoil on cover and side slopes, verification survey performed for thickness and slopes – Topsoil Layer approved on August 12. Then surface was ripped and tilled in preparation for seeding. Topsoil not placed on the Native Soil Layer in 9 locations that required final adjustment until they were approved on August 4.
Seeding and Mulching	August 19, 2009	September 2, 2009	Tilled and drill-seeded entire cover surface, side slopes, and disturbed areas. Approximately ½ the seed was hand-broadcasted to minimize compaction caused by multiple passes with the tractor. After rain delays, seeding began on August 25 and the final step of crimping straw mulch into surface was completed and approved on September 2.

Table 1 (cont'd.)
Summary of Mixed Waste Landfill Subgrade and ET Cover Construction Activities

Activity	Start	Finish	Description
2009 ET Cover Construction Activities (cont'd.)			
Supplemental Watering	August 12, 2009	October 20, 2009	Temporary irrigation system set up and tested August 12 through September 2. System operated from September 3 through October 20 to help establish native vegetation.
Administrative Fence	August 31, 2009	September 2, 2009	Perimeter administrative security fence installed around MWL.
Grading and Revegetation of the Borrow Pit	August 18, 2009	August 24, 2009	Borrow Pit Area graded for proper drainage from August 18-24. Will be seeded and reclaimed during the 2010 growing season if it is not transferred to SNL/NM Facilities for continued use.

CMIP = Corrective Measures Implementation Plan
CQA = Construction Quality Assurance.
ET = Evapotranspirative
MWL = Mixed Waste Landfill
NMED = New Mexico Environment Department
SNL/NM = Sandia National Laboratories/New Mexico
SWPPP = Storm Water Pollution Prevention Program

Table 2
Summary of CQA Personnel Qualifications
Mixed Waste Landfill ET Cover Construction Project

Position	Individual(s)	Qualifications
2006 Subgrade Construction		
CQA Engineer	Kelly Peil, PhD, P.E.	Employed by MKM Engineers, Inc.; registered Professional Engineer in the State of New Mexico.
CQA Inspector	Corey Woods, E.I.T.	Employed by MKM Engineers, Inc.; experienced in performing appropriate field tests and making observations during construction activities.
CQA Certifying Engineer	Kelly Peil, PhD, P.E.	Employed by MKM Engineers, Inc.; registered Professional Engineer in the State of New Mexico.
2009 ET Cover Construction		
CQA Certifying Engineer	Donald T. Lopez, PE	Employed by URS Group, Inc.; registered Professional Engineer in the State of New Mexico.
CQA Inspector	Paul Molina, E.I.T.	Employed by URS Group, Inc.; experienced in performing appropriate field tests and making observations during construction activities.
CQA Engineers	Harry Buckner, P.E.	Employed by URS Group, Inc.; experienced in land surveying and is a registered Professional Engineer in the State of New Mexico.
	Marshall W. Nay, PhD, P.E., PLS	Employed by URS Group, Inc.; registered Professional Engineer in the State of New Mexico.

CQA = Construction Quality Assurance
ET = Evapotranspirative

Table 3
Mixed Waste Landfill 2009 ET Cover Construction
Quality Resolution Meetings and Cover Layer Approval

Date	Meeting[1]/Form	Topic	Comments
Existing Subgrade			
5/22/2009	Quality Resolution	Approval of Subgrade	QA and QC moisture/density testing results and QC survey reviewed and approved by the CQA Engineer. Subgrade approved - construction of the Biointrusion Layer may proceed.
5/22/2009	*APPROVAL FORM*	*Subgrade Approval Form AP# 001*	*Subgrade surface approved. See approval form in Attachment 2 for additional information.*
Biointrusion Layer			
5/26/2009	Quality Resolution	Construction field tests and thickness verification	Biointrusion Layer installation method determination and decision to place all of rock prior to adding dry, loose soil to surface to fill voids.
5/26/2009	*APPROVAL FORM*	*Biointrusion Rock, Installation Procedure, and Thickness Verification Approval Form AP# 002*	*Biointrusion rock, installation procedure, and thickness verification requirement approved. See approval form in Attachment 2 for additional information.*
6/1/2009	Quality Resolution	QC survey and QA verification survey coordination	50-foot verification grid system established.
6/4/2009	Quality Resolution	Rock volume and thickness issues	Additional rock required to complete the Biointrusion Layer. Thickness of the layer in relation to the construction method and nature of rock material was addressed.
6/5/2009	Quality Resolution	QA verification survey and approval for soil placement on the Biointrusion Layer surface	South portion of Biointrusion Layer approved - placement of soil over the rock can proceed except at 4 grid points on the west slope at the south end. Thickness at these points will be adjusted and resurveyed prior to approval.
6/5/2009	*APPROVAL FORM*	*Biointrusion Thickness Approval Form AP# 003*	*Biointrusion Layer thickness approved (South). See approval form in Attachment 2 for additional information.*
6/8/2009	*APPROVAL FORM*	*Additional Biointrusion Rock Approval Form AP# 004*	*Additional Biointrusion Layer rock approved. See approval form in Attachment 2 for additional information.*
6/9/2009	Quality Resolution	QA verification survey and approval for soil placement on the Biointrusion Layer surface	The thickness at the 4 points on the west slope at south end adjusted, resurveyed, and approved – placement of soil over the rock at these 4 grid points approved. Northwest portion of Biointrusion Layer approved except for 2 points on the north slope that will be adjusted, resurveyed, and approved prior to placement of soil.
6/9/2009	*APPROVAL FORM*	*Biointrusion Thickness Approval Form AP# 005*	*Biointrusion Layer thickness approved (Northwest and South corrections). See approval form in Attachment 2 for additional information.*

Table 3 (cont'd.)
Mixed Waste Landfill 2009 ET Cover Construction
Quality Resolution Meetings and Cover Layer Approval

Date	Meeting[1]/Form	Topic	Comments
Biointrusion Layer (cont'd.)			
6/10/2009	Quality Resolution	Biointrusion Layer east-to-west surface design slope	Discussion whether to use the thin soil layer covering the Biointrusion Layer or the actual Biointrusion Layer rock surface as the new datum for establishing the 2% east-to-west surface design slope. It was decided the 2% surface design slope would be corrected during construction of the Native Soil and Topsoil Layers.
6/15/2009	Quality Resolution	QA verification survey and approval for soil placement on the Biointrusion Layer surface	Northeast portion of Biointrusion Layer approved – placement of soil over the rock can proceed. 2 points on the north slope at the northwest end of the Biointrusion Layer were corrected, resurveyed, and approved – placement of soil over the rock at these 2 points approved.
6/15/2009	*APPROVAL FORM*	*Biointrusion Layer Approval Form AP# 006*	*Biointrusion Layer (Northeast and Northwest corrections) approved. Entire Biointrusion Layer approved, see approval form in Attachment 2 for additional information.*
Thin Soil Layer above Biointrusion Layer			
6/16/2009	Quality Resolution	Biointrusion Layer and overlying thin soil layer thickness, construction of Native Soil Layer, establishing a new datum for the 2% east-to-west surface design slope, establishing the 6:1 side slopes, and K-sat testing	Thin soil layer over Biointrusion Layer to be new construction datum. Thin soil layer thickness to be a nominal 3 inches or less. Native Soil Layer construction procedure (using wedge lifts) to establish the 2% east-to-west surface design slope and 6:1 side slopes. K-sat testing requirements and potential schedule impacts discussed and clarified.
6/17/2009	Quality Resolution	QC survey of thin soil layer overlying the Biointrusion Layer and 2% surface design slope correction.	Review and approval of the thin soil layer QC survey results (average 3 inches thick). Correction of the 2% east-to-west surface design slope to be implemented using wedge lifts.
6/17/2009	*APPROVAL FORM*	*Biointrusion Layer/Thin Soil Layer Approval Form AP# 007*	*Thin soil layer overlying the Biointrusion Layer approved. See approval form in Attachment 2 for additional information.*
Native Soil Layer			
6/22/2009	Quality Resolution	Review of QC survey for Wedge Lifts 1 and 2, construction approach for Polishing Lifts 3 and 4, and QA density/moisture retest	Review and approval of Wedge Lifts 1 and 2. Approach for constructing Polishing Lifts 3 and 4 developed. QA density/moisture retest and approval of North Side Slope Lift 8.
6/22/2009	*APPROVAL FORM*	*Wedge Lifts 1 and 2 Approval Form AP# 008*	*Wedge Lifts 1 and 2 approved. See approval form in Attachment 2 for additional information.*

Table 3 (cont'd.)
Mixed Waste Landfill 2009 ET Cover Construction
Quality Resolution Meetings and Cover Layer Approval

Date	Meeting[1]/Form	Topic	Comments
Native Soil Layer (cont'd.)			
6/30/2009	Quality Resolution	QC survey results for Polishing Lifts 3 and 4	QC survey results reviewed and Native Soil Polishing Lifts 3 and 4 approved. Installation of Native Soil Lift 5 approved.
6/30/2009	*APPROVAL FORM*	*Polishing Lifts 3 and 4 Approval Form AP# 009*	*Polishing Lifts 3 and 4 approved. See approval form in Attachment 2 for additional information.*
7/1/2009	Quality Resolution	Lift 5 low area	Low area on east side of Grid Block 7 located. Procedure to address consistent with CMIP developed and implemented. Area resurveyed and confirmed prior to installing Lift 6.
7/14/2009	Quality Resolution	Soil fill material shortfall for Native and Topsoil Layers addressed - QA review of EDi soil volume estimates for additional material needed	Stockpiled soil fill material based on CMIP estimates is not sufficient to complete construction of the Native Soil and Topsoil Layers. QA review of EDi additional soil material estimates completed, and path forward resolved.
7/30/2009	Quality Resolution	Native Soil Layer QA and QC verification surveys	Review of Native Soil QA and QC verification survey. Native Soil Layer approved with the exception of 9 locations to be corrected, resurveyed, and approved.
7/30/2009	*APPROVAL FORM*	*Native Soil Layer Approval Form AP# 010*	*Native Soil Layer thickness approval except for 9 locations requiring adjustment. See approval form in Attachment 2 for additional information.*
8/4/2009	Quality Resolution	Native Soil Layer Final QA and QC verification surveys	Corrections at the 9 grid points that required correction reviewed and verified.
8/4/2009	*APPROVAL FORM*	*Native Soil Layer Approval Form AP# 011*	*Final Native Soil Layer approval, including 9 grid point corrections, 2% east-to-west surface design slope, and 6:1 side slopes. See approval form in Attachment 2 for additional information.*
Topsoil Layer			
6/25/2009	Quality Resolution	Review of sieve results for available 3/8-inch crushed gravel to admix with topsoil fill material	No available aggregate met specifications for percent passing through the #4 sieve. Aggregate approved by the CQA Engineer in the formal submittal process.
8/12/2009	Quality Resolution	Topsoil Layer QA and QC verification surveys	QA and QC verification survey results reviewed and the Topsoil Layer approved.
8/12/2009	*APPROVAL FORM*	*Topsoil Layer Approval Form AP# 012*	*Topsoil Layer approved. See approval form in Attachment 2 for additional information.*
Reclamation Seeding and Mulching			
8/19/2009	Quality Resolution	Seed and mulch material inspections and elimination of starter fertilizer	Seed was visually inspected, labels checked, and approved. Mulch also approved. Elimination of fertilizer approved.

Table 3 (cont'd.)
Mixed Waste Landfill 2009 ET Cover Construction
Quality Resolution Meetings and Cover Layer Approval

Date	Meeting[1]/Form	Topic	Comments
Reclamation Seeding and Mulching (cont'd.)			
8/25/2009	Quality Resolution	Increased seeding rate and application method	Approval of increased seeding rate (from 20 to 80 pounds per acre) and placement method (hand-broadcasting combined with drill-seeding).
8/25/2009	*APPROVAL FORM*	*Seed, Fertilizer, and Mulch Approval Form AP# 013*	*Increased seeding rate and method, elimination of starter fertilizer, and mulch approved. See approval form in Attachment 2 for additional information.*
9/2/2009	Quality Resolution	Inspection and approval of the seeding and mulch	QA approval of seed and mulch as placed on Topsoil Layer.
9/2/2009	*APPROVAL FORM*	*Reclamation Seeding and Mulching Approval Form AP# 014*	*Seed and mulch placement approved based on visual inspection. See approval form in Attachment 2 for additional information.*

[1] All Quality Resolution Meetings are documented in Attachment 1.
CQA = Construction Quality Assurance
EDi = Environmental Dimensions, Inc.
ET = Evapotranspirative
QA = Quality assurance
QC = Quality control

Table 4
Mixed Waste Landfill 2006 Subgrade Construction
Standard Proctor CQC Laboratory Results

Test Number	Date Sampled	Description	Gradation/ Classification Meet Specification[1]	Maximum Dry Density (lb/ft^3)	Optimum Moisture Content (%)	Testing Laboratory[2]
MWL-ES-001	10/2/2006	Existing Surface	NA[3]	115.5	13.4	AMEC
MWL-ES-002	10/27/2006	Existing Surface	NA[3]	116.5	11.5	AMEC
MWL-ES-003	10/27/2006	Existing Surface	NA[3]	114.5	11.7	AMEC
MWL-ES-004	10/27/2006	Existing Surface	NA[3]	114.1	14.2	AMEC
MWL-SG-001	10/2/2006	Subgrade Stockpile	YES	113.2	10.9	AMEC
MWL-SG-002	10/31/2006	Subgrade Stockpile	YES	113.3	13.2	AMEC
MWL-SG-003	10/31/2006	Subgrade Stockpile	YES	117.4	12.9	AMEC
MWL-SG-004	10/31/2006	Subgrade Stockpile	YES	118.3	12.7	AMEC
MWL-SG-005	11/2/2006	Subgrade Stockpile	YES	116.7	12.9	AMEC
MWL-SG-006	11/2/2006	Subgrade Stockpile	YES	119.6	11.0	AMEC
MWL-SG-007	11/2/2006	Subgrade Stockpile	YES	115.4	12.9	AMEC
MWL-SG-008	11/8/2006	Subgrade Stockpile	YES	116.6	12.8	AMEC
MWL-SG-009	11/8/2006	Subgrade Stockpile	YES	113.6	12.9	AMEC
MWL-SG-010	11/8/2006	Subgrade Stockpile	YES	113.6	12.6	AMEC
MWL-SG-011[4]	11/14/2006	Existing Soil	YES	121.2	10.0	AMEC
MWL-SG-012[4]	11/14/2006	Existing Soil	YES	121.5	9.6	AMEC
MWL-SG-013	11/14/2006	Subgrade Stockpile	YES	116.0	12.3	AMEC
MWL-SG-014	11/16/2006	Subgrade Stockpile	YES	117.9	13.0	AMEC
MWL-SG-015	11/16/2006	Subgrade Stockpile	YES	116.7	12.9	AMEC
MWL-SG-016[5]	11/20/2006	Subgrade Stockpile	YES	116.4	13.2	AMEC
MWL-SG-017[5]	11/20/2006	Subgrade Stockpile	YES	116.2	13.1	AMEC
MWL-SG-018[5]	11/20/2006	Subgrade Stockpile	YES	120.1	11.6	AMEC
MWL-SG-019	11/27/2006	Stockpile at Borrow Area[6]	YES	112.4	13.6	AMEC
MWL-SG-020	11/27/2006	Stockpile at Borrow Area	YES	118.4	12.7	AMEC
MWL-SG-021	11/27/2006	Stockpile at Borrow Area	YES	119.0	12.0	AMEC
MWL-SG-022	12/5/2006	Newly Excavated Soils[7]	YES	115.9	12.2	AMEC
MWL-SG-023	12/12/2006	Newly Excavated Soils[7]	YES	117.9	12.1	AMEC
MWL-SG-024	12/12/2006	Newly Excavated Soils[7]	YES	116.7	11.8	AMEC
MWL-SG-025	12/14/2006	Newly Excavated Soils[7]	YES	114.1	12.8	AMEC
MWL-SG-026[8]	12/14/2006	Newly Excavated Soils[7]	YES	113.8	13.5	AMEC

[1] Gradation and Classification results are on same laboratory cover sheet with Standard Proctor results in Attachment 7.
[2] Testing laboratory is AMEC Earth & Environmental, Albuquerque, New Mexico (AMEC).
[3] NA = not applicable; there was no gradation specification for the existing surface.
[4] These samples were collected from TA-3 soil that was stockpiled at the MWL prior to Subgrade construction activities. Although the soil met the gradation/classification specifications, it was not used during Subgrade construction. This soil was later used during 2009 ET Cover construction.
[5] These samples were collected but the results were not used; previous samples were sufficient to cover the soil volume used for Subgrade construction.
[6] This soil was excavated and screened along with the initial subgrade material but was not hauled to the MWL until needed.
[7] This soil was excavated and screened after start of Subgrade installation due to additional volume needs.
[8] Proctor not used; soil volume related to Proctor not used until 2009 ET Cover construction.
CQC = Construction Quality Control
lb/ft^3 = pounds per cubic foot

Table 5
Mixed Waste Landfill 2009 ET Cover Construction
Standard Proctor CQC Laboratory Results

Test Number	Date Sampled	Description	Gradation/ Classification Meet Specification[1]	Maximum Dry Density (lb/ft^3)	Optimum Moisture Content (%)	Testing Laboratory[2]
SNL MWL 052009-1	5/20/2009	Native Soil	YES	116.7	10.6	AMEC
SNL MWL 052009-2	5/20/2009	Native Soil	YES	119.1	10.3	AMEC
SNL MWL 052009-3	5/20/2009	Native Soil	YES	119.3	10.3	AMEC
SNL MWL 052909-4	5/29/2009	Native Soil	YES	117.0	12.0	AMEC
SNL MWL 052909-5	5/29/2009	Native Soil	YES	115.7	12.6	AMEC
SNL MWL 052909-6	5/29/2009	Native Soil	YES	116.2	12.8	AMEC
SNL MWL 052909-7	5/29/2009	Native Soil	YES	115.8	12.3	AMEC
SNL MWL 052909-8	5/29/2009	Native Soil	YES	117.0	12.0	AMEC
SNL MWL 060909-9	6/9/2009	Native Soil	YES	116.2	12.5	AMEC
SNL MWL 060909-10	6/9/2009	Native Soil	YES	113.2	13.5	AMEC
SNL MWL 060909-11	6/9/2009	Native Soil	YES	112.2	14.6	AMEC
SNL MWL 060909-12	6/9/2009	Native Soil	YES	113.9	13.6	AMEC
SNL MWL 060909-13	6/9/2009	Native Soil	YES	115.9	12.3	AMEC
SNL MWL 062409-14	6/24/2009	Native Soil	YES	114.7	13.3	AMEC
SNL MWL 062409-15	6/24/2009	Native Soil	YES	117.7	11.8	AMEC
SNL MWL 062409-16	6/24/2009	Native Soil	YES	116.6	12.4	AMEC
SNL MWL 062409-17	6/24/2009	Native Soil	YES	116.9	11.0	AMEC
SNL MWL 062409-18	6/24/2009	Native Soil	YES	117.6	11.6	AMEC
SNL MWL 062909-19	6/29/2009	Native Soil	YES	117.7	12.0	AMEC
SNL MWL 062909-20	6/29/2009	Native Soil	YES	116.9	12.2	AMEC
SNL MWL 062909-21	6/29/2009	Native Soil	NO	115.9	12.7	AMEC
SNL MWL 062909-22	6/29/2009	Native Soil	YES	117.8	11.8	AMEC
SNL MWL 062909-23	6/29/2009	Native Soil	YES	116.6	11.6	AMEC
SNL MWL 062909-24	6/29/2009	Native Soil	YES	117.7	11.3	AMEC
SNL MWL 063009-25	6/30/2009	Native Soil	YES	118.4	11.7	AMEC
SNL MWL 063009-26	6/30/2009	Native Soil	YES	118.0	11.8	AMEC
SNL MWL 063009-27	6/30/2009	Native Soil	YES	118.3	11.2	AMEC
SNL MWL 063009-28	6/30/2009	Native Soil	YES	118.1	10.8	AMEC
SNL MWL 063009-29	6/30/2009	Native Soil	YES	118.2	11.6	AMEC
SNL MWL 063009-30	6/30/2009	Native Soil	YES	117.8	12.5	AMEC
SNL MWL Berm-1[3]	6/30/2009	Native Soil	YES	115.0	10.0	AMEC
SNL MWL Berm-2[3]	6/30/2009	Native Soil	YES	117.0	10.4	AMEC
SNL MWL Berm-3[3]	6/30/2009	Native Soil	YES	116.2	10.2	AMEC
SNL MWL Berm-4	7/10/2009	Native Soil	YES	117.8	11.1	AMEC
SNL MWL Berm-5	7/10/2009	Native Soil	YES	117.0	11.1	AMEC
SNL MWL Berm-6	7/14/2009	Native Soil	YES	116.2	12.3	AMEC

Table 5 (cont'd.)
Mixed Waste Landfill 2009 MWL ET Cover Construction
Standard Proctor CQC Laboratory Results

Test Number	Date Sampled	Description	Gradation/ Classification Meet Specification[1]	Maximum Dry Density (lb/ft^3)	Optimum Moisture Content (%)	Testing Laboratory[2]
SNL MWL Berm-7	7/14/2009	Native Soil	YES	116.6	12.7	AMEC
SNL MWL Berm-8	7/14/2009	Native Soil	YES	118.6	11.3	AMEC
SNL MWL Berm-9	7/16/2009	Native Soil	YES	114.6	13.0	AMEC
SNL MWL Berm-10	7/16/2009	Native Soil	YES	116.0	11.2	AMEC
SNL MWL Berm-11	7/16/2009	Native Soil	YES	115.3	13.2	AMEC
SNL MWL Berm-12	7/16/2009	Native Soil	YES	117.7	12.1	AMEC
SNL MWL Berm-13	7/16/2009	Native Soil	YES	115.0	13.0	AMEC
SNL MWL Berm-14	7/16/2009	Native Soil	YES	114.2	13.5	AMEC
SNL MWL Berm-15	7/16/2009	Native Soil	YES	115.9	11.3	AMEC
SNL MWL Berm-16	7/16/2009	Native Soil	YES	116.0	14.4	AMEC
SNL MWL Berm-17	7/23/2009	Native Soil	YES	114.9	15.0	AMEC
SNL MWL Berm-18	7/23/2009	Native Soil	YES	114.7	11.6	AMEC
SNL MWL Berm-19	7/23/2009	Native Soil	YES	117.5	10.9	AMEC
SNL MWL 060209-4	6/2/2009	Topsoil	YES	118.9	9.6	AMEC
SNL MWL 060209-6	6/2/2009	Topsoil	YES	116.2	10.9	AMEC
SNL MWL 071009-8	7/10/2009	Topsoil	YES	117.8	11.8	AMEC
SNL MWL 071409-10	7/14/2009	Topsoil	YES	118.0	11.2	AMEC

[1] Gradation and Classification results are presented in Tables 6 and 7, and are on same laboratory cover sheet with Standard Proctor results in Attachment 7.
[2] Testing laboratory is AMEC Earth & Environmental, Albuquerque, New Mexico (AMEC).
[3] Sample identification number on laboratory data sheet in Attachment 7 incorrectly spells 'berm' as 'burm' for these samples.

CQC = Construction Quality Control
ET = Evapotranspirative
lb/ft^3 = Pounds per cubic foot
MWL = Mixed Waste Landfill

Table 6
Mixed Waste Landfill 2009 ET Cover Construction
Native Soil Layer Gradation and Classification CQC Laboratory Results

Test Number	Date Sampled	Material Description	% Passing Sieve Size						Soil Classification
			3/4 inch	1/2 inch	3/8 inch	#10	#40	#200	
SNL MWL 052009-1	5/20/2009	Native Soil Stockpile[1]	100	100	100	95	87	34	SC-SM
SNL MWL 052009-2	5/20/2009	Native Soil Stockpile[1]	100	98	97	90	81	26	SC-SM
SNL MWL 052009-3	5/20/2009	Native Soil Stockpile[1]	100	98	98	90	82	26	SC-SM
SNL MWL 052909-4	5/29/2009	Native Soil Stockpile[1]	99	98	98	90	81	31	SM
SNL MWL 052909-5	5/29/2009	Native Soil Stockpile[1]	98	98	97	92	86	36	SC-SM
SNL MWL 052909-6	5/29/2009	Native Soil Stockpile[1]	100	100	99	96	90	38	SC
SNL MWL 052909-7	5/29/2009	Native Soil Stockpile[1]	100	100	100	96	90	37	SC-SM
SNL MWL 052909-8	5/29/2009	Native Soil Stockpile[1]	99	99	98	94	87	32	SC-SM
SNL MWL 060909-9	6/9/2009	Native Soil Stockpile[1]	99	99	98	93	87	36	SC
SNL MWL 060909-10	6/9/2009	Native Soil Stockpile[1]	100	100	99	95	88	38	SC
SNL MWL 060909-11	6/9/2009	Native Soil Stockpile[1]	99	99	98	94	88	29	SC-SM
SNL MWL 060909-12	6/9/2009	Native Soil Stockpile[1]	100	100	99	94	87	35	SC-SM
SNL MWL 060909-13	6/9/2009	Native Soil Stockpile[1]	100	100	99	93	86	27	SC-SM
SNL MWL 062409-14	6/24/2009	Native Soil Stockpile[1]	100	100	100	95	89	38	SC-SM
SNL MWL 062409-15	6/24/2009	Native Soil Stockpile[1]	100	100	99	95	89	35	SC-SM
SNL MWL 062409-16	6/24/2009	Native Soil Stockpile[1]	100	100	99	93	86	33	SM
SNL MWL 062409-17	6/24/2009	Native Soil Stockpile[1]	100	100	100	95	88	33	SM
SNL MWL 062409-18	6/24/2009	Native Soil Stockpile[1]	100	100	100	93	86	33	SM
SNL MWL 062909-19	6/29/2009	Native Soil Stockpile[1]	99	98	97	93	86	33	SC-SM
SNL MWL 062909-20	6/29/2009	Native Soil Stockpile[1]	100	100	100	96	90	36	SC-SM
SNL MWL 062909-21	6/29/2009	Native Soil Stockpile[1]	100	99	98	93	86	**41**	SC-SM
SNL MWL 062909-22	6/29/2009	Native Soil Stockpile[1]	100	100	100	96	90	36	SM
SNL MWL 062909-23	6/29/2009	Native Soil Stockpile[1]	100	99	99	93	88	36	SM
SNL MWL 062909-24	6/29/2009	Native Soil Stockpile[1]	100	100	99	94	88	34	SC-SM
SNL MWL 063009-25	6/30/2009	Native Soil Stockpile[1]	99	98	98	92	86	34	SC-SM
SNL MWL 063009-26	6/30/2009	Native Soil Stockpile[1]	99	98	97	93	87	36	SC-SM
SNL MWL 063009-27	6/30/2009	Native Soil Stockpile[1]	98	97	96	91	85	32	SM
SNL MWL 063009-28	6/30/2009	Native Soil Stockpile[1]	100	100	99	95	88	33	SM
SNL MWL 063009-29	6/30/2009	Native Soil Stockpile[1]	100	99	99	94	88	33	SM
SNL MWL 063009-30	6/30/2009	Native Soil Stockpile[1]	100	100	99	96	91	39	SC-SM
SNL MWL Berm-1[2]	6/30/2009	Native Soil Excavated[3]	100	99	99	96	92	30	SM
SNL MWL Berm-2[2]	6/30/2009	Native Soil Excavated[3]	99	98	97	92	86	27	SM

Table 6 (cont'd.)
Mixed Waste Landfill 2009 ET Cover Construction Phase CQC
Native Soil Layer Gradation and Classification Laboratory Results

Test Number	Date Sampled	Material Description	% Passing Sieve Size						Soil Classification
			3/4 inch	1/2 inch	3/8 inch	#10	#40	#200	
SNL MWL Berm-3[2]	6/30/2009	Native Soil Excavated[3]	99	97	96	91	86	26	SM
SNL MWL Berm-4	7/10/2009	Native Soil Excavated	100	100	100	97	90	28	SC-SM
SNL MWL Berm-5	7/10/2009	Native Soil Excavated[3]	100	98	97	91	85	24	SM
SNL MWL Berm-6	7/14/2009	Native Soil Excavated[3]	100	100	100	95	88	32	SM
SNL MWL Berm-7	7/14/2009	Native Soil Excavated[3]	100	99	99	94	88	32	SC-SM
SNL MWL Berm-8	7/14/2009	Native Soil Excavated[3]	100	100	99	95	89	36	SC-SM
SNL MWL Berm-9	7/16/2009	Native Soil Excavated[3]	100	99	99	97	92	38	SC-SM
SNL MWL Berm-10	7/16/2009	Native Soil Excavated[3]	100	100	99	95	90	30	SM
SNL MWL Berm-11	7/16/2009	Native Soil Excavated[3]	100	100	100	96	91	36	SC-SM
SNL MWL Berm-12	7/16/2009	Native Soil Excavated[3]	100	99	98	94	89	32	SC-SM
SNL MWL Berm-13	7/16/2009	Native Soil Excavated[3]	100	100	99	94	89	37	SC
SNL MWL Berm-14	7/16/2009	Native Soil Excavated[3]	100	99	99	97	92	34	SM
SNL MWL Berm-15	7/16/2009	Native Soil Excavated[3]	100	100	100	97	92	37	SC-SM
SNL MWL Berm-16	7/16/2009	Native Soil Excavated[3]	100	100	99	96	90	34	SC-SM
SNL MWL Berm-17	7/23/2009	Native Soil Excavated[3]	100	98	98	93	87	34	SM
SNL MWL Berm-18	7/23/2009	Native Soil Excavated[3]	97	95	94	91	86	26	SM
SNL MWL Berm-19	7/23/2009	Native Soil Excavated[3]	100	100	100	97	92	34	SM

[1] Native soil excavated, screened to 2-inch minus, and stockpiled in 2006.
[2] Sample identification number on laboratory data sheet incorrectly spells 'berm' as 'burm' for these samples.
[3] Native soil excavated, screened to 2-inch minus, and stockpiled during 2009 ET Cover construction.

Table 7
Mixed Waste Landfill 2009 ET Cover Construction
Topsoil Gradation and Classification CQC Laboratory Results

Test Number	Date Sampled	Material Description[1]	% Passing Sieve Size						Soil Classification	Gradation/Classification Meet Specification
			3/4 inch	1/2 inch	3/8 inch	#10	#40	#200		
SNL MWL -060209-1	6/2/2009	Topsoil excavated and screened in 2006	100	100	100	98	92	32	SM	YES
SNL MWL -060209-2	6/2/2009	Topsoil excavated and screened in 2006	100	100	100	94	86	29	SM	YES
SNL MWL -060209-3	6/2/2009	Topsoil excavated and screened in 2006	100	100	100	98	93	33	SM	YES
SNL MWL -060209-4	6/2/2009	Topsoil excavated and screened in 2006	100	100	100	98	91	30	SM	YES
SNL MWL -060209-5	6/2/2009	Topsoil excavated and screened in 2006	100	100	100	97	90	30	SM	YES
SNL MWL -060209-6	6/2/2009	Topsoil excavated and screened in 2006	100	100	99	96	90	31	SM	YES
SNL MWL -071009-7	7/10/2009	Topsoil excavated and screened in 2009 from west side of borrow area	100	100	100	97	92	27	SM	YES
SNL MWL 071009-8	7/10/2009	Topsoil excavated and screened in 2009 from west site of borrow area	100	99	99	95	89	21	SM	YES
SNL MWL 071009-9	7/10/2009	Topsoil excavated and screened in 2009 from west side of borrow area	100	100	99	96	90	26	SM	YES
SNL MWL 071409-10	7/14/2009	Topsoil excavated and screened in 2009 from west side of borrow area	100	99	99	95	89	31	SM	YES
SNL MWL 071609-11	7/16/2009	Topsoil excavated and screened in 2009 from west side of borrow area	100	100	100	98	94	36	SC-SM	YES
SNL MWL 071609-12	7/23/2009	Topsoil excavated and screened in 2009 from south side of borrow area	100	100	100	96	90	29	SM	YES

[1] All samples of topsoil fill were collected prior to mixing with 3/8 inch crushed gravel.

Table 8
Mixed Waste Landfill 2009 ET Cover Construction
Saturated Hydraulic Conductivity CQC Laboratory Results

Sample Description	Location	Date Sampled	Sample Compaction	Average Saturated Hydraulic Conductivity[1] (K_{sat}) in cm/s[2]
Native Soil Wedge Lift 1	Grid Block 8	6/19/2009	90.0%	**4.02E-04**
Native Soil Wedge Lift 2	Grid Block 11	6/22/2009	89.0%	**3.58E-05**
Native Soil Lift 3-1	Collected Prior to Placement	6/17/2009	90.2%	**1.59E-06**
Native Soil Lift 3-2	Collected Prior to Placement	6/17/2009	89.7%	**1.81E-06**
Native Soil Lift 3-3	Collected Prior to Placement	6/17/2009	91.0%	**1.98E-06**
Native Soil Lift 4	Grid Block 2	6/30/2009	84.6%	**2.52E-04**
Native Soil Lift 4	Grid Block 6	6/30/2009	81.2%	**1.87E-04**
Native Soil Lift 4	Grid Block 9	6/30/2009	89.8%	**2.14E-04**
Native Soil Lift 5	Grid Block 1	7/9/2009	90.0%	**2.66E-04**
Native Soil Lift 5	Grid Block 4 Retest	7/8/2009	95.3%	**1.43E-04**
Native Soil Lift 5	Grid Block 8 Retest	7/8/2009	94.6%	**1.63E-04**
Native Soil Lift 6-1	Grid Block 3	7/16/2009	90.2%	**3.05E-04**
Native Soil Lift 6-2	Grid Block 6	7/16/2009	90.3%	**3.51E-04**
Native Soil Lift 6-3	Grid Block 12	7/16/2009	89.5%	**2.55E-04**
Native Soil Lift 7	Grid Block 1 Retest	7/20/2009	94.8%	**2.18E-04**
Native Soil Lift 7	Grid Block 5 Retest	7/20/2009	94.8%	**1.87E-04**
Native Soil Lift 7	Grid Block 13	7/22/2009	89.5%	**2.50E-04**
Native Soil Lift 8	Grid Block 2	7/27/2009	90.4%	**1.22E-06**
Native Soil Lift 8	Grid Block 7	7/27/2009	90.0%	**1.23E-06**
Native Soil Lift 8	Grid Block 9	7/27/2009	90.0%	**1.36E-06**
Average			**90.2%**	**1.62E-04**
Geometric Mean			**90.2%**	**4.72E-05**
Median			**90.0%**	**1.87E-04**

[1] Maximum Value is 4.6E-04.
[2] Tests were performed using ASTM D5856 Rigid Wall Method.
CQC = Construction Quality Control
ET = Evapotranspirative

Table 9
Mixed Waste Landfill 2006 Subgrade Construction
In-Place Density and Moisture Content CQC Field Results

Test Number	Date of Field Test	Description	Location	Standard Proctor Maximum Density (lb/ft^3)[1]	Standard Proctor Optimum Moisture Content (%)	Percent of Maximum Density Required	Percent Compaction Achieved	Moisture Content Achieved	Meets Density Specification	Meets Moisture Specification	Testing Laboratory[3]
MWL-ES1-001	10/27/2006	Existing Soil Surface	Figure 5	115.5	13.4	NA[2]	90.1	13.8	NA[2]	NA[2]	AMEC
MWL-ES1-002	10/27/2006	Existing Soil Surface	Figure 5	115.5	13.4	NA	96.8	7.5	NA	NA	AMEC
MWL-ES1-003	10/27/2006	Existing Soil Surface	Figure 5	115.5	13.4	NA	95.4	7.8	NA	NA	AMEC
MWL-ES1-004	10/27/2006	Existing Soil Surface	Figure 5	115.5	13.4	NA	91.8	10.2	NA	NA	AMEC
MWL-ES1-005	10/27/2006	Existing Soil Surface	Figure 5	115.5	13.4	NA	92.5	7.1	NA	NA	AMEC
MWL-ES1-006	10/27/2006	Existing Soil Surface	Figure 5	115.5	13.4	NA	93.3	7.4	NA	NA	AMEC
MWL-ES1-007	10/27/2006	Existing Soil Surface	Figure 5	115.5	13.4	NA	96.1	9.5	NA	NA	AMEC
MWL-ES1-008	10/27/2006	Existing Soil Surface	Figure 5	115.5	13.4	NA	93.7	10.6	NA	NA	AMEC
MWL-ES1-009	10/27/2006	Existing Soil Surface	Figure 5	115.5	13.4	NA	94.1	8.0	NA	NA	AMEC
MWL-ES1-010	10/27/2006	Existing Soil Surface	Figure 5	115.5	13.4	NA	89.6	11.9	NA	NA	AMEC
MWL-ES1-011	10/27/2006	Existing Soil Surface	Figure 5	115.5	13.4	NA	93.2	8.4	NA	NA	AMEC
MWL-ES1-012	10/27/2006	Existing Soil Surface	Figure 5	115.5	13.4	NA	>100	8.1	NA	NA	AMEC
MWL-ES1-013	10/27/2006	Existing Soil Surface	Figure 5	115.5	13.4	NA	98.9	8.8	NA	NA	AMEC
MWL-ES1-014	10/27/2006	Existing Soil Surface	Figure 5	115.5	13.4	NA	95.4	8.8	NA	NA	AMEC
MWL-ES1-015	10/27/2006	Existing Soil Surface	Figure 5	115.5	13.4	NA	95.1	11.9	NA	NA	AMEC
MWL-SG1-001	10/31/2006	Subgrade Lift 1	Figure 6	113.2	10.9	90	100.0	9.1	YES	YES	AMEC
MWL-SG1-002	10/31/2006	Subgrade Lift 1	Figure 6	113.2	10.9	90	99.6	9.8	YES	YES	AMEC
MWL-SG2-001	10/31/2006	Subgrade Lift 2	Figure 7	113.2	10.9	90	97.7	11.1	YES	YES	AMEC
MWL-SG2-002	10/31/2006	Subgrade Lift 2	Figure 7	113.2	10.9	90	99.8	10.6	YES	YES	AMEC
MWL-SG3-001	10/31/2006	Subgrade Lift 3	Figure 8	113.2	10.9	90	94.3	10.0	YES	YES	AMEC
MWL-SG3-002	10/31/2006	Subgrade Lift 3	Figure 8	113.2	10.9	90	93.0	10.6	YES	YES	AMEC
MWL-SG3-003	10/31/2006	Subgrade Lift 3	Figure 8	113.2	10.9	90	99.8	10.0	YES	YES	AMEC
MWL-SG3-004	10/31/2006	Subgrade Lift 3	Figure 8	113.2	10.9	90	96.8	10.7	YES	YES	AMEC
MWL-SG3-005	10/31/2006	Subgrade Lift 3	Figure 8	113.2	10.9	90	100.0	9.0	YES	YES	AMEC
MWL-SG4-001	10/31/2006	Subgrade Lift 4	Figure 9	113.2	10.9	90	93.8	10.7	YES	YES	AMEC

Table 9 (cont'd.)
Mixed Waste Landfill 2006 Subgrade Construction
In-Place Density and Moisture Content CQC Field Results

Test Number	Date of Field Test	Description	Location	Standard Proctor Maximum Density (lb/ft^3)[1]	Standard Proctor Optimum Moisture Content (%)	Percent of Maximum Density Required	Percent Compaction Achieved	Moisture Content Achieved	Meets Density Specification	Meets Moisture Specification	Testing Laboratory[3]
MWL-SG4-002	10/31/2006	Subgrade Lift 4	Figure 9	113.2	10.9	90	94.3	10.5	YES	YES	AMEC
MWL-SG4-003	11/1/2006	Subgrade Lift 4	Figure 9	113.2	10.9	90	91.0	11.1	YES	YES	AMEC
MWL-SG4-004	11/1/2006	Subgrade Lift 4	Figure 9	113.2	10.9	90	98.2	9.6	YES	YES	AMEC
MWL-SG4-005	11/2/2006	Subgrade Lift 4	Figure 9	113.2	10.9	90	90.4	8.9	YES	YES	AMEC
MWL-SG5-001	11/1/2006	Subgrade Lift 5	Figure 10	113.2	10.9	90	96.1	10.2	YES	YES	AMEC
MWL-SG6-001	11/2/2006	Subgrade Lift 6	Figure 11	113.2	10.9	90	100.0	9.2	YES	YES	AMEC
MWL-SG6-002	11/2/2006	Subgrade Lift 6	Figure 11	113.2	10.9	90	97.6	11.0	YES	YES	AMEC
MWL-SG6-003	11/2/2006	Subgrade Lift 6	Figure 11	113.2	10.9	90	95.0	12.1	YES	YES	AMEC
MWL-SG7-001	11/6/2006	Subgrade Lift 7	Figure 12	113.3	13.2	90	96.9	11.2	YES	YES	AMEC
MWL-SG8-001	11/7/2006	Subgrade Lift 8	Figure 13	113.3	13.2	90	98.4	11.5	YES	YES	AMEC
MWL-SG8-002	11/7/2006	Subgrade Lift 8	Figure 13	113.3	13.2	90	94.8	11.5	YES	YES	AMEC
MWL-SG8-003	11/7/2006	Subgrade Lift 8	Figure 13	113.3	13.2	90	92.1	12.5	YES	YES	AMEC
MWL-SG9-001	11/7/2006	Subgrade Lift 9	Figure 14	117.4	12.9	90	91.6	14.2	YES	YES	AMEC
MWL-SG9-002	11/7/2006	Subgrade Lift 9	Figure 14	117.4	12.9	90	96.9	11.0	YES	YES	AMEC
MWL-SG9-003	11/7/2006	Subgrade Lift 9	Figure 14	117.4	12.9	90	93.8	11.0	YES	YES	AMEC
MWL-SG9-004	11/8/2006	Subgrade Lift 9	Figure 14	117.4	12.9	90	92.3	12.7	YES	YES	AMEC
MWL-SG9-005	11/9/2006	Subgrade Lift 9	Figure 14	118.3	12.7	90	95.7	11.7	YES	YES	AMEC
MWL-SG10-001	11/9/2006	Subgrade Lift 10	Figure 15	118.3	12.7	90	94.0	13.8	YES	YES	AMEC
MWL-SG10-002	11/9/2006	Subgrade Lift 10	Figure 15	118.7	12.4	90	93.3	11.3	YES	YES	AMEC
MWL-SG10-003	11/9/2006	Subgrade Lift 10	Figure 15	118.7	12.4	90	91.2	11.7	YES	YES	AMEC
MWL-SG10-004	11/14/2006	Subgrade Lift 10	Figure 15	119.6	11.2	90	94.4	9.6	YES	YES	AMEC
MWL-SG10-005	11/14/2006	Subgrade Lift 10	Figure 15	119.6	11.2	90	98.2	9.6	YES	YES	AMEC
MWL-SG10-006	11/14/2006	Subgrade Lift 10	Figure 15	119.6	11.2	90	94.4	12.5	YES	YES	AMEC
MWL-SG10-007	11/14/2006	Subgrade Lift 10	Figure 15	119.6	11.2	90	95.8	9.4	YES	YES	AMEC
MWL-SG10-008	11/14/2006	Subgrade Lift 10	Figure 15	119.6	11.2	90	98.7	10.9	YES	YES	AMEC
MWL-SG10-009	11/14/2006	Subgrade Lift 10	Figure 15	115.4	12.9	90	92.3	13.9	YES	YES	AMEC
MWL-SG10-010	11/14/2006	Subgrade Lift 10	Figure 15	115.4	12.9	90	99.1	12.4	YES	YES	AMEC
MWL-SG11-001	11/15/2006	Subgrade Lift 11	Figure 16	115.4	12.9	90	99.3	11.8	YES	YES	AMEC
MWL-SG11-002	11/15/2006	Subgrade Lift 11	Figure 16	115.4	12.9	90	97.8	14.2	YES	YES	AMEC
MWL-SG11-003	11/16/2006	Subgrade Lift 11	Figure 16	116.5	13.0	90	93.5	14.1	YES	YES	AMEC
MWL-SG11-004	11/16/2006	Subgrade Lift 11	Figure 16	116.5	13.0	90	98.4	11.5	YES	YES	AMEC
MWL-SG11-005	11/16/2006	Subgrade Lift 11	Figure 16	116.5	13.0	90	98.2	12.7	YES	YES	AMEC

Table 9 (cont'd.)
Mixed Waste Landfill 2006 Subgrade Construction
In-Place Density and Moisture Content CQC Field Results

Test Number	Date of Field Test	Description	Location	Standard Proctor Maximum Density (lb/ft^3)[1]	Standard Proctor Optimum Moisture Content (%)	Percent of Maximum Density Required	Percent Compaction Achieved	Moisture Content Achieved	Meets Density Specification	Meets Moisture Specification	Testing Laboratory[3]
MWL-SG11-006	11/16/2006	Subgrade Lift 11	Figure 16	113.5	13.0	90	93.9	11.8	YES	YES	AMEC
MWL-SG11-007	11/16/2006	Subgrade Lift 11	Figure 16	113.5	13.0	90	99.6	14.1	YES	YES	AMEC
MWL-SG11-008	11/16/2006	Subgrade Lift 11	Figure 16	113.5	13.0	90	100.0	12.6	YES	YES	AMEC
MWL-SG11-009	11/20/2006	Subgrade Lift 11	Figure 16	113.5	13.0	90	100.0	14.1	YES	YES	AMEC
MWL-SG11-010	11/20/2006	Subgrade Lift 11	Figure 16	113.5	13.0	90	96.3	12.0	YES	YES	AMEC
MWL-SG11-011	11/21/2006	Subgrade Lift 11	Figure 16	113.6	12.6	90	96.8	14.3	YES	YES	AMEC
MWL-SG11-012	11/21/2006	Subgrade Lift 11	Figure 16	113.6	12.6	90	100.0	11.8	YES	YES	AMEC
MWL-SG11-013	11/21/2006	Subgrade Lift 11	Figure 16	113.6	12.6	90	92.9	13.7	YES	YES	AMEC
MWL-SG11-014	11/21/2006	Subgrade Lift 11	Figure 16	113.6	12.6	90	93.7	12.3	YES	YES	AMEC
MWL-SG11-015	11/21/2006	Subgrade Lift 11	Figure 16	116.0	12.3	90	97.8	10.7	YES	YES	AMEC
MWL-SG11-016	11/21/2006	Subgrade Lift 11	Figure 16	116.0	12.3	90	98.4	11.6	YES	YES	AMEC
MWL-SG11-017	11/21/2006	Subgrade Lift 11	Figure 16	116.0	12.3	90	97.2	13.9	YES	YES	AMEC
MWL-SG11-018	11/22/2006	Subgrade Lift 11	Figure 16	116.0	12.3	90	100.0	13.2	YES	YES	AMEC
MWL-SG12-001	11/30/2006	Subgrade Lift 12	Figure 17	117.9	13.0	90	93.2	12.2	YES	YES	AMEC
MWL-SG12-002	11/30/2006	Subgrade Lift 12	Figure 17	117.9	13.0	90	96.9	11.7	YES	YES	AMEC
MWL-SG12-003	11/30/2006	Subgrade Lift 12	Figure 17	118.1	13.3	90	99.7	11.8	YES	YES	AMEC
MWL-SG12-004	11/30/2006	Subgrade Lift 12	Figure 17	118.1	13.3	90	99.1	12.2	YES	YES	AMEC
MWL-SG12-005	12/5/2006	Subgrade Lift 12	Figure 17	118.4	12.7	90	100.0	12.3	YES	YES	AMEC
MWL-SG12-006	12/5/2006	Subgrade Lift 12	Figure 17	118.4	12.7	90	94.6	12.4	YES	YES	AMEC
MWL-SG12-007	12/7/2006	Subgrade Lift 12	Figure 17	112.4	13.6	90	100.0	13.1	YES	YES	AMEC
MWL-SG12-008	12/7/2006	Subgrade Lift 12	Figure 17	112.4	13.6	90	100.0	14.1	YES	YES	AMEC
MWL-SG12-009	12/7/2006	Subgrade Lift 12	Figure 17	119.0	12.0	90	94.4	13.6	YES	YES	AMEC
MWL-SG12-010	12/7/2006	Subgrade Lift 12	Figure 17	119.0	12.0	90	92.8	11.9	YES	YES	AMEC
MWL-SG12-011	12/13/2006	Subgrade Lift 12	Figure 17	115.9	12.2	90	99.1	10.8	YES	YES	AMEC
MWL-SG12-012	12/13/2006	Subgrade Lift 12	Figure 17	115.9	12.2	90	97.6	12.1	YES	YES	AMEC
MWL-SG12-013	12/15/2006	Subgrade Lift 12	Figure 17	115.9	12.2	90	96.9	12.3	YES	YES	AMEC
MWL-SG12-014	12/15/2006	Subgrade Lift 12	Figure 17	117.9	12.1	90	96.0	13.7	YES	YES	AMEC
MWL-SG12-015	12/18/2006	Subgrade Lift 12	Figure 17	117.9	12.1	90	92.2	14.0	YES	YES	AMEC
MWL-SG12-016	12/18/2006	Subgrade Lift 12	Figure 17	117.9	12.1	90	94.2	13.1	YES	YES	AMEC

[1] lb/ft^3 = Pounds per cubic foot.
[2] NA = Not applicable; there were no Maximum Density and Moisture Content specifications for the existing surface.
[3] AMEC = AMEC Earth & Environmental, Albuquerque, New Mexico.

Table 10
Mixed Waste Landfill 2009 ET Cover Construction
In-Place Density and Moisture Content CQC Field Results

Test Number	Date of Field Test	Description	Location[1]	Standard Proctor Maximum Density (lb/ft^3)[2]	Standard Proctor Optimum Moisture Content (%)	Percent of Maximum Density Required	Percent Compaction Achieved	Moisture Content Achieved	Meets Density Spec?	Meets Moisture Spec?	Testing Laboratory[3]
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 1[4]	120.1	11.6	90%	97	11.4	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 2[4]	120.1	11.6	90%	99	9.8	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 3[4]	120.1	11.6	90%	100	9.8	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 4[4]	120.1	11.6	90%	100	9.9	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 5[4]	120.1	11.6	90%	98	11.6	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 6[4]	120.1	11.6	90%	98	10.5	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 7[4]	120.1	11.6	90%	100	10.2	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 8[4]	120.1	11.6	90%	98	11.5	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 9[4]	120.1	11.6	90%	98	9.7	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 10[4]	120.1	11.6	90%	96	11.6	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 11[4]	120.1	11.6	90%	99	9.8	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 12[4]	120.1	11.6	90%	97	10.2	YES	YES	AMEC
EDi Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 13[4]	120.1	11.6	90%	98	10.2	YES	YES	AMEC
EDi North Slope Lift 1	6/17/2009	North Slope, Lift 1	North Side Slope[5]	120.1	11.6	90%	97	11.2	YES	YES	AMEC
EDi North Slope Lift 2	6/17/2009	North Slope, Lift 2	North Side Slope[5]	120.1	11.6	90%	99	10.8	YES	YES	AMEC
EDi North Slope Lift 3	6/17/2009	North Slope, Lift 3	North Side Slope[5]	120.1	11.6	90%	97	11.8	YES	YES	AMEC
EDi North Slope Lift 4	6/17/2009	North Slope, Lift 4	North Side Slope[5]	120.1	11.6	90%	95	12.7	YES	YES	AMEC
EDi North Slope Lift 5	6/18/2009	North Slope, Lift 5	North Side Slope[5]	120.1	11.6	90%	97	11.8	YES	YES	AMEC
EDi North Slope Lift 6	6/18/2009	North Slope, Lift 6	North Side Slope[5]	120.1	11.6	90%	99	11.1	YES	YES	AMEC
EDi North Slope Lift 7	6/19/2009	North Slope, Lift 7	North Side Slope[5]	115.8	12.3	90%	93	14.3	YES	YES	AMEC
EDi North Slope Lift 8	6/19/2009	North Slope, Lift 8	North Side Slope[5]	115.8	12.3	90%	93	14.2	YES	YES	AMEC
EDi East Slope Lift 1	6/17/2009	East Slope, Lift 1	East Side Slope[5]	120.1	11.6	90%	97	11.0	YES	YES	AMEC
EDi East Slope Lift 2	6/17/2009	East Slope, Lift 2	East Side Slope[5]	120.1	11.6	90%	97	11.2	YES	YES	AMEC
EDi East Slope Lift 3	6/17/2009	East Slope, Lift 3	East Side Slope[5]	120.1	11.6	90%	97	12.2	YES	YES	AMEC
EDi East Slope Lift 4	6/17/2009	East Slope, Lift 4	East Side Slope[5]	120.1	11.6	90%	98	11.3	YES	YES	AMEC
EDi East Slope Lift 5	6/18/2009	East Slope, Lift 5	East Side Slope[5]	120.1	11.6	90%	96	11.3	YES	YES	AMEC
EDi East Slope Lift 6	6/18/2009	East Slope, Lift 6	East Side Slope[5]	120.1	11.6	90%	99	11.7	YES	YES	AMEC
EDi West Slope Lift 1	6/17/2009	West Slope, Lift 1	West Side Slope[5]	120.1	11.6	90%	96	11.7	YES	YES	AMEC
EDi West Slope Lift 2	6/17/2009	West Slope, Lift 2	West Side Slope[5]	120.1	11.6	90%	98	11.8	YES	YES	AMEC
EDi West Slope Lift 3	6/17/2009	West Slope, Lift 3	West Side Slope[5]	120.1	11.6	90%	96	11.1	YES	YES	AMEC
EDi West Slope Lift 4	6/17/2009	West Slope, Lift 4	West Side Slope[5]	120.1	11.6	90%	97	11.1	YES	YES	AMEC
EDi West Slope Lift 5	6/18/2009	West Slope, Lift 5	West Side Slope[5]	120.1	11.6	90%	97	11.3	YES	YES	AMEC

Table 10 (cont'd.)
Mixed Waste Landfill 2009 ET Cover Construction
In-Place Density and Moisture Content CQC Field Results

Test Number	Date of Field Test	Description	Location[1]	Standard Proctor Maximum Density (lb/ft^3)[2]	Standard Proctor Optimum Moisture Content (%)	Percent of Maximum Density Required	Percent Compaction Achieved	Moisture Content Achieved	Meets Density Spec?	Meets Moisture Spec?	Testing Laboratory[3]
EDi West Slope Lift 6	6/18/2009	West Slope, Lift 6	West Side Slope[5]	120.1	11.6	90%	98	11.9	YES	YES	AMEC
EDi Dog Leg Lift 1	6/18/2009	Lift 1 on Dog Leg	Dog Leg Side Slope[5]	120.1	11.6	90%	97	11.9	YES	YES	AMEC
EDi Dog Leg Lift 2	6/18/2009	Lift 2 on Dog Leg	Dog Leg Side Slope[5]	120.1	11.6	90%	97	11.1	YES	YES	AMEC
EDi Wedge Lift 1	6/19/2009	Native Soil Lift 1	Grid Block 7	115.8	12.3	90%	96	11.1	YES	YES	AMEC
EDi Wedge Lift 1	6/19/2009	Native Soil Lift 1	Grid Block 8	115.8	12.3	90%	97	12.4	YES	YES	AMEC
EDi Wedge Lift 1	6/19/2009	Native Soil Lift 1	Grid Block 11	115.8	12.3	90%	94	12.2	YES	YES	AMEC
EDi Wedge Lift 2	6/19/2009	Native Soil Lift 2	Grid Block 7	115.8	12.3	90%	97	11.7	YES	YES	AMEC
EDi Wedge Lift 2	6/19/2009	Native Soil Lift 2	Grid Block 8	115.8	12.3	90%	96	10.6	YES	YES	AMEC
EDi Wedge Lift 2	6/19/2009	Native Soil Lift 2	Grid Block 11	115.8	12.3	90%	96	11.5	YES	YES	AMEC
EDi NS Lift 3	6/23/2009	Native Soil Lift 3	Grid Block 1	115.8	12.3	90%	100	10.7	YES	YES	AMEC
EDi NS Lift 3	6/23/2009	Native Soil Lift 3	Grid Block 2	115.8	12.3	90%	100	10.3	YES	YES	AMEC
EDi NS Lift 3	6/24/2009	Native Soil Lift 3	Grid Block 6	117.0	12.0	90%	97	11.6	YES	YES	AMEC
EDi NS Lift 3	6/24/2009	Native Soil Lift 3	Grid Block 8	117.0	12.0	90%	95	10.9	YES	YES	AMEC
EDi NS Lift 3	6/26/2009	Native Soil Lift 3	Grid Block 11 SE	117.0	12.0	90%	99	11.4	YES	YES	AMEC
EDi NS Lift 3	6/26/2009	Native Soil Lift 3	Grid Block 11 NE	117.0	12.0	90%	91	12.4	YES	YES	AMEC
EDi NS Lift 4	6/26/2009	Native Soil Lift 4	Grid Block 1	117.0	12.0	90%	100	13.8	YES	YES	AMEC
EDi NS Lift 4	6/26/2009	Native Soil Lift 4	Grid Block 2	117.0	12.0	90%	98	11.6	YES	YES	AMEC
EDi NS Lift 4	6/26/2009	Native Soil Lift 4	Grid Block 3	117.0	12.0	90%	94	13.8	YES	YES	AMEC
EDi NS Lift 4	6/26/2009	Native Soil Lift 4	Grid Block 4	117.0	12.0	90%	97	12.4	YES	YES	AMEC
EDi NS Lift 4	6/26/2009	Native Soil Lift 4	Grid Block 5	117.0	12.0	90%	97	12.9	YES	YES	AMEC
EDi NS Lift 4	6/26/2009	Native Soil Lift 4	Grid Block 6	117.0	12.0	90%	100	13.5	YES	YES	AMEC
EDi NS Lift 4	6/26/2009	Native Soil Lift 4	Grid Block 7	117.0	12.0	90%	99	11.6	YES	YES	AMEC
EDi NS Lift 4	6/26/2009	Native Soil Lift 4	Grid Block 8	117.0	12.0	90%	100	12.7	YES	YES	AMEC
EDi NS Lift 4	6/26/2009	Native Soil Lift 4	Grid Block 9	117.0	12.0	90%	100	12.0	YES	YES	AMEC
EDi NS Lift 4	6/26/2009	Native Soil Lift 4	Grid Block 10	117.0	12.0	90%	97	12.0	YES	YES	AMEC
EDi NS Lift 4	6/29/2009	Native Soil Lift 4	Grid Block 11	117.0	12.0	90%	98	10.1	YES	YES	AMEC
EDi NS Lift 4	6/29/2009	Native Soil Lift 4	Grid Block 12	117.0	12.0	90%	96	13.1	YES	YES	AMEC
EDi NS Lift 4	6/29/2009	Native Soil Lift 4	Grid Block 13	117.0	12.0	90%	97	10.9	YES	YES	AMEC
EDi NS Lift 5	7/7/2009	Native Soil Lift 5	Grid Block 1	117.0	12.0	90%	94	12.3	YES	YES	AMEC
EDi NS Lift 5 Retest[6]	7/9/2009	Native Soil Lift 5	Grid Block 1	117.0	12.0	90%	95	10.9	YES	YES	AMEC
EDi NS Lift 5	7/7/2009	Native Soil Lift 5	Grid Block 2	117.0	12.0	90%	91	6.8	YES	**NO**	AMEC
EDi NS Lift 5 Retest[6]	7/9/2009	Native Soil Lift 5	Grid Block 2	117.0	12.0	90%	100	10.5	YES	YES	AMEC

Table 10 (cont'd.)
Mixed Waste Landfill 2009 ET Cover Construction
In-Place Density and Moisture Content CQC Field Results

Test Number	Date of Field Test	Description	Location[1]	Standard Proctor Maximum Density (lb/ft^3)[2]	Standard Proctor Optimum Moisture Content (%)	Percent of Maximum Density Required	Percent Compaction Achieved	Moisture Content Achieved	Meets Density Spec?	Meets Moisture Spec?	Testing Laboratory[3]
EDi NS Lift 5	7/7/2009	Native Soil Lift 5	Grid Block 3	117.0	12.0	90%	89	12.2	**NO**	YES	AMEC
EDi NS Lift 5 Retest[6]	7/9/2009	Native Soil Lift 5	Grid Block 3	117.0	12.0	90%	99	12.2	YES	YES	AMEC
EDi NS Lift 5	7/7/2009	Native Soil Lift 5	Grid Block 4	117.0	12.0	90%	95	11.9	YES	YES	AMEC
EDi NS Lift 5 Retest[6]	7/9/2009	Native Soil Lift 5	Grid Block 4	117.0	12.0	90%	100	12.1	YES	YES	AMEC
EDi NS Lift 5	7/7/2009	Native Soil Lift 5	Grid Block 5	117.0	12.0	90%	89	6.9	**NO**	**NO**	AMEC
EDi NS Lift 5 Retest[6]	7/9/2009	Native Soil Lift 5	Grid Block 5	117.0	12.0	90%	99	13.5	YES	YES	AMEC
EDi NS Lift 5	7/2/2009	Native Soil Lift 5	Grid Block 6	117.0	12.0	90%	100	13.4	YES	YES	AMEC
EDi NS Lift 5	7/1/2009	Native Soil Lift 5	Grid Block 7 East Edge[7]	117.0	12.0	90%	89	7.1	**NO**	**NO**	AMEC
EDi NS Lift 5 Retest[6]	7/1/2009	Native Soil Lift 5	Grid Block 7 East Edge[7]	117.0	12.0	90%	96	10.3	YES	YES	AMEC
EDi NS Lift 5	7/2/2009	Native Soil Lift 5	Grid Block 7	117.0	12.0	90%	96	13.6	YES	YES	AMEC
EDi NS Lift 5	7/2/2009	Native Soil Lift 5	Grid Block 8	117.0	12.0	90%	97	10.8	YES	YES	AMEC
EDi NS Lift 5	7/2/2009	Native Soil Lift 5	Grid Block 9	117.0	12.0	90%	98	11.9	YES	YES	AMEC
EDi NS Lift 5	7/2/2009	Native Soil Lift 5	Grid Block 10	117.0	12.0	90%	94	11.1	YES	YES	AMEC
EDi NS Lift 5	7/1/2009	Native Soil Lift 5	Grid Block 11	117.0	12.0	90%	91	10.2	YES	YES	AMEC
EDi NS Lift 5	7/1/2009	Native Soil Lift 5	Grid Block 12	117.0	12.0	90%	96	11.5	YES	YES	AMEC
EDi NS Lift 5	7/1/2009	Native Soil Lift 5	Grid Block 13	117.0	12.0	90%	95	12.1	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 1	117.0	12.0	90%	97	14.0	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 2	117.0	12.0	90%	96	14.0	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 3	117.0	12.0	90%	99	10.2	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 4	117.0	12.0	90%	94	10.1	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 5	117.0	12.0	90%	99	12.5	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 6	117.0	12.0	90%	94	10.7	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 7	117.0	12.0	90%	91	10.0	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 8	117.0	12.0	90%	100	11.6	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 9	117.0	12.0	90%	100	12.4	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 10	117.0	12.0	90%	100	10.5	YES	YES	AMEC
EDi NS Lift 6	7/14/2009	Native Soil Lift 6	Grid Block 11	117.0	12.0	90%	99	10.9	YES	YES	AMEC
EDi NS Lift 6	7/14/2009	Native Soil Lift 6	Grid Block 12	117.0	12.0	90%	99	12.7	YES	YES	AMEC
EDi NS Lift 6	7/14/2009	Native Soil Lift 6	Grid Block 13	117.0	12.0	90%	99	13.2	YES	YES	AMEC
EDi NS Lift 6	7/17/2009	Native Soil Lift 6	MW-4	117.0	12.0	90%	94	9.6	YES	**NO**	AMEC
EDi NS Lift 6 Retest[6]	7/21/2009	Native Soil Lift 6	MW-4	117.0	12.0	90%	91	10.3	YES	YES	AMEC
EDi NS Lift 7	7/22/2009	Native Soil Lift 7	Grid Block 1	117.0	12.0	90%	94	13.7	YES	YES	AMEC

Table 10 (cont'd.)
Mixed Waste Landfill 2009 ET Cover Construction
In-Place Density and Moisture Content CQC Field Results

Test Number	Date of Field Test	Description	Location[1]	Standard Proctor Maximum Density (lb/ft^3)[2]	Standard Proctor Optimum Moisture Content (%)	Percent of Maximum Density Required	Percent Compaction Achieved	Moisture Content Achieved	Meets Density Spec?	Meets Moisture Spec?	Testing Laboratory[3]
EDi NS Lift 7	7/22/2009	Native Soil Lift 7	Grid Block 2	117.0	12.0	90%	96	13.6	YES	YES	AMEC
EDi NS Lift 7	7/22/2009	Native Soil Lift 7	Grid Block 3	117.0	12.0	90%	94	11.4	YES	YES	AMEC
EDi NS Lift 7	7/22/2009	Native Soil Lift 7	Grid Block 4	117.0	12.0	90%	94	13.0	YES	YES	AMEC
EDi NS Lift 7	7/22/2009	Native Soil Lift 7	Grid Block 5	117.0	12.0	90%	95	11.8	YES	YES	AMEC
EDi NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 6	117.0	12.0	90%	100	10.6	YES	YES	AMEC
EDi NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 7	117.0	12.0	90%	100	12.2	YES	YES	AMEC
EDi NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 8	117.0	12.0	90%	96.0	11.0	YES	YES	AMEC
EDi NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 9	117.0	12.0	90%	100	12.4	YES	YES	AMEC
EDi NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 10	117.0	12.0	90%	100	12.6	YES	YES	AMEC
EDi NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 11	117.0	12.0	90%	99	11.9	YES	YES	AMEC
EDi NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 12	117.0	12.0	90%	95	13.8	YES	YES	AMEC
EDi NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 13	117.0	12.0	90%	99	11.2	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 1	117.0	12.0	90%	100	10.7	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 2	117.0	12.0	90%	99	11.4	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 3	117.0	12.0	90%	99	12.5	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 4	117.0	12.0	90%	99	11.4	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 5	117.0	12.0	90%	97	13.4	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 6	117.0	12.0	90%	100	10.0	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 7	117.0	12.0	90%	100	10.0	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 8	117.0	12.0	90%	98	8.6	YES	**NO**	AMEC
EDi NS Lift 8 Retest[6]	7/28/2009	Native Soil Lift 8	Grid Block 8	117.0	12.0	90%	100	10.3	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 9	117.0	12.0	90%	100	10.1	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 10	117.0	12.0	90%	98	7.6	YES	**NO**	AMEC
EDi NS Lift 8 Retest[6]	7/28/2009	Native Soil Lift 8	Grid Block 10	117.0	12.0	90%	100	11.2	YES	YES	AMEC
EDi NS Lift 8	7/24/2009	Native Soil Lift 8	Grid Block 11	117.0	12.0	90%	100	10.5	YES	YES	AMEC
EDi NS Lift 8	7/24/2009	Native Soil Lift 8	Grid Block 12	117.0	12.0	90%	100	11.9	YES	YES	AMEC
EDi NS Lift 8	7/24/2009	Native Soil Lift 8	Grid Block 13	117.0	12.0	90%	100	10.9	YES	YES	AMEC
EDi NS Lift 8	7/28/2009	Native Soil Lift 8	MW-4	117.0	12.0	90%	98	8.8	YES	**NO**	AMEC
EDi NS Lift 8 Retest[6]	7/28/2009	Native Soil Lift 8	MW-4	117.0	12.0	90%	97	10.3	YES	YES	AMEC
EDi NS Top Soil[8]	9/03/2009	Topsoil	Grid Block 12 4" depth	118.9	9.6	NA[9]	89	4.7	NA[9]	NA[9]	AMEC
EDi NS Top Soil[8]	9/03/2009	Topsoil	Grid Block 12 10" depth	118.9	9.6	NA[9]	94	4.9	NA[9]	NA[9]	AMEC

Table 10 (cont'd.)
Mixed Waste Landfill 2009 ET Cover Construction
In-Place Density and Moisture Content CQC Field Results

Test Number	Date of Field Test	Description	Location[1]	Standard Proctor Maximum Density (lb/ft^3)[2]	Standard Proctor Optimum Moisture Content (%)	Percent of Maximum Density Required	Percent Compaction Achieved	Moisture Content Achieved	Meets Density Spec?	Meets Moisture Spec?	Testing Laboratory[3]
EDi NS Top Soil[8]	9/03/2009	Topsoil	Grid Block 8 4" depth	118.9	9.6	NA[9]	75	3.9	NA[9]	NA[9]	AMEC
EDi NS Top Soil[8]	9/03/2009	Topsoil	Grid Block 8 6" depth	118.9	9.6	NA[9]	82	3.9	NA[9]	NA[9]	AMEC
EDi NS Top Soil[8]	9/03/2009	Topsoil	Grid Block 2 4" depth	118.9	9.6	NA[9]	89	3.8	NA[9]	NA[9]	AMEC
EDi NS Top Soil[8]	9/03/2009	Topsoil	Grid Block 2 8" depth	118.9	9.6	NA[9]	96	3.7	NA[9]	NA[9]	AMEC
EDi NS Top Soil[8]	9/03/2009	Topsoil	Grid Block 5 4" depth	118.9	9.6	NA[9]	88	5.4	NA[9]	NA[9]	AMEC
EDi NS Top Soil[8]	9/03/2009	Topsoil	Grid Block 5 8" depth	118.9	9.6	NA[9]	94	3.8	NA[9]	NA[9]	AMEC

[1] Locations shown for all CQC field tests, except Topsoil Layer tests, in Figures 21 through 29.
[2] lb/ft^3 = Pounds per cubic foot.
[3] AMEC = AMEC Earth and Environmental, Albuquerque, New Mexico.
[4] Location incorrectly referred to as 'Grid Line' instead of Grid Block on laboratory data sheet.
[5] All side slope work to establish the required 6 to 1 slope angle was performed as the first part of Native Soil Layer construction around the northern half of the MWL boundary (North, West, East, and Dog Leg boundary areas). Locations of all CQC side slope tests are shown in Figure 22.
[6] All retests were performed at the same location as the original test.
[7] This location is labeled "EDi-NS-L5-GB7A" in Figure 26 and is located on the northeastern boundary of Grid Block 6.
[8] Topsoil Layer density and moisture testing were performed but not required. These test locations were not surveyed.
[9] NA = Not applicable; Maximum Density and Moisture Content specifications and tests do not apply to the topsoil layer.

Table 11
Mixed Waste Landfill 2009 ET Cover Construction
In-Place Density and Moisture Content CQA Field Results

Test Number	Date of Field Test	Description	Location[1]	Standard Proctor Maximum Density (lb/ft^3)[2]	Standard Proctor Optimum Moisture Content (%)	Percent of Maximum Density Required	Percent Compaction Achieved	Moisture Content Achieved	Meets Density Spec?	Meets Moisture Spec?	Testing Laboratory[3]
URS Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 5	120.1	11.6	90%	98	10.6	YES	YES	AMEC
URS Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 12	120.1	11.6	90%	97	11.0	YES	YES	AMEC
URS Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 8	120.1	11.6	90%	99	10.0	YES	YES	AMEC
URS Sub-Grade	5/22/2009	Subgrade Surface	Grid Block 1	120.1	11.6	90%	98	10.0	YES	YES	AMEC
URS North Slope Lift 7	6/19/2009	North Slope Lift 7	North Slope[4]	115.8	12.3	90%	92	14	YES	YES	AMEC
URS North Slope Lift 8	6/19/2009	North Slope Lift 8	North Slope[4]	115.8	12.3	90%	89	15.2	**NO**	**NO**	AMEC
URS North Slope Lift 8 Retest[5]	6/22/2009	North Slope Lift 8	Grid Block 5[4]	115.8	12.3	90%	92	11.0	YES	YES	AMEC
URS North Slope Lift 8 Retest[5]	6/22/2009	North Slope Lift 8	Grid Block 10[4]	115.8	12.3	90%	92	10.5	YES	YES	AMEC
URS North Slope Lift 8 Retest[5]	6/22/2009	North Slope Lift 8	Grid Block 13[4]	115.8	12.3	90%	91	10.9	YES	YES	AMEC
URS East Slope Lift 5	6/19/2009	East Slope Lift 5	East Slope[4]	120.1	11.6	90%	94	10.3	YES	YES	AMEC
URS East Slope Lift 6	6/19/2009	East Slope Lift 6	East Slope[4]	120.1	11.6	90%	98	10.1	YES	YES	AMEC
URS West Slope Lift 5	6/19/2009	West Slope Lift 5	West Slope[4]	120.1	11.6	90%	96	10.6	YES	YES	AMEC
URS West Slope Lift 6	6/19/2009	West Slope Lift 6	West Slope[4]	120.1	11.6	90%	98	11.1	YES	YES	AMEC
URS Wedge Lift 1	6/19/2009	Native Soil Lift 1	Grid Block 8	115.8	12.3	90%	91	10.7	YES	YES	AMEC
URS Wedge Lift 1	6/19/2009	Native Soil Lift 1	Grid Block 11	115.8	12.3	90%	92	11.0	YES	YES	AMEC
URS Wedge Lift 2	6/19/2009	Native Soil Lift 2	Grid Block 11	115.8	12.3	90%	94	11.0	YES	YES	AMEC
URS NS Lift 3	6/23/2009	Native Soil Lift 3	Grid Block 2	115.8	12.3	90%	97	10.8	YES	YES	AMEC
URS NS Lift 3	6/24/2009	Native Soil Lift 3	Grid Block 8	117.0	12.0	90%	94	10.0	YES	YES	AMEC
URS NS Lift 3	6/26/2009	Native Soil Lift 3	Grid Block 11	117.0	12.0	90%	98	13.7	YES	YES	AMEC
URS NS Lift 4	6/26/2009	Native Soil Lift 4	Grid Block 1	117.0	12.0	90%	100	14.0	YES	YES	AMEC
URS NS Lift 4	6/26/2009	Native Soil Lift 4	Grid Block 3	117.0	12.0	90%	95	13.5	YES	YES	AMEC
URS NS Lift 4	6/26/2009	Native Soil Lift 4	Grid Block 5	117.0	12.0	90%	95	12.8	YES	YES	AMEC
URS NS Lift 4	6/26/2009	Native Soil Lift 4	Grid Block 9	117.0	12.0	90%	98	11.5	YES	YES	AMEC
URS NS Lift 4	6/26/2009	Native Soil Lift 4	Grid Block 7	117.0	12.0	90%	96	11.6	YES	YES	AMEC
URS NS Lift 4	6/29/2009	Native Soil Lift 4	Grid Block 13	117.0	12.0	90%	98	11.6	YES	YES	AMEC
URS NS Lift 4	6/29/2009	Native Soil Lift 4	Grid Block 11	117.0	12.0	90%	97	10.1	YES	YES	AMEC
URS NS Lift 5	7/1/2009	Native Soil Lift 5	Grid Block 12	117.0	12.0	90%	92	10.0	YES	YES	AMEC
URS NS Lift 5	7/2/2009	Native Soil Lift 5	Grid Block 10	117.0	12.0	90%	94	12.3	YES	YES	AMEC
URS NS Lift 5	7/2/2009	Native Soil Lift 5	Grid Block 8	117.0	12.0	90%	93	12.8	YES	YES	AMEC
URS NS Lift 5	7/2/2009	Native Soil Lift 5	Grid Block 6	117.0	12.0	90%	97	13.5	YES	YES	AMEC
URS NS Lift 5	7/9/2009	Native Soil Lift 5	Grid Block 4	117.0	12.0	90%	100	10.0	YES	YES	AMEC

Table 11 (cont'd.)
Mixed Waste Landfill 2009 ET Cover Construction
In-Place Density and Moisture Content CQA Field Results

Test Number	Date of Field Test	Description	Location[1]	Standard Proctor Maximum Density (lb/ft^3)[2]	Standard Proctor Optimum Moisture Content (%)	Percent of Maximum Density Required	Percent Compaction Achieved	Moisture Content Achieved	Meets Density Spec?	Meets Moisture Spec?	Testing Laboratory[3]
URS NS Lift 5	7/9/2009	Native Soil Lift 5	Grid Block 2	117.0	12.0	90%	97	10.2	YES	YES	AMEC
URS NS Lift 6	7/14/2009	Native Soil Lift 6	Grid Block 11	117.0	12.0	90%	99	10.4	YES	YES	AMEC
URS NS Lift 6	7/14/2009	Native Soil Lift 6	Grid Block 13	117.0	12.0	90%	100	12.2	YES	YES	AMEC
URS NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 8	117.0	12.0	90%	100	12.8	YES	YES	AMEC
URS NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 6	117.0	12.0	90%	93	10.3	YES	YES	AMEC
URS NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 2	117.0	12.0	90%	95	14.0	YES	YES	AMEC
URS NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 4	117.0	12.0	90%	97	10.9	YES	YES	AMEC
URS NS Lift 6	7/17/2009	Native Soil Lift 6	Grid Block 9	117.0	12.0	90%	100	11.4	YES	YES	AMEC
URS NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 11	117.0	12.0	90%	96	12.0	YES	YES	AMEC
URS NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 13	117.0	12.0	90%	98	12.8	YES	YES	AMEC
URS NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 9	117.0	12.0	90%	99	11.9	YES	YES	AMEC
URS NS Lift 7	7/21/2009	Native Soil Lift 7	Grid Block 7	117.0	12.0	90%	100	12.4	YES	YES	AMEC
URS NS Lift 7	7/22/2009	Native Soil Lift 7	Grid Block 1	117.0	12.0	90%	93	14.0	YES	YES	AMEC
URS NS Lift 7	7/22/2009	Native Soil Lift 7	Grid Block 3	117.0	12.0	90%	92	10.5	YES	YES	AMEC
URS NS Lift 7	7/22/2009	Native Soil Lift 7	Grid Block 5	117.0	12.0	90%	95	12.2	YES	YES	AMEC
URS NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 12	117.0	12.0	90%	100	10.0	YES	YES	AMEC
URS NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 6	117.0	12.0	90%	99	10.0	YES	YES	AMEC
URS NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 2	117.0	12.0	90%	99	10.8	YES	YES	AMEC
URS NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 4	117.0	12.0	90%	97	12.1	YES	YES	AMEC
URS NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 8	117.0	12.0	90%	100	10.3	YES	YES	AMEC
URS NS Lift 8	7/28/2009	Native Soil Lift 8	Grid Block 10	117.0	12.0	90%	99	11.0	YES	YES	AMEC

[1] Locations shown for all CQA field tests in Figures 21 through 29.
[2] lb/ft^3 = Pounds per cubic foot.
[3] AMEC = AMEC Earth and Environmental, Albuquerque, New Mexico.
[4] All side slope work to establish the required 6 to 1 slope angle was performed as the first part of Native Soil Layer construction around the northern half of the MWL boundary (North, West, and East boundary areas). Locations of all CQC side slope tests are shown in Figure 22.
[5] Three retests were performed for the one North Slope Lift 8 test that failed (6-19-09 test). The three retests were performed on 6-22-09 across the northern slope area within Grid Blocks 5, 10, and 13 to make sure density and moisture specifications were consistently met across the entire northern boundary for Lift 8. The original failed test location and three retest locations are shown in Figure 22.

Table 12
Mixed Waste Landfill 2009 ET Cover Construction CQC
Land Survey Elevation Data

Grid No.	Subgrade		Biointrusion Rock Layer			Thin Soil Layer above Biointrusion Layer			Native Soil Layer			Topsoil Layer		
	Pt. No.	Elev.	Pt. No.	Elev.	Depth (ft)	Pt. No.	Elev.	Depth (ft)	Pt. No.	Elev.	Depth (ft)	Pt. No.	Elev.	Depth (ft)
A1	1043	5379.49	1747	5380.75	1.26	1905	5380.94	0.19	5311	5383.51	2.76	5256	5384.52	1.01
A2	1071	5380.15	1755	5381.28	1.13	1904	5381.54	0.26	5310	5384.04	2.76	5262	5385.03	0.99
A3	1080	5380.94	1758	5382.26	1.32	1903	5382.43	0.17	5307	5384.93	2.67	5264	5385.99	1.06
A4	1095	5381.97	1761	5383.18	1.21	1923	5383.46	0.28	5306	5385.99	2.81	5267	5387.02	1.03
A5	1106	5383.08	1770	5384.54	1.46	1929	5384.78	0.24	5290	5387.28	2.74	5274	5388.33	1.05
A6	1127	5383.83	1806	5385.11	1.28	1940	5385.40	0.29	5289	5387.93	2.82	5279	5388.89	0.96
A7	1139	5384.83	1820	5386.03	1.20	1955	5386.35	0.32	5347	5388.54	2.51	5281	5389.58	1.04
B1	1044	5380.16	1777	5381.49	1.33	1900	5381.74	0.25	5312	5384.36	2.87	5276	5385.40	1.04
B2	1070	5380.88	1754	5382.13	1.25	1921	5382.39	0.26	5309	5384.87	2.74	5261	5385.90	1.03
B3	1081	5382.03	1759	5383.32	1.29	1901	5383.51	0.19	5300	5385.98	2.66	5265	5387.00	1.02
B4	1094	5382.97	1760	5384.17	1.20	1902	5384.47	0.30	5305	5386.99	2.82	5266	5388.01	1.02
B5	1112	5384.18	1769	5385.46	1.28	1928	5385.61	0.15	5291	5388.09	2.63	5273	5389.08	0.99
B6	1126	5385.06	1805	5386.18	1.12	1939	5386.39	0.21	5292	5388.92	2.74	5278	5389.87	0.95
B7	1140	5386.02	1821	5387.19	1.17	1950	5387.26	0.07	5346	5389.37	2.18	5282	5390.50	1.13
C1	1048	5380.74	1778	5382.24	1.50	1898	5382.38	0.14	5313	5384.87	2.63	5277	5385.88	1.01
C2	1069	5381.65	1746	5382.86	1.21	1920	5383.15	0.29	5340	5385.59	2.73	5255	5386.56	0.97
C3	1082	5382.47	1711	5383.75	1.28	1897	5384.05	0.30	5315	5386.61	2.86	5247	5387.60	0.99
C4	1093	5383.43	1712	5384.70	1.27	1896	5384.94	0.24	5304	5387.52	2.82	5248	5388.55	1.03
C5	1113	5384.80	1713	5385.88	1.08	1895	5386.01	0.13	5294	5388.59	2.71	5249	5389.59	1.00
C6	1125	5385.76	1835	5386.97	1.21	1938	5387.26	0.29	5345	5389.57	2.60	5284	5390.65	1.08
C7	1141	5386.37	1834	5387.66	1.29	1949	5387.96	0.30	5293	5390.48	2.82	5283	5391.59	1.11

Table 12 (cont'd.)
Mixed Waste Landfill 2009 ET Cover Construction CQC
Land Survey Elevation Data

Grid No.	Subgrade		Biointrusion Rock Layer			Thin Soil Layer above Biointrusion			Native Soil Layer			Topsoil Layer		
	Pt. No.	Elev.	Pt. No.	Elev.	Depth (ft)	Pt. No.	Elev.	Depth (ft)	Pt. No.	Elev.	Depth (ft)	Pt. No.	Elev.	Depth (ft)
D1	1049	5381.12	1719	5382.38	1.26	1889	5382.59	0.21	5314	5385.09	2.71	5254	5386.07	0.98
D2	1068	5381.85	1710	5383.13	1.28	1892	5383.35	0.22	5341	5385.77	2.64	5246	5386.78	1.01
D3	1083	5382.71	1709	5383.83	1.12	1891	5384.07	0.24	5316	5386.80	2.97	5245	5387.78	0.98
D4	1092	5383.55	1708	5384.80	1.25	1893	5385.08	0.28	5303	5387.77	2.97	5244	5388.78	1.01
D5	1114	5384.75	1707	5385.78	1.03	1894	5386.01	0.23	5295	5388.73	2.95	5243	5389.77	1.04
D6	1124	5385.90	1847	5387.17	1.27	1931	5387.35	0.18	5296	5389.74	2.57	5288	5390.78	1.04
D7	1142	5386.36	1837	5387.64	1.28	1953	5387.94	0.30	5297	5390.77	3.13	5285	5391.79	1.02
E1	1054	5381.20	1717	5382.43	1.23	1882	5382.71	0.28	5319	5385.22	2.79	5253	5386.21	0.99
E2	1067	5381.76	1702	5383.05	1.29	1886	5383.20	0.15	5318	5385.86	2.81	5238	5386.84	0.98
E3	1084	5382.77	1703	5383.98	1.21	1883	5384.24	0.26	5317	5386.84	2.86	5239	5387.84	1.00
E4	1091	5383.58	1704	5384.69	1.11	1884	5384.97	0.28	5302	5387.85	3.16	5240	5388.83	0.98
E5	1115	5384.28	1705	5385.45	1.17	1885	5385.75	0.30	5301	5388.85	3.40	5241	5389.82	0.97
E5.1	1116	5384.56	1706	5385.79	1.23	1933	5386.09	0.30	5300	5389.12	3.33	5242	5390.06	0.94
E6	1123	5384.76	1846	5386.17	1.41	1932	5386.49	0.32	5299	5389.83	3.66	5287	5390.83	1.00
E7	1143	5385.07	1845	5386.91	1.84	1948	5387.24	0.33	5298	5390.89	3.98	5286	5391.91	1.02
F1	1055	5380.98	1716	5382.09	1.11	1887	5382.34	0.25	5320	5384.87	2.78	5252	5385.88	1.01
F2	1066	5381.78	1701	5382.85	1.07	1880	5383.11	0.26	5321	5385.49	2.64	5237	5386.52	1.03
F3	1085	5382.73	1700	5383.80	1.07	1879	5384.09	0.29	5322	5386.57	2.77	5236	5387.61	1.04
F4	1090	5383.53	1699	5384.81	1.28	1878	5384.89	0.08	5323	5387.48	2.67	5235	5388.63	1.15
F5	1117	5384.19	1698	5385.41	1.22	1877	5385.67	0.26	5324	5388.46	3.05	5234	5389.49	1.03

Table 12 (cont'd.)
Mixed Waste Landfill 2009 ET Cover Construction CQC
Land Survey Elevation Data

Grid No.	Subgrade		Biointrusion Rock Layer			Thin Soil Layer above Biointrusion			Native Soil Layer			Topsoil Layer		
	Pt. No.	Elev.	Pt. No.	Elev.	Depth (ft)	Pt. No.	Elev.	Depth (ft)	Pt. No.	Elev.	Depth (ft)	Pt. No.	Elev.	Depth (ft)
G1	1058	5380.64	1715	5381.97	1.33	1868	5382.25	0.28	5329	5384.75	2.78	5251	5385.77	1.02
G2	1065	5381.27	1692	5382.51	1.24	1871	5382.75	0.24	5328	5385.34	2.83	5232	5386.42	1.08
G3	1086	5382.40	1749	5383.72	1.32	1872	5383.92	0.20	5327	5386.42	2.70	5258	5387.49	1.07
G4	1089	5383.14	1748	5384.40	1.26	1873	5384.99	0.59	5326	5387.44	3.04	5257	5388.45	1.01
G5	1118	5383.98	1695	5385.21	1.23	1874	5385.54	0.33	5325	5388.41	3.20	5233	5389.39	0.98
H1	1063	5380.35	1714	5381.73	1.38	1866	5382.02	0.29	5330	5384.43	2.70	5250	5385.52	1.09
H2	1064	5381.28	1691	5382.33	1.05	1869	5382.62	0.29	5331	5385.17	2.84	5231	5386.19	1.02
H3	1087	5382.00	1768	5383.44	1.44	1864	5383.74	0.30	5332	5386.19	2.75	5272	5387.24	1.05
H4	1088	5382.97	1766	5384.42	1.45	1865	5384.68	0.26	5333	5387.20	2.78	5270	5388.27	1.07
H5	1119	5383.87	1688	5384.94	1.07	1863	5385.28	0.34	5334	5388.19	3.25	5230	5389.27	1.08
I1	1189	5379.82	1750	5381.09	1.27	1853	5381.34	0.25	5339	5383.82	2.73	5259	5384.83	1.01
I2	1184	5380.56	1751	5381.87	1.31	1855	5382.07	0.20	5338	5384.53	2.66	5260	5385.55	1.02
I3	1180	5381.40	1683	5382.73	1.33	1857	5382.99	0.26	5337	5385.70	2.97	5228	5386.64	0.94
I4	1177	5382.56	1767	5383.89	1.33	1861	5384.14	0.25	5336	5386.59	2.70	5271	5387.66	1.07
I5	1172	5383.51	1685	5384.58	1.07	1859	5384.78	0.20	5335	5387.60	3.02	5229	5388.60	1.00
			Average Depth =		**1.25**	**Average Depth =**		**0.25**	**Average Depth =**		**2.85**	**Average Depth =**		**1.02**

Note: The location of verification survey grid points is shown in Figure 18.

Table 13
Mixed Waste Landfill 2009 ET Cover Construction Equipment Summary

Vehicle	Make/Model	Gross Weight (lbs)	Tire Size	Tire Pressure (if applicable)	Specific Application	Other Pertinent Information
Motor Grader	JD 670 D	37,790	14.00-24 12PR	55	Place, process and grade native soil and topsoil	
Dozer	JD 650 J	18,598	NA		Spread and grade biointrusion layer rock and soil	Shoe size 18 in., track length (on ground surface) 7.25 ft
Vibratory Roller	IR SD100	22,490 Total Drum 13,320	23.1 x 26-8PR	35	Proof roll subgrade, compaction of native soil lifts	Drum: 84"W × 59"Dia., 52,520 lbs max centrifugal force
Wheel Loader	JD 644 J	40,620	23.5 R25	40	Placement of biointrusion rock, material loading	
Wheel Loader	JD 544 J	28,534	20.5 R25	40	Material loading, grading on landfill cover	
Skid Steer Loader	CAT 242B	6,914	12-16.5	50	T-post removal, site grading, transport jumping jack compactor	
Secondary Vehicles						
Water Truck	4000 Gallon	46,000	11R-22.5	110	Material processing, dust suppression	
Water Truck	2000 Gallon	29,000	11R-22.5	110	Material processing, dust suppression	
Dump Truck, Tandem (3)	12 Cu. Yd.	46,000			Haul biointrusion rock	
Bottom Dump Truck (4)	20 Cu. Yd.	80,000	11R-22.5	110	Haul and place native soil and topsoil	Dumps with 8-ft axle spread Max 86,000 G.V.W.
Ag Tractor	KUBOTA M7040	4,608	Front 9.5-24 Rear 16.9-30	Front 45 Rear 25	Tilling , drill seeding and crimping straw mulch	
Dump Truck Single Axle	GMC Top Kick	26,000	19.5 R-20	100	Haul straw bales, tow straw blower	

Table 13 (cont'd.)
Mixed Waste Landfill 2009 ET Cover Construction Equipment Summary

Vehicle	Make/Model	Gross Weight (lbs)	Tire Size	Tire Pressure (if applicable)	Specific Application	Other Pertinent Information
Borrow Pit Operations						
Excavator	JD 200 CLC	44,750	NA		Excavate native and topsoil, feed screen plant	Shoe size 32 in., track length (on ground surface) 12 ft
Excavator	JD 240 CLC	54,654	NA		Load trucks, excavate native and topsoil, feed screen plant	Shoe size 32 in., track length (on ground surface) 12.5 ft
Wheel Loader	JD 644 J	40,620	23.5 R25	40	Load trucks, support screening plant operations	
Wheel Loader	JD 544 J	28,534	20.5 R25	40	Load trucks, support screening plant operations	
Wheel Loader	CAT 966 E	44,551	26.5-25 14PR	40	Feed pug mill during topsoil blending	
Wheel Loader	CAT 966 F	45,162	26.5-25 14PR	40	Wheel material away from pug mill, build stockpile	
Motor Grader	JD 670 D	37,790	14.00-24 12PR	55	Site grading, road maintenance at borrow area	

ET = Evapotranspirative
NA = Not applicable

Table 14
Mixed Waste Landfill Subgrade and ET Cover Design Change Summary

CMIP Specification	Description	No Adverse Quality Impact Summary
2006 Subgrade Preparation		
Appendix A, Earthwork, 02200, Section 3.3.3	Existing surface was to be compacted with 10 passes of a roller with ballasted weight of 25 tons and a minimum tire pressure of 90 psi – a smaller roller and fewer passes used and compaction specifications were met. Optimum moisture content could not be attained for the existing ground surface, but was not a requirement.	Field tests were not required but used to verify soil density specifications were met with the equipment used.
Appendix A, Earthwork, 02200, Section 3.4.2 and Table 3.1	First Standard Proctor sample used to characterize ~1,384 cy (versus 500 cy) because the next two sample results were not available after the initial 500 cy was installed (due to laboratory turnaround times).	Fill soil properties are consistent.
2009 ET Cover Construction		
Design drawings	The Subgrade top east-to-west surface slope was less than the 2% design slope in the east-central portion of the Subgrade surface (~1.8%)	2% design slope established with Native and Topsoil Layers.
Design drawings	The Subgrade side slopes were steeper than 6:1	6:1 side slopes established with Native and Topsoil Layers.
Design drawings	The Biointrusion Layer side slopes were steeper than 6:1, consistent with the Subgrade side slopes.	6:1 side slopes established with Native and Topsoil Layers.
Design drawings	The Biointrusion surface slope was less than the 2% design slope in specific areas, consistent with the Subgrade surface (~1.8%).	2% design slope established with Native and Topsoil Layers.
Appendix A, Earthwork, 02200, Section 3.3.5	The procedure for filling void spaces in the Biointrusion Layer was not addressed in the CMIP.	Soil added to void spaces created a more structurally sound cover less prone to subsidence.
Appendix A, Earthwork, 02200, Section 3.3.5	Establishing a smooth surface on the Biointrusion Layer upon which the Native Soil Layer could be constructed was not addressed in the CMIP.	Thin soil layer added created a more regular surface on which the Native Soil Layer was constructed, resulting in a more structurally sound Native Soil Layer.
Appendix B, Section 5.0 and Grades, Lines, and Levels, Section 1.4.2	The Native Soil Layer average thickness exceeded the maximum thickness of 2.75 feet by 0.10 feet.	Slight thickness exceedence resulted in a more protective Native Soil Layer.
Appendix A, Earthwork, 02200, Section 2.1.2	The 3/8-inch crushed gravel used in the Topsoil Layer did not meet specifications for the percent passing the #4 sieve (the “no more than 5%” requirement was exceeded). No locally available 3/8-inch gravel met the specification.	Approved aggregate had the lowest percent passing of available material.
Appendix A, Reclamation Seeding and Mulching, Section 2.2.1	Topsoil Layer seeding rate was increased from 20 to 80 pounds per acre. Some of the additional seed quantity was applied by hand (hand broadcasting) to ensure a relatively even distribution across the cover surface, side slopes, and disturbed areas.	Higher seeding rate and application process increased the probability of successful revegetation.

Table 14 (cont'd.)
Mixed Waste Landfill Subgrade and ET Cover Design Change Summary

CMIP Specification	Description	No Adverse Quality Impact Summary
2009 ET Cover Construction (cont'd.)		
Appendix A, Reclamation Seeding and Mulching, Section 2.2.2	A starter fertilizer was not used because the seeding was performed late in the growing season. When fertilizer is used late in the growing season, growth is artificially stimulated and seedlings are more susceptible to frost damage.	Use of fertilizer late in the growing season can be harmful to long-term plant growth.
Appendix A, Reclamation Seeding and Mulching	Use of supplemental watering (i.e., as temporary irrigation system) was not addressed in the CMIP, but was approved by the NMED in the conditional approval of the CMIP (Bearzi, December 2008).	Use of supplemental watering increases the probability of successful revegetation.
Appendix A, Earthwork, 02200	Soil drainage diversions at monitoring well locations along the west slope of the cover were not addressed in the CMIP. They are necessary to divert runoff around monitoring well locations due to the larger footprint of the cover.	Drainage features will protect the existing monitoring wells from side-slope drainage.
Section 6.0 of CMIP main text and Design Drawings	Soil and rock volumes used to construct the ET Cover are larger then the estimated volumes in the CMIP.	Larger volumes used resulted in a more protective final cover.
Design Drawings	Final footprint of the cover is larger then the CMIP design.	Larger footprint is structurally sound and more protective of the disposal areas.
Appendix A, Monitoring Well MW-4 Extension, 02670, Section 3.1	The existing concrete pad of MWL-MW-4 was not broken up and removed when the well and protective casing were extended. It was left around the protective steel casing and incorporated into the Subgrade.	Incorporating the concrete pad into the Subgrade created a structurally sound "anchor" for the extended casing.
Appendix A, Monitoring Well MW-4 Extension, 02670, Section 3.1	The final height of the MWL-MW-4 well casing is less than the minimum specification of 2 feet, 6 inches above the final grade of the constructed cover.	The height of the well casing (16 inches) does not adversely impact access to the well or well performance.
Not Included in the CMIP	Two soil-vapor monitoring points were installed through the ET Cover per the NMED conditional approval of the CMIP (Bearzi, December 2008) and direction received from NMED.	Required by NMED and installed prior to revegetation of Topsoil Layer to minimize impact to cover.
Section 7.1 of CMIP main text and Design drawings	Three angled boreholes for vadose zone moisture monitoring are addressed in the CMIP and shown on the design drawings but were installed in August 2003. The installation and construction of these boreholes will be documented in the MWL Long-Term Monitoring and Maintenance Plan.	Boreholes located on the edge of the cover side slope.

CMIP = Corrective Measures Implementation Plan
ET = Evapotranspirative
MWL = Mixed Waste Landfill
NMED = New Mexico Environment Department

Table 15
Mixed Waste Landfill Final In-Place Subgrade and ET Cover Layer Soil and Rock Volume Estimates

MWL ET Cover Layer	Volume Estimates Reflect Placed, Compacted Cubic Yards (cy)		Explanation
	CMIP Volume	As-Constructed Volume	
Subgrade	6,500	7,700	The MWL existing surface required more elevation increase than anticipated in the CMIP design.
Biointrusion Layer	4,900	6,800	The average thickness of the installed Biointrusion Layer is 0.25 feet greater than the CMIP design. The in-place surveyed volume is approximately 5,800 cy. The 1,000-cy discrepancy is most likely due to the fact that the Subgrade surface elevation was lowered approximately 1 to 2 inches during the scarification process prior to installing the rock material. The surveyed volume estimate does not account for the volume of rock penetrating down into the Subgrade.
Biointrusion Layer – Void filling and overlying 3-inch-thick soil layer	Not Estimated	3,100	Volume estimate is based on truckload tallies and represents a loose, uncompacted estimate. Volume cannot be accurately estimated due to some soil moving down into rock void space. To estimate an approximate total volume of compacted soil for the MWL ET Cover, a compaction factor of 16% was used for this thin soil layer, resulting in an estimated compacted volume of 2,600 cy.
Native Soil	13,200	17,300	The average thickness of the constructed Native Soil Layer is approximately 2.85 feet (versus 2.5 feet minimum in the CMIP) due to wedge lifts required to correct the 2% slope in the Subgrade and Biointrusion Layer.
Topsoil	3,900	5,400	The average thickness of the Topsoil Layer is approximately 0.33 feet greater than the CMIP design.
Total	**28,500**	**36,200**	**7,700 cy difference (27% increase from original estimate).** The 36,200-cy total does not include the 3,100 cy used for the void space filling and thin soil layer above the Biointrusion Layer.

[1] The CMIP estimates were based upon minimum thickness specifications for each cover layer. The greater cover layer thicknesses resulted in a larger cover footprint, increasing the volume of soil material required for the side slopes.
[2] The increase in soil and rock material volumes results in a thicker, larger, more protective ET Cover.
CMIP = Corrective Measures Implementation Plan
ET = Evapotranspirative
MWL = Mixed Waste Landfill

Figures

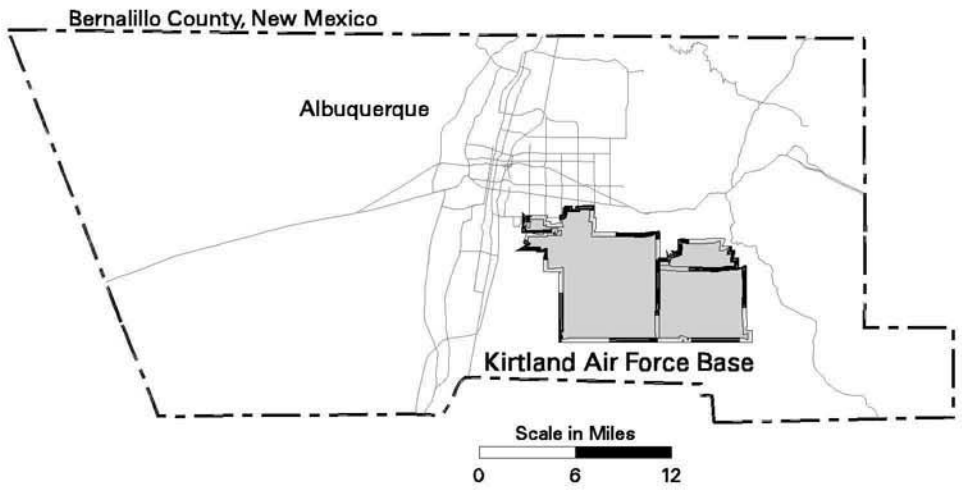
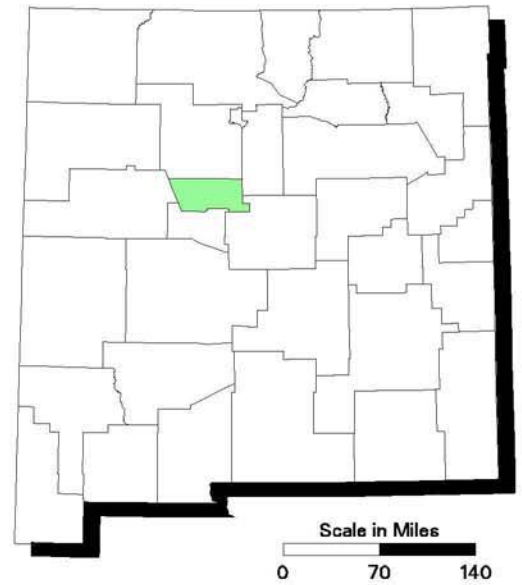
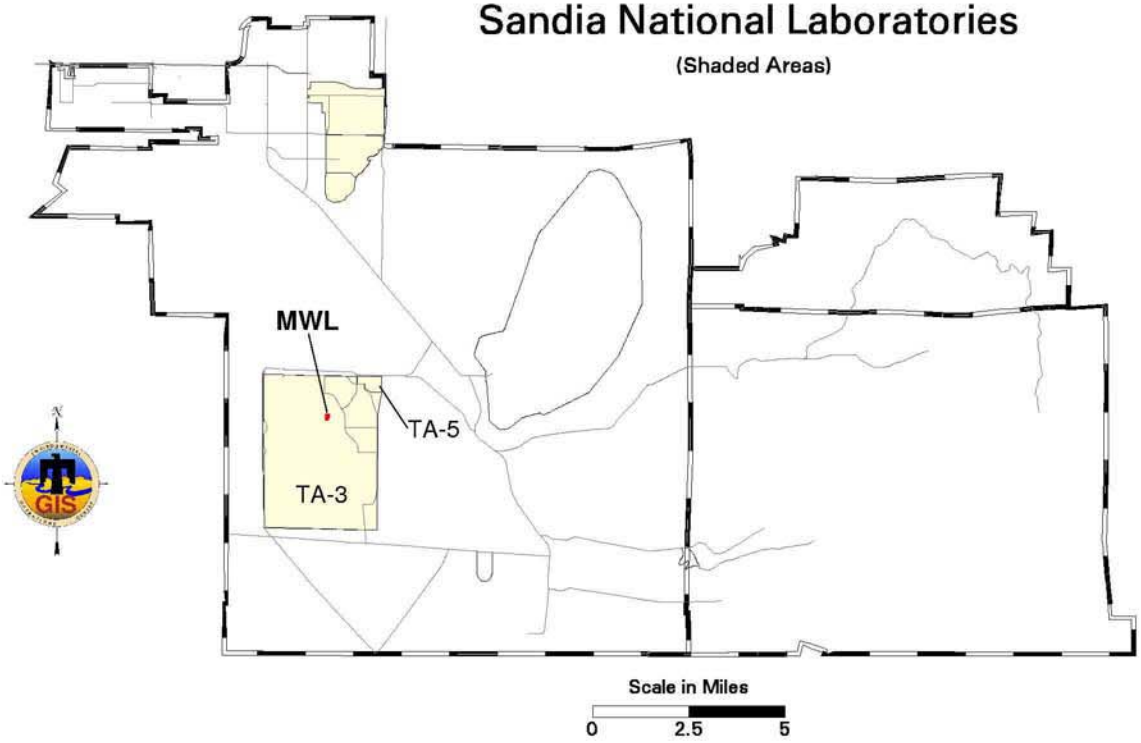
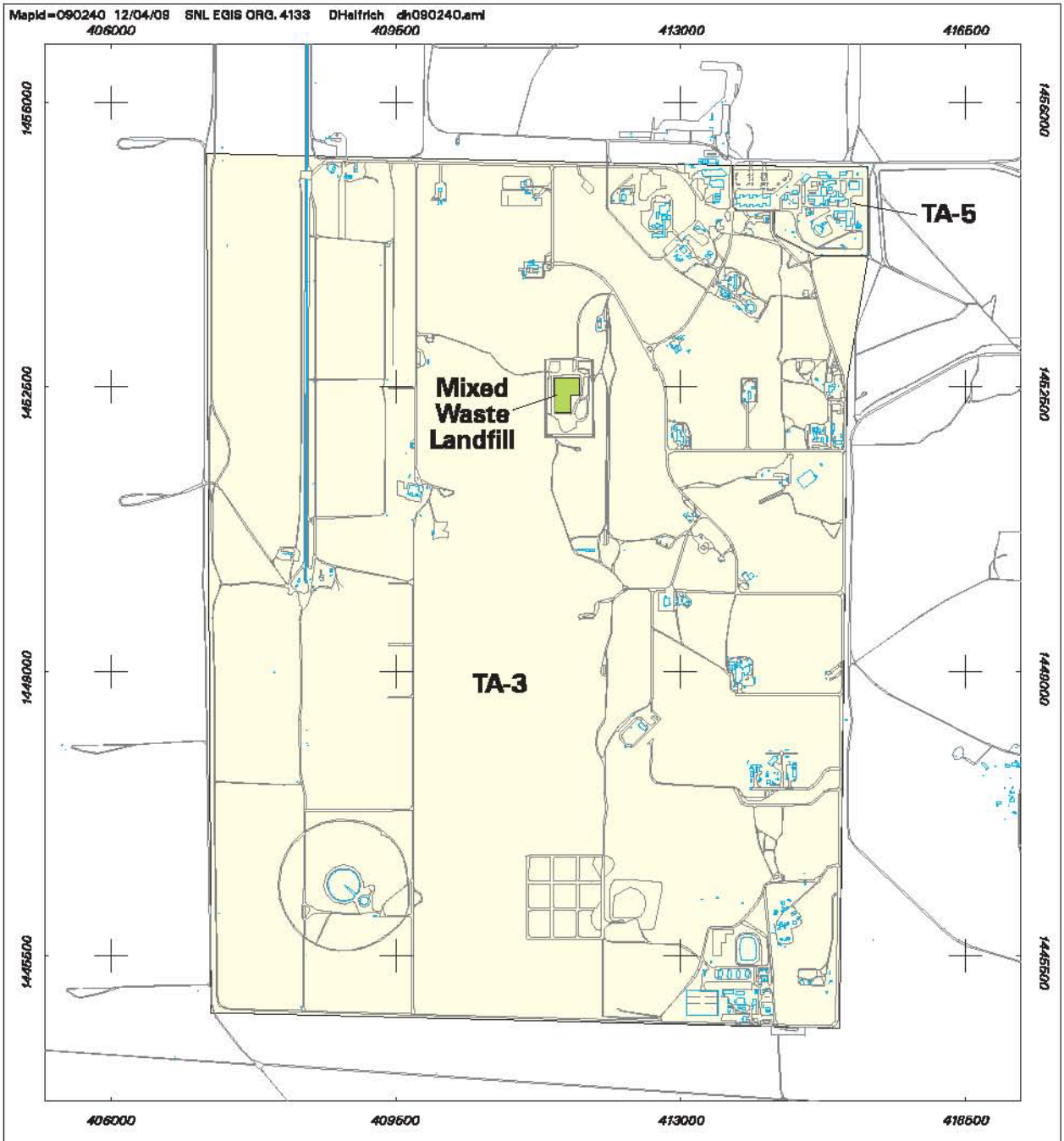


Figure 1
Location of Kirtland Air Force Base, Sandia National Laboratories, New Mexico and the Mixed Waste Landfill







Legend

- Building / Structure
- Paved and Unpaved Road
- SNL Technical Area 3 & 5
- Mixed Waste Landfill

Figure 2
Location of Technical Areas 3 & 5 and the Mixed Waste Landfill

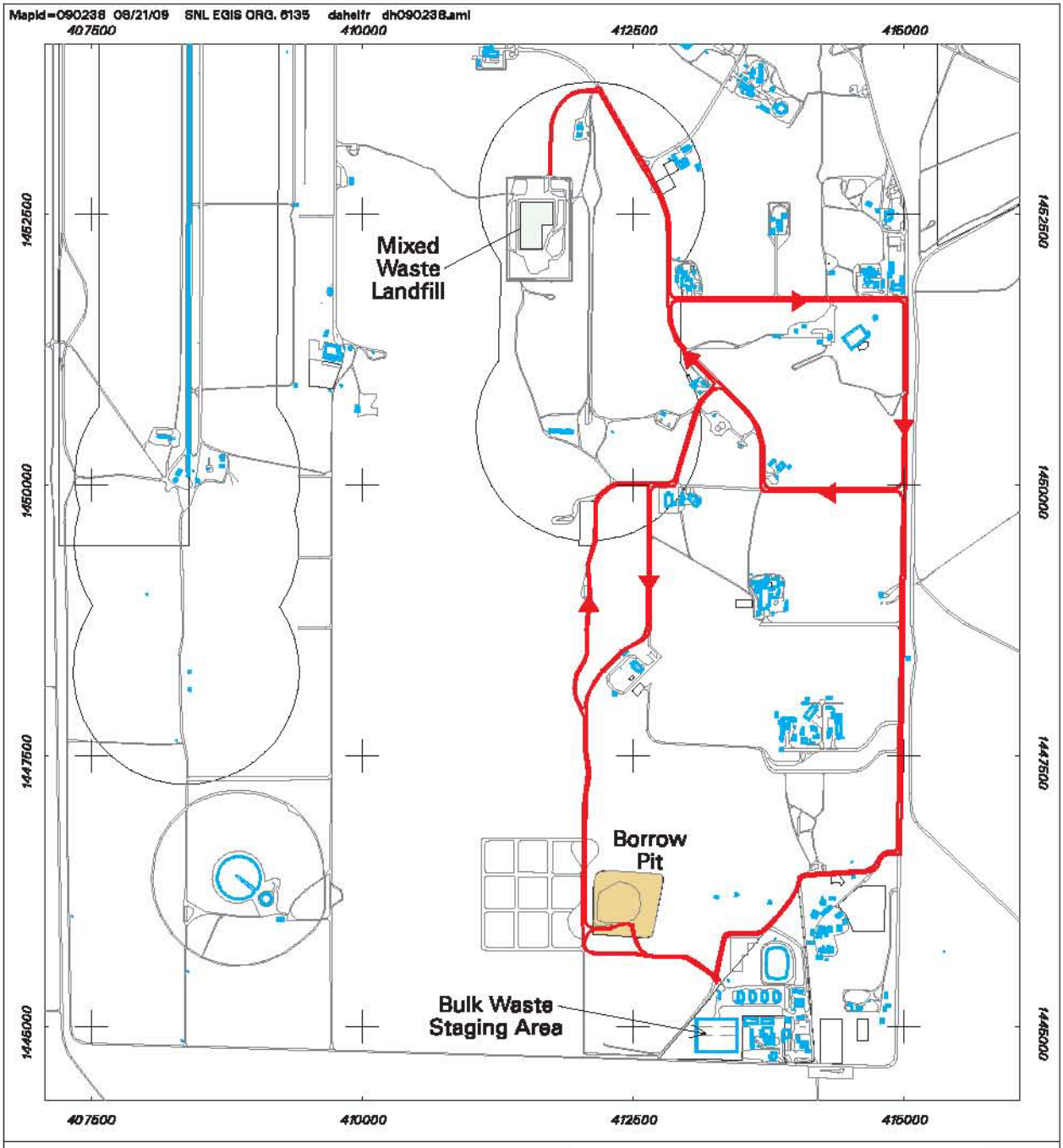
0 1000 2000
Scale in Feet

0 240 480
Scale in Meters

N

GIS

Sandia National Laboratories, New Mexico
Environmental Geographic Information System



Legend

- Building / Structure
- Paved and Unpaved Road
- Haul Route
- Mixed Waste Landfill
- MWL Borrow Pit

Figure 3
Location of the Mixed Waste Landfill, Borrow Pit, Bulk Waste Staging Area, and Haul Routes

0 750 1500
Scale in Feet

0 180 360
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

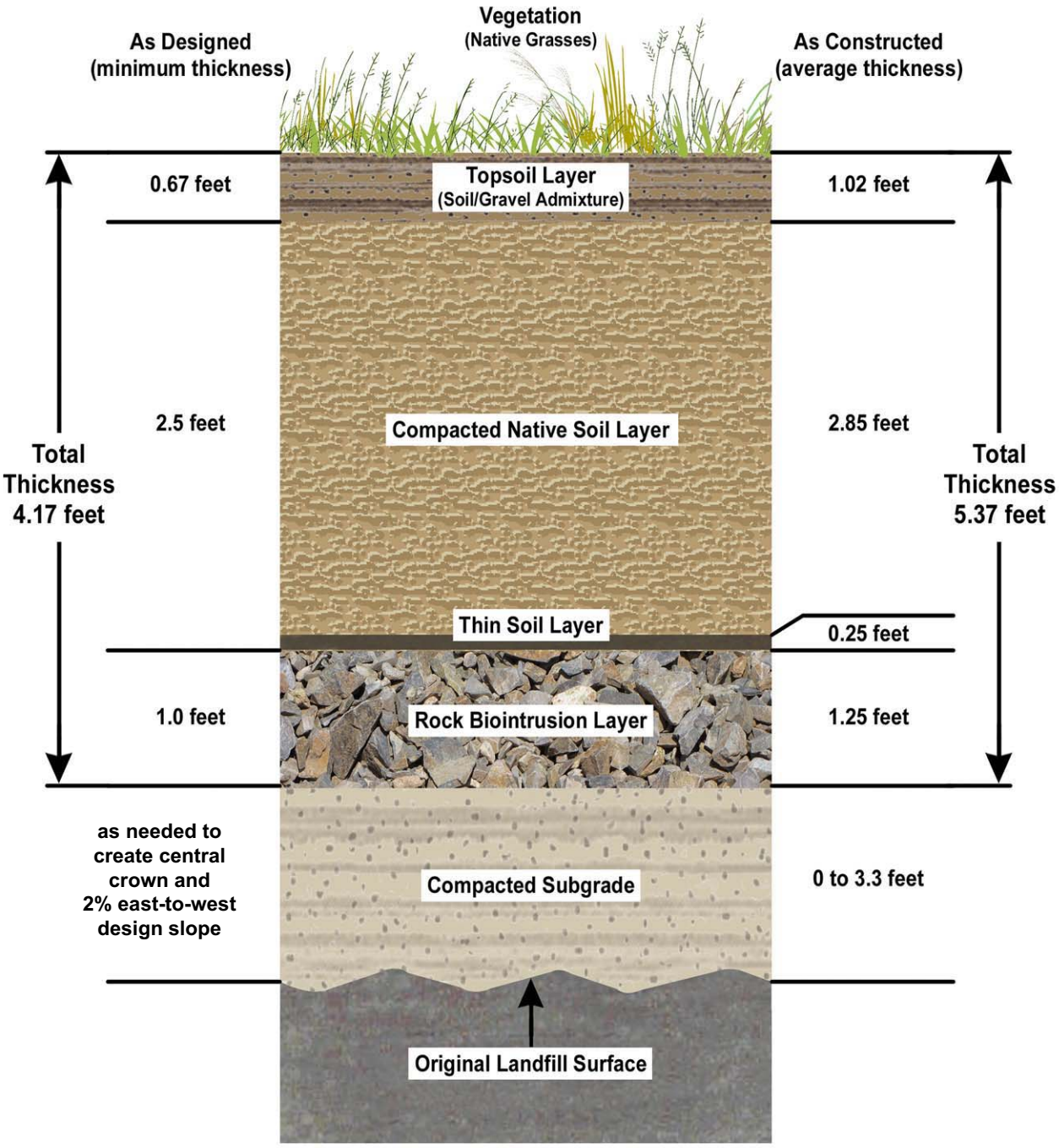


Figure 4
Schematic Diagram of the Mixed Waste Landfill Alternative Evapotranspirative Cover

Legend

- In-Place Field Density and Moisture Test Location
- Unpaved Road
- Mixed Waste Landfill

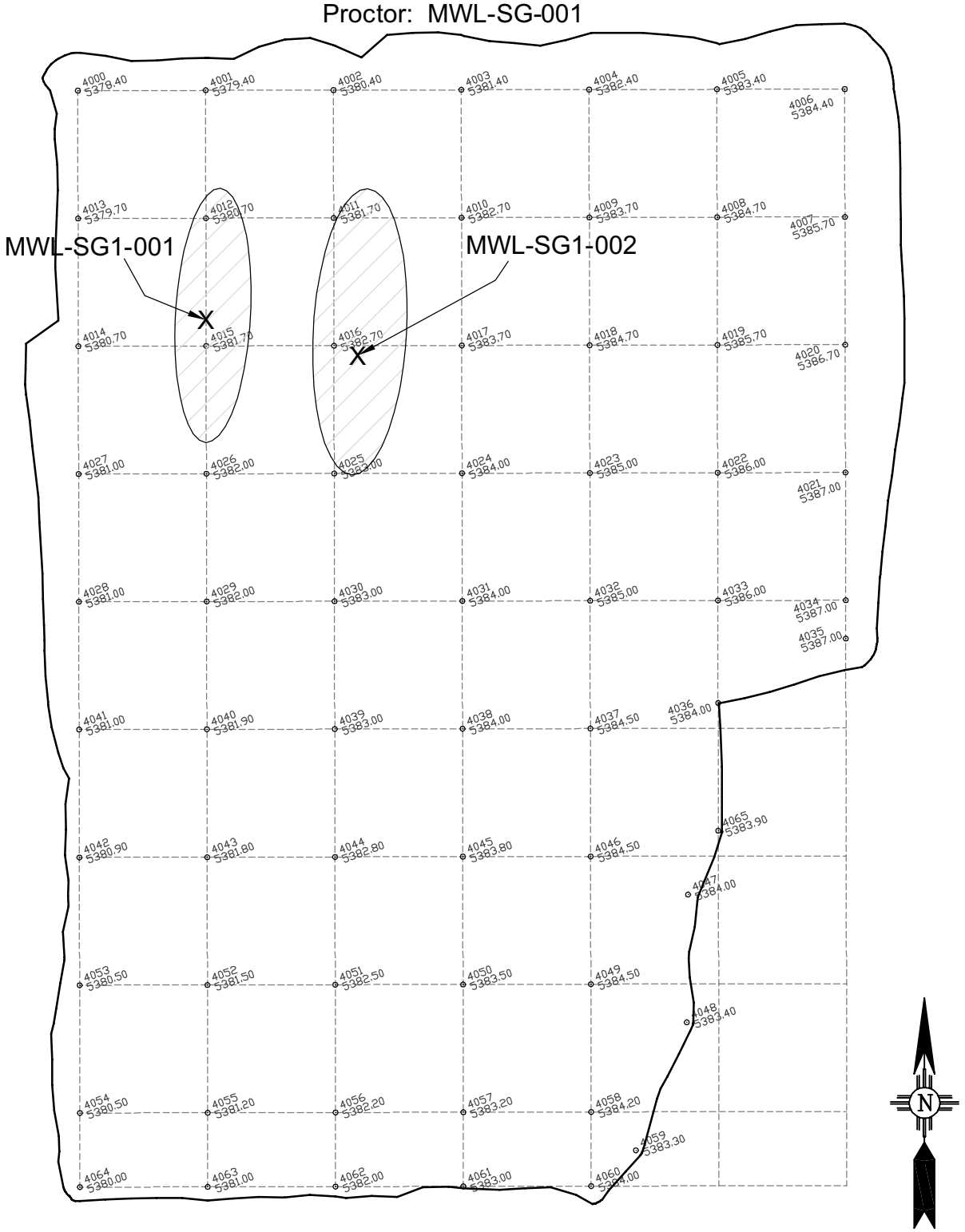
Figure 5
Mixed Waste Landfill
2006 Existing Surface Map

0 50 100
Scale in Feet

0 12 24
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

Proctor: MWL-SG-001

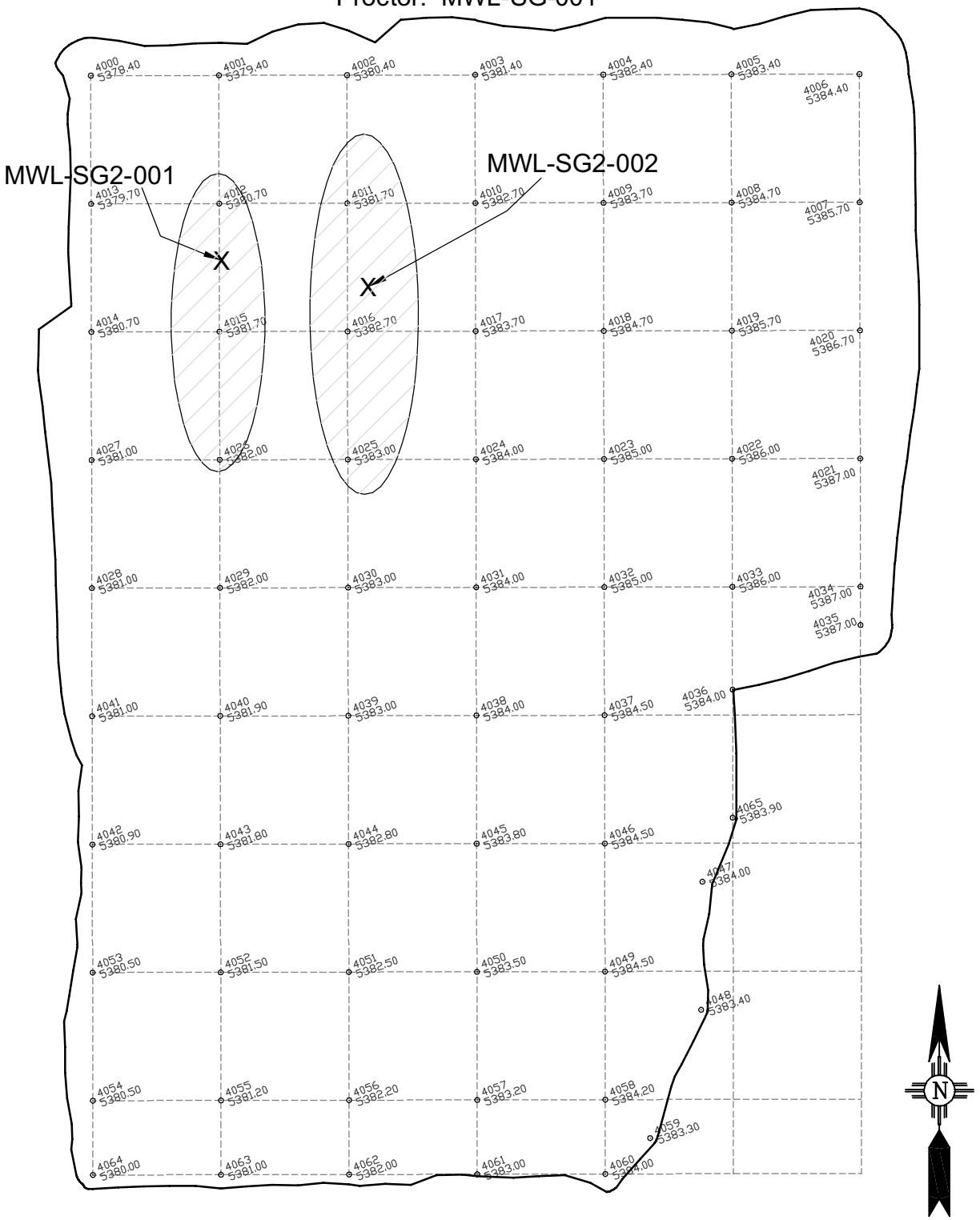


X = Compaction Test Site

Figure 6
Mixed Waste Landfill
Subgrade Lift 1 Map

URS

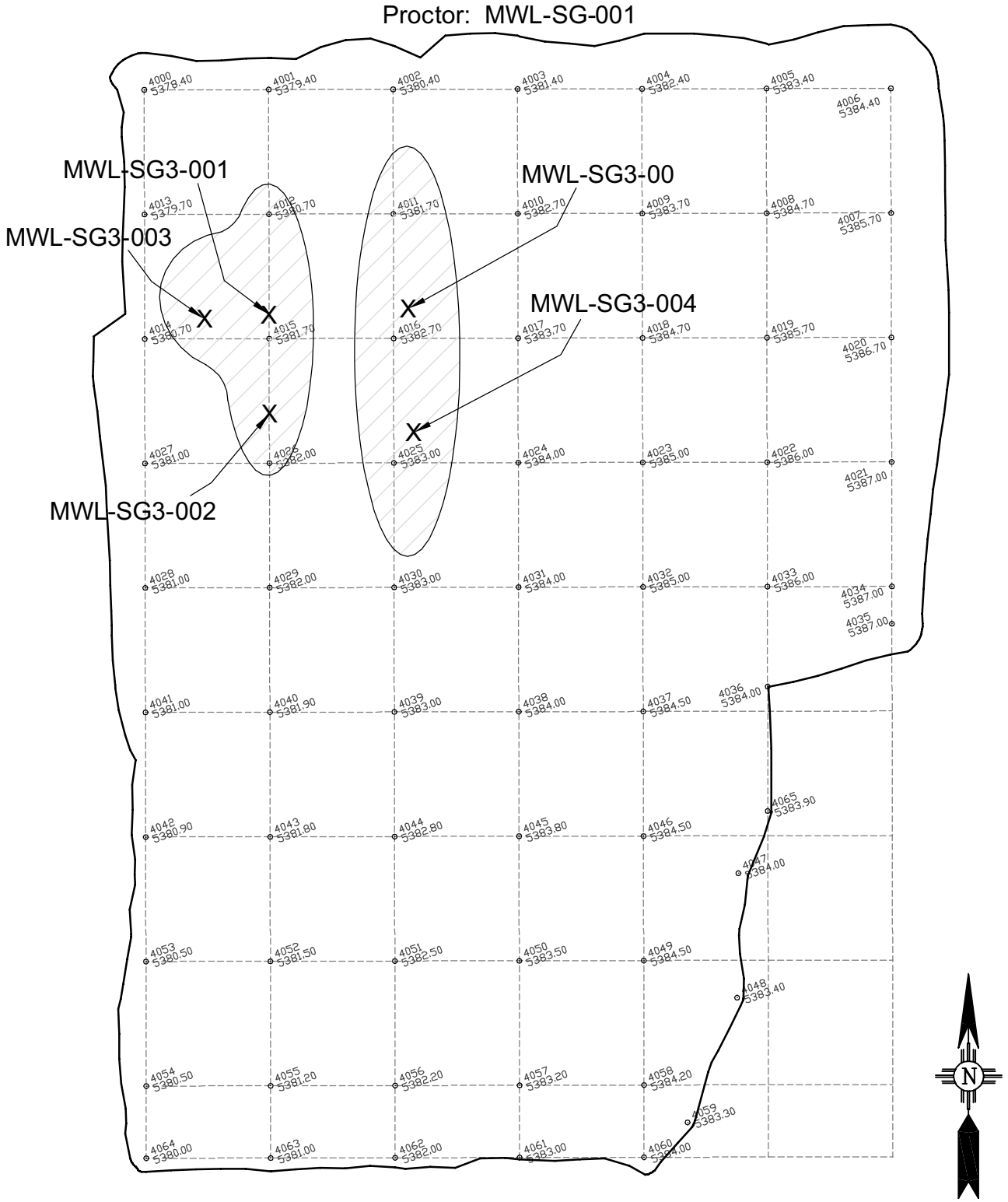
Proctor: MWL-SG-001



X = Compaction Test Site

Figure 7
Mixed Waste Landfill
Subgrade Lift 2 Map

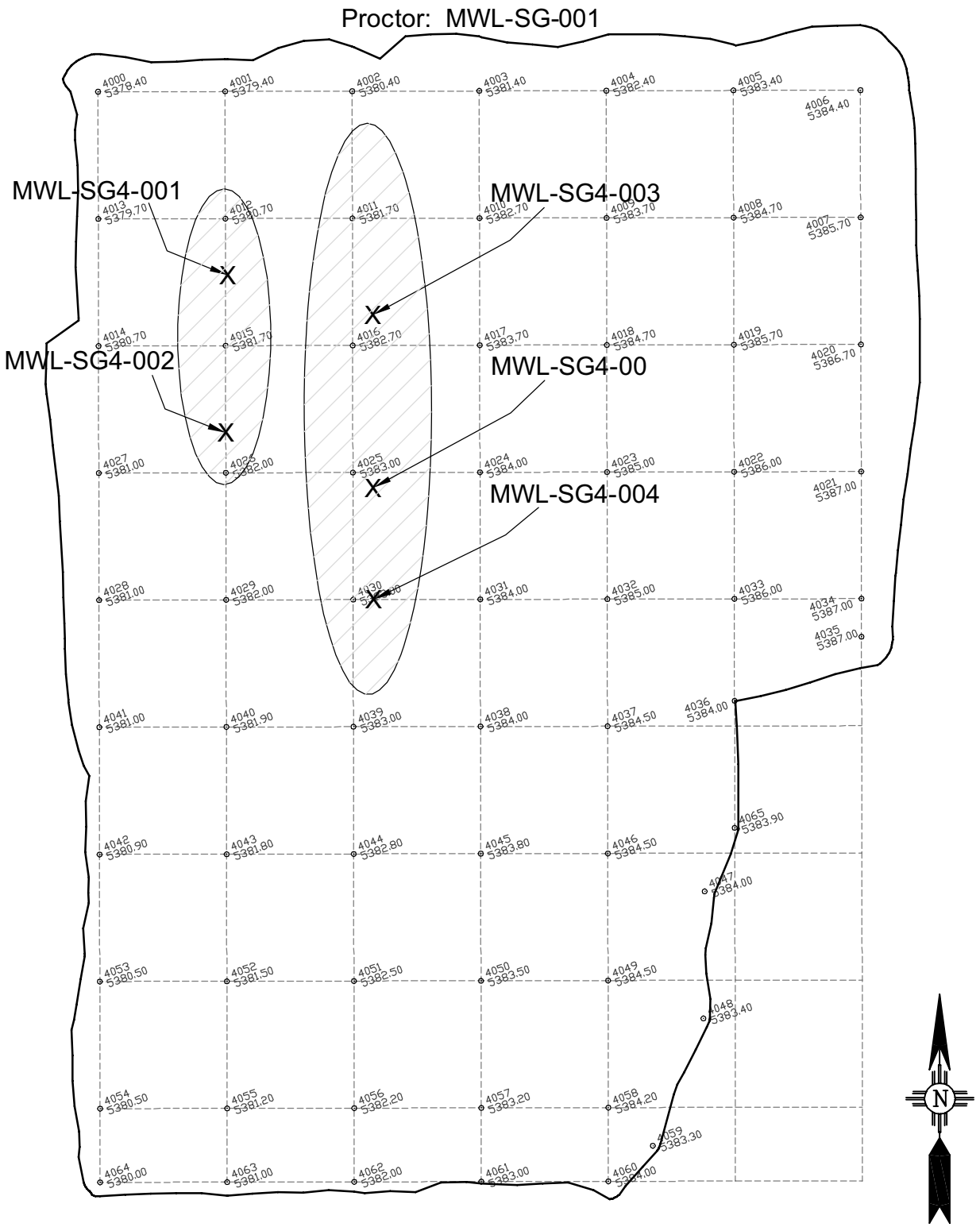
URS



X = Compaction Test Site

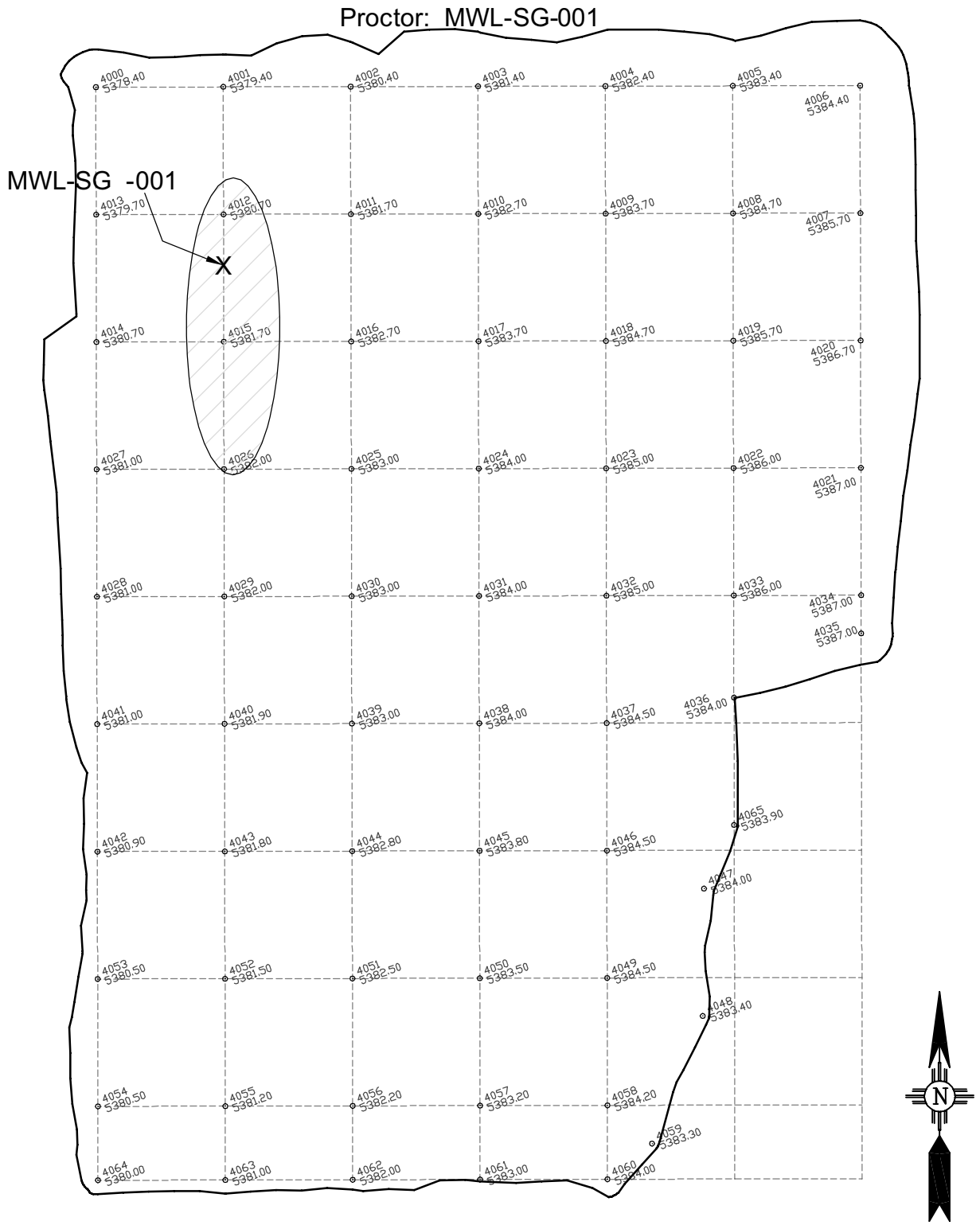
Figure 8
Mixed Waste Landfill
Subgrade Lift 3 Map

URS



X = Compaction Test Site

Figure 9
Mixed Waste Landfill
Subgrade Lift 4 Map

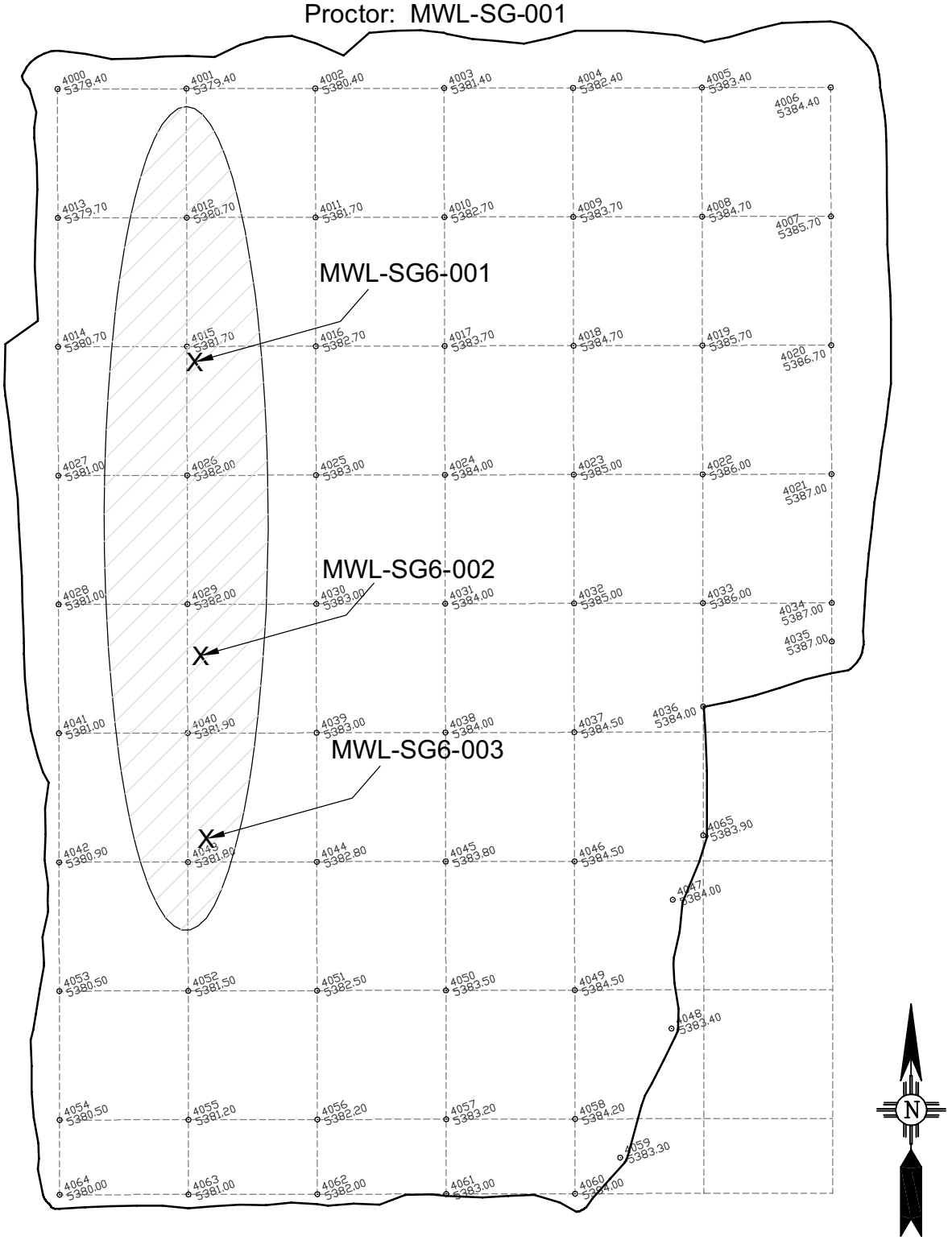


X = Compaction Test Site

Figure 10
Mixed Waste Landfill
Subgrade Lift 5 Map

URS

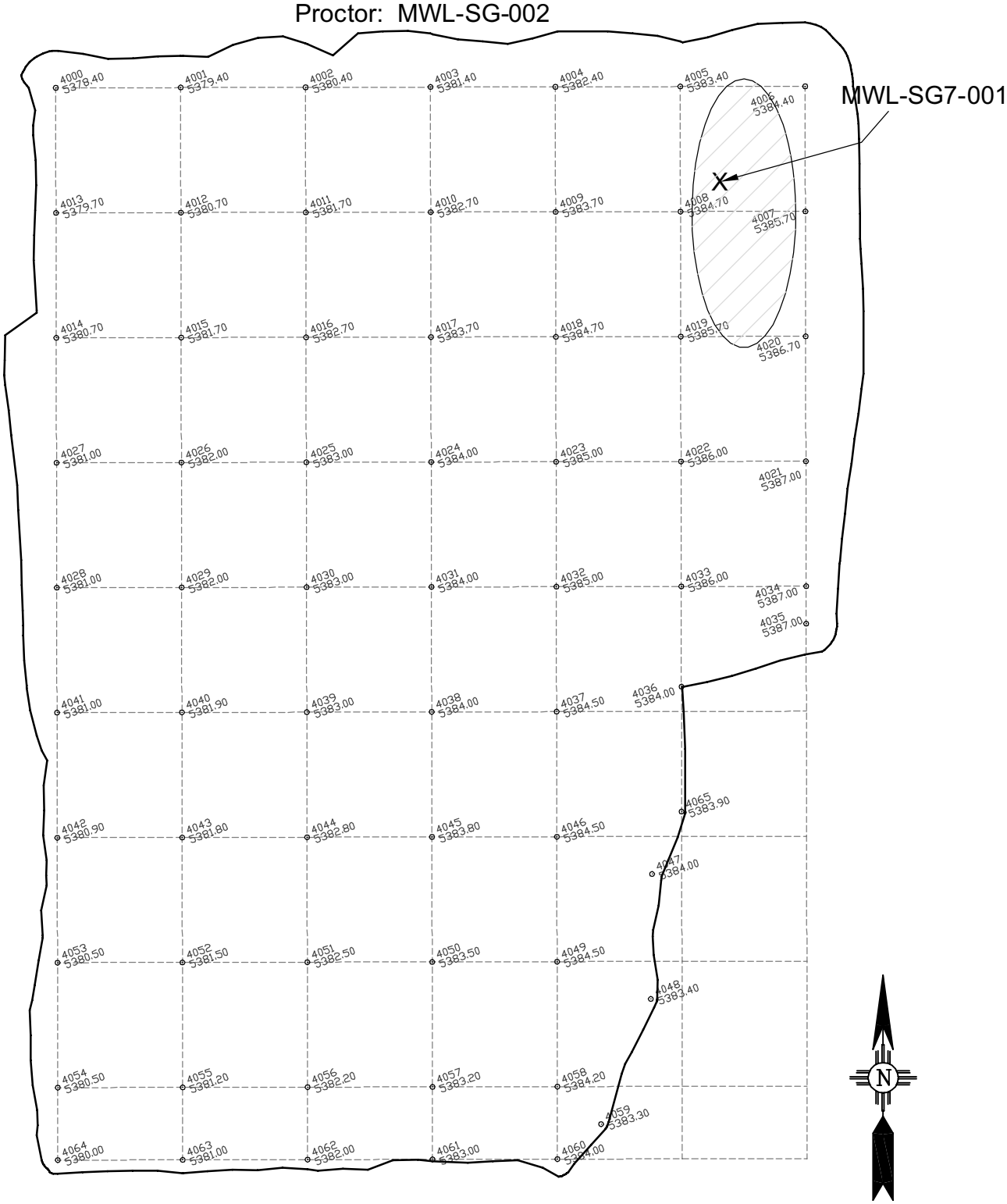
Proctor: MWL-SG-001



X = Compaction Test Site

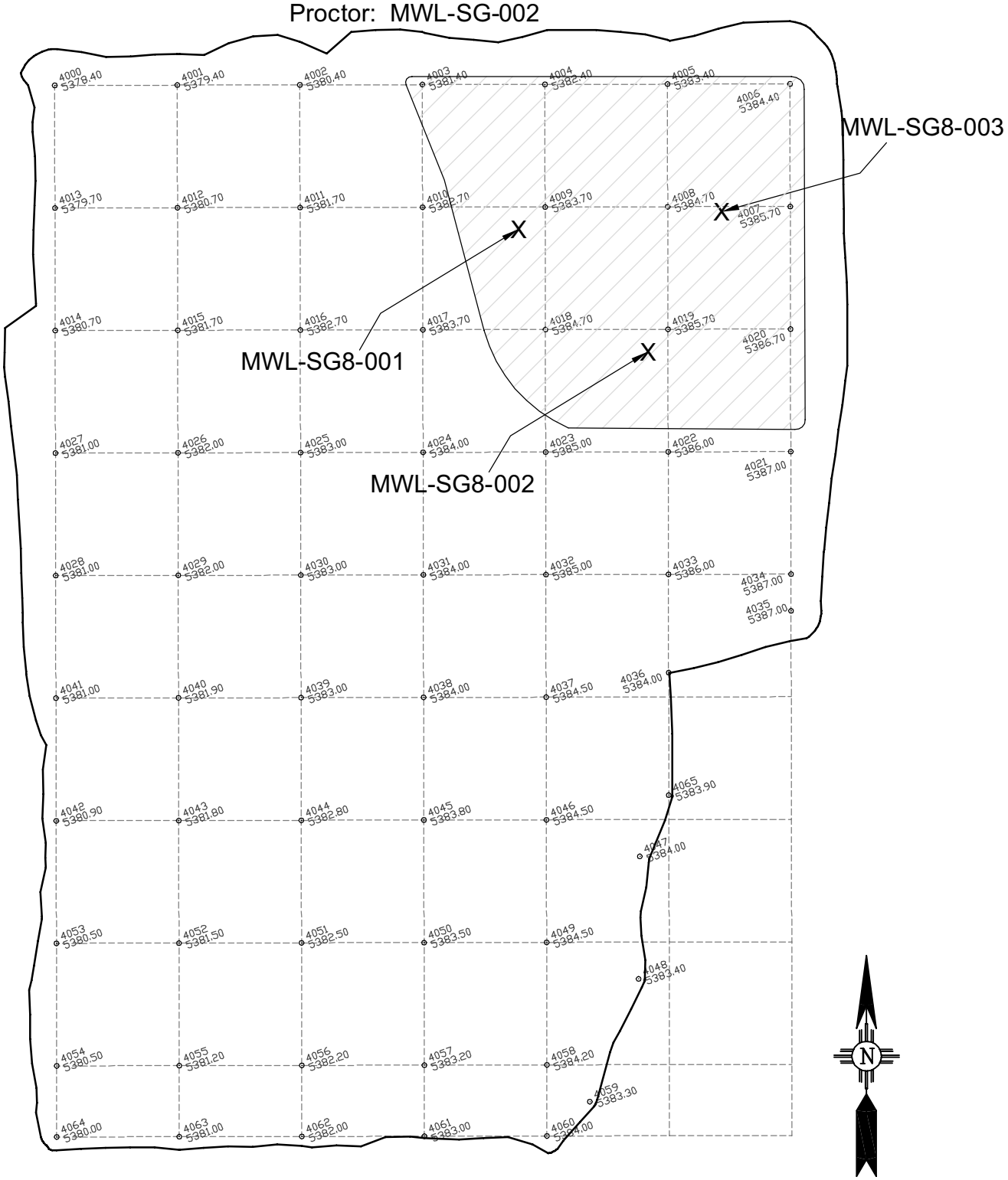
Figure 11
Mixed Waste Landfill
Subgrade Lift 6 Map

URS



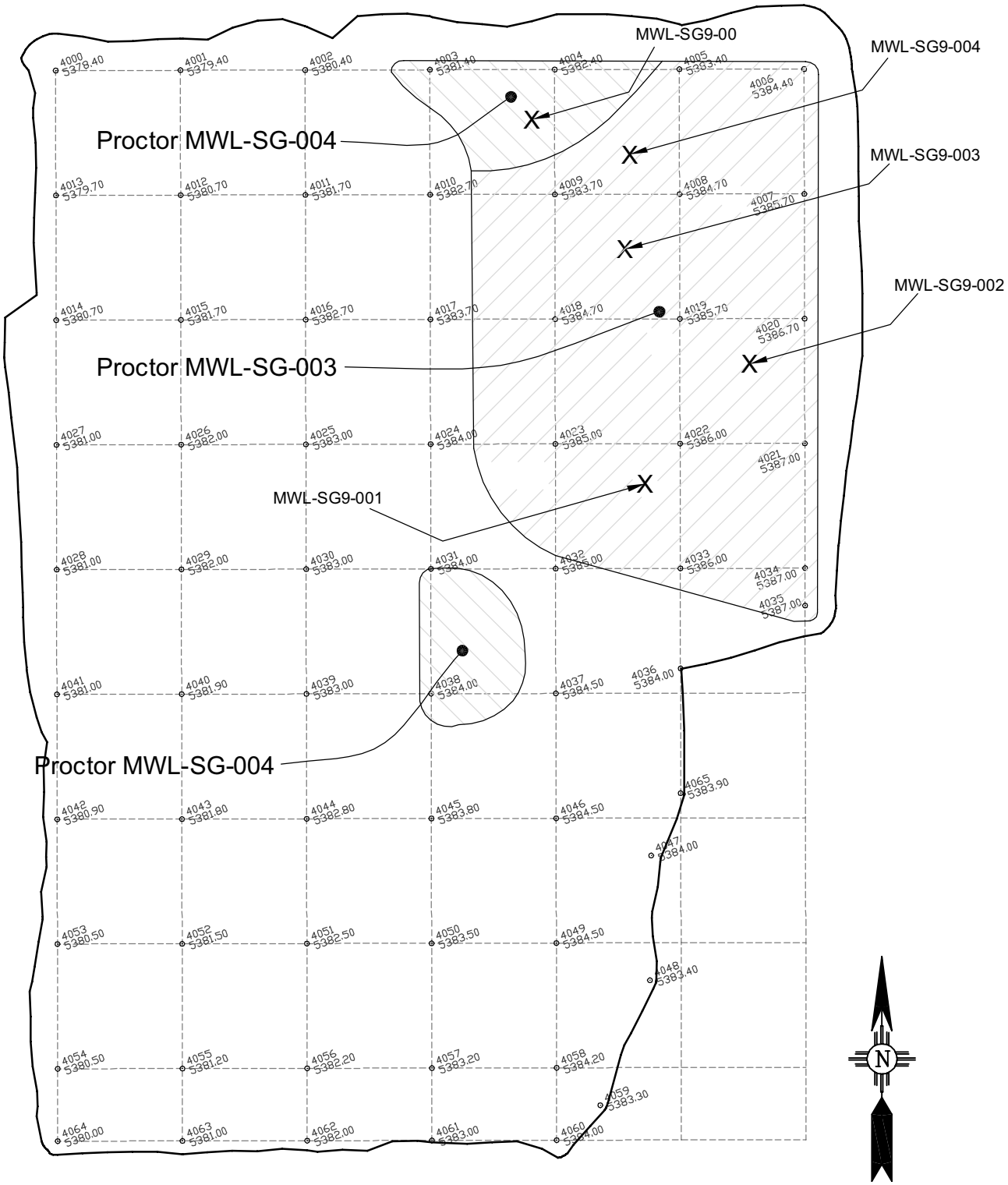
X = Compaction Test Site

Figure 12
Mixed Waste Landfill
Subgrade Lift 7 Map



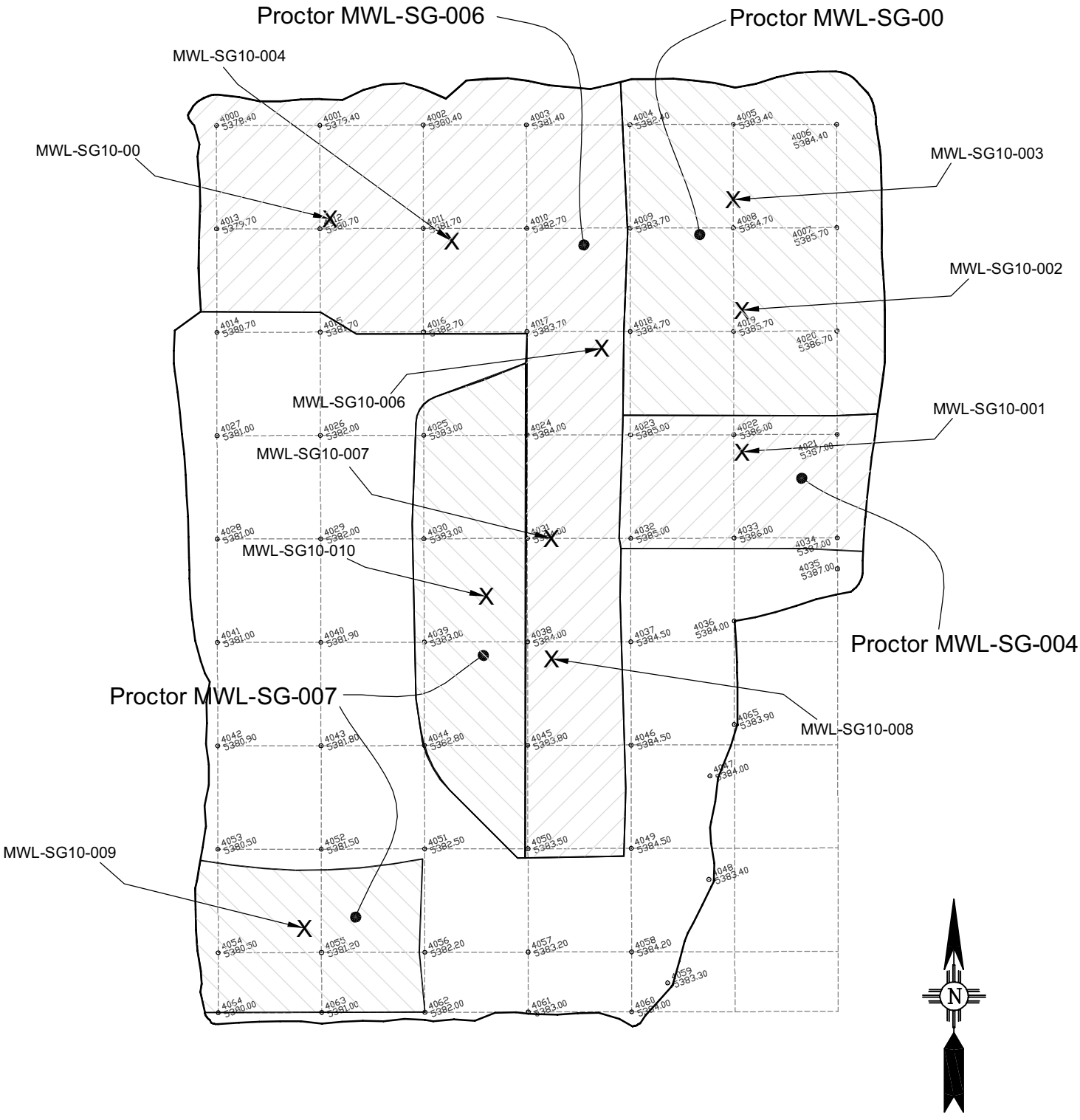
X = Compaction Test Site

Figure 13
Mixed Waste Landfill
Subgrade Lift 8 Map



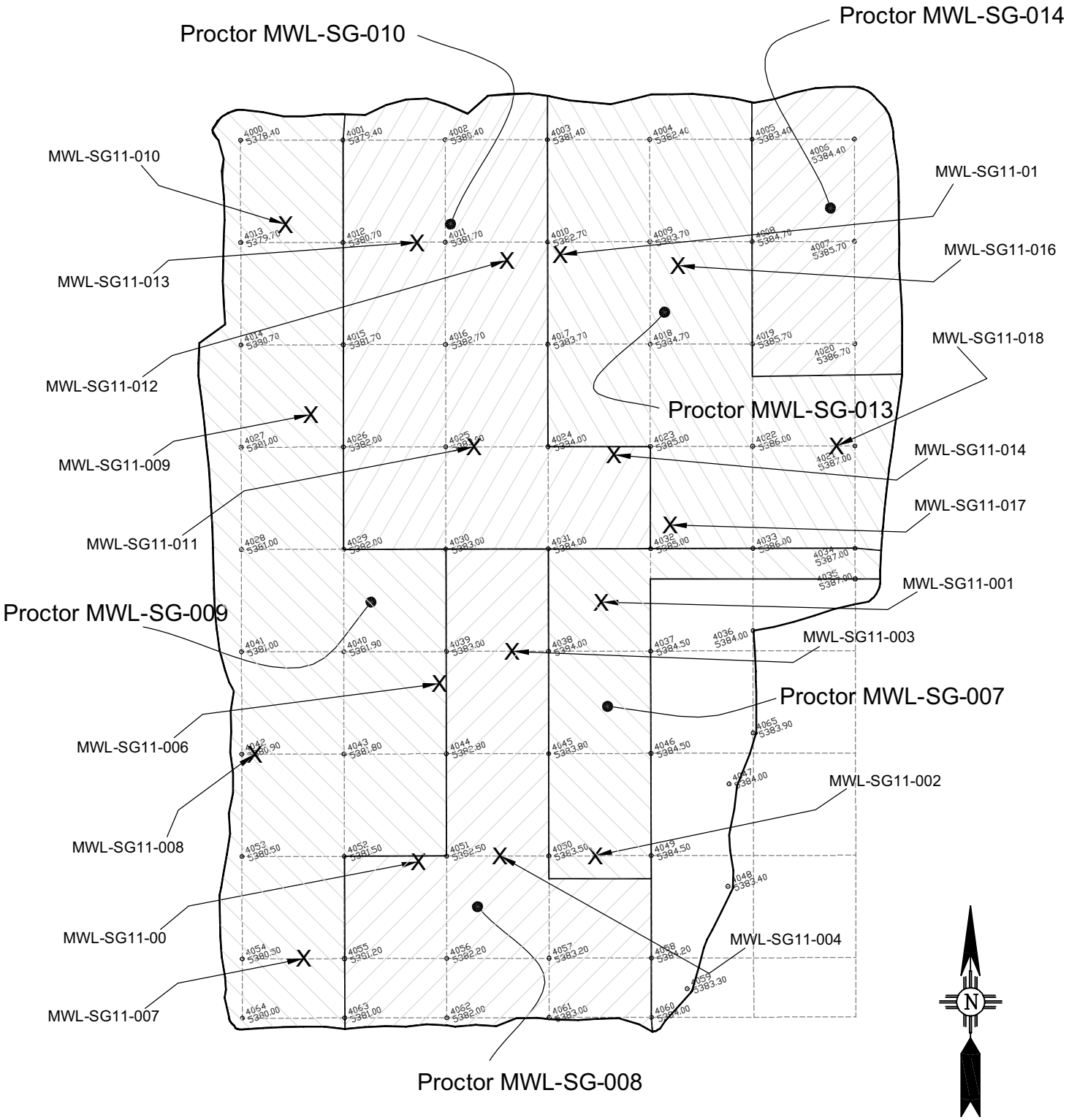
X = Compaction Test Site

Figure 14
Mixed Waste Landfill
Subgrade Lift 9 Map



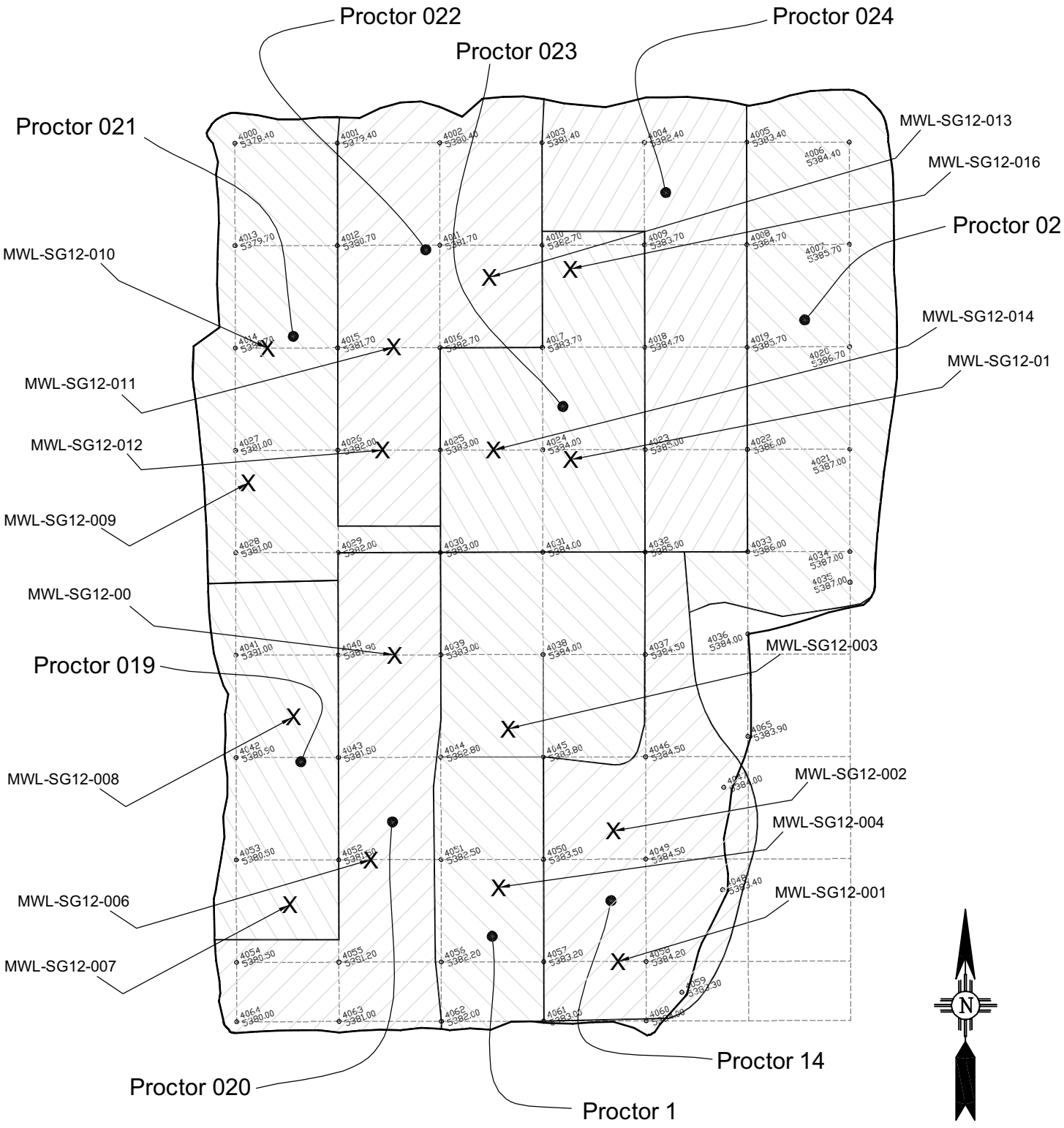
X = Compaction Test Site

Figure 15
Mixed Waste Landfill
Subgrade Lift 10 Map



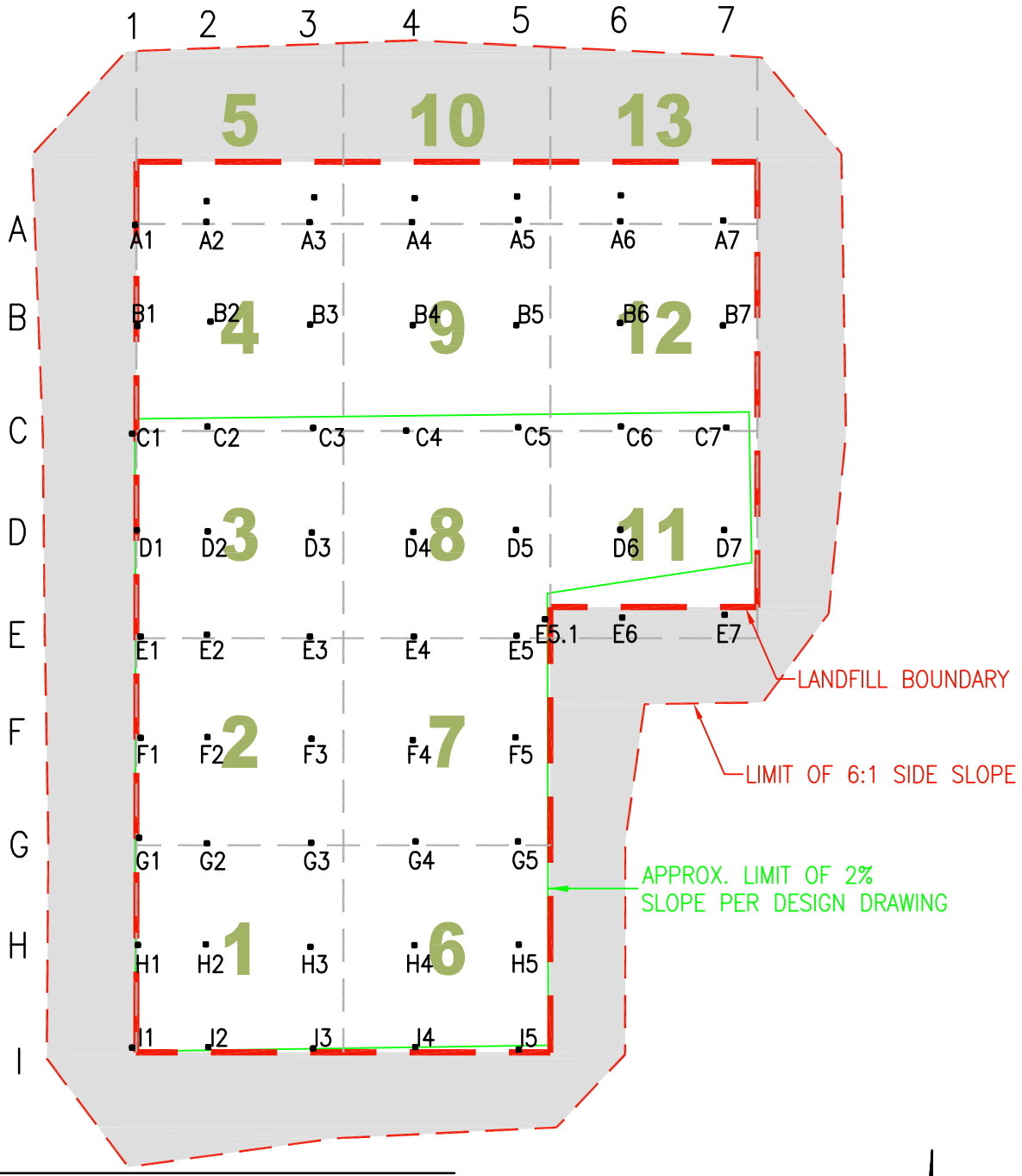
X = Compaction Test Site

Figure 16
Mixed Waste Landfill
Subgrade Lift 11 Map



X = Compaction Test Site

Figure 17
Mixed Waste Landfill
Subgrade Lift 12 Map



LEGEND:

- **6** — GRID BLOCK NUMBER
- H3 — QC SURVEY VERIFICATION GRID POINTS
- GRID BLOCK BOUNDARY
- LANDFILL BOUNDARY
- LIMIT OF SIDESLOPE (APPROX 6:1)
- SLOPE AREAS

0' 40' 80'
SCALE: 1"=80'

AMEC Earth & Environmental
8519 Jefferson, NE
Albuquerque, NM 87113

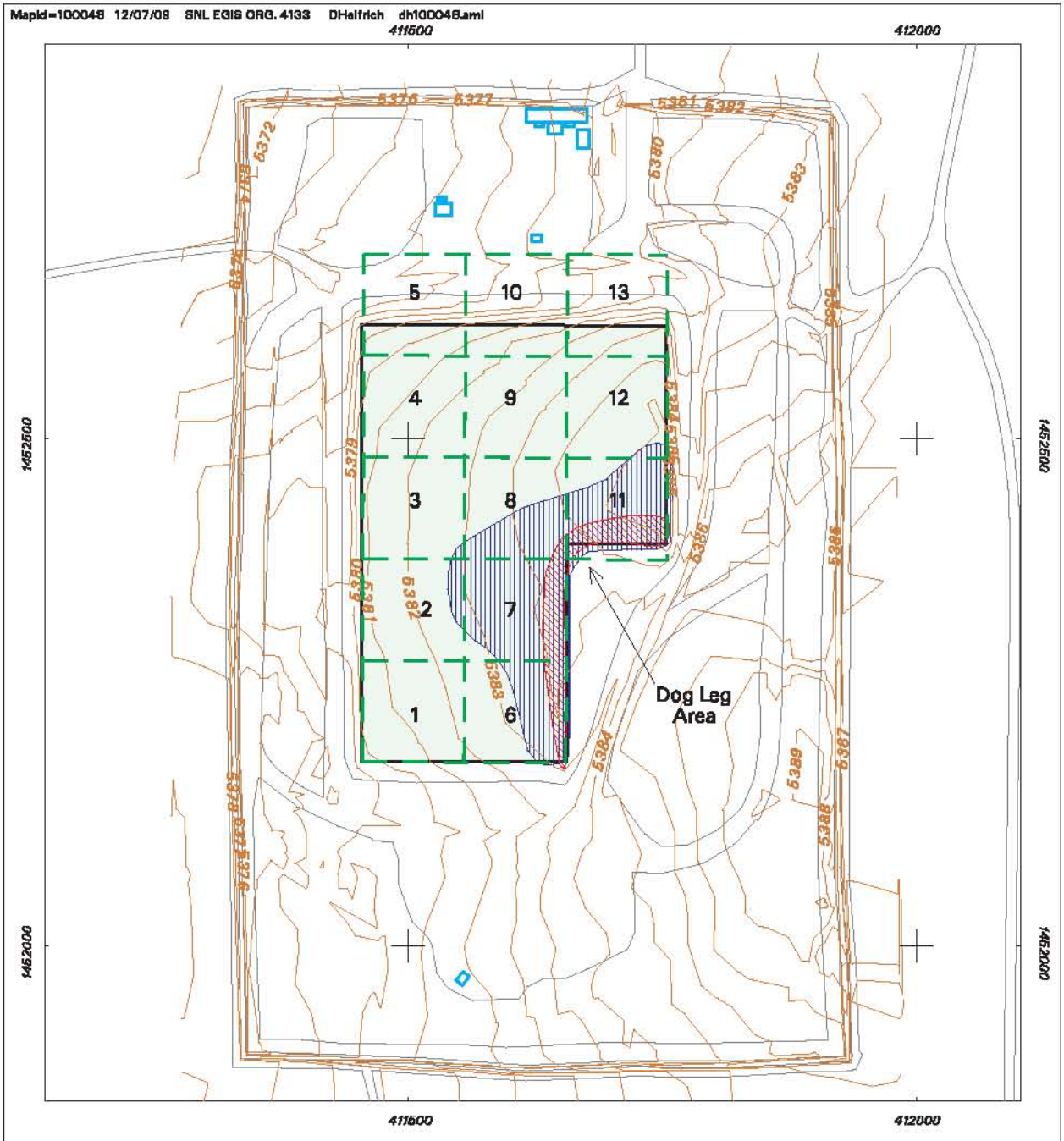
CLIENT LOGO

CLIENT: **SANDIA NATIONAL LABORATORIES**

TITLE: **MIXED WASTE LANDFILL SURVEY VERIFICATION GRID POINTS AND FIELD TESTING GRID BLOCKS**

DWN BY: BDP	DATUM: –	DATE: NOV 2009	
CHK'D BY: CW	REV. NO.: A	PROJECT NO: 9-517-00022G	
PROJECTION: –	SCALE: AS SHOWN	FIGURE No. 18	

G:\CAD\MIXED WASTE LANDFILL\951700022G\FIG 3-4.dwg Dec 07,2009 10:21am



Legend

- Mobile Office / Shed / Water Tank
- 1-ft. Subgrade Contour Interval
- Edge of unpaved Road
- 100-ft. Sample Grid
- MWL Disposal Area
- Wedge Lift 1
- Wedge Lift 2

Figure 19
Mixed Waste Landfill
Cover Grid Blocks and Locations of Native Soil Layer Wedge Lifts 1 & 2

0 80 160
Scale in Feet

0 19.2 38.4
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

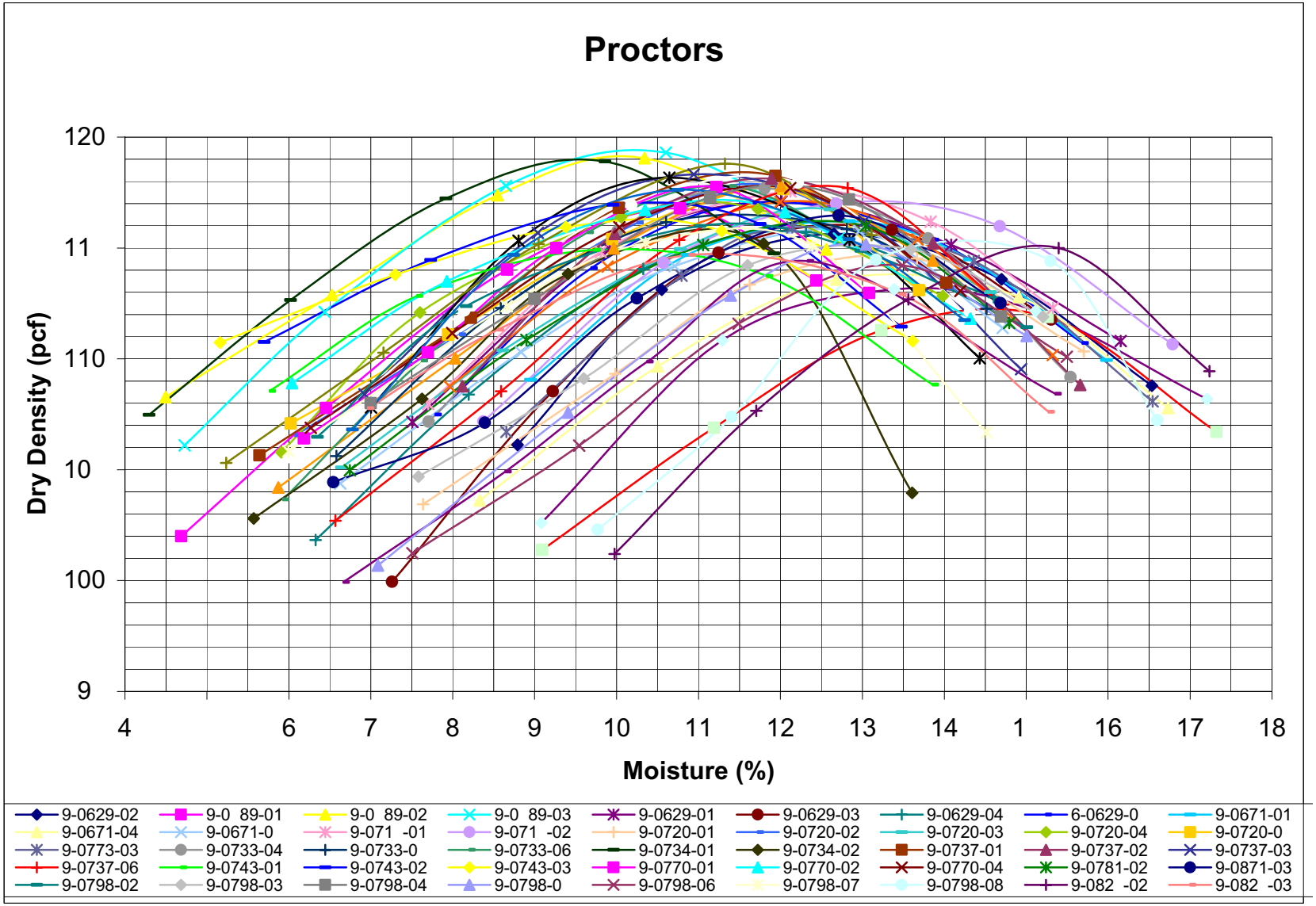
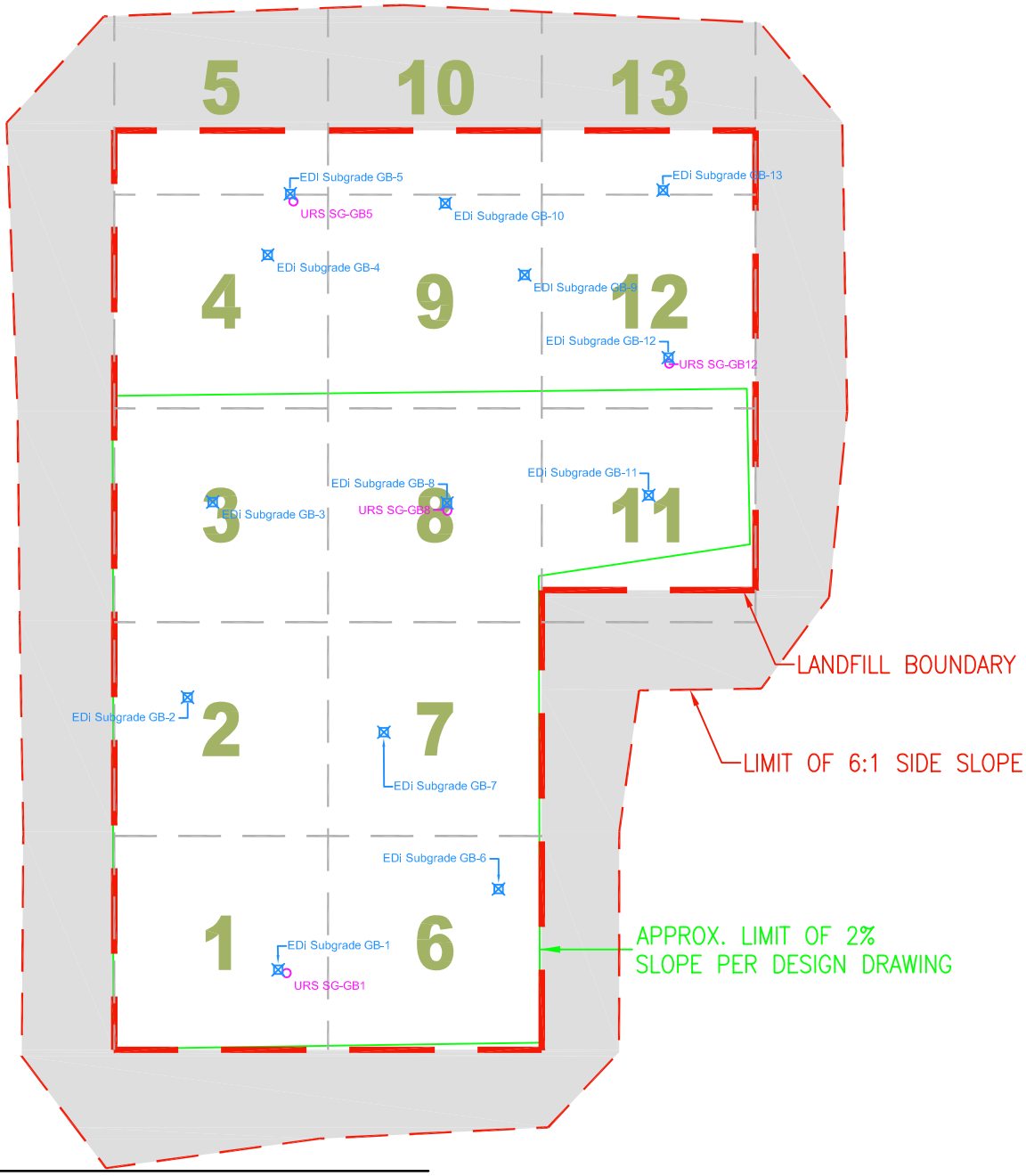


Figure 20. Graphical Representation of all MWL Alternative Cover Standard Proctor Results



LEGEND:

- 6 — GRID BLOCK NUMBER
- QC TEST LOCATIONS
- QA TEST LOCATIONS
- GRID BLOCK BOUNDARY
- LANDFILL BOUNDARY
- LIMIT OF SIDESLOPE (APPROX 6:1)
- SLOPE AREAS

0' 40' 80'
SCALE: 1"=80'

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Albuquerque, NM 87113

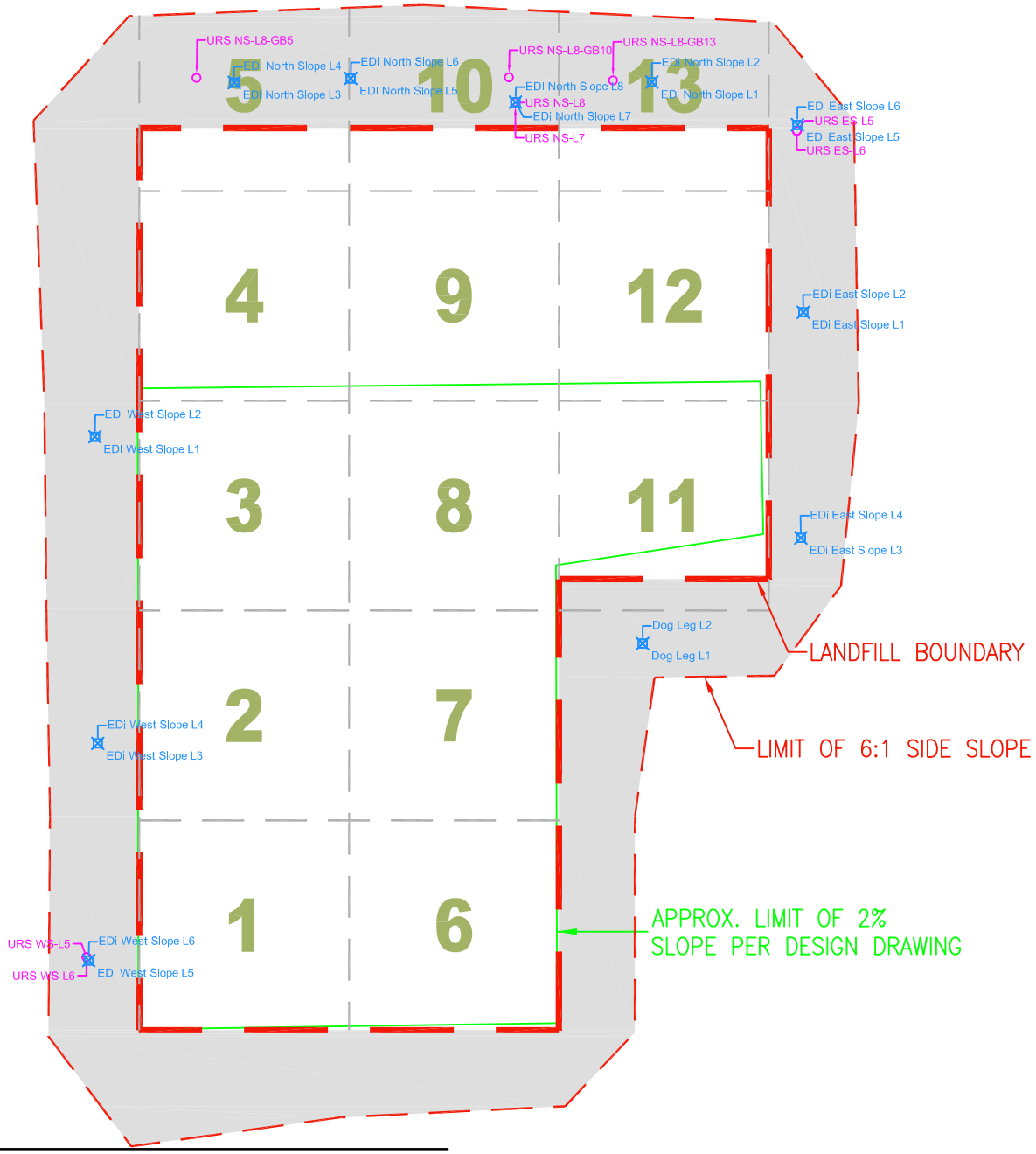
CLIENT LOGO

CLIENT
SANDIA NATIONAL LABORATORIES

TITLE
MIXED WASTE LANDFILL
MOISTURE/DENSITY TEST LOCATIONS
2009 SUBGRADE SURFACE

DWN BY: BDP	DATUM: --	DATE: OCT 2009	
CHK'D BY: CW	REV. NO.: A	PROJECT NO: 9-517-00022G	
PROJECTION: --	SCALE: AS SHOWN	FIGURE No. 21	

G:\CAD\MIXED WASTE LANDFILL\951700022G\FIG 3-5.dwg Nov 06,2009 10:58am



LEGEND:

6	GRID BLOCK NUMBER
⊠	QC TEST LOCATIONS
○	QA TEST LOCATIONS
— — —	GRID BLOCK BOUNDARY
▬▬▬	LANDFILL BOUNDARY
— — —	LIMIT OF SIDESLOPE (APPROX 6:1)
▭	SLOPE AREAS

0' 40' 80'

SCALE: 1"=80'

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Albuquerque, NM 87113

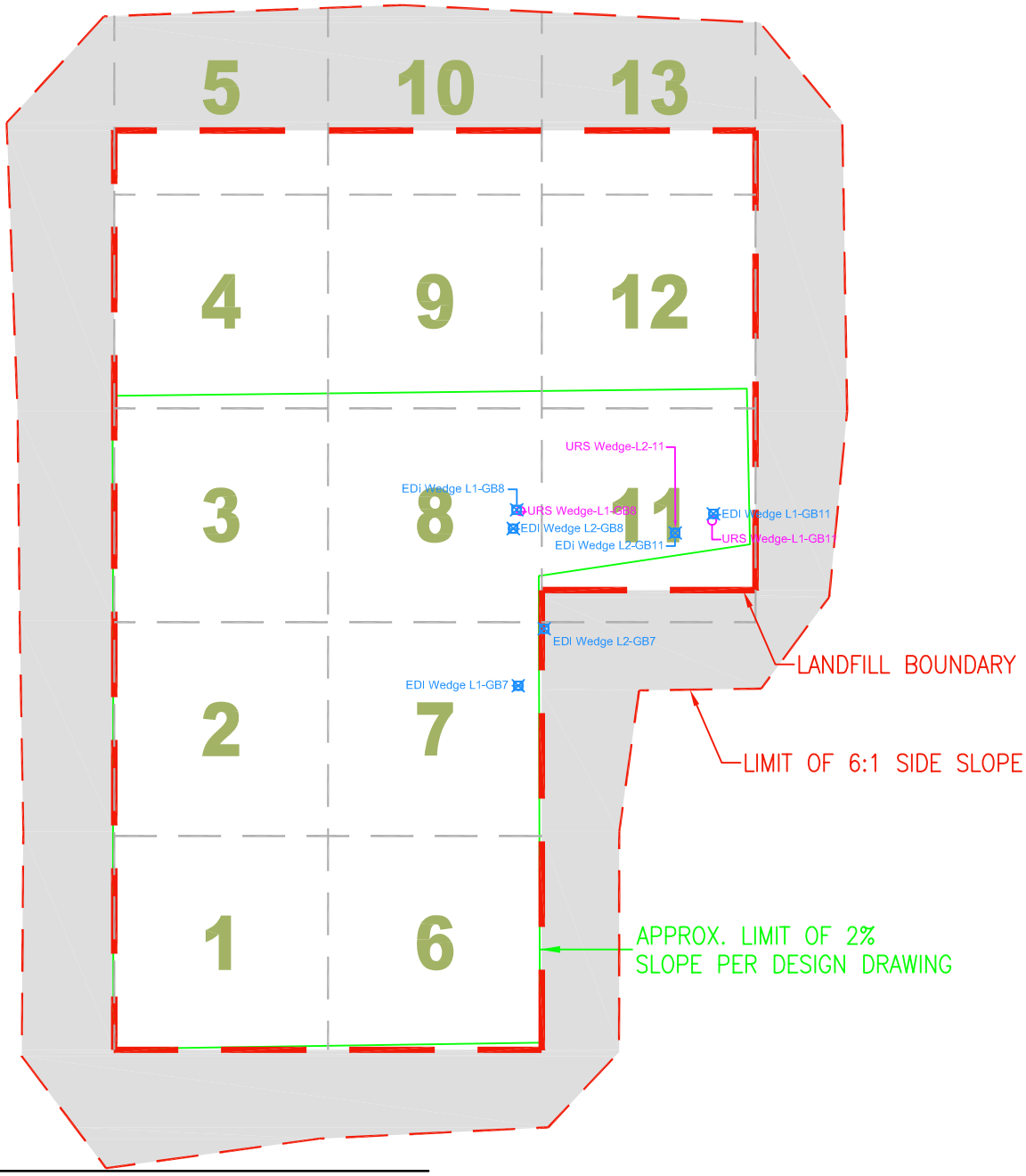
CLIENT LOGO

CLIENT
SANDIA NATIONAL LABORATORIES

TITLE
MIXED WASTE LANDFILL
MOISTURE/DENSITY TEST LOCATIONS
SIDE SLOPE LIFTS

DWN BY: BDP	DATUM: --	DATE: OCT 2009	
CHK'D BY: CW	REV. NO.: A	PROJECT NO: 9-517-00022G	
PROJECTION: --	SCALE: AS SHOWN	FIGURE No. 22	

G:\CAD\MIXED WASTE LANDFILL\951700022G\FIG 3-6.dwg Nov 04,2009 10:02am



LEGEND:

- 6 — GRID BLOCK NUMBER
- QC TEST LOCATIONS
- QA TEST LOCATIONS
- GRID BLOCK BOUNDARY
- LANDFILL BOUNDARY
- LIMIT OF SIDESLOPE (APPROX 6:1)
- SLOPE AREAS

0' 40' 80'
SCALE: 1"=80'

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Albuquerque, NM 87113

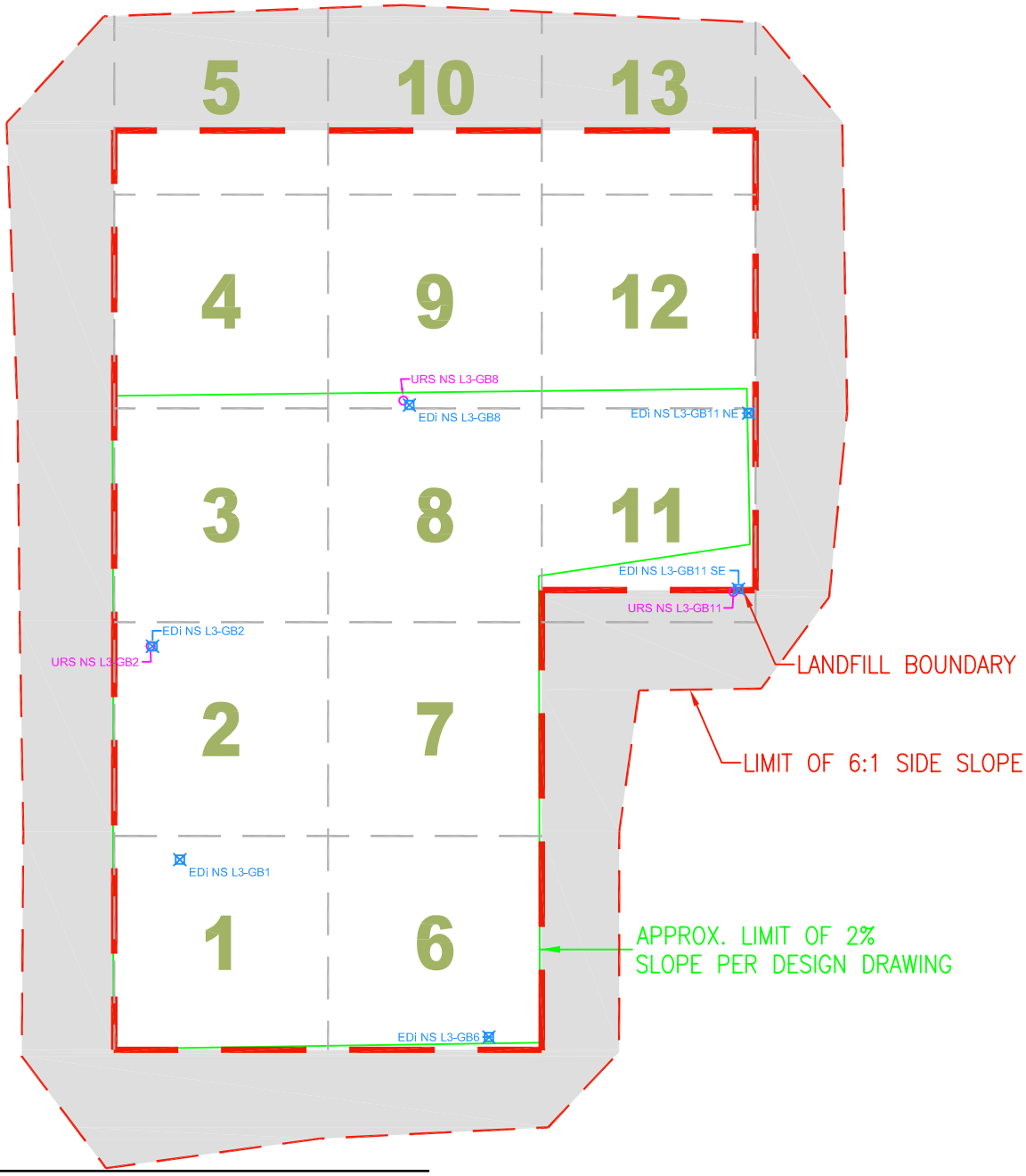
CLIENT LOGO

CLIENT: SANDIA NATIONAL LABORATORIES

TITLE: MIXED WASTE LANDFILL
MOISTURE/DENSITY TEST LOCATIONS
NATIVE SOIL LAYER WEDGE LIFTS 1 & 2

DWN BY: BDP	DATUM: --	DATE: OCT 2009	
CHK'D BY: CW	REV. NO.: A	PROJECT NO: 9-517-00022G	
PROJECTION: --	SCALE: AS SHOWN	FIGURE No. 23	

G:\CAD\MIXED WASTE LANDFILL\951700022G\FIG 3-7.dwg Nov 04,2009 10:02am



LEGEND:

- 6 — GRID BLOCK NUMBER
- QC TEST LOCATIONS
- QA TEST LOCATIONS
- GRID BLOCK BOUNDARY
- LANDFILL BOUNDARY
- LIMIT OF SIDESLOPE (APPROX 6:1)
- SLOPE AREAS

0' 40' 80'
SCALE: 1"=80'

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Albuquerque, NM 87113

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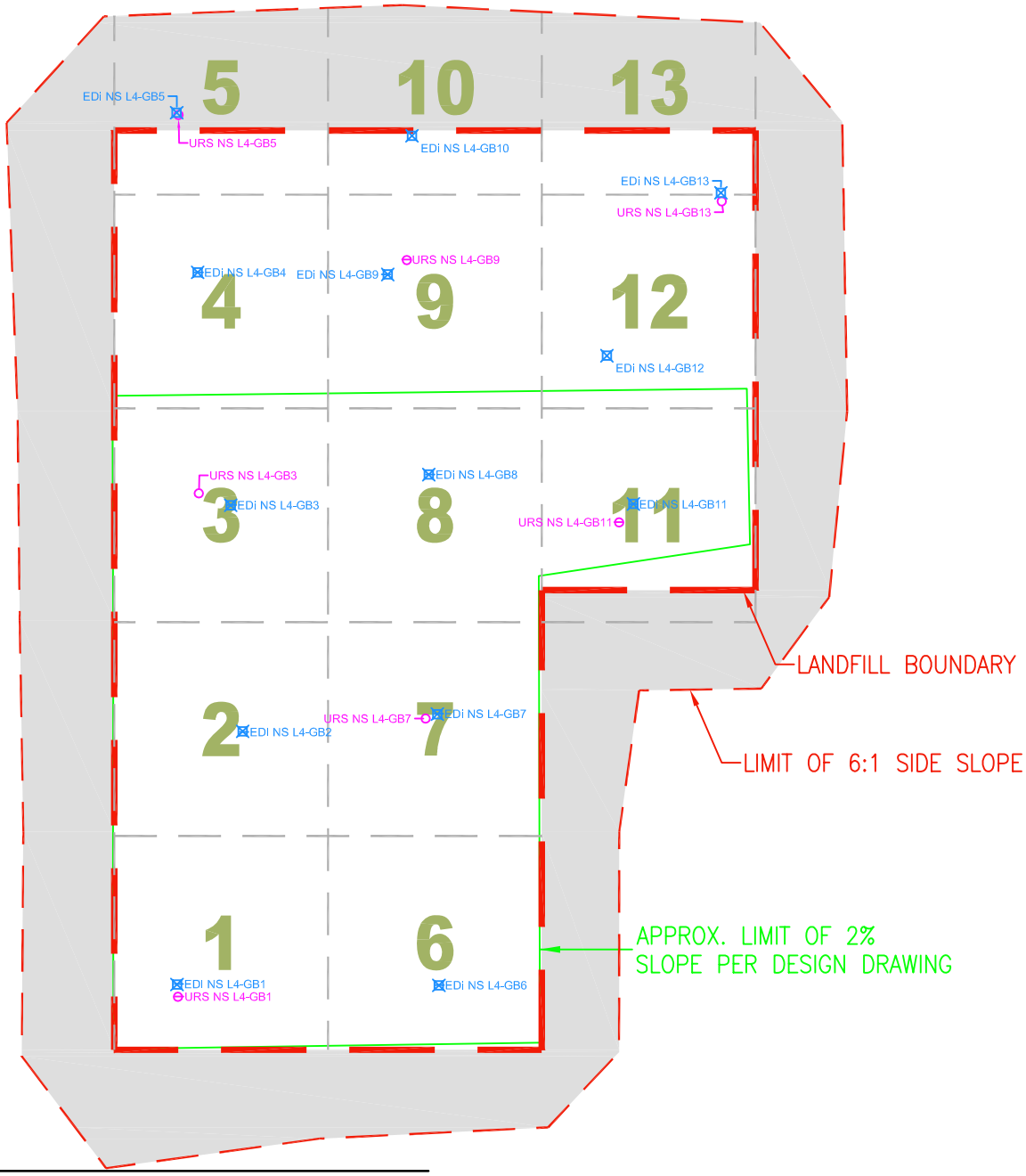
CLIENT
SANDIA NATIONAL LABORATORIES

TITLE
MIXED WASTE LANDFILL
MOISTURE/DENSITY TEST LOCATIONS
NATIVE SOIL LAYER LIFT 3

DWN BY: BDP	DATUM: --	DATE: OCT 2009	
CHK'D BY: CW	REV. NO.: A	PROJECT NO: 9-517-00022G	
PROJECTION: --	SCALE: AS SHOWN	FIGURE No. 24	

G:\CAD\MIXED WASTE LANDFILL\951700022G\FIG 3-8.dwg Nov 04,2009 10:01am



LEGEND:

- 6 — GRID BLOCK NUMBER
- QC TEST LOCATIONS
- QA TEST LOCATIONS
- GRID BLOCK BOUNDARY
- LANDFILL BOUNDARY
- LIMIT OF SIDESLOPE (APPROX 6:1)
- SLOPE AREAS

0' 40' 80'
SCALE: 1"=80'

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Albuquerque, NM 87113

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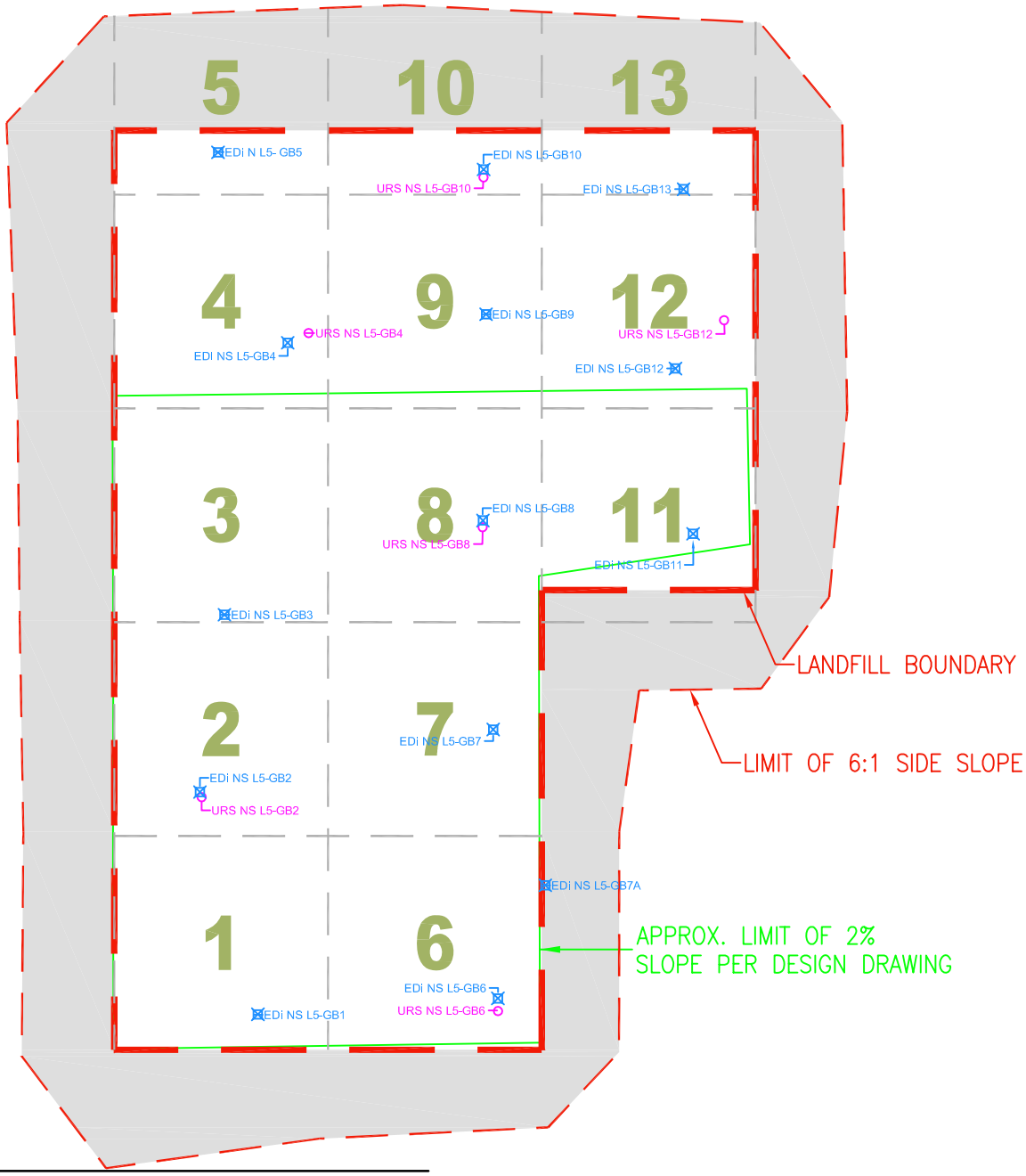
TITLE
MIXED WASTE LANDFILL
MOISTURE/DENSITY TEST LOCATIONS
NATIVE SOIL LAYER LIFT 4

DWN BY: BDP	DATUM: --	DATE: OCT 2009	
CHK'D BY: CW	REV. NO.: A	PROJECT NO: 9-517-00022G	
PROJECTION: --	SCALE: AS SHOWN	FIGURE No. 25	

G:\CAD\MIXED WASTE LANDFILL\951700022G\FIG 3-9.dwg Nov 04,2009 10:01am



LEGEND:

- 6 — GRID BLOCK NUMBER
- QC TEST LOCATIONS
- QA TEST LOCATIONS
- GRID BLOCK BOUNDARY
- LANDFILL BOUNDARY
- LIMIT OF SIDESLOPE (APPROX 6:1)
- SLOPE AREAS

0' 40' 80'
SCALE: 1"=80'

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Albuquerque, NM 87113

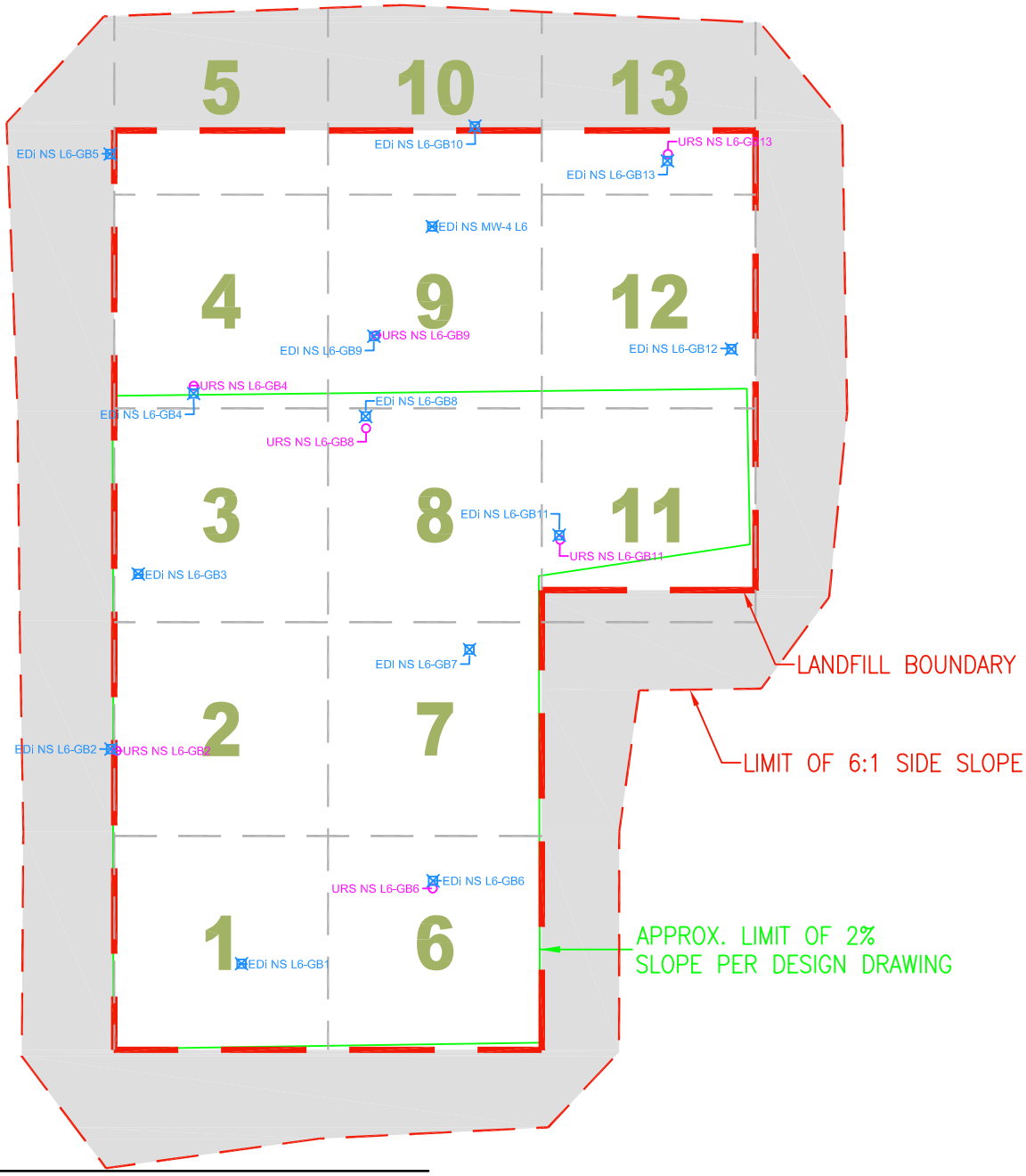
CLIENT LOGO

CLIENT: SANDIA NATIONAL LABORATORIES

TITLE: MIXED WASTE LANDFILL
MOISTURE/DENSITY TEST LOCATIONS
NATIVE SOIL LAYER LIFT 5

DWN BY: BDP	DATUM: --	DATE: OCT 2009	
CHK'D BY: CW	REV. NO.: A	PROJECT NO: 9-517-00022G	
PROJECTION: --	SCALE: AS SHOWN	FIGURE No. 26	

G:\CAD\MIXED WASTE LANDFILL\951700022G\FIG 3-10.dwg Nov 04,2009 10:20am



LEGEND:

- 6 — GRID BLOCK NUMBER
- QC TEST LOCATIONS
- QA TEST LOCATIONS
- GRID BLOCK BOUNDARY
- LANDFILL BOUNDARY
- LIMIT OF SIDESLOPE (APPROX 6:1)
- SLOPE AREAS

0' 40' 80'
SCALE: 1"=80'

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Albuquerque, NM 87113

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CLIENT
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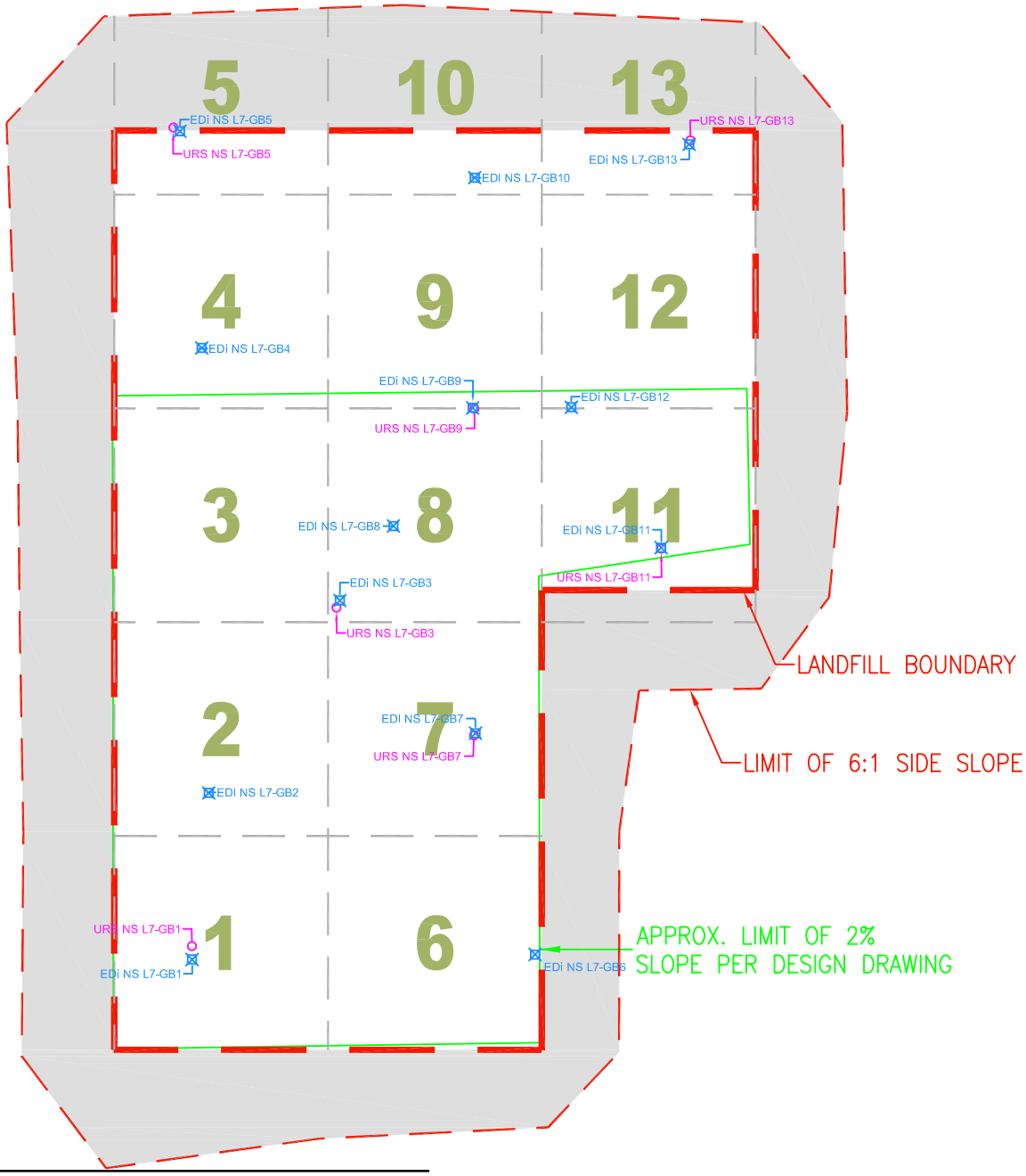
TITLE
MIXED WASTE LANDFILL
MOISTURE/DENSITY TEST LOCATIONS
NATIVE SOIL LAYER LIFT 6

DWN BY: BDP	DATUM: --	DATE: OCT 2009	
CHK'D BY: CW	REV. NO.: A	PROJECT NO: 9-517-00022G	
PROJECTION: --	SCALE: AS SHOWN	FIGURE No. 27	

G:\CAD\MIXED WASTE LANDFILL\951700022G\FIG 3-11.dwg Nov 04,2009 10:01am



LEGEND:

- 6 — GRID BLOCK NUMBER
- QC TEST LOCATIONS
- QA TEST LOCATIONS
- GRID BLOCK BOUNDARY
- LANDFILL BOUNDARY
- LIMIT OF SIDESLOPE (APPROX 6:1)
- SLOPE AREAS

0' 40' 80'
SCALE: 1"=80'

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Albuquerque, NM 87113

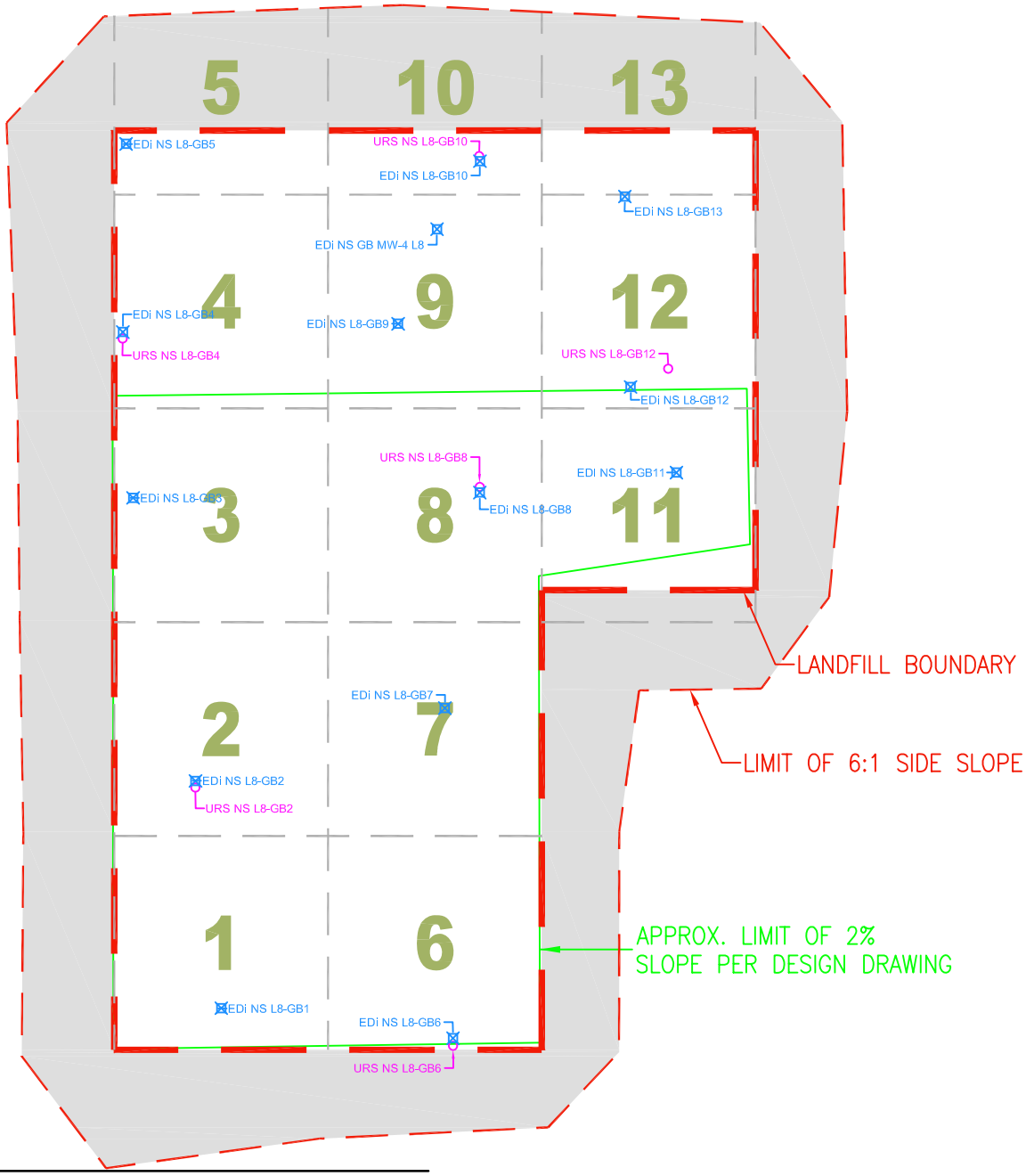
CLIENT LOGO

CLIENT
SANDIA NATIONAL LABORATORIES

TITLE
MIXED WASTE LANDFILL
MOISTURE/DENSITY TEST LOCATIONS
NATIVE SOIL LAYER LIFT 7

DWN BY: BDP	DATUM: --	DATE: OCT 2009	
CHK'D BY: CW	REV. NO.: A	PROJECT NO: 9-517-00022G	
PROJECTION: --	SCALE: AS SHOWN	FIGURE No. 28	

G:\CAD\MIXED WASTE LANDFILL\951700022G\FIG 3-12.dwg Nov 04,2009 10:00am



LEGEND:

- 6 — GRID BLOCK NUMBER
- QC TEST LOCATIONS
- QA TEST LOCATIONS
- GRID BLOCK BOUNDARY
- LANDFILL BOUNDARY
- LIMIT OF SIDESLOPE (APPROX 6:1)
- SLOPE AREAS

0' 40' 80'
SCALE: 1"=80'

AMEC Earth & Environmental
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Albuquerque, NM 87113

CLIENT LOGO

CLIENT
SANDIA NATIONAL LABORATORIES

TITLE
MIXED WASTE LANDFILL
MOISTURE/DENSITY TEST LOCATIONS
NATIVE SOIL LAYER LIFT 8

DWN BY: BDP	DATUM: --	DATE: OCT 2009	
CHK'D BY: CW	REV. NO.: A	PROJECT NO: 9-517-00022G	
PROJECTION: --	SCALE: AS SHOWN	FIGURE No. 29	

G:\CAD\MIXED WASTE LANDFILL\951700022G\FIG 3-13.dwg Nov 04,2009 10:00am

As-Built Drawings

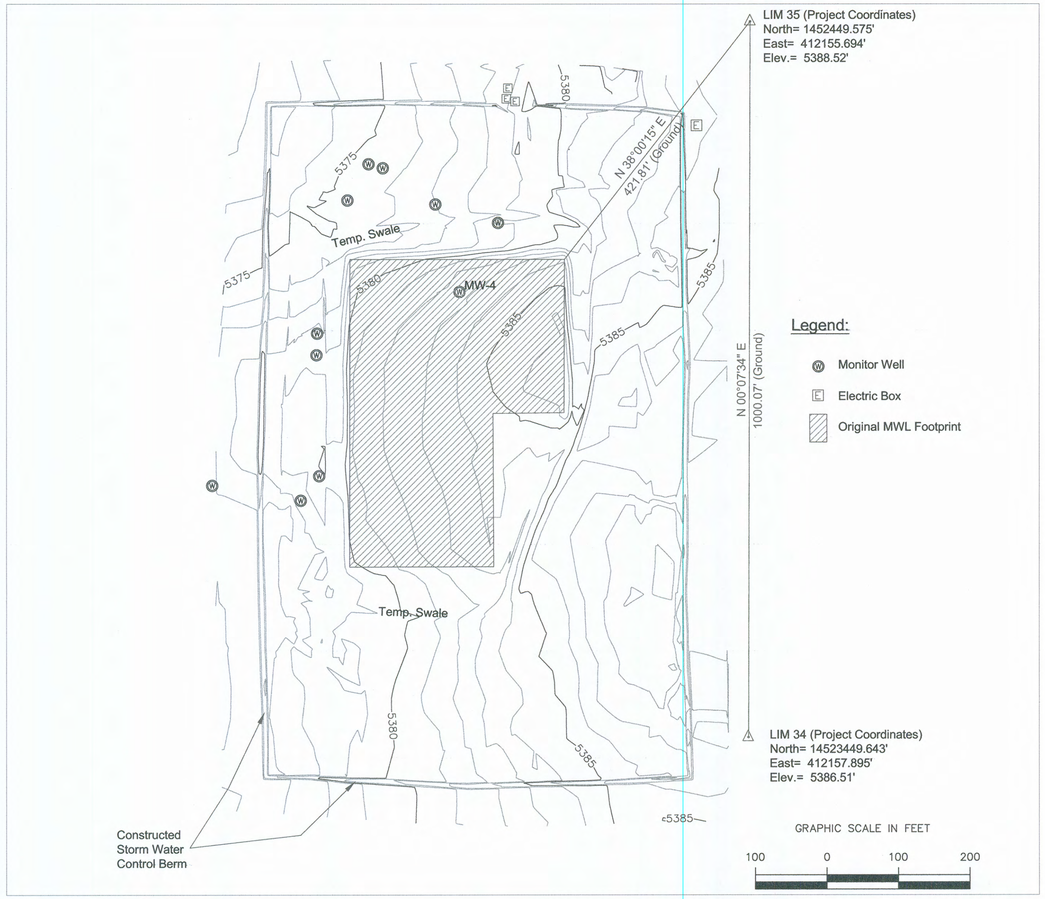
2006 Subgrade As-Built Drawing

MIXED WASTE LANDFILL
FINISHED SUBGRADE SURVEY

MWL

TECH AREA III

Sandia National Laboratories
Bernalillo County, New Mexico
August 2007



Survey Notes:

1.) "Finished Subgrade" conditions based on topographic surveys by URS Corporation April 2007.

2.) Elevations for this survey are based on SNL/KAFB Monument "LIM 35" with an NGVD 29 elevation of 5388.52'. Contour interval is one foot.

3.) Survey Control Coordinates are modified state plane (or "Ground"), based on New Mexico State Plane, Central Zone, North American Datum of 1927. A Combined Scale Factor of .999651675 was used to derive project coordinates. State Plane (or "Grid") values of Control Points Used:
LIM 34 (North= 1452943.37, East= 412014.33) and LIM 35 (North= 1451943.65, East= 412012.13)

4.) Only surface appurtenances of underground utilities are shown. Other utilities may exist that are not shown on this survey. SNL ESD files were not incorporated into this survey.

5.) Distances shown are ground.

6.) This is not a boundary survey. No property corners or lines are shown.

7.) This map has been produced according to procedures that have been demonstrated to produce data that meets or exceeds the minimum standards for a topographic map compiled at a scale of 1 inch equals 100 feet with a contour interval of 1 foot.

SURVEYOR'S CERTIFICATION

I, RUSSELL D. ELLIOTT, NEW MEXICO PROFESSIONAL SURVEYOR No. 13838, HEREBY CERTIFY THAT A TOPOGRAPHIC SURVEY, AS SHOWN HEREON, HAS BEEN SURVEYED AND PLATTED IN ACCORDANCE WITH THE STANDARDS FOR TOPOGRAPHIC SURVEYS IN THE STATE OF NEW MEXICO, RULE 500.5, AND IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF. I, FURTHER CERTIFY THAT THIS SURVEY AND PLAT DO NOT MEET THE REQUIREMENTS OF ANY (MUNICIPAL, COUNTY AND/OR STATE) SUBDIVISION ORDINANCES AND IS NOT INTENDED TO SUBDIVIDE ANY EXISTING PARCEL. THIS IS NOT A BOUNDARY SURVEY.

RUSSELL D. ELLIOTT, NEW MEXICO, 13838, PROFESSIONAL SURVEYOR, 8-30-07

8-30-2007

RUSSELL D. ELLIOTT N.M.P.S. No. 13838 DATE

CAD DRAWING

FILE NAME: MWL-FinishedGrade

P.O. OR W.O. / PROJECT NO.	REV	DATE	DESCRIPTION	DWN	CKD	APP

U.S. DEPARTMENT OF ENERGY
KIRTLAND AREA OFFICE ALBUQUERQUE, NEW MEXICO

SANDIA NATIONAL LABORATORIES
ALBUQUERQUE, NEW MEXICO: LIVERMORE, CALIFORNIA: TONOPAH, NEVADA

SNL/NM MIXED WASTE LANDFILL
2006 Finished Subgrade

P.O. OR W.O.	
PROJECT NO.	
DRAWN BY	DW/JDL
CHECKED BY	HFB
APPROVED BY	RDE
DATE	08/07

SURVEY

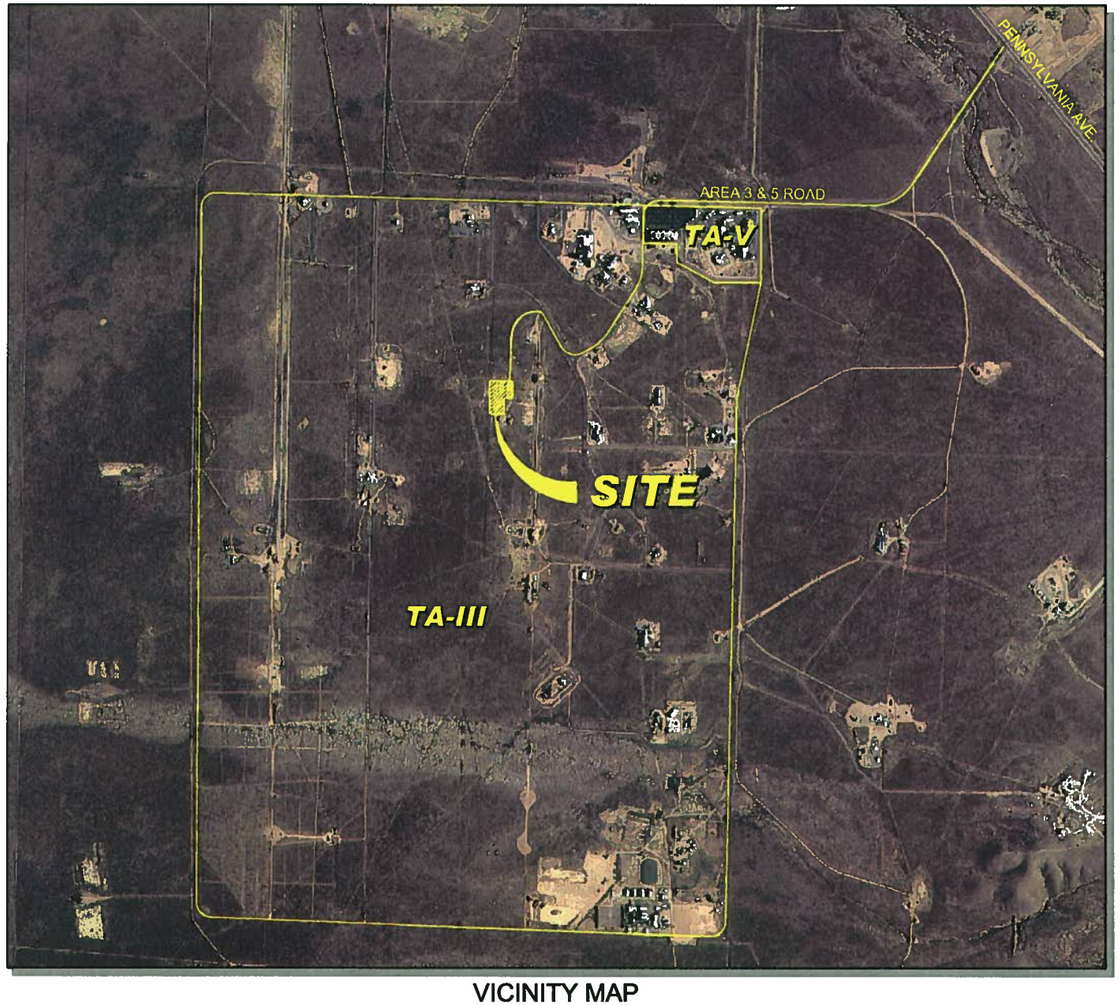
SIZE | DRAWING NO. 1 | SEQ. 1/1

URS
URS CORPORATION

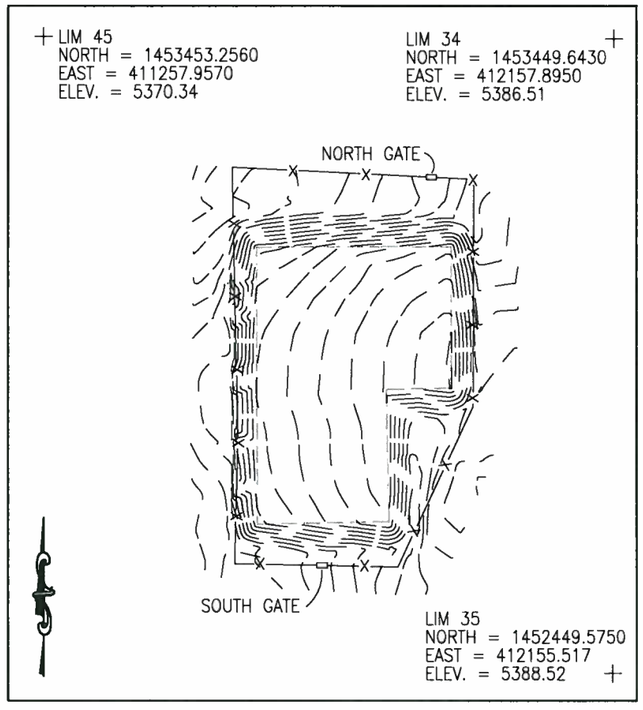
243426410\07 Design\Survey\Finish Surface\dwg\MWL-FinishedGrade.dwg

2009 Alternative Cover
As-Built Drawings

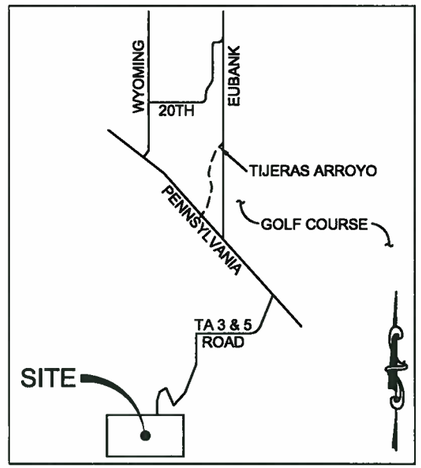
AS-BUILT DRAWINGS
MIXED WASTE LANDFILL ALTERNATIVE
EVAPOTRANSPIRATIVE COVER
SANDIA NATIONAL LABORATORIES
ALBUQUERQUE, NEW MEXICO
JULY 2010



VICINITY MAP
N.T.S.



BENCHMARK MAP



LOCATION MAP
N.T.S.

INDEX

DESCRIPTION	PAGE
TITLE SHEET	1
SITE PLAN	2
SECTIONS	3
DETAILS	4

SANDIA NATIONAL LABORATORIES

AMEC Earth & Environmental
8519 Jefferson, NE
Albuquerque, NM 87113

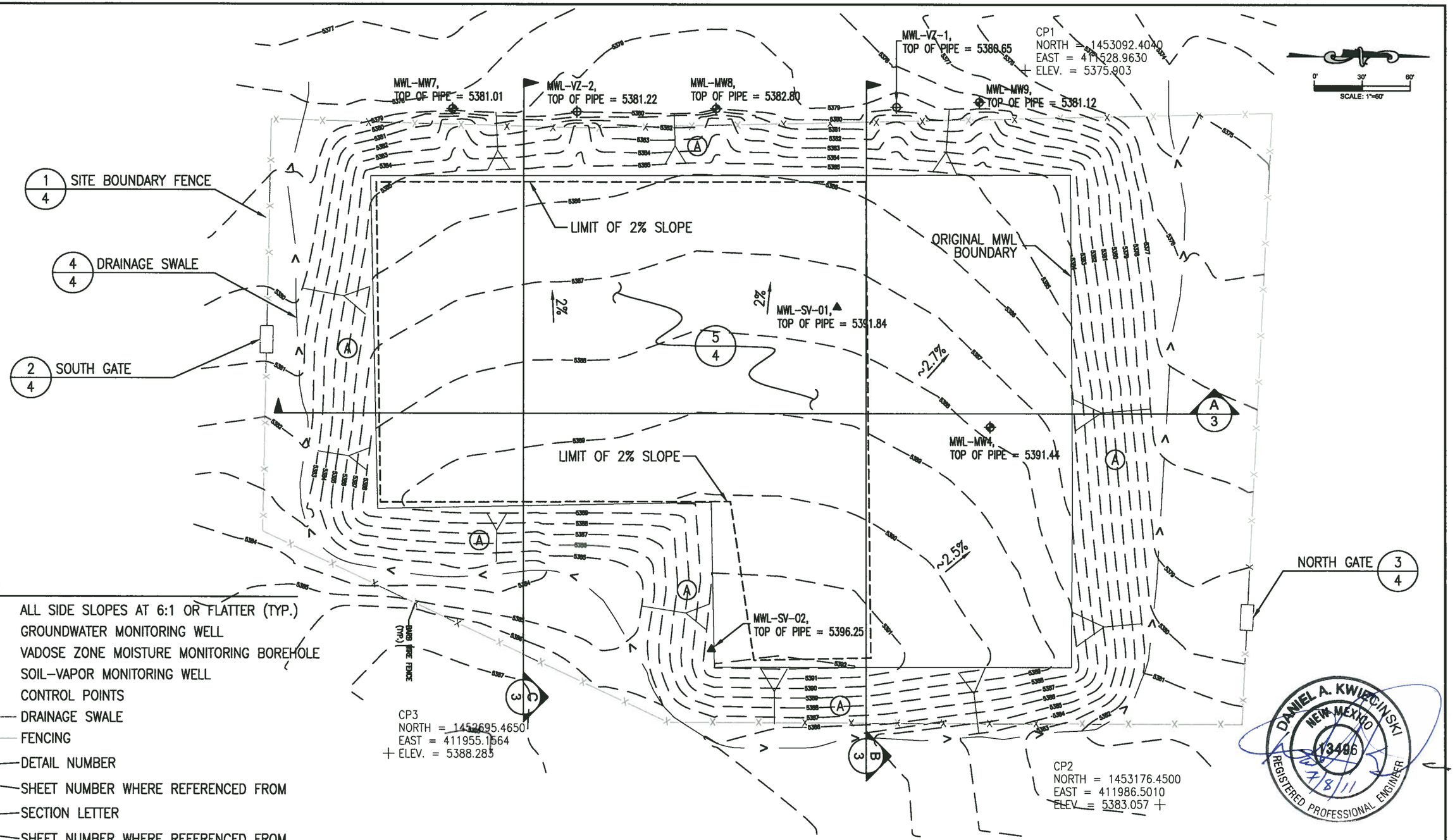
DWN BY:	BDP
CHK'D BY:	CW
DATUM:	N/A
PROJECTION:	N/A
SCALE:	AS SHOWN

PROJECT: MIXED WASTE LANDFILL ALTERNATIVE EVAPOTRANSPIRATIVE COVER

TITLE: TITLE SHEET

DATE:	JUL 2011
CONTRACT NO:	9-517-00022G
REV. NO.:	A
FIGURE NO.	1

G:\CAD\PROJECTS\MIXED WASTE LANDFILL\951700022G\FIG 1.dwg Jul 08,2011 1:50pm



LEGEND:

- (A) ALL SIDE SLOPES AT 6:1 OR FLATTER (TYP.)
- GROUNDWATER MONITORING WELL
- VADOSE ZONE MOISTURE MONITORING BOREHOLE
- SOIL-VAPOR MONITORING WELL
- CONTROL POINTS
- DRAINAGE SWALE
- FENCING
- 3/4 DETAIL NUMBER / SHEET NUMBER WHERE REFERENCED FROM
- C/4 SECTION LETTER / SHEET NUMBER WHERE REFERENCED FROM

SOURCE:
SURVEY PROVIDED BY ALBUQUERQUE SURVEYING CO. INC.,
2119 Menaul Blvd. N.E., Albuquerque, New Mexico 87107
(1.4.2010)

SANDIA NATIONAL LABORATORIES

AMEC Earth & Environmental
8519 Jefferson, NE
Albuquerque, NM 87113

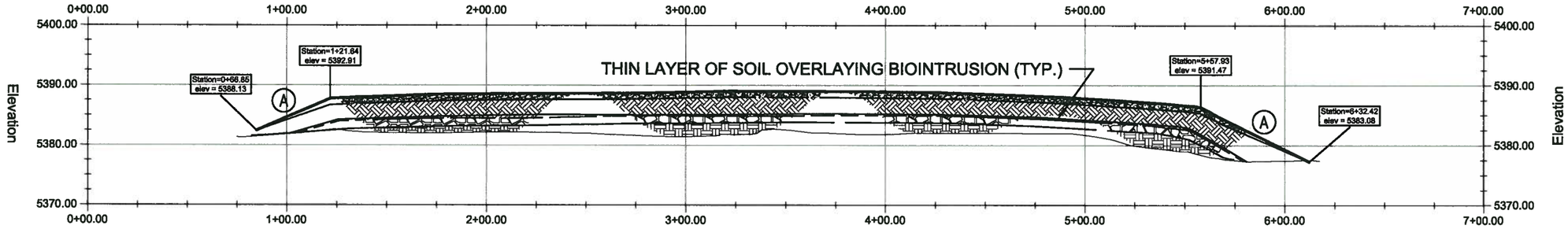
DWN BY:	BDP
CHK'D BY:	CW
DATUM:	N/A
PROJECTION:	N/A
SCALE:	AS SHOWN

PROJECT: **MIXED WASTE LANDFILL ALTERNATIVE EVAPOTRANSPIRATIVE COVER**

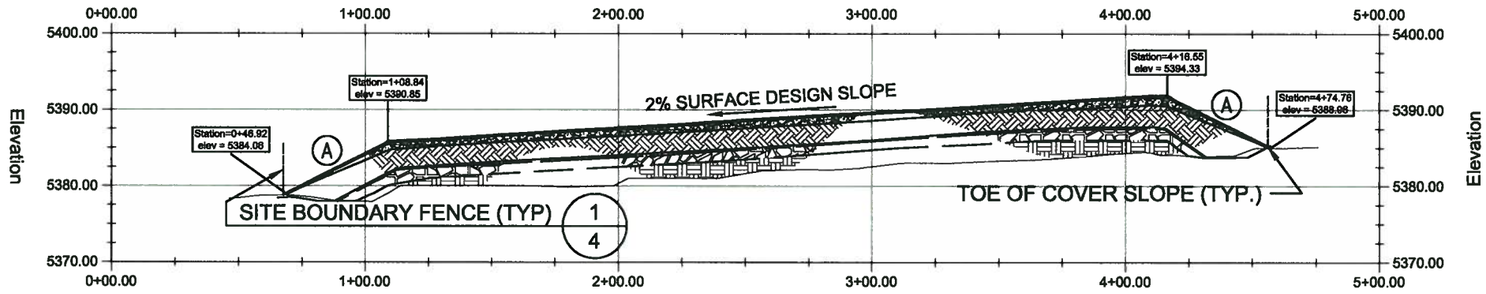
TITLE: **SITE PLAN**

DATE:	JUL 2011
CONTRACT NO:	9-517-00022G
REV. NO.:	A
FIGURE NO.	2

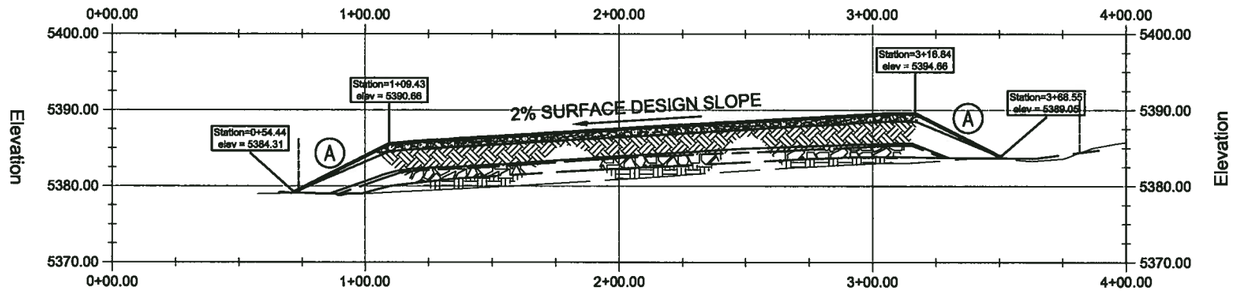
G:\CAD\PROJECTS\MIXED WASTE LANDFILL\9517000220\FIG 2-NEW.dwg Jul 08,2011 2:38pm



A/2 SECTION
SCALE: VERTICAL 1" = 20', HORIZONTAL 1" = 60'



B/2 SECTION
SCALE: VERTICAL 1" = 20', HORIZONTAL 1" = 60'



C/2 SECTION
SCALE: VERTICAL 1" = 20', HORIZONTAL 1" = 60'

LEGEND:

- TOPSOIL
- NATIVE SOIL
- BIOINTRUSION
- SUBGRADE
- EXISTING SURFACE
- (A) ALL SIDE SLOPES AT 6:1 OR FLATTER (TYP.)
- C/2 SECTON LETTER / SHEET NUMBER WHERE REFERENCED FROM

DANIEL A. KWIECINSKI
NEW MEXICO
13496
REGISTERED PROFESSIONAL ENGINEER
7/8/11

NOTE:
EXISTING SURFACE BASED ON MAY 10, 2006
PRE-CONSTRUCTION SURVEY PERFORMED BY URS CORP.

SANDIA NATIONAL LABORATORIES

AMEC Earth & Environmental
8519 Jefferson, NE
Albuquerque, NM 87113

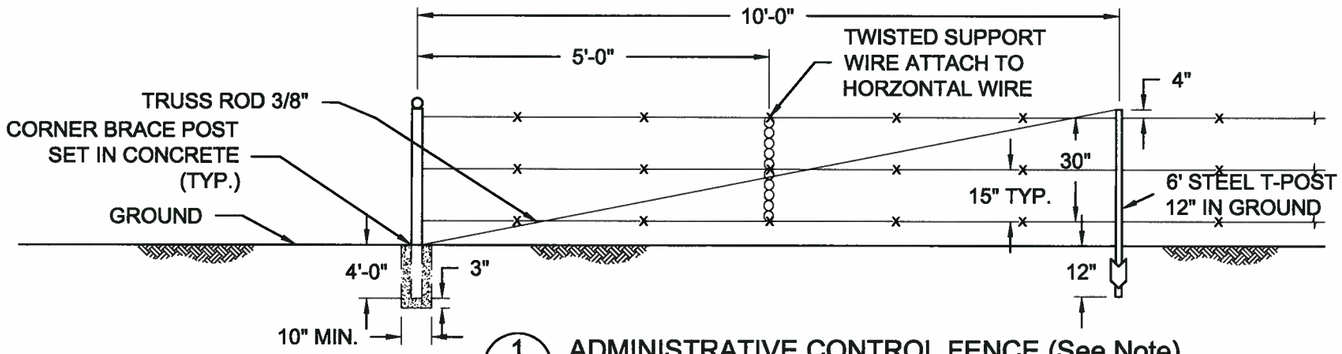
DWN BY:	BDP
CHK'D BY:	CW
DATUM:	N/A
PROJECTION:	N/A
SCALE:	AS SHOWN

PROJECT: **MIXED WASTE LANDFILL ALTERNATIVE EVAPOTRANSPIRATIVE COVER**

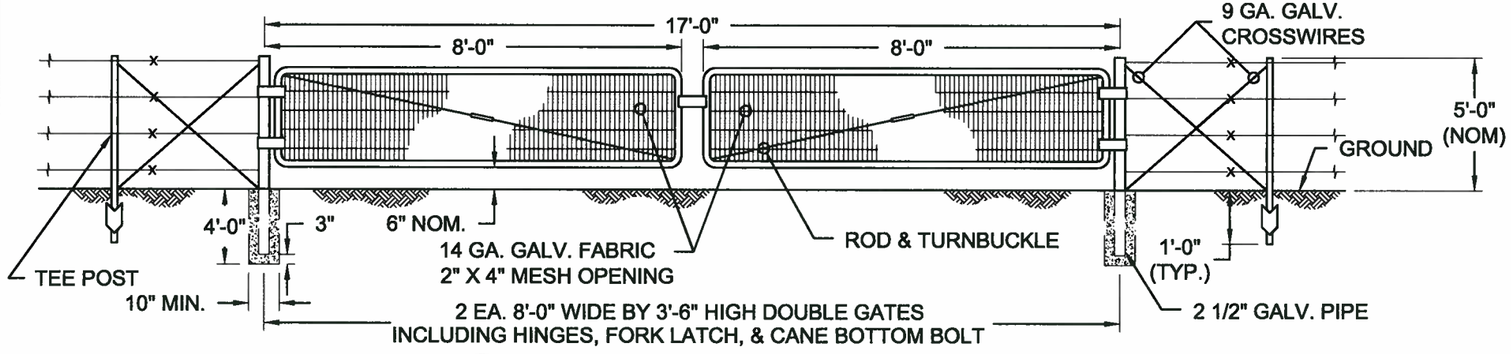
TITLE: **SECTIONS**

DATE:	JUL 2011
CONTRACT NO:	9-517-00022G
REV. NO.:	A
FIGURE NO.	3

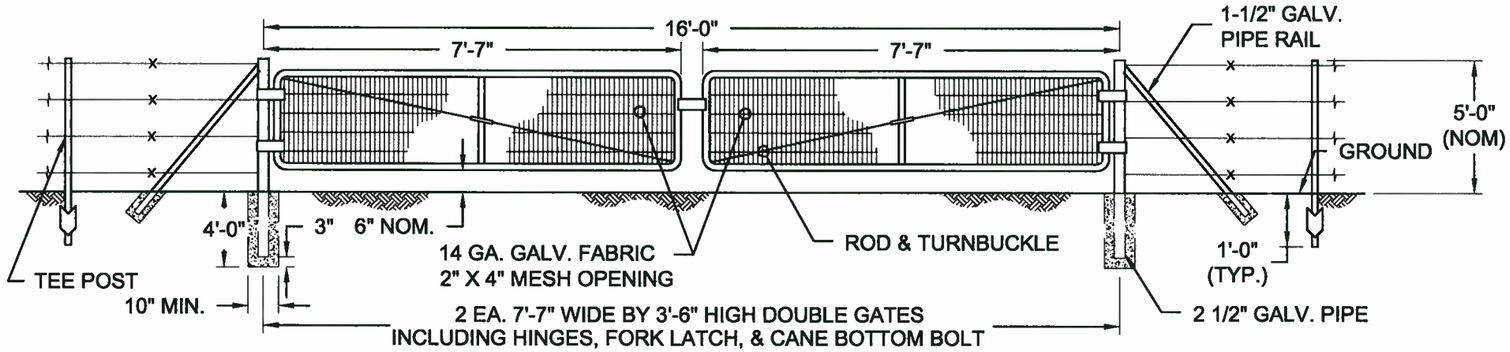
G:\CAD\PROJECTS\MIXED WASTE LANDFILL\09117000222\FIG 3.dwg Jul 08,2011 3:38pm



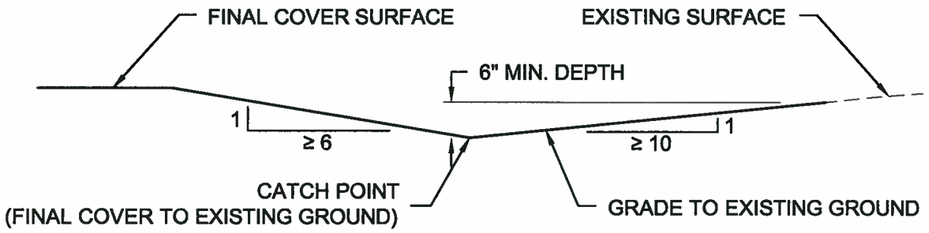
1 / 2 ADMINISTRATIVE CONTROL FENCE (See Note) DETAIL NTS



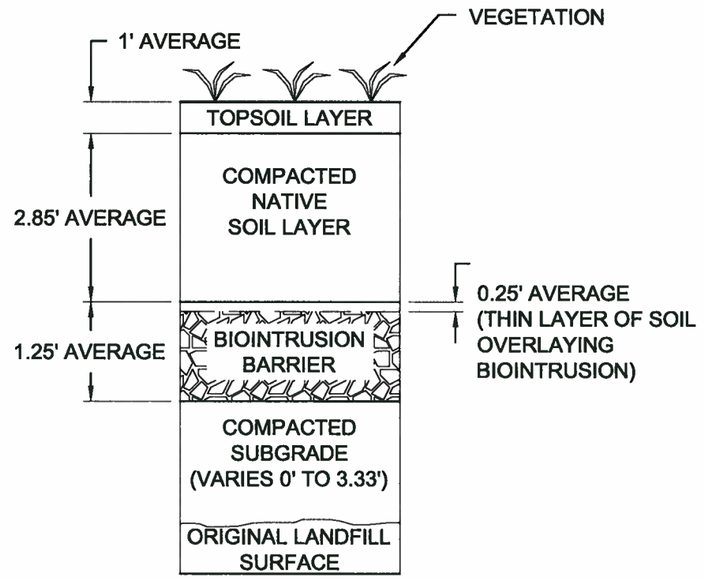
2 / 2 SOUTH GATE (See Note) DETAIL NTS



3 / 2 NORTH GATE (See Note) DETAIL NTS



4 / 2 TYPICAL DRAINAGE SWALE SECTION DETAIL NTS



5 / 2 GENERALIZED COVER CROSS SECTION DETAIL NTS

LEGEND:

3 / 2 — 3 DETAIL NUMBER; 2 SHEET NUMBER WHERE REFERENCED FROM

DANIEL A. KWIECINSKI NEW MEXICO 13496 REGISTERED PROFESSIONAL ENGINEER 7/8/11

NOTE:

ADMINISTRATIVE CONTROL FENCE IS 3-STRAND BARBED WIRE WITH TEE-POSTS DRIVEN INTO THE GROUND AND STEEL CORNER POSTS SET IN CONCRETE. GATE IS A TUBULAR STEEL GALVANIZED GATE, 2-IN DIAMETER. ALL END AND CORNER POSTS ARE BRACED BY MEANS OF 3/8-IN ø DIAGONAL TRUSS RODS.

SANDIA NATIONAL LABORATORIES

AMEC Earth & Environmental
8519 Jefferson, NE
Albuquerque, NM 87113

DWN BY:	BDP
CHK'D BY:	CW
DATUM:	N/A
PROJECTION:	N/A
SCALE:	AS SHOWN

PROJECT: **MIXED WASTE LANDFILL ALTERNATIVE EVAPOTRANSPIRATIVE COVER**

TITLE: **DETAILS**

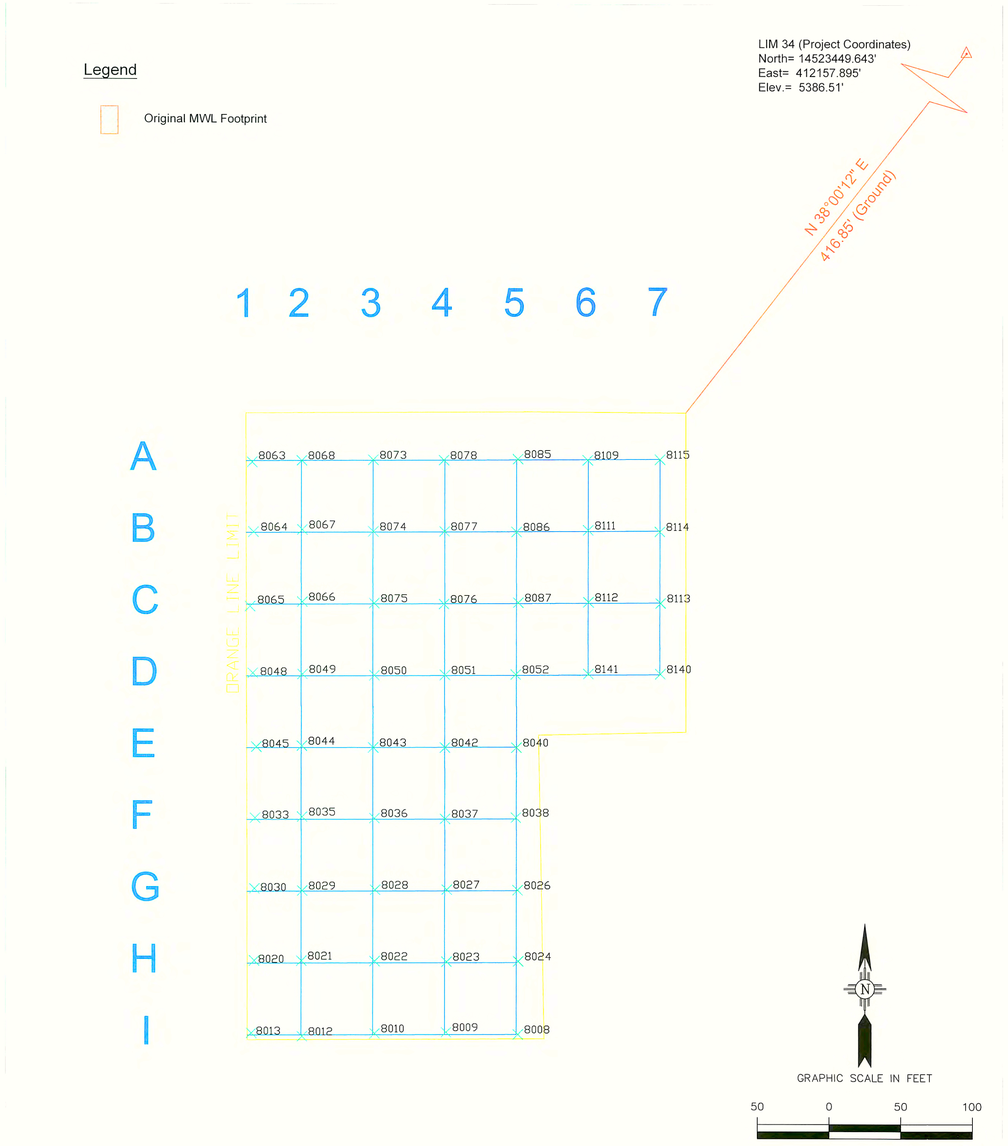
DATE:	JUL 2011
CONTRACT NO:	9-517-00022G
REV. NO.:	A
FIGURE NO.	4

Q:\CAD\PROJECTS\MIXED WASTE LANDFILL\9517000222G\FIG 4.dwg Jul 08,2011 8:12pm

QA Verification Survey Plates

MIXED WASTE LANDFILL
BIOINTRUSION LAYER QA SURVEY

MWL



URS BIO LAYER QA SHOTS

GRID	URS PT #	TOP BIO ELEV	ASCI PT #	SUB GRADE ELEV	FILL
A1	8063	5380.81	1043	5379.49	1.32
A2	8068	5381.35	1071	5380.15	1.20
A3	8073	5382.32	1080	5380.94	1.38
A4	8078	5383.27	1095	5381.97	1.30
A5	8085	5384.63	1106	5383.08	1.55
A6	8109	5385.28	1127	5383.83	1.45
A7	8115	5386.02	1139	5384.83	1.19
B1	8064	5381.59	1044	5380.16	1.43
B2	8067	5382.37	1070	5380.88	1.49
B3	8074	5383.29	1081	5382.03	1.26
B4	8077	5384.22	1094	5382.97	1.25
B5	8086	5385.35	1112	5384.18	1.17
B6	8111	5386.24	1126	5385.06	1.18
B7	8114	5387.27	1140	5386.02	1.25
C1	8065	5382.24	1048	5380.74	1.49
C2	8066	5383.02	1069	5381.65	1.37
C3	8075	5383.51	1082	5382.47	1.04
C4	8076	5384.80	1093	5383.43	1.37
C5	8087	5385.90	1113	5384.80	1.10
C6	8112	5387.14	1125	5385.76	1.38
C7	8113	5387.89	1141	5386.37	1.52
D1	8048	5382.20	1049	5381.12	1.07
D2	8049	5383.18	1068	5381.85	1.33
D3	8050	5383.83	1083	5382.71	1.12
D4	8051	5384.82	1092	5383.55	1.27
D5	8052	5385.89	1114	5384.75	1.14
D6	8141	5387.26	1124	5385.90	1.36
D7	8140	5387.72	1142	5386.36	1.36
E1	8045	5382.44	1054	5381.20	1.24
E2	8044	5383.06	1067	5381.76	1.30
E3	8043	5383.95	1084	5382.76	1.19
E4	8042	5384.68	1091	5383.58	1.10
E5	8040	5385.43	1115	5384.28	1.15
F1	8033	5382.08	1055	5380.98	1.10
F2	8035	5382.85	1066	5381.78	1.07
F3	8036	5383.82	1085	5382.73	1.09
F4	8037	5384.91	1090	5383.53	1.38
F5	8038	5385.44	1117	5384.19	1.25
G1	8030	5382.01	1058	5380.64	1.37
G2	8029	5382.58	1065	5381.27	1.31
G3	8028	5383.63	1086	5382.40	1.23
G4	8027	5385.04	1089	5383.14	1.90
G5	8026	5385.24	1118	5383.98	1.26
H1	8020	5381.70	1063	5380.35	1.35
H2	8021	5382.30	1064	5381.28	1.02
H3	8022	5383.54	1087	5382.00	1.54
H4	8023	5384.46	1088	5382.97	1.49
H5	8024	5385.04	1119	5383.87	1.17
I1	8013	5381.33	1189	5379.82	1.51
I2	8012	5381.72	1183	5380.56	1.14
I3	8010	5383.11	1180	5381.40	1.71
I4	8009	5383.93	1177	5382.56	1.37
I5	8008	5384.52	1172	5383.51	1.01
				AVERAGE	1.29

TECH AREA III

Sandia National Laboratories
Bernalillo County, New Mexico
June, 2009

Survey Notes:

1.) Biointrusion Layer conditions based on spot elevations surveyed by URS, June 2009.

2.) Elevations for this survey are based on SNL/KAFB Monument "LIM 35" with an NGVD 29 elevation of 5388.52'.

3.) Survey Control Coordinates are modified state plane (or "Ground"), based on New Mexico State Plane, Central Zone, North American Datum of 1927. A Combined Scale Factor of .999651675 was used to derive project coordinates. State Plane (or "Grid") values of Control Points Used:
LIM 34 (North= 1452943.37, East= 412014.33) and LIM 35 (North= 1451943.65, East= 412012.13)

4.) No surface appurtenances of underground utilities are shown. Other utilities may exist that are not shown on this survey. SNL ESD files were not incorporated into this survey.

5.) Distances shown are ground.

6.) This is not a boundary survey. No property corners or lines are shown.

7.) The table compares URS survey data (the 2 left-hand columns), shot on the top of the Biointrusion Layer with earlier ASCI survey data (the next 2 columns), shot on the top of the Subgrade. The FILL column shows the thickness of the Biointrusion Layer.

8.) Survey was not collected by URS on grid points E5.1, E6, and E7 for the Biointrusion Layer. See Figure 17 for Surveyed Verification Grid Points And Filed Testing Grid Blocks Description.

URS

URS CORPORATION

SURVEYOR'S CERTIFICATION

I, KIM STELZER, NEW MEXICO PROFESSIONAL SURVEYOR No. 7482, HEREBY CERTIFY THAT A TOPOGRAPHIC SURVEY, AS SHOWN HEREON, HAS BEEN SURVEYED AND PLATTED IN ACCORDANCE WITH THE STANDARDS FOR TOPOGRAPHIC SURVEYS IN THE STATE OF NEW MEXICO, RULE 500.5, AND IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF. I FURTHER CERTIFY THAT THIS SURVEY AND PLAT DO NOT MEET THE REQUIREMENTS OF ANY (MUNICIPAL, COUNTY AND/OR STATE) SUBDIVISION ORDINANCES AND IS NOT INTENDED TO SUBDIVIDE ANY EXISTING PARCEL. THIS IS NOT A BOUNDARY SURVEY.

KIM STELZER N.M.P.S. No. 7482 — DATE Dec. 29, 2009

NEW MEXICO 7482 REGISTERED PROFESSIONAL LAND SURVEYOR

CAD DRAWING
FILE NAME:
MWL-QA SURVEY 9-4-2009

P.O. OR W.O. / PROJECT NO.	REV	DATE	DESCRIPTION	DWN	CKD	APP

U.S. DEPARTMENT OF ENERGY
KIRTLAND AREA OFFICE — ALBUQUERQUE, NEW MEXICO
SANDIA NATIONAL LABORATORIES
ALBUQUERQUE, NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH, NEVADA

SNL/NM MIXED WASTE LANDFILL
Biointrusion Layer

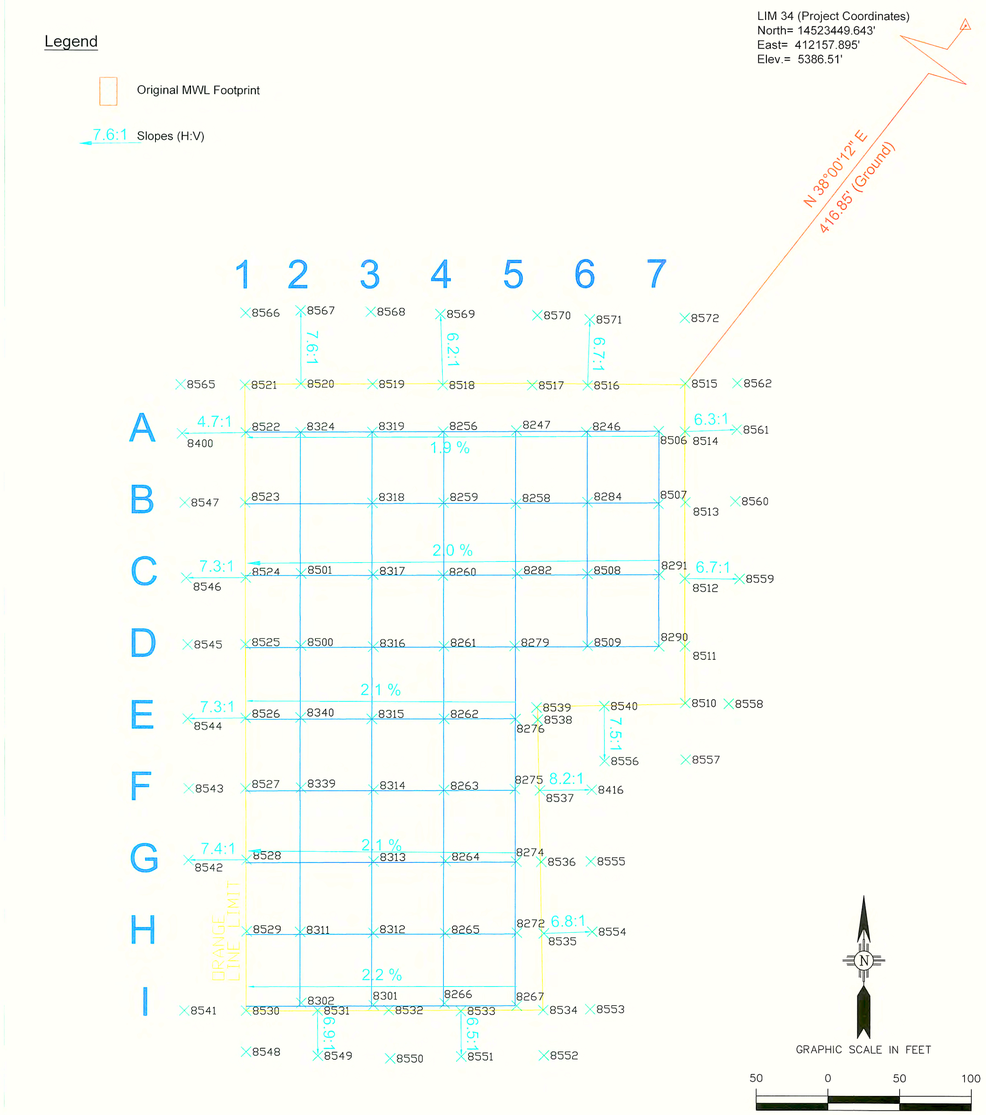
P.O. OR W.O.	
PROJECT NO.	
DRAWN BY	HFB
CHECKED BY	RDE
APPROVED BY	RDE
DATE	06/09
SIZE	PLATE NO: 1
SEQ.	1/1

SURVEY

2434264\07 Design\Survey\Bio Intrusion Layer\dwg\MWL-URS QA SURVEY-FINAL BIO LAYER EXHIBIT 9-4-2009.dwg

MIXED WASTE LANDFILL
NATIVE SOIL LAYER QA SURVEY

MWL



GRID	URS PT #	TOP NAT ELEV	ASCI PT #	TOP THIN SOIL	FILL
A1	8522	5383.37	1905	5380.94	2.43
A2	8324	5384.01	1904	5381.54	2.47
A3	8319	5384.87	1903	5382.43	2.44
A4	8256	5386.11	1923	5383.46	2.65
A5	8247	5387.27	1929	5384.78	2.49
A6	8246	5387.98	1940	5385.4	2.58
A7	8506	5388.88	1955	5386.35	2.53
B1	8432	5384.38	1900	5381.74	2.64
B3	8318	5385.95	1901	5383.51	2.44
B4	8259	5387.02	1902	5384.47	2.55
B5	8258	5388.10	1928	5385.61	2.49
B6	8284	5388.91	1939	5386.39	2.52
B7	8507	5389.81	1950	5387.26	2.55
C1	8433	5384.92	1898	5382.38	2.54
C2	8501	5385.69	1920	5383.15	2.54
C3	8317	5386.51	1897	5384.05	2.46
C4	8260	5387.72	1896	5384.94	2.78
C5	8282	5388.62	1895	5386.01	2.61
C6	8508	5389.78	1938	5387.26	2.52
C7	8291	5390.38	1949	5387.96	2.42
D1	8434	5385.07	1889	5382.59	2.48
D2	8500	5385.91	1892	5383.35	2.56
D3	8316	5386.76	1891	5384.07	2.69
D4	8261	5387.90	1893	5385.08	2.82
D5	8279	5388.73	1894	5386.01	2.72
D6	8509	5389.88	1931	5387.35	2.53

GRID	URS PT #	TOP NAT ELEV	ASCI PT #	TOP THIN SOIL	FILL
D7	8290	5391.03	1953	5387.94	3.09
E1	8435	5385.27	1882	5382.71	2.56
E2	8340	5385.78	1886	5383.2	2.58
E3	8315	5386.87	1883	5384.24	2.63
E4	8262	5387.95	1884	5384.97	2.98
E5	8276	5388.90	1885	5385.75	3.15
F1	8436	5385.12	1887	5382.34	2.78
F2	8339	5385.60	1880	5383.11	2.49
F3	8314	5386.73	1879	5384.09	2.64
F4	8263	5387.80	1878	5384.89	2.91
F5	8275	5388.89	1877	5385.67	3.22
G1	8437	5385.01	1868	5382.25	2.76
G3	8313	5386.60	1872	5383.92	2.68
G4	8264	5387.63	1873	5384.99	2.64
G5	8274	5388.63	1874	5385.54	3.09
H1	8438	5384.82	1866	5382.02	2.80
H2	8311	5385.39	1869	5382.62	2.77
H3	8312	5386.32	1864	5383.74	2.58
H4	8265	5387.36	1865	5384.68	2.68
H5	8272	5388.32	1863	5385.28	3.04
I1	8530	5383.46	1853	5381.34	2.12
I2	8302	5385.03	1855	5382.07	2.96
I3	8301	5385.84	1857	5382.99	2.85
I4	8266	5386.81	1861	5384.14	2.67
I5	8267	5387.73	1859	5384.78	2.95
				AVERAGE	2.67

URS NATIVE SOIL LAYER TOP SHOTS

URS PT #	ELEV	URS PT #	ELEV
8255	5385.99	8520	5382.80
8510	5391.13	8521	5382.58
8511	5391.23	8531	5384.84
8512	5390.67	8532	5385.92
8513	5389.68	8533	5386.75
8514	5388.77	8534	5387.87
8515	5387.44	8535	5388.57
8516	5386.50	8536	5388.47
8517	5385.49	8537	5388.77
8518	5385.13	8538	5389.13
8519	5383.50	8539	5389.04
		8540	5390.06

URS NATIVE SOIL LAYER TOE SHOTS

URS PT #	ELEV	URS PT #	ELEV	URS PT #	ELEV
8400	5373.96	8549	5380.24	8560	5384.31
8416	5384.39	8550	5380.94	8561	5383.02
8541	5377.84	8551	5381.86	8562	5382.15
8542	5379.20	8552	5383.03	8565	5375.88
8543	5379.76	8553	5383.44	8566	5375.41
8544	5379.44	8554	5383.62	8567	5376.12
8545	5379.16	8555	5383.79	8568	5376.76
8546	5379.02	8556	5384.93	8569	5377.18
8547	5377.59	8557	5385.57	8570	5378.88
8548	5379.21	8558	5385.93	8571	5379.68
		8559	5384.93	8572	5380.55

TECH AREA III

Sandia National Laboratories
Bernalillo County, New Mexico
June, 2009

Survey Notes:

1.) Native Soil Layer data based on spot elevations surveyed by URS, June 2009.

2.) Elevations for this survey are based on SNL/KAFB Monument "LIM 35" with an NGVD 29 elevation of 5388.52'.

3.) Survey Control Coordinates are modified state plane (or "Ground"), based on New Mexico State Plane, Central Zone, North American Datum of 1927. A Combined Scale Factor of .999651675 was used to derive project coordinates. State Plane (or "Grid") values of Control Points Used:
LIM 34 (North= 1452943.37, East= 412014.33) and LIM 35 (North= 1451943.65, East= 412012.13)

4.) No surface appurtenances of underground utilities are shown. Other utilities may exist that are not shown on this survey. SNL ESD files were not incorporated into this survey.

5.) Distances shown are ground.

6.) This is not a boundary survey. No property corners or lines are shown.

7.) The 6 columned table titled "URS NATIVE SOIL LAYER QA SHOTS" compares URS survey data (columns 2&3), shot on the top of the Native Soil Layer with earlier ASCI survey data (columns 4&5), shot on the top of the thin soil layer. The "FILL" column shows the thickness of the Native Soil Layer.

8.) The tables titles "URS NATIVE SOIL LAYER TOP SHOTS" and "URS NATIVE SOIL LAYER TOE SHOTS" are shown for slope verification only. No thickness can be inferred from this data.

9.) The northwest corner side slope of the Native Soil Layer is 4.7:1 in lieu of 6:1. The northwest corner side slope will be adjusted to 6:1 during the construction of the Topsoil Layer.

10.) Survey was not collected by URS on grid points B2, E5.1, E6, E7, and G2 for the Native Soil Layer. See Figure 17 for Surveyed Verification Grid Points And Field Testing Grid Blocks Description.

SURVEYOR'S CERTIFICATION

I, KIM STELZER, NEW MEXICO PROFESSIONAL SURVEYOR No. 7482, HEREBY CERTIFY THAT A TOPOGRAPHIC SURVEY, AS SHOWN HEREON, HAS BEEN SURVEYED AND PLATTED IN ACCORDANCE WITH THE STANDARDS FOR TOPOGRAPHIC SURVEYS IN THE STATE OF NEW MEXICO, RULE 500.5, AND IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF. I FURTHER CERTIFY THAT THIS SURVEY AND PLAT DO NOT MEET THE REQUIREMENTS OF ANY (MUNICIPAL, COUNTY AND/OR STATE) SUBDIVISION ORDINANCES AND IS NOT INTENDED TO SUBDIVIDE ANY EXISTING PARCEL. THIS IS NOT A BOUNDARY SURVEY.

KIM STELZER N.M.P.E.S. No. 7482 — DATE: Dec 29, 2009

URS

URS CORPORATION

P.O. OR W.O. / PROJECT NO.	REV.	DATE	DESCRIPTION	DWN	CKD	APP

U.S. DEPARTMENT OF ENERGY
KIRTLAND AREA OFFICE — ALBUQUERQUE, NEW MEXICO

ALBUQUERQUE, NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH, NEVADA

SNL/NM MIXED WASTE LANDFILL
Native Soil Layer

P.O. OR W.O.	
PROJECT NO.	
DRAWN BY	HFB
CHECKED BY	RDE
APPROVED BY	RDE
DATE	06/09

SURVEY

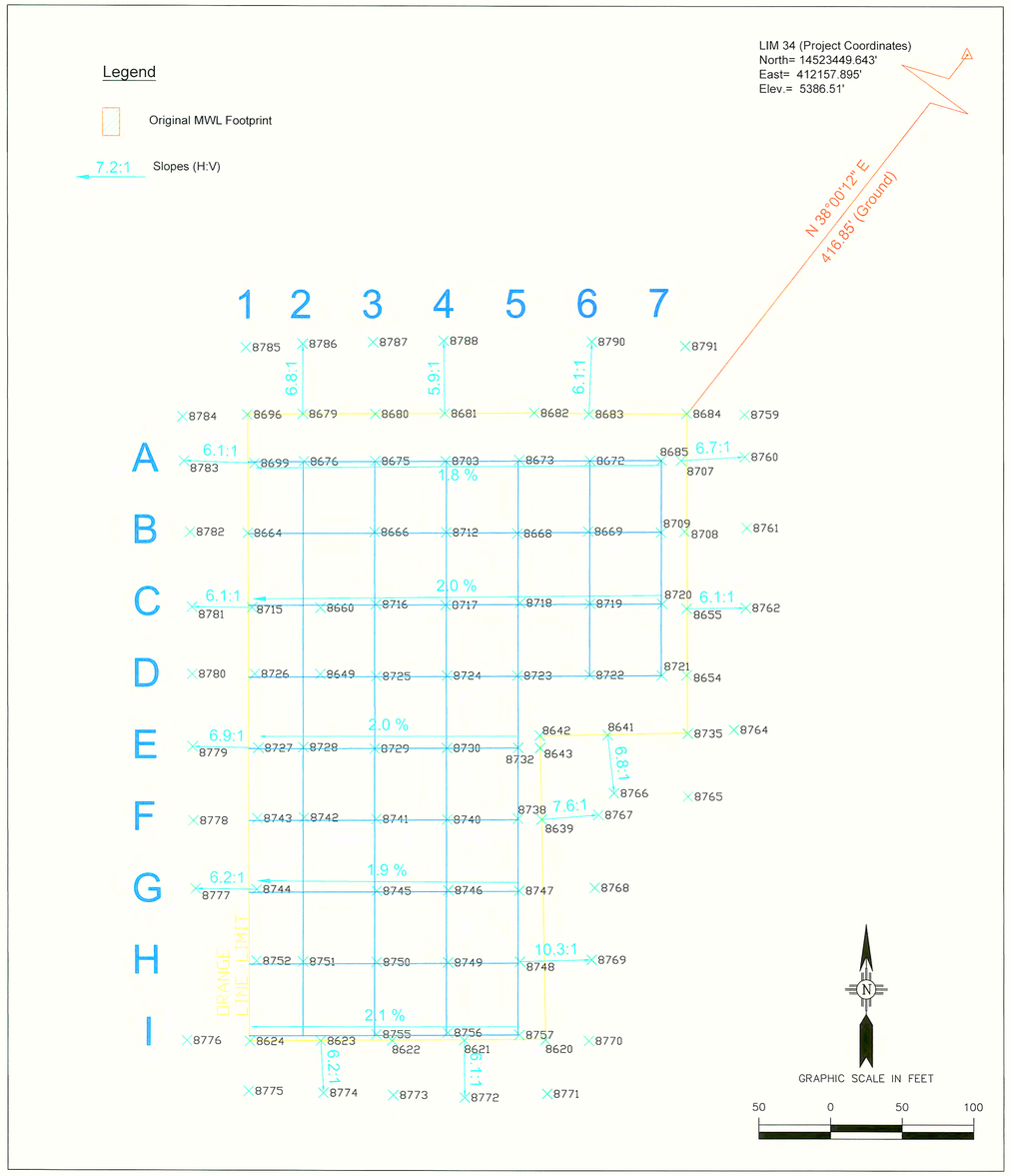
SIZE: | Plate No: 2 | SEQ. 1/1

FILE NAME: MWL-URS QA SURVEY-FINAL NAT SOIL LAYER EXHIBIT 9-1-2009.dwg

2434264D\07 Design\Survey\Bio intrusion Layer\dwg\MWL-URS QA SURVEY-FINAL NAT SOIL LAYER EXHIBIT 9-1-2009.dwg

MIXED WASTE LANDFILL
TOPSOIL LAYER QA SURVEY

MWL



URS TOPSOIL LAYER QA SHOTS

GRID	URS PT #	TOP SOIL ELEV	URS PT #	TOP NAT ELEV	FILL
A1	8699	5384.54	8522	5383.37	1.17
A2	8676	5385.00	8324	5384.01	0.98
A3	8675	5385.89	8319	5384.87	1.02
A4	8703	5387.00	8256	5386.11	0.89
A5	8673	5388.28	8247	5387.27	1.01
A6	8672	5389.00	8246	5387.98	1.02
A7	8685	5389.76	8506	5388.88	0.88
B1	8664	5385.31	8432	5384.38	0.93
B3	8666	5386.97	8318	5385.95	1.02
B4	8712	5388.00	8259	5387.02	0.98
B5	8668	5389.07	8258	5388.10	0.97
B6	8669	5389.88	8284	5388.91	0.96
B7	8709	5390.63	8507	5389.81	0.82
C1	8715	5385.71	8433	5384.92	0.79
C2	8660	5386.87	8501	5385.69	1.17
C3	8716	5387.60	8317	5386.51	1.09
C4	8717	5388.55	8260	5387.72	0.83
C5	8718	5389.53	8282	5388.62	0.91
C6	8719	5390.57	8508	5389.78	0.79
C7	8720	5391.41	8291	5390.38	1.03
D1	8726	5386.08	8434	5385.07	1.01
D2	8649	5387.05	8500	5385.91	1.14
D3	8725	5387.80	8316	5386.76	1.04
D4	8724	5388.80	8261	5387.90	0.90
D5	8723	5389.74	8279	5388.73	1.01
D6	8722	5390.84	8509	5389.88	0.96

GRID	URS PT #	TOP SOIL ELEV	URS PT #	TOP NAT ELEV	FILL
D7	8721	5392.01	8290	5391.03	0.98
E1	8727	5386.27	8435	5385.27	1.00
E2	8728	5386.90	8340	5385.78	1.12
E3	8729	5387.80	8315	5386.87	0.93
E4	8730	5388.73	8262	5387.95	0.78
E5	8732	5389.90	8276	5388.90	1.00
F1	8743	5386.03	8436	5385.12	0.91
F2	8742	5386.73	8339	5385.60	1.14
F3	8741	5387.70	8314	5386.73	0.97
F4	8740	5388.61	8263	5387.80	0.81
F5	8738	5389.70	8275	5388.89	0.80
G1	8744	5385.93	8437	5385.01	0.92
G3	8745	5387.60	8313	5386.60	1.00
G4	8746	5388.54	8264	5387.63	0.91
G5	8747	5389.40	8274	5388.63	0.77
H1	8752	5385.77	8438	5384.02	1.75
H2	8751	5386.37	8311	5385.39	0.97
H3	8750	5387.43	8312	5386.32	1.11
H4	8749	5388.36	8265	5387.36	1.00
H5	8748	5389.24	8272	5388.33	0.91
I3	8755	5387.00	8301	5385.84	1.16
I4	8756	5387.90	8266	5386.81	1.09
I5	8757	5388.70	8267	5387.73	0.97
				AVERAGE	0.99

URS TOPSOIL LAYER TOP SHOTS

URS PT #	ELEV
8620	5389.00
8621	5387.90
8622	5386.89
8623	5385.81
8624	5384.68
8639	5389.93
8641	5391.07
8642	5390.15
8643	5390.03
8654	5392.17

URS PT #	ELEV
8655	5391.93
8679	5383.88
8680	5384.62
8681	5386.14
8682	5386.70
8683	5387.36
8684	5388.65
8696	5383.63
8707	5389.79
8708	5390.57
8735	5391.92

URS TOPSOIL LAYER TOE SHOTS

URS PT #	ELEV
8759	5382.11
8760	5383.13
8761	5384.42
8762	5385.13
8764	5386.7
8765	5385.99
8766	5385.06
8767	5384.7
8768	5384.17
8769	5384.37

URS PT #	ELEV
8770	5384.11
8771	5382.83
8772	5381.37
8773	5380.65
8774	5379.96
8775	5379.08
8776	5377.91
8777	5379.11
8778	5379.76
8779	5379.64

URS PT #	ELEV
8780	5379.27
8781	5378.89
8782	5377.91
8783	5376.39
8784	5376.11
8785	5375.73
8786	5376.74
8787	5377.14
8788	5377.55
8790	5379.08
8791	5380.54

TECH AREA III

Sandia National Laboratories
Bernalillo County, New Mexico
September, 2009

Survey Notes:

1.) Topsoil Layer data based on spot elevations surveyed by URS, June 2009.

2.) Elevations for this survey are based on SNL/KAFB Monument "LIM 35" with an NGVD 29 elevation of 5388.52'.

3.) Survey Control Coordinates are modified state plane (or "Ground"), based on New Mexico State Plane, Central Zone, North American Datum of 1927. A Combined Scale Factor of .999651675 was used to derive project coordinates. State Plane (or "Grid") values of Control Points Used:
LIM 34 (North= 1452943.37, East= 412014.33) and LIM 35 (North= 1451943.65, East= 412012.13)

4.) No surface appurtenances of underground utilities are shown. Other utilities may exist that are not shown on this survey. SNL ESD files were not incorporated into this survey.

5.) Distances shown are ground.

6.) This is not a boundary survey. No property corners or lines are shown.

7.) The 6 columned table titled "URS TOPSOIL LAYER QA SHOTS" compares URS survey data (columns 2&3), shot on the top of the Topsoil Layer with earlier URS survey data (columns 4&5), shot on the top of the Native Soil Layer. The FILL column shows the thickness of the Topsoil Layer above the Native Soil Layer.

7.) The tables titled "URS TOPSOIL LAYER TOP SHOTS" and "URS TOPSOIL LAYER TOE SHOTS" are shown for slope verification only. No thickness can be inferred from this data

8.) Survey was not collected by URS on grid points B2, E5.1, E6, E7, G2, I1, and I2 for the Topsoil Layer. See Figure 17 for Surveyed Verification Grid Points And Field Testing Grid Blocks Description.

SURVEYOR'S CERTIFICATION

I, KIM STELZER, NEW MEXICO PROFESSIONAL SURVEYOR No. 7482, HEREBY CERTIFY THAT A TOPOGRAPHIC SURVEY, AS SHOWN HEREON, HAS BEEN SURVEYED AND PLATTED IN ACCORDANCE WITH THE STANDARDS FOR TOPOGRAPHIC SURVEYS IN THE STATE OF NEW MEXICO, RULE 500.5, AND IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF. I FURTHER CERTIFY THAT THIS SURVEY AND PLAT DO NOT MEET THE REQUIREMENTS OF ANY (MUNICIPAL, COUNTY AND/OR STATE) SUBDIVISION ORDINANCES AND IS NOT INTENDED TO SUBDIVIDE ANY EXISTING PARCEL. THIS IS NOT A BOUNDARY SURVEY.

KIM STELZER 7482 N.M.P.S. No. 7482 — Dec. 29, 2009 DATE

NEW MEXICO REGISTERED PROFESSIONAL LAND SURVEYOR

URS
URS CORPORATION

P.O. OR W.O.	REV	DATE	DESCRIPTION	DWN	CKD	APP
PROJECT NO.						

U.S. DEPARTMENT OF ENERGY
KIRTLAND AREA OFFICE — ALBUQUERQUE, NEW MEXICO
ALBUQUERQUE, NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH, NEVADA

SNL/NM MIXED WASTE LANDFILL
Topsoil Layer

P.O. OR W.O.	
PROJECT NO.	
DRAWN BY	HFB
CHECKED BY	RDE
APPROVED BY	RDE
DATE	09/09
SIZE	Plate No: 3
SEQ.	1/1

SURVEY

FILE NAME: MWL-URS QA SURVEY-FINAL TOPSOIL LAYER EXHIBIT 9-28-2009.dwg

24342640\07 Design\Survey\Bio Intrusion Layer\dwg\MWL-MWL-URS QA SURVEY-FINAL TOPSOIL LAYER EXHIBIT 9-28-2009.dwg

Photographic Logs

Log No. 1

Mixed Waste Landfill
2006 Subgrade Construction Photographic Log

	Date: 06/14/06 Time: 1457 Photo Taken by: Dave Ransbarger Description: MWL Borrow Pit Area site preparation Facing: South
	Date: 06/14/06 Time: 1457 Photo Taken by: Dave Ransbarger Description: MWL Borrow Area site preparation Facing: South-Southwest
	Date: 06/14/06 Time: 1457 Photo Taken by: Dave Ransbarger Description: Excavating soils for screening to 2-inch minus Facing: North-Northeast

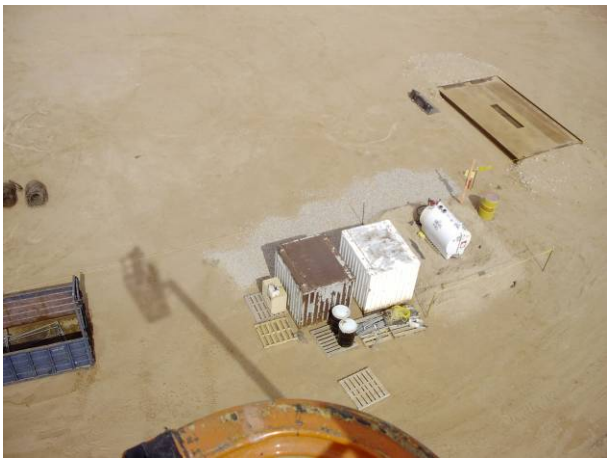
	Date: 06/15/06 Time: 1029 Photo Taken by: Dave Ransbarger Description: Screening soils to 2-inch minus at the MWL Borrow Pit Area Facing: South-Southwest
	Date: 06/15/06 Time: 1029 Photo Taken by: Dave Ransbarger Description: Excavated soils stockpiled at the MWL Borrow Pit Area Facing: North
	Date: 06/15/06 Time: 1029 Photo Taken by: Dave Ransbarger Description: Screening soils to 2-inch minus at the MWL Borrow Pit Area Facing: Southwest

	Date: 06/15/06 Time: 1029 Photo Taken by: Dave Ransbarger Description: Screening soils at the MWL Borrow Pit Area Facing: South
	Date: 06/19/06 Time: 1511 Photo Taken by: Dave Ransbarger Description: Screening soils to 2-inch minus at the MWL Borrow Pit Area Facing: North-northeast
	Date: 06/19/06 Time: 1511 Photo Taken by: Dave Ransbarger Description: Excavating soils at the MWL Borrow Pit Area Facing: Northeast

	Date: 06/20/06 Time: 1427 Photo Taken by: Dave Ransbarger Description: Berm around the MWL Borrow Pit Area Facing: North-northeast
	Date: 06/20/06 Time: 1427 Photo Taken by: Dave Ransbarger Description: Berm around the MWL Borrow Pit Area Facing: Northeast
	Date: 06/20/06 Time: 1428 Photo Taken by: Dave Ransbarger Description: Berm around the MWL Borrow Pit Area Facing: East

	Date: 06/27/06 Time: 1509 Photo Taken by: Dave Ransbarger Description: Berm around the MWL Borrow Pit Area Facing: Northeast
	Date: 06/27/06 Time: 1511 Photo Taken by: Dave Ransbarger Description: Berm around the MWL Borrow Pit Area Facing: East
	Date: 06/27/06 Time: 1511 Photo Taken by: Dave Ransbarger Description: Screened soil stockpile at the MWL Borrow Pit Area Facing: East

	Date: 06/27/06 Time: 1515 Photo Taken by: Dave Ransbarger Description: Berm around the MWL Borrow Pit Area Facing: North-northeast
	Date: 06/28/06 Time: 1622 Photo Taken by: Dave Ransbarger Description: MWL Borrow Pit Area after rain Facing: North-northeast
	Date: 06/28/06 Time: 1622 Photo Taken by: Dave Ransbarger Description: MWL Borrow Pit Area after rain Facing: North

	Date: 10/02/06 Time: 1516 Photo Taken by: Dave Ransbarger Description: Overhead view of MWL prior to site work Facing: North-northeast
	Date: 10/02/06 Time: 1517 Photo Taken by: Dave Ransbarger Description: Screened soil stockpile at MWL Facing: East
	Date: 10/02/06 Time: 1517 Photo Taken by: Dave Ransbarger Description: Overhead view of staging area at MWL Facing: Northeast

	Date: 10/02/06 Time: 1007 Photo Taken by: Dave Ransbarger Description: Removal of fence around unclassified area. Facing: Southeast
	Date: 10/04/06 Time: 1328 Photo Taken by: Dave Ransbarger Description: Removing fenceposts around unclassified area Facing: North-northeast
	Date: 10/04/06 Time: 1551 Photo Taken by: Dave Ransbarger Description: Removal of vegetation in unclassified area Facing: East

	Date: 10/04/06 Time: 1551 Photo Taken by: Dave Ransbarger Description: Dust control Facing: Southeast
	Date: 10/05/06 Time: 1511 Photo Taken by: Dave Ransbarger Description: Clearing and grubbing existing surface, unclassified area Facing: East-southeast
	Date: 10/05/06 Time: 1511 Photo Taken by: Dave Ransbarger Description: Clearing and grubbing existing surface Facing: East-southeast

	Date: 10/05/06 Time: 1512 Photo Taken by: Dave Ransbarger Description: Progress at end of day Facing: Southeast
	Date: 10/05/06 Time: 1512 Photo Taken by: Dave Ransbarger Description: Overhead view of existing surface after clearing/grubbing Facing: Northeast
	Date: 10/11/06 Time: 1553 Photo Taken by: Dave Ransbarger Description: Removal of fence around classified area. Facing: South-southwest

	Date: 10/11/06 Time: 1553 Photo Taken by: Dave Ransbarger Description: Pulling fenceposts around classified area Facing: South
	Date: 10/11/06 Time: 1553 Photo Taken by: Dave Ransbarger Description: Hauling fence material to staging area for radiological screening Facing: East
	Date: 10/11/06 Time: 1553 Photo Taken by: Dave Ransbarger Description: Soil subsidence above a classified area pit before backfilling and compacting to grade Facing: East

	Date: 10/12/06 Time: 1542 Photo Taken by: Dave Ransbarger Description: Cutting fenceposts from concrete Facing: North
	Date: 10/12/06 Time: 1542 Photo Taken by: Dave Ransbarger Description: Screening grubbed material from classified area Facing: South
	Date: 10/12/06 Time: 1542 Photo Taken by: Dave Ransbarger Description: Overhead view of screening/staging grubbed material Facing: Northeast

	Date: 10/18/06 Time: 1624 Photo Taken by: Dave Ransbarger Description: Overhead view of fence material staging area Facing: North
	Date: 10/18/06 Time: 1624 Photo Taken by: Dave Ransbarger Description: Breaking up concrete pad in SE corner of classified area Facing: Southeast
	Date: 10/18/06 Time: 1624 Photo Taken by: Dave Ransbarger Description: Monitoring radiological conditions at concrete pad, southeast corner of classified area Facing: East

	Date: 10/18/06 Time: 1624 Photo Taken by: Dave Ransbarger Description: Soil subsidence above a classified area pit after removal of concrete cap before backfilling and compacting to grade Facing: East
	Date: 10/18/06 Time: 1625 Photo Taken by: Dave Ransbarger Description: Removal of concrete cap in SE corner of classified area Facing: South
	Date: 10/18/06 Time: 1625 Photo Taken by: Dave Ransbarger Description: Area of soil subsidence in classified area after backfilling and compacting to grade Facing: Southwest

	Date: 10/23/06 Time: 1608 Photo Taken by: Dave Ransbarger Description: Fence material staging area Facing: East
	Date: 10/23/06 Time: 1608 Photo Taken by: Dave Ransbarger Description: Completion of screening and shredding material grubbed from existing surface Facing: East
	Date: 10/25/06 Time: 0859 Photo Taken by: Dave Ransbarger Description: Overhead view of existing surface after completion of clearing/grubbing Facing: North-northeast

	Date: 10/25/06 Time: 0859 Photo Taken by: Dave Ransbarger Description: Performing Existing Landfill Surface and Perimeter Clear and Grub inspection. Facing: East
	Date: 10/30/06 Time: 1618 Photo Taken by: Dave Ransbarger Description: Placement of subgrade material in low-lying areas of unclassified area, Lift 1. Facing: West
	Date: 10/30/06 Time: 1619 Photo Taken by: Dave Ransbarger Description: Placement of stakes by URS for elevation reference in low-lying areas. Facing: North

	Date: 10/31/06 Time: 1554 Photo Taken by: Dave Ransbarger Description: Performing compaction testing, Lifts 2 and 3. Facing: Northwest
	Date: 10/31/06 Time: 1555 Photo Taken by: Dave Ransbarger Description: Compaction of subgrade material, Lift 3. Facing: Northeast

	Date: 11/01/06 Time: 1717 Photo Taken by: Dave Ransbarger Description: Placement of subgrade material in low-lying areas of northern unclassified area, Lift 5. Facing: West
	Date: 11/01/06 Time: 1717 Photo Taken by: Dave Ransbarger Description: Placement of subgrade to elevation marked by surveyors, Lift 5. Facing: Southwest
	Date: 11/02/06 Time: 1627 Photo Taken by: Dave Ransbarger Description: Placement of subgrade material in low-lying areas of central unclassified area, Lift 6. Facing: North-northeast

	Date: 11/06/06 Time: 1716 Photo Taken by: Dave Ransbarger Description: Continued placement of subgrade material, Lift 8. Facing: Northeast
	Date: 11/06/06 Time: 1716 Photo Taken by: Dave Ransbarger Description: Installing subgrade, Lift 8. Facing: Northeast
	Date: 11/07/06 Time: 1552 Photo Taken by: Dave Ransbarger Description: Performing compaction tests, Lift 9. Facing: Northwest

	Date: 11/07/06 Time: 1552 Photo Taken by: Dave Ransbarger Description: Screened subgrade material stockpile. Facing: East
	Date: 11/07/06 Time: 1552 Photo Taken by: Dave Ransbarger Description: Placement of subgrade material, Lift 9. Facing:
	Date: 11/07/06 Time: 1552 Photo Taken by: Dave Ransbarger Description: Installing subgrade, Lift 9. Facing: East-Southeast

	Date: 11/08/06 Time: 1723 Photo Taken by: Dave Ransbarger Description: Compacting subgrade material, Lift 10. Facing: Southwest
	Date: 11/08/06 Time: 1723 Photo Taken by: Dave Ransbarger Description: Installing and compacting subgrade material, Lift 10. Facing: Northeast
	Date: 11/08/06 Time: 1725 Photo Taken by: Dave Ransbarger Description: Progress at end of day. Facing: North-northeast

	Date: 11/09/06 Time: 1647 Photo Taken by: Dave Ransbarger Description: Continued placement of subgrade material, Lift 10. Facing: East
	Date: 11/09/06 Time: 1647 Photo Taken by: Dave Ransbarger Description: Continued placement of subgrade material, Lift 10. Facing: Northeast
	Date: 11/09/06 Time: 1647 Photo Taken by: Dave Ransbarger Description: Loose lift to elevation marked by surveyors. Facing: North

	Date: 11/13/06 Time: 1742 Photo Taken by: Dave Ransbarger Description: Continued placement of subgrade material, Lift 10. Facing: South
	Date: 11/13/06 Time: 1742 Photo Taken by: Dave Ransbarger Description: Progress at end of day. Facing: North
	Date: 11/15/06 Time: 1710 Photo Taken by: Dave Ransbarger Description: Installation of subgrade material, Lift 11. Facing: East-northeast

	Date: 11/15/06 Time: 1711 Photo Taken by: Dave Ransbarger Description: Installation of subgrade material, Lift 11. Facing: East-Northeast
	Date: 11/16/06 Time: 1716 Photo Taken by: Dave Ransbarger Description: Finished surface, Classified Area Lift 11. Facing: North
	Date: 11/20/06 Time: 1648 Photo Taken by: Dave Ransbarger Description: Screened subgrade material stockpile. Facing: East

	Date: 11/21/06 Time: 1824 Photo Taken by: Dave Ransbarger Description: Installation of subgrade material, Lift 11. Facing: East
	Date: 11/22/06 Time: 1312 Photo Taken by: Dave Ransbarger Description: Subgrade material stockpile. Facing: East
	Date: 11/22/06 Time: 1313 Photo Taken by: Dave Ransbarger Description: Overhead view of unclassified area, Lift 11. Facing: North-northeast

	Date: 11/28/06 Time: 1727 Photo Taken by: Dave Ransbarger Description: Completed Lift 11 surface. Facing: Northeast
	Date: 11/28/06 Time: 1727 Photo Taken by: Dave Ransbarger Description: Beginning installation of Lift 12. Facing: East-northeast
	Date: 11/29/06 Time: 1703 Photo Taken by: Dave Ransbarger Description: Stockpile of soil existing prior to field operations, soil not used as subgrade. Facing: Southeast

Date: 11/29/06 Time: 1703

Photo Taken by: Dave Ransbarger

Description: Hauling subgrade for placement in Lift 12.

Facing: Southeast

	Date: 12/04/06 Time: 1712 Photo Taken by: Dave Ransbarger Description: Placement of Subgrade material, Lift 12. Facing: Northeast
	Date: 12/04/06 Time: 1457 Photo Taken by: Dave Ransbarger Description: Installation of Subgrade, Lift 12 Facing: North
	Date: 12/18/06 Time: 1650 Photo Taken by: Dave Ransbarger Description: Overhead view, final surface of Subgrade Lift 12 prior to final grading Facing: North

	Date: 12/20/06 Time: 1046 Photo Taken by: Dave Ransbarger Description: No personnel on site due to snow, material too wet to perform final grading. Facing: South
	Date: 12/20/06 Time: 1046 Photo Taken by: Dave Ransbarger Description: No personnel on site due to snow, material too wet to perform final grading. Facing: Northeast

	Date: 01/30/07 Time: 1527 Photo Taken by: Dave Ransbarger Description: Erosion of Subgrade slopes following snow melt. Facing: East
	Date: 01/30/07 Time: 1528 Photo Taken by: Dave Ransbarger Description: Erosion of Subgrade slopes following snow melt. Facing: Southeast
	Date: 01/30/07 Time: 1529 Photo Taken by: Dave Ransbarger Description: Erosion of Subgrade slopes following snow melt. Facing: East

	Date: 04/03/07 Time: 1233 Photo Taken by: Dave Ransbarger Description: Installation of erosion control blanket. Facing: Northwest
	Date: 04/03/07 Time: 1233 Photo Taken by: Dave Ransbarger Description: Anchor trench for erosion control blanket. Facing: West
	Date: 04/03/07 Time: 1233 Photo Taken by: Dave Ransbarger Description: Installing staple to hold erosion control blanket in place Facing: Northeast

Log No. 2

Mixed Waste Landfill
2009 Evapotranspirative Cover Construction
Photographic Log

	Date: 05/18/09 Time: 1445 Photo Taken by: C. M. Timm II Description: Silt Fence Installation Facing: South
	Date: 05/20/09 Time: 0740 Photo Taken by: C. M. Timm II Description: MWL Subgrade before 2009 clearing and preparation activities Facing: South
	Date: 05/20/09 Time: 1443 Photo Taken by: C. M. Timm II Description: Removal of vegetation from the Subgrade surface Facing: North

	Date: 05/22/09 Time: 0826 Photo Taken by: C. M. Timm Description: In-situ density and moisture tests of Subgrade Facing: South
	Date: 05/22/09 Time: 0740 Photo Taken by: C. M. Timm Description: MWL Subgrade after vegetation was removed and prior to placement of the Biointrusion Layer rock Facing: North

	Date: 05/26/09 Time: 1150 Photo Taken by: C. M. Timm Description: Placement of Biointrusion Layer installation test Facing: Southwest
	Date: 05/26/09 Time: 1151 Photo Taken by: C. M. Timm Description: Surveying the biointrusion rock layer during installation test to verify thickness Facing: Southwest
	Date: 05/26/09 Time: 1159 Photo Taken by: C. M. Timm Description: Compacting thin soil layer over Biointrusion Layer during installation test to determine effectiveness of installation approach to fill rock void Facing: Northeast

Date: 05/28/09 Time: 0834

Photo Taken by: C. M. Timm

Description: Start of Biointrusion Layer rock installation – south-central part of MWL

Facing: Southwest

Date: 05/28/09 Time: 1517

Photo Taken by: C. M. Timm

Description: Biointrusion Layer rock placed on Subgrade surface and spread by bulldozer

Facing: South

Date: 05/28/09 Time: 0733

Photo Taken by: C. M. Timm

Description: Close up of biointrusion rock placed on Subgrade

Facing: South

	Date: 06/1/09 Time: 1026 Photo Taken by: C. M. Timm Description: Surveyor recording elevation of the Biointrusion Layer during installation to check and control thickness Facing: East
	Date: 06/2/09 Time: 0741 Photo Taken by: C. M. Timm Description: View of MWL during installation of Biointrusion Layer – MWL partially covered with ~1.25 feet of biointrusion rock Facing: North
	Date: 06/03/09 Time: 0758 Photo Taken by: C. M. Timm Description: Delivery of biointrusion rock by dump trucks and spreading with bulldozer near northwest end of MWL Facing: Southwest

	Date: 06/08/09 Time: 0727 Photo Taken by: C. M. Timm Description: Biointrusion rock layer over the Subgrade except the for northeast corner (classified area) Facing: North
	Date: 06/12/09 Time: 1421 Photo Taken by: J. Schermerhorn Description: Biointrusion Layer installation completed in the northeast corner (classified area) – thin soil layer installation over the Biointrusion Layer proceeding over northeast corner Facing: Northeast

	Date: 06/08/09 Time: 0941 Photo Taken by: J. Schermerhorn Description: Spreading the thin soil layer over the Biointrusion Layer with the grader to fill in voids and make a level surface Facing: Southwest
	Date: 06/09/09 Time: 0727 Photo Taken by: J. Schermerhorn Description: The southern half of the MWL covered with the thin soil layer overlying the Biointrusion layer Facing: North
	Date: 06/09/09 Time: 0738 Photo Taken by: J. Schermerhorn Description: Close up of the dry, loose soil filling voids in the upper part of the Biointrusion Layer Facing: South

	Date: 06/12/09 Time: 1305 Photo Taken by: J. Schermerhorn Description: Dry loose soil penetrating down into the rock layer filling the voids at the northwest corner Facing: Southeast
	Date: 06/12/09 Time: 1259 Photo Taken by: J. Schermerhorn Description: Biointrusion rock showing through the thin soil layer – location was scraped with the grader to make sure the overlying soil layer was as thin as possible Facing: Southwest
	Date: 06/17/09 Time: 0718 Photo Taken by: J. Schermerhorn Description: The completed thin soil layer overlying the Biointrusion Layer before installation of the Native Soil Layer – view of northeast corner of MWL – note steep side slopes Facing: Southwest

	Date: 06/17/09 Time: 0814 Photo Taken by: J. Schermerhorn Description: Soil compaction test (in-place density and moisture test) on east slope at the north end of the MWL during initial slope build up to 6 to 1 – first phase of Native Soil Layer installation Facing: Northwest
	Date: 06/18/09 Time: 1003 Photo Taken by: J. Schermerhorn Description: Building north end side slope of the cover during initial Native Soil Layer installation – survey stakes show extent of the slope (i.e., the toe) Facing: West

	Date: 06/18/09 Time: 1548 Photo Taken by: J. Schermerhorn Description: Survey stakes outlining area of Wedge Lift 1 Facing: South
	Date: 06/19/09 Time: 1050 Photo Taken by: J. Schermerhorn Description: Compacting placed material in Wedge Lift 1 Facing: South
	Date: 06/19/09 Time: 0750 Photo Taken by: J. Schermerhorn Description: Aerial picture of construction of Wedge Lift 1 – water truck adding moisture to soil and grader spreading the soil fill to the proper thickness Facing: Southeast

	Date: 06/23/09 Time: 1136 Photo Taken by: J. Schermerhorn Description: Constructing Lift 3 – grading lift to proper thickness based on survey grade stakes Facing: South
	Date: 06/23/09 Time: 0742 Photo Taken by: J. Schermerhorn Description: Adding water to placed soil fill material on west side of cover for Lift 4. Facing: Southwest
	Date: 06/25/09 Time: 1412 Photo Taken by: J. Schermerhorn Description: Compacting soil material during Lift 4 installation Facing: Southeast

	Date: 06/24/09 Time: 0731 Photo Taken by: J. Schermerhorn Description: Aerial picture of Native Soil Lift 3 construction Facing: South
	Date: 06/29/09 Time: 1358 Photo Taken by: J. Schermerhorn Description: Compacting soil around the extended groundwater monitoring well MWL-MW4 with a manually-operated compactor during Native Soil Lift 4 construction Facing: Northeast
	Date: 07/07/09 Time: 1604 Photo Taken by: J. Schermerhorn Description: Adding water to increase the moisture to Lift 5 soil (grid blocks 1 and 2) after area ripped with grader scarifier shanks to a depth of ~6 inches after initial field compaction tests failed for moisture content Facing: South

	Date: 07/15/09 Time: 0813 Photo Taken by: J. Schermerhorn Description: Soil being placed by bottom dump truck and graded during construction of Native Soil Lift 6 Facing: South
	Date: 07/15/09 Time: 0824 Photo Taken by: J. Schermerhorn Description: Adding water to soil during grading of Native Soil Lift 6 to bring the moisture content to within 2% of the optimal moisture Facing: North
	Date: 07/17/09 Time: 1337 Photo Taken by: J. Schermerhorn Description: Compacting Native Soil Lift 6 on the west slope – note groundwater monitoring wells in background (orange fencing surrounds them) Facing: Southwest

	Date: 07/20/09 Time: 0835 Photo Taken by: J. Schermerhorn Description: Grade stakes showing the thickness of soil to be placed for the next Native Soil Layer Lift (Lift 7) Facing: Northeast
	Date: 07/28/09 Time: 0835 Photo Taken by: J. Schermerhorn Description: Grade stakes after soil placed and compacted for native Soil Layer Lift 8 Facing: Northeast

	Date: 08/06/09 Time: 0924 Photo Taken by: J. Schermerhorn Description: Building the Topsoil Layer in one lift and applying water to moisture condition the soil and minimize dust generation Facing: South
	Date: 08/07/09 Time: 0921 Photo Taken by: J. Schermerhorn Description: Close up of the 3/8-inch gravel in the Topsoil Layer fill Facing: East- Northeast
	Date: 08/10/09 Time: 1401 Photo Taken by: J. Schermerhorn Description: Blue whiskers that indicate “blue topping” and final elevation of Topsoil Layer. Facing: South

	Date: 08/11/09 Time: 0657 Photo Taken by: J. Schermerhorn Description: MWL ET Cover after Topsoil Layer placement – final CQC and CQA survey verification of thickness and slopes completed Facing: Northeast
	Date: 08/12/09 Time: 0933 Photo Taken by: J. Schermerhorn Description: Scarifying the Topsoil Layer with the scarifier shanks on the grader after approval of thickness and slopes in preparation for seeding Facing: South
	Date: 08/12/09 Time: 1238 Photo Taken by: J. Schermerhorn Description: MWL ET Cover (Topsoil Layer surface) after scarifying and prior to seeding Facing: South

	Date: 08/20/09 Time: 1025 Photo Taken by: J. Schermerhorn Description: Tilling the soil prior to seed placement to break up any large clumps of soil Facing: West
	Date: 08/21/09 Time: 0850 Photo Taken by: J. Schermerhorn Description: Tilling to loosen the soil and help facilitate re-vegetation Facing: Southwest
	Date: 08/26/09 Time: 0953 Photo Taken by: J. Schermerhorn Description: Hand-broadcasting the seed according to the approved procedure to avoid compacting the soil with additional passes of the tractor/drill seeder to accommodate increased seeding rate – note supplemental watering irrigation pipe with sprinkler heads in photograph Facing: Northeast

Date: 08/26/09 Time: 1401

Photo Taken by: J. Schermerhorn

Description: Drill seeding on the north slope of the ET Cover

Facing: Southeast

Date: 08/28/09 Time: 0904

Photo Taken by: J. Schermerhorn

Description: Blowing straw mulch to cover the planted grass seed and help retain moisture in the soil.

Facing: Southeast

Date: 08/28/00 Time: 1024

Photo Taken by: J. Schermerhorn

Description: Crimping the straw mulch into the soil on the north slope of the ET Cover to keep it from blowing away

Facing: Southwest

	Date: 08/31/09 Time: 1443 Photo Taken by: J. Schermerhorn Description: MWL ET Cover after seeding and crimping the straw mulch in place – irrigation piping for the supplemental watering system visible in photograph Facing: North
	Date: 09/1/09 Time: 1148 Photo Taken by: J. Schermerhorn Description: Installing the T-posts for the barbed wire Administrative Security Fence around the site Facing: West
	Date: 09/02/09 Time: 1140 Photo Taken by: J. Schermerhorn Description: The barbed wire Administrative Security Fence and gate (background) on the north end of the ET Cover Facing: East

	Date: 05/27/09 Time: 1251 Photo Taken by: C. M. Timm Description: Groundwater monitoring well MWL-MW4 PVC casing being extended prior to installation of Biointrusion Layer on this part of the ET Cover – outer steel casing cut near ground surface (yellow) and white extended PVC well casing shown Facing: East
	Date: 05/27/09 Time: 1434 Photo Taken by: C. M. Timm Description: MWL-MW4 outer steel protective casing extended to accommodate the ET Cover thickness Facing: East

	Date: 08/05/09 Time: 1314 Photo Taken by: J. Schermerhorn Description: Installation of Soil-Vapor Well MWL-SV2 in the northeast corner of the MWL during Topsoil Layer installation prior to seeding and mulching Facing: East
	Date: 08/05/09 Time: 1303 Photo Taken by: J. Schermerhorn Description: Aerial picture of installation of Soil-Vapor Well MWL-SV2 Soil-Vapor Well MWL-SV2 Facing: Southeast
	Date: 08/06/05 Time: 1352 Photo Taken by: J. Schermerhorn Description: Installing Soil-Vapor Well MWL-SV2 Facing: Southeast

	Date: 08/06/09 Time: 1524 Photo Taken by: J. Schermerhorn Description: Installation of Soil-Vapor Well MWL-SV1 Facing: South
	Date: 08/07/09 Time: 0842 Photo Taken by: J. Schermerhorn Description: Installation of Soil-Vapor Well MWL-SV1 Facing: Southwest

	Date: 05/26/09 Time: 0843 Photo Taken by: C. M. Timm Description: Constructing the drive-off pad on the south side of the MWL Borrow Pit Facing: South
	Date: 06/30/09 Time: 1329 Photo Taken by: J. Schermerhorn Description: Loading native soil fill into a bottom-dump truck at the MWL Borrow Pit for transport to the MWL site Facing: South
	Date: 07/06/09 Time: 1333 Photo Taken by: J. Schermerhorn Description: Screening soil to 2-inch minus and stockpiling at the MWL Borrow Pit Facing: West

	Date: 07/09/09 Time: 0912 Photo Taken by: J. Schermerhorn Description: Pug Mill operation used to mix 3/8-inch gravel and topsoil fill at a 25% by volume ratio to produce the topsoil fill used to construct the Topsoil Layer of the ET Cover Facing: West
	Date: 07/15/09 Time: 0905 Photo Taken by: J. Schermerhorn Description: Pug Mill operation (background), native soil and topsoil excavation and screening to 2-inch minus (foreground), screened soil stockpiles, and native soil loading in bottom-dump trucks (background) for transport to MWL site Facing: Southeast
	Date: 08/20/09 Time: 1139 Photo Taken by: J. Schermerhorn Description: MWL Borrow Pit after completion of construction activities and grading to ensure proper drainage Facing: Southeast

	Date: 08/13/09 Time: 1508 Photo Taken by: J. Schermerhorn Description: MWL ET Cover with irrigation pipe installed for the supplemental watering system Facing: South
	Date: 08/18/09 Time: 0953 Photo Taken by: J. Schermerhorn Description: Testing of the supplemental watering system prior to seeding and mulching Facing: South
	Date: 09/10/09 Time: 1317 Photo Taken by: J. Schermerhorn Description: Close up of grass growing on the north slope of the cover Facing: West

	Date: 09/22/09 Time: 1108 Photo Taken by: J. Schermerhorn Description: MWL ET Cover with seed and mulch in place – grass seedling growth indicated by green areas Facing: South
	Date: 09/22/09 Time: 1110 Photo Taken by: J. Schermerhorn Description: Close up of grass seedling growth on surface of the ET Cover with the supplemental watering system in place Facing: Southeast

APPENDIX A

Mixed Waste Landfill Alternative Cover Construction Quality Assurance Report January 2010 Revision 1

Volume 2 Attachments

(provided electronically on compact disc)

Attachments in Volume 2 of Appendix A are provided in electronic format (PDF files) on a CD. Separately bound hard copies of Volume 2 are available in the NMED Hazardous Waste Bureau document library (Santa Fe, New Mexico); the DOE/Sandia document repository (Public Reading Room, Zimmerman Library at the University of New Mexico, Albuquerque, New Mexico); and the SNL/NM Customer Funded Records Center (formerly known as the ES&H and Security Records Center).

List of Attachments

Attachment	*Title*
1	Record of Meetings and Approvals
	2006 Meetings
	2009 Meetings
2	CQA Submittals and Approvals
	2009 QA Submittal Cover Pages
	2009 Cover Layer Approval Forms
3	Daily Quality Control Reports
	2006 Daily Quality Control Reports
	2009 Daily Quality Control Reports
4	Receiving Inspection Forms and Documentation
	2005 Biointrusion Rock
	2009 Biointrusion Rock
	2009 Aggregate
	2009 Seed and Mulch
	2009 Seed Bag Labels
5	Construction Inspection Forms
	2006 Construction Inspection Forms
	2009 Construction Inspection Forms
6	Testing Inspection Forms
	2006 Testing Inspection Forms
	2009 Testing Inspection Forms
7	Laboratory and Field Test Results and Supporting Data
	2006 Standard Proctor, Gradation, and Classification Tests
	2006 Density and Moisture Tests
	2009 Standard Proctor, Gradation, and Classification Tests
	2009 Density and Moisture Tests
	2009 Saturated Hydraulic Conductivity Tests
8	Summary Report for the Extension of Monitoring Well MWL-MW4 at the Mixed Waste Landfill

Volume III

TAB 13

Notice of Public Comment Period for Sandia National Laboratories Mixed Waste Landfill Corrective Measures Implementation Report, January 2010

From: NMED/Kieling
To: Interested Citizen

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BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

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Hazardous Waste Bureau

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RON CURRY
Secretary

SARAH COTTRELL
Deputy Secretary

PUBLIC NOTICE NO. 10-06

NEW MEXICO ENVIRONMENT DEPARTMENT
HAZARDOUS WASTE BUREAU
SANTA FE, NEW MEXICO
November 29, 2010

NOTICE OF PUBLIC COMMENT PERIOD FOR SANDIA NATIONAL LABORATORIES MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION REPORT

The federal Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §§ 6901 to 6992(k), provides for the regulation of hazardous waste. Congress waived the immunity of the federal government for actions brought under state hazardous and solid waste laws as well as under RCRA. Pursuant to Section 3006 of RCRA, 42 U.S.C § 6926, the U.S. Environmental Protection Agency (EPA) delegated to the New Mexico Environment Department (Department), on April 16, 1985 by delegation numbers 8-31 and 8-32, the authority to enforce the Hazardous Waste Act (HWA) and its implementing regulations, the New Mexico Hazardous Waste Management Regulations (HWMR), 20.4.1 NMAC, in lieu of EPA enforcement through RCRA. The Department has maintained its delegation from EPA over hazardous waste management in New Mexico and from time to time has amended its state program to conform to statutory or regulatory changes in RCRA. The HWMR requires corrective action at solid waste management units (SWMUs) where releases of hazardous waste or hazardous constituents have or may have occurred.

The U. S. Department of Energy, owner and operator, and Sandia Corporation, co-operator, (hereinafter referred to as the Permitees) have been issued a HWA Permit (Permit) for the Sandia National Laboratories (SNL) Facility, located in Bernalillo County, New Mexico, EPA ID# NM5890110518. The Permittees must comply with the HWA, the HWMR, and the Permit, all of which require that Permittees to conduct corrective action as necessary to protect human health and the environment.

On May 26, 2005, the Department Secretary issued a final permit modification and ordered a final remedy for SNL's Mixed Waste Landfill. As part of these actions, the Permittees were required to submit to the Department a Corrective Measures Implementation (CMI) Report. The CMI Report, dated January 26, 2010, was received by the Department on January 28, 2010.

Pursuant to the Secretary's order, the Department is seeking public comment on the CMI Report prior to final action on the CMI Report.

LOCATION OF THE SNL FACILTY AND THE MWL

The Permittees are located at the following addresses: SNL, 1515 Eubank SE, Albuquerque, NM, 87123; and NNSA/DOE, Sandia Site Office, KAFB-East, Pennsylvania & H Street, Albuquerque, NM 87116. The Permittee's primary contact for this action is Mr. John Gould, NNSA/Sandia Site Office, DOE, at P.O. Box 5400, Albuquerque, NM 87185.

SNL is located within the boundaries of Kirtland Air Force Base (KAFB), south of Albuquerque in Bernalillo County, New Mexico. KAFB occupies 52,233 acres. The SNL research and administration facilities occupy 2,842 acres and are divided into five Technical Areas (TAs), (designated 1 through 5) and several test areas. TA-1, TA-2, and TA-4 are separate research facilities in the north-central portion of KAFB. TA-3 and TA-5 are contiguous research facilities forming a 4.5-square-mile rectangular area in the southwestern portion of KAFB. TA-3 alone encompasses 2,000 acres.

The MWL is located approximately 5 miles southeast of the Albuquerque International Sunport and 4 miles south of TA-1. The MWL occupies 2.6 acres in the north-central portion of TA-3.

FACILITY OPERATIONS

SNL, in operation since 1945, is engaged in research and development of conventional and nuclear weapons, alternative energy sources, and a wide variety of national security related research and development. As a result of these activities, SNL has generated hazardous, radioactive, mixed (those wastes containing both hazardous and radioactive components), and solid wastes. From 1945 to 1988 most of these wastes were disposed of at SNL at numerous locations, which have been classified by the NMED as Solid Waste Management Units (SWMUs) or Areas of Concern (AOCs). The SWMUs and AOCs include unpermitted landfills, septic-system drainfields and seepage pits, outfalls, waste piles, and test areas. Past waste management activities at SNL have caused the release of hazardous and radioactive contaminants into the environment. The MWL is designated as SWMU 76.

DESCRIPTION AND HISTORY OF THE MIXED WASTE LANDFILL

The MWL was opened as the "TA-3 low-level radioactive waste dump" in March 1959. The MWL accepted low-level radioactive waste and mixed waste from SNL research facilities and off-site generators from March 1959 to December 1988. Approximately 100,000 cubic feet of radioactive waste containing 6,300 curies (Ci) of activity (at the time of disposal) were disposed of at the MWL in unlined trenches and pits.

Investigations at the landfill indicate that tritium is the primary contaminant that has been released from the landfill. Results of a risk assessment prepared by the Permittees indicate that releases of contaminants from the MWL pose little risk to human health or the environment under an industrial land use scenario. Tritium activities at the MWL will decrease steadily with time due to its relatively short half-life of 12.3 years. Because of tritium's short half-life and in

consideration of current activity levels, the Department believes that tritium releases at the MWL does not pose a threat to groundwater, human health, or the environment.

REGULATORY BACKGROUND

The Department issued a HWA Permit for storage of hazardous waste at SNL on August 6, 1992. On February 6, 2002, the Permittees applied to the Department to renew their HWA permit. That application is pending. The existing permit remains in effect until final action is taken on the renewal request. On October 11, 2001, the Department directed the Permittees to conduct a Corrective Measures Study (CMS) to evaluate a range of alternatives for a final remedy for the MWL. The CMS Work Plan was approved with conditions by the Department on October 10, 2002.

After approval of the CMS Work Plan, a CMS was conducted by the Permittees to identify, develop, and evaluate corrective measures alternatives and recommend a final remedy for at the MWL. The results of the CMS were documented in a CMS Report; the report was received by the Department on May 21, 2003. The CMS Report was deemed complete by the Department on January 5, 2004.

On January 23, 2004, the Permittees requested a Class 3 modification of the Permit, and that the Department select a final remedy for the MWL. During the 60-day public comment period initiated by the Permittees, a public meeting concerning the CMS Report and the Permittees' preferred remedy was held on February 26, 2004 in Albuquerque, New Mexico. Following completion of the Permittees' public comment period, the Department issued a public notice and began an additional public comment period starting August 11, 2004. The Department's public notice was accompanied by a Statement of Basis which explained in detail the Department's proposed remedy.

A public hearing on the selection of a final remedy for the MWL was held by the Department on December 2-3 and 8-9, 2005; the Department's public comment period was held from August 11, 2004 to December 2, 2004, and extended until December 9, 2005, the conclusion of the public hearing. Based on the administrative record and the Hearing Officer's Report, on May 26, 2005, the Department Secretary approved a modification to the Permit that included a final remedy for SNL's Mixed Waste Landfill -- a vegetative soil cover with bio-intrusion barrier as the final remedy. The Secretary's order requires that interested member of the public be afforded the opportunity to review and comment on the CMI Report prior to the Department taking final action on it.

On December 22, 2008, the Department approved with conditions the MWL CMI Plan (dated November 2005), which in particular describes construction specifications for the installation of the vegetative soil cover with bio-intrusion barrier. The purpose of the CMI Report is to provide information on the actual construction of the cover so that the Department can assess whether the cover was constructed substantially in compliance with the approved CMI Plan. Section VII.D.5.a of the SNL Compliance Order on Consent (April 29, 2004) lists the major components of what must be included in the CMI Report.

PUBLIC REVIEW OF THE CMI REPORT

The CMI Report may be reviewed by any member of the public at the following locations during the public comment period:

NMED – Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
(505) 476-6000
Monday - Friday from 8:00 a.m. to 5:00 p.m.
Contact: *Pam Allen*

NMED-District 1 Albuquerque Office
5500 San Antonio NE
Albuquerque, New Mexico 87109
(505) 222-9551
Monday - Friday from 8:00 a.m. to 4:30 p.m.
Contact: *William Moats*

The CMI Report is also available electronically on the Department website at: http://www.nmenv.state.nm.us/hwb/snlperm.html#MWLCMIReport. To obtain a copy of the CMI Report or a portion thereof, in addition to further information, please contact Mr. John Kieling at (505) 476-6000, or at the Santa Fe address given above. The Department will provide copies, or portions thereof, of the CMI Report, at a cost to the requestor.

NMED issues this public notice on **November 29, 2010** to announce the beginning of a 60-day comment period on the CMI Report that will end at **5:00 p.m. MST, January 28, 2011**. Any person who wishes to comment should submit written or electronic mail (e-mail) comment(s) with the commenter's name and address to the respective address below. Only comments submitted in this manner and received on or before **5:00 p.m. MST, January 28, 2011** will be considered.

John E. Kieling, Program Manager
Hazardous Waste Bureau - New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303
Ref: Sandia National Laboratories – MWL CMI Report
E-mail: john.kieling@state.nm.us

All written comments submitted during the public comment period will become part of the administrative record, will be considered prior to the Department taking final action on the CMI Report. The Department will respond in writing to all written public comment received during the public comment period. The Department will notify all persons providing written comments, and post its response on the Department's website.

The Department's final action will be made publicly available. The Department will provide notice to the Permittees by certified mail of the final action. All persons on the mailing list, or that provided written comments, or who requested notification in writing, will be notified of the final action.

PUBLIC MEETING

The Department will hold a public meeting on **December 14, 2010** from **6:00 p.m. to 8:00 p.m.** MST at the **Cesar Chavez Community Center**, 7505 Kathryn SE, in Albuquerque. The Department is holding the public meeting for the purposes of providing information to interested members of the public, fielding questions from interested members of the public, and listening to concerns and comments about the CMI Report. The meeting will not be recorded, and oral comments made will not be responded to. Persons may submit written comments on the CMI Report at the meeting, and those will be responded to as explained above.

ARRANGEMENTS FOR PERSONS WITH DISABILITIES

Persons having a disability and requiring assistance or auxiliary aid to participate in this process should contact Judy Bentley at the New Mexico Environment Department, Human Resources Bureau, P.O. Box 5469, 1190 St. Francis Drive, Santa Fe, New Mexico, 87502, telephone number: (505) 827-9872. TDY users please access her number via the New Mexico Relay Network at 1-800-659-8331.

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TAB 14

Extension of Public Comment Period for Sandia National Laboratories Mixed Waste Landfill Corrective Measures Implementation Report, January 2010

From: NMED/Kieling
To: Interested Citizen

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NEW MEXICO
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Governor

JOHN A. SANCHEZ
Lieutenant Governor

DAVE MARTIN
Secretary

RAJ SOLOMON, P.E.
Deputy Secretary

PUBLIC NOTICE NO. 11-01

NEW MEXICO ENVIRONMENT DEPARTMENT
HAZARDOUS WASTE BUREAU
SANTA FE, NEW MEXICO
January 28, 2011

EXTENSION OF PUBLIC COMMENT PERIOD
FOR SANDIA NATIONAL LABORATORIES MIXED WASTE LANDFILL
CORRECTIVE MEASURES IMPLEMENTATION REPORT

This is a notice extending the period for submission of public comments on Sandia National Laboratories' (SNLs) Mixed Waste Landfill (MWL) Corrective Measures Implementation (CMI) Report. On November 29, 2010, the New Mexico Environment Department (NMED) issued an initial public notice to submit public comment by January 28, 2011. Since issuance of that initial notice, NMED has received requests to extend the public comment period.

The public comment period is being extended and NMED will now receive comments through **5:00 p.m. MST, February 28, 2011.**

The CMI Report, dated January 26, 2010, was received by the Department on January 28, 2010. Pursuant to the Secretary's order on the final remedy the Department is seeking public comment on the CMI Report prior to final action on the CMI Report.

PUBLIC REVIEW OF THE CMI REPORT

The CMI Report may be reviewed by any member of the public at the following locations during the public comment period:

NMED – Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
(505) 476-6000
Monday - Friday from 8:00 a.m. to 5:00 p.m.
Contact: *Pam Allen*

NMED-District 1 Albuquerque Office
5500 San Antonio NE
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Contact: *William Moats*

The CMI Report is also available electronically on the Department website at: http://www.nmenv.state.nm.us/hwb/snlperm.html#MWLCMIReport. To obtain a copy of the CMI Report or a portion thereof, in addition to further information, please contact Mr. John Kieling at (505) 476-6000, or at the Santa Fe address given above. The Department will provide copies, or portions thereof, of the CMI Report, at a cost to the requestor.

NMED issues this public notice on **January 28, 2011** to announce the extension of the comment period on the CMI Report that will end at **5:00 p.m. MST, February 28, 2011**. Any person who wishes to comment should submit written or electronic mail (e-mail) comment(s) with the commenter's name and address to the respective address below. Only comments submitted in this manner and received on or before **5:00 p.m. MST, February 28, 2011** will be considered.

John E. Kieling, Program Manager
Hazardous Waste Bureau - New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303
Ref: Sandia National Laboratories – MWL CMI Report
E-mail: john.kieling@state.nm.us

All written comments submitted during the public comment period will become part of the administrative record, will be considered prior to the Department taking final action on the CMI Report. The Department will respond in writing to all written public comment received during the public comment period. The Department will notify all persons providing written comments, and post its response on the Department's website.

The Department's final action will be made publicly available. The Department will provide notice to the Permittees by certified mail of the final action. All persons on the mailing list, or that provided written comments, or who requested notification in writing, will be notified of the final action.

ARRANGEMENTS FOR PERSONS WITH DISABILITIES

Persons having a disability and requiring assistance or auxiliary aid to participate in this process should contact Judy Bentley at the New Mexico Environment Department, Human Resources Bureau, P.O. Box 5469, 1190 St. Francis Drive, Santa Fe, New Mexico, 87502, telephone number: (505) 827-9872. TDY users please access her number via the New Mexico Relay Network at 1-800-659-8331.

Volume III

TAB 15

NOD: Mixed Waste Landfill Corrective Measures

Implementation Report, January 2010

From: NMED/Kieling
To: SNL/Wagner

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NEW MEXICO ENVIRONMENT DEPARTMENT

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Lieutenant Governor

DAVE MARTIN
Secretary

RAJ SOLOMON, P.E.
Deputy Secretary

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

May 20, 2011

Patty Wagner
Manager
U. S. Department of Energy
NNSA/Sandia Site Office
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

S. Andrew Orrell
Director
Nuclear Energy & Fuel Cycle Programs
Sandia National Laboratories
P.O. Box 5800, MS 0771
Albuquerque, NM 87185-0771

RE: NOTICE OF DISAPPROVAL
MIXED WASTE LANDFILL
CORRECTIVE MEASURES IMPLEMENTATION REPORT, JANUARY 2010
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-10-005

Dear Ms. Wagner and Mr. Orrell:

The New Mexico Environment Department (NMED) has reviewed the *Mixed Waste Landfill Corrective Measures Implementation Report*, dated January 2010, and submitted on January 26, 2010 by the U. S. Department of Energy on behalf of itself and Sandia Corporation (collectively, the Permittees). This Notice of Disapproval (NOD) is issued to the Permittees with the intent that the Permittees address the deficiencies identified herein.

1. **Construction Quality Assurance (CQA) During Subgrade Layer Construction**
The Corrective Measures Implementation (CMI) Report, Section 2.2, second paragraph, first sentence states: "During the 2006 Subgrade Construction phase, the CQA [Construction Quality Assurance] Team was responsible for all CQC [Construction Quality Control] data and CQA documentation requirements." Similarly, the first paragraph of Section 2.6 of Appendix A of the CQA Report states: "The CQA personnel roles and responsibilities were generally the same for both the 2006 and 2009 construction phases. However, some differences between the two construction phases reflect a more robust CQC and CQA program for the 2009 ET [Evapotranspiration] Cover Construction phase (i.e., construction of the Biointrusion, Native Soil, and Topsoil

Layers)." The subsequent paragraph states "During the 2006 Subgrade Construction phase, the CQA Team was responsible for all CQC laboratory testing (i.e., Standard Proctor, Gradation, and Classification soil data), field testing (i.e., in-place density and moisture testing), as well as associated oversight of the testing laboratory."

The "more robust" quality assurance/quality control (QA/QC) implementation during the 2009 construction phase was actually more in accordance with the CMI Plan (CMIP) than the 2006 Subgrade Layer construction because the project requirements for independent QA testing of the Subgrade Layer were evidently not done in 2006. For example, Paragraph 3.3.4 (6) of Section 02200 Earthwork specification (Corrective Measures Implementation Plan [CMIP], Appendix A) indicates that "the Contractor shall perform field-testing of the compacted fill" and "the Contractor shall submit test results to the CQA Engineer and Operator for approval...." Section 3.4.1 of this Specification states: "the Contractor shall be responsible for the performance of all pre-acceptance and quality control testing." However, the fourth bullet of Section 2.6.2 of the CQA Plan (Appendix B of the CMIP) states that "CQA testing will be conducted at a frequency of at least 5 percent (%) of that done by the Construction Contractor," which refers to testing by CQA Inspection personnel. Similarly, Section 5.1.2.3 of the CQA Plan states that "testing shall be performed at a minimum frequency of 5% of that done by the Construction Contractor" for the Subgrade Layer.

Similar language is also presented in the third paragraph of Section 4.0 of the CQA Report, where it is stated "In general, CQC and CQA data and documentation can be collected by either the Construction Team or the CQA Team or a combination of both." According to the CMIP Specifications and CQA Plan, this statement is not correct.

With regards to this issue, NMED notes reference to a different CQA Plan (May 2006) for the Subgrade Layer construction, but contends that a different CQA Plan should not diminish the project requirements of 5% CQA field testing for Subgrade Layer compaction and moisture content tests. Neither NMED conditional approval for the CMIP (December 2008), nor subsequent submittals (i.e., the CMIP replacement pages; Davis, February 2009) recognized a different CQA plan for the Subgrade Layer construction. However, NMED notes the efforts of the 2009 Contractor and CQA staff to re-condition, re-compact, and re-test (as well as re-survey) the upper surface of the Subgrade Layer during the subsequent 2009 construction phase.

Therefore, the fact that the Permittees did not conduct QC testing of the Subgrade Layer by the Contractor, and 5% independent QA testing by CQA personnel, should be documented as a nonconformance. As part of the resolution of this comment (i.e., documentation of the nonconformance), revise as appropriate the CMI Report and the CQA Report (Appendix A of the CMI Report).

2. **Hydraulic Conductivity Testing**

CQA Report, Section 4.3.1, Saturated Hydraulic Conductivity (ASTM Method D5856-95 [2007]): NMED agrees in general with the technical validity of the testing approach for hydraulic conductivity, and concurs that the results meet the performance specification of 4.6×10^{-4} centimeters per second (cm/s) or less. However, the sampling and testing approach do not appear to conform to the project Specifications, and a design change (Table 14) was not provided. It is evident that the Specifications in the CMIP intended for collection of *in situ* samples from the cover for hydraulic conductivity testing, rather than remolded samples (as was performed). Specifically, Paragraph 3.3.6(6) of the Section 02200 Earthwork specification states (regarding the Native Soil Layer):

> *Samples shall be obtained by means of a thin-walled sample tube or equivalent sampling device in a manner that minimizes disturbance to the lift and in the direction perpendicular to the plane of compaction. Samples shall be sealed and carefully stored to prevent drying during storage and transport. Hydraulic conductivity testing shall be performed in the laboratory according to ASTM specifications for rigid wall testing.*

Clearly the intent of the Specification was not to use remolded samples, although there is some lack of clarity because the ASTM method was not specified, and because the term "rigid wall" was used in the Specifications.

See also the June 16, 2009, Quality Resolution Meeting minutes discussion of ASTM D-5084 flexible wall sample (undisturbed) vs. ASTM D-5856 rigid wall (remolded sample) hydraulic conductivity testing. Furthermore, it is not clear what test methods were used for the hydraulic conductivity results that were reported. Re-evaluate the hydraulic conductivity requirements and testing performed, and provide documentation of this matter as a nonconformance. Revise as appropriate the CMI Report and the CQA Report.

3. **Equipment Lists.**

CQA Report, Section 5.2.1, 2nd paragraph and bullet list: Provide a more detailed equipment list for the 2006 Subgrade Layer work. Note the detail provided in Table 13 for the 2009 construction phase; make and model number of the 2006 earthwork equipment (or other indication of size) should be provided at a minimum. As an example illustrating this need, CQA Report, Table 14, first line, states that a smaller roller was used for landfill surface compaction than specified; however, there are no details of the actual equipment used in 2006.

4. **Stockpiled Volume of Native Soil**

CQA Report, Section 5.4, second paragraph, third sentence reads as follows: "Soil fill stockpiled at the Borrow Pit in 2006 based on CMIP estimates was not sufficient to complete construction of the Native Soil and Topsoil Layers." NMED suggests changing this sentence to read: "The quantity of soil fill stockpiled at the Borrow Pit..." to prevent

potential confusion regarding the sufficiency of quality of the stockpiled material, which was adequate for soil fill.

5. **Engineering Certification**

CQA Report, Section 9: It seems odd that the certification of the subgrade is dated August 31, 2007, but also states that their original MKM Engineers, Inc. CQA Report "has been incorporated into this report," which appears to refer to the current 2010 CQA Report. NMED notes also that the 2009 CQA Engineer certified both the Subgrade Layer and the overlying ET Cover, which is appropriate given the re-testing of the Subgrade surface and oversight of the ET Cover construction.

Provide clarification of the engineering certification. It may be more appropriate to include a copy of the original CQA Engineer subgrade certification, without modifying it to conform to the format of the current report.

6. **Hydraulic Conductivity Table**

CQA Report, Table 8, 4th column: NMED suggests changing the title of the 4th column to "Sample" Compaction (to avoid confusion with in-place cover compaction) to better describe that the hydraulic conductivity tests were apparently performed on samples that were remolded in the laboratory. With the current column heading one might make the erroneous assumption that 90% compaction was not achieved at all test locations on the cover. Also, regarding Footnote 1, change "Minimum" to "Maximum" with regards to the specified comparison criteria for hydraulic conductivity results.

7. **Disposition of Grubbed Vegetation**

Volume 2 of the CQA Report, Attachment 1, Record of Meeting for June 5, 2006: item 9 indicated "grubbed vegetation may contain tritium, and will be mulched and stored for placement with topsoil at a later time". Indicate whether the grubbed vegetation that was removed from the MWL surface in 2006 was tested. Indicate also if this vegetation contained tritium and the disposition of this material. Note the October 2, 2006 Record of Meeting, Item 2 which indicates "shredded brush will be stored for future reuse in covered containers." However, the material is not mentioned in the February 12, 2007 minutes which indicated the project would be mothballed and stabilized due to approval delays. The following statement is made in the CQA Report (Section 5.1, second paragraph, third sentence), but no backup was provided in the attachments: "The vegetation removed from the existing MWL surface and the perimeter area was shredded and containerized for future disposition. The material was sampled for radiological contamination and approved for reuse." Provide additional clarification and supporting documentation in the CMI Report concerning the management and disposition of the grubbed vegetation.

8. **Monitoring Well Extension**

CQA Report, Attachment 8, Figure 2-5, center of figure: "PVC Slip Coupling w/ Stainless Steel Screens" should read "PVC Slip Coupling w/Stainless Steel Screws".

Also in Attachment 8, Section 3, first bullet provides justification of the "double anchored" well resulting from not demolishing the original well pad. The Permittees should carefully monitor and observe the upper 10 feet of the interior casing during future sample events to monitor whether this arrangement causes damage to the well casing from potential settlement of underlying waste.

The Permittees must respond in writing to these comments by **August 19, 2011**. As part of the response letter that accompanies the revisions to the CMI Report (and CQA report), include a table that details where all revisions have been made and that cross-references NMED's numbered comments.

If you have any questions regarding this matter, please contact Mr. William Moats of my staff at (505) 222-9551.

Sincerely,

John E. Kieling
Acting Chief
Hazardous Waste Bureau

cc: W. Moats, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
J. Cochran, SNL, MS 0719
J. Gould, DOE, MS 0184
File: SNL 2011 and Reading

Volume III

TAB 16

NMED Response to Public Comments Regarding the Mixed Waste Landfill Corrective Measures Implementation Report, January 2010

From: NMED/Kieling
To: SNL/Wagner

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Lieutenant Governor

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DAVE MARTIN
Secretary

RAJ SOLOMON, P.E.
Deputy Secretary

May 20, 2011

RE: SANDIA NATIONAL LABORATORIES MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION REPORT

Dear Commenters:

The New Mexico Environment Department (NMED) received numerous comments regarding the Corrective Measures Implementation Report (CMI Report) for the Sandia National Laboratories (SNL) Mixed Waste Landfill (MWL). In accordance with the May 26, 2005 Final Order issued by the NMED Secretary, the NMED issued a noticed on November 29, 2010 announcing a 60-day public comment period for the CMI Report. The comment period was later extended 30 days from January 28, 2011, to February 28, 2011. The following table summarizes the comments received and contains NMED's responses.

In addition, NMED issued a Notice of Disapproval (NOD) to SNL on April 29, 2011 regarding the MWL CMI Report. This letter, the attached response to comments and the April 29, 2011 NOD can be viewed on the NMED website at:
http://www.nmenv.state.nm.us/hwb/snlperm.html#MWLCMIReport

Sincerely,

John E. Kieling
Acting Chief
Hazardous Waste Bureau

Response to Comments Received by NMED on the SNL MWL CMI Report
May 2011

On May 26, 2005, the New Mexico Environment Department (NMED) Cabinet Secretary issued a Final Order requiring in part the installation of a vegetative soil cover with bio-intrusion barrier at the Sandia National Laboratories' (SNL's) Mixed Waste Landfill (MWL). The U. S. Department of Energy and Sandia Corporation (Permittees) were also required under provisions of the Final Order and associated modification of Module IV of the SNL Hazardous Waste Operating Permit to submit to the NMED a Corrective Measures Implementation (CMI) Report for the MWL within 180 days of completing construction of the cover. The MWL CMI Report was transmitted to the NMED on January 26, 2010. The purpose of the CMI Report is to document the as-built construction of the landfill cover.

On November 29, 2010, the NMED issued a notice announcing a 60-day public comment period for the CMI Report. The comment period was later extended 30 days from January 28, 2011, to February 28, 2011. The following table summarizes the comments received and contains the NMED's responses thereto as required by the May 26, 2005 Final Order.

Comment Number	Topic Area	Summary of Public Comment	NMED Response
1	Deny the CMI Report and Conduct a Hearing on Remedy Selection	The Mixed Waste Landfill (MWL) Corrective Measures Implementation (CMI) Report should be denied and a public hearing held to select a different remedy.	The NMED will not deny the Mixed Waste Landfill (MWL) Corrective Measures Implementation (CMI) Report. The NMED held a public hearing in December 2004 for the purpose of remedy selection. The final decision to construct the cover, along with other requirements, was made by the NMED Cabinet Secretary (at the time) in his Final Order of May 26, 2005. NMED will not revisit remedy selection for the MWL unless there is credible scientific information that the remedy is not protective of human health and the environment. The five-year reviews ordered by the Secretary on May 26, 2005, provides for periodic analysis of the future protectiveness of the cover. The cover will maintain a low and thus acceptable level of risk to the public, workers, and the environment, is a proven reliable and effective technology, and will further reduce waste mobility. The cover will prevent wastes from endangering our citizens, our ground water, and our environment by minimizing the infiltration and percolation of moisture into the landfill, by preventing the intrusion of small animals into waste, and by shielding people, workers, and the environment from harmful radiation.
2	Risk Assessment	The commenters state that a risk assessment should be performed for the MWL. They refer to a 1998 Notice of Deficiency (NOD) issued by the NMED to support their argument that a risk assessment should be performed, and especially a risk assessment that considers groundwater as a complete pathway to human receptors. They also state that a risk assessment is needed because new information has surfaced since the 2004	The comment is not relevant to the CMI Report. The 1998 NOD addressed the risk assessment found in the Phase II RCRA Facility Investigation Report for the MWL. An additional risk assessment was prepared as part of the MWL Corrective Measures Study (CMS) Report completed in May 2003. The risk assessment in the CMS was debated in considerable detail during the public hearing held in December 2004 and was a significant line of evidence considered in the selection of the evapotranspiration (ET) cover combined with long-term monitoring and maintenance as the best remedial alternative for the landfill.

		public hearing for remedy selection.	Both the newly installed (2008) wells and the now-abandoned older wells at the MWL have yielded water samples demonstrating that the landfill has not caused groundwater contamination (see Comment Number 12). Furthermore, vadose-zone investigations completed since 2004 have yielded results that are consistent with data obtained during the RCRA Facility Investigation (RFI) completed in 1996 and continue to indicate that groundwater is unlikely to become contaminated (see also Comment Number R23). Because groundwater is not and is unlikely to become contaminated, a complete pathway to receptors does not exist and will not likely exist via the groundwater pathway. Thus, a revised risk assessment with groundwater as a pathway in the analysis is not warranted.
3	Excavate the MWL	Excavate the MWL and store the waste in an engineered facility located on site.	The comment is not relevant to the CMI Report. NMED will not require that the MWL be excavated in the absence of information demonstrating that the cover is not protective of human health and the environment. See Comment Number 1.
4	Install Groundwater Monitoring Wells	The commenters believe that new groundwater monitoring wells should be installed at the MWL, with the installation plans made available to the public for comment as required by 40 CFR § 270.42. They further state that the NMED requirement in 2007 to install new groundwater monitoring wells was a significant alteration of the permit for the MWL and that the installation plan should have been subjected to public comment as a Class 3 permit modification request. Furthermore, they believe that the current monitoring well network (MWL-MW4, MWL-MW5, MWL-MW6, MWL- MW7, MWL-MW8 and MWL-MW9 and MWL-BW2) needs to be replaced because it does not meet the intended purposes to monitor contamination at the water table, measure the elevation of the water table and accurately determine the direction and velocity of groundwater flow.	The comment is not relevant to the CMI Report. The regulations at 20.4.1.900 NMAC incorporating 40 CFR § 270.42 (concerning permit modifications) do not apply to the MWL. See Comment Number 30. The newest wells at the MWL were installed in 2008 and are screened across the water table. These wells are suitable for monitoring for contaminants in groundwater at the water table and now make up the primary monitoring well network for the MWL. The wells also can be used to measure the elevation of the water table, and thus, can be used to evaluate the direction and gradient of groundwater flow. The average linear velocity of the groundwater can also be estimated using the gradient and also taking into account the hydraulic conductivity and the porosity of the aquifer. Wells MWL-MW4, MWL-MW5, and MWL-MW6 are being maintained for future groundwater monitoring if circumstances should arise that require them.
5	Disclosure of Information and effectiveness of Regulatory Oversight	The commenter states that grounds exist for the termination of the MWL permit under 40 CFR § 270.43, which provides for the termination of permits where relevant facts have not been fully disclosed and/or relevant facts have been misrepresented.	The comment is not relevant to the CMI Report. There is no permit for the MWL to terminate. See Comment Number 30. NMED has properly overseen corrective action at the MWL in accordance with requirements of the New Mexico Hazardous Waste Act and the New Mexico Hazardous Waste Management Regulations, the latter which adopts the regulations under RCRA by incorporation.

		The commenter further states that NMED has failed to properly oversee the MWL under the Resource Conservation and Recovery Act (RCRA), including failure to issue approvals for proposed corrective actions based upon true and correct information, repeatedly issuing approvals which do not conform to the requirements of RCRA, failure to comply with public participation requirements, and failure to determine compliance, verify the accuracy of information submitted by the Permittees, and verify the accuracy of sampling, monitoring and other methods. The commenter also claims that NMED and Sandia presented erroneous testimony at the public hearing for the CMS in December 2004 by claiming that a reliable network of monitoring wells was in place at the MWL.	The administrative record that existed at the time of the December 2004 public hearing was made available to the public. Parties to the hearing and the public and had access to the entire record before and during the public hearing. Furthermore, the New Mexico Court of Appeals affirmed that the NMED followed all regulatory requirements to involve the public in the remedy decision-making process, which included hosting the public hearing, and that NMED even went beyond what is required to provide for public participation. NMED has provided or offered to make available additional information to the Parties and the public since the hearing. Furthermore, NMED did not state at the public hearing and does not currently agree that the groundwater monitoring network was unreliable (see also Comment Number 17). Thus, NMED did not present erroneous or false testimony at the December 2004 hearing. The taking of and responding to public comment on this document (CMI Report) is yet another example of NMED going beyond what is required by regulation or law with regard to providing public participation opportunities.
6	Monitoring Well Locations	The commenters state that groundwater monitoring wells are not properly located downgradient from the MWL, including south of the landfill, thus, contaminants may not be detected. The commenters also assert that an upgradient background monitoring well was not installed until 2008. The commenters refer to a 1991 Tiger Team assessment report, a 1991 Los Alamos National Laboratory report, NMED reports from 1993 and 1994, a Notice of Deficiency (NOD) issued by the U. S. Environmental Protection Agency (EPA) in 1994, and a NOD issued by the NMED in 1998 to support their argument that wells at the MWL are not properly located.	The comment is not relevant to the CMI Report. The commenters cite old, out-of-date reports and other documents. Additional groundwater monitoring wells have been installed at the MWL since these reports and other documents were prepared by the NMED, Los Alamos National Laboratory, EPA, and the U. S. Department of Energy Tiger Team. The horizontal component of groundwater flow beneath the MWL is approximately west-northwest. The wells completed on the west boundary of the MWL, including the wells installed in 2008, are appropriately located in consideration of the groundwater flow direction. The original background well (MWL-BW1), installed in 1989 and located cross-gradient at a distance of approximately 450 ft from the landfill, yielded groundwater samples that showed no evidence of contamination from the landfill. Thus, the original background well was adequate to serve its intended purpose, it yielded water samples representative of background conditions. MWL-BW1 has since been abandoned, and replaced with well MWL-BW2, which is located east of the landfill.
7	Corroded Well Screens	Groundwater monitoring wells have corroded wells screens	The comment is not relevant to the CMI Report. The stainless-steel screens of wells MWL-MW1 and MWL-MW3 succumbed to appreciable corrosion which became particularly problematic for the wells during the last years of their service lives. As time passed, water samples obtained from these wells carried chromium and

			nickel at increasing concentrations that eventually exceeded background levels because of corrosion. NMED is confident that the chromium and nickel did not originate as a release from the landfill because these metals are not present pervasively above background levels in subsurface soil beneath the landfill. Wells MWL-MW1 and MWL-MW3 have now been abandoned. The newest monitoring wells at the MWL (installed in 2008) are constructed with polyvinyl chloride (PVC) screens. The PVC screens do not contain chromium or nickel. Chromium and nickel have been detected in water samples obtained from these new wells only at background levels, confirming that these metals are not groundwater contaminants.
8	Detection of Contaminants	The commenters argue that groundwater monitoring wells at the MWL were drilled using bentonite mud, and that the drilling mud prevents contamination from being detected. The wells, therefore, can not provide representative and reliable water samples. The commenters refer to a 1993 NMED report, and a NMED letter issued to the Permittees on July 2, 2007, to support their argument that wells at the MWL can not provide representative and reliable groundwater samples because they were installed using the mud-rotary method, and with bentonite mud.	The comment is not relevant to the CMI Report. Only some of the older wells installed at the MWL were completed using the mud rotary drilling method. All of the wells installed in 2008 were completed using the air rotary casing hammer (ARCH) drilling method. Although wells drilled by the mud rotary method can yield representative groundwater samples if the wells are properly developed, the NMED discourages the use of the mud rotary drilling method to install monitoring wells. NMED determined that the older, now-abandoned, wells at the MWL provided reliable and representative groundwater samples (see Comment Number 17). The wells installed at the MWL in 2008 were completed without the use of bentonite mud or the mud rotary drilling method. Water samples obtained from these new wells continue to indicate that groundwater has not been contaminated by the landfill.
9	Releases of Tritium and Solvents	The commenters state that there is a new release of tritium and solvents from the MWL based on data from a field investigation conducted in 2008. The commenters argue that a 10-fold increase of tritium contamination was found by the investigation and that further investigation is warranted.	The comment is not relevant to the CMI Report. Some soil samples collected in 2008 exhibited tritium levels that were higher than those observed in 1995 because they were collected closer to the disposal areas containing tritium sources. The tritium levels detected in 2008 do not indicate that a new release of tritium has occurred, and more importantly, do not represent a threat to human health or the environment. Thus, further investigation of tritium is unwarranted based on the 2008 sampling results. Additionally, the NMED does not have the authority to regulate tritium, a radioactive substance. Soil-gas (solvent) monitoring results for the 2008 investigation are consistent with those observed during the RCRA Facility Investigation completed in 1996. The soil-gas concentrations detected in the landfill in both 2006 and 2008 are low, and like tritium, do not pose a threat to human health or the environment.
10	Pumping and Slug Tests	The commenter asserts that the Permittees used flawed pumping and slug test data to calculate hydraulic conductivities and	The comment is not relevant to the CMI Report. Hydraulic conductivity data, along with porosity and gradient, can be used to estimate the

		estimates of groundwater velocity**.** The commenter refers to a 1998 NOD issued by the NMED to support their argument that the pumping test data are flawed.	average linear velocity of groundwater. The hydraulic conductivity obtained from a pumping test conducted at MWL-MW4 is not considered by the NMED to be reliable data as indicated by the NMED in the 1998 document cited by the commenter. The pumping test failed because the pumping rate was too low to stress the aquifer and produce drawdown in observation wells that matched a type curve. Slug tests were also conducted on the older, now abandoned monitoring wells. The slug test results yielded hydraulic conductivity data that are consistent with what would be expected for the lithologies encountered at the screen intervals of these wells. Finally, as pointed out in the 1998 NOD, "Unless groundwater contamination is detected and confirmed in one or more MWL wells, there is no need to establish hydraulic properties of the aquifer from field studies". Pumping tests are almost never done at sites where groundwater clean ups are not required.
11	Monitoring Well MWL-MW-4	The commenter states that groundwater monitoring well MWL-MW4 is defective based on a NOD issued by the NMED in 1998. The commenter excerpts from this NOD that: 1.) the top of the upper screen of MWL-MW4 is located approximately 22 ft below the water table. Because of the vertical gradient and the way the well is constructed, MWL-MW4 is of no value for determining the elevation of the water table (and therefore, the horizontal direction of ground-water flow and the horizontal gradient), and 2.) Because the top of the upper screen of MWL-MW4 is located 22 feet below the water table, the well is of little value for detecting any groundwater contamination (if any exists) that may be present in the saturated zone just below the water table.	The comment is not relevant to the CMI Report. Well MWL-MW4 is not defective. As pointed out in the NMED's NOD issued in 1998, the well can not provide water-level or water-quality data *that are representative of conditions at the water table*. However, the well, which is constructed with two screened intervals, which are normally separated by a packer, does have value in that it can be and has been used to assess total head and water quality at two different depths below the water table.
12	Groundwater Quality	The commenters cite excerpts from a 1998 NOD issued by the NMED in an effort to demonstrate that the MWL is the source for nickel contamination in the groundwater. They also claim that background water quality data from well MWL-BW2, and	The comment is not relevant to the CMI Report. The MWL has not caused groundwater contamination as demonstrated by nearly two decades of monitoring. The excerpts cited by the commenters from the 1998 NOD point to certain detections of metals

		comparison of recent data from the older and newest wells provide evidence that wastes in the landfill have contaminated the groundwater with nickel, cadmium, chromium, and nitrate, and possibly with tetrachloroethene (PCE).	in a few soil samples that exceeded the approved background concentrations for these constituents. NMED later determined based on further analysis that these data, including those for nickel and chromium, were not representative of a contaminant release from the landfill. Although it appears that a release of cadmium at low concentrations occurs in soil beneath the west side of the landfill, cadmium is not a groundwater contaminant at the MWL. Water samples from groundwater monitoring wells installed in 2008 along the west boundary of the landfill continue to confirm that cadmium is not a groundwater contaminant. Nitrate occurs in the groundwater at the MWL at about 4 mg/L or at about half the New Mexico Water Quality Control Commission (NMWQCC) standard of 10 mg/L. There are no known nitrate sources in the MWL suggesting that the nitrate may originate from local septic systems. Regardless, the nitrate levels do not exceed the NMWQCC standard. The elevated nickel and chromium levels seen in groundwater samples from wells MWL-MW1 and MWL-MW3 were derived from the corrosion of their stainless-steel well screens (see Comment Number 7). Water samples collected from the new background well MWL-BW2, as well as from the other new wells installed in 2008, contain only background levels of naturally-occurring groundwater constituents, including nickel and chromium. Although tetrachloroethene (PCE) has been detected in soil gas beneath the MWL, the concentrations of PCE in the soil gas are too low to contaminate groundwater.
13	TechLaw Report	The commenter asserts that the TechLaw report concerned computer modeling and cover construction for the MWL, and furthermore, that the Department kept the report secret via a lawsuit until the report was released in late 2009. The commenter also states that the NMED provided no opportunity to the public to be informed of or to discuss the concerns identified for the landfill cover in the TechLaw Report. The commenter also asserts that the TechLaw Report describes the Sandia computer model (Fate and Transport model) as a "Black Box," and cautioned NMED against its acceptance to predict contaminant movement beneath the MWL.	The comment is not relevant to the CMI Report. TechLaw was tasked by the NMED to review the Fate and Transport Model (FTM) found in Appendix E of the CMI Plan. TechLaw did not review the CMI Report. TechLaw was not asked to review the cover design presented in the CMI Plan because the design was essentially identical to another design previously reviewed by TechLaw and the NMED. All but four of the eleven TechLaw comments were included in the NOD issued for the CMI Plan on November 20, 2006 (some comments were edited by the NMED for clarity). The November 2006 NOD was made available for public inspection via its posting on NMED's web page. In addition to the eleven TechLaw review comments, one other issue raised by TechLaw in their transmittal letter that accompanied their review comments was added to the NOD. This additional comment concerned the "Black Box" issue, and as mentioned above, this comment was included as Comment #11, Part 2, of the NOD that was made available to the public. The four TechLaw comments that were not used to generate the 2006 NOD are as follows: 1.) TechLaw comment #2 recommended inclusion of a regulatory reference for hydraulic conductivity (40 CFR § 264.310(a)(5)); 2.) TechLaw comment #5 expressed concern whether the cover was designed to last 1000

			years or more, and opined that it was unlikely that the U. S. Government can or will maintain the integrity of the cover for 1000 years; 3.) TechLaw comment #6 concerned use of a different waste thickness for the modeling of cadmium compared to most other hazardous constituents; and 4.) TechLaw comment #9 recommended that the trigger evaluation process be revised. Aside from this not being a particularly significant comment, TechLaw comment #2 was not included in the November 2006 NOD because the regulation suggested as an additional reference does not apply to the MWL (because the landfill does not have an operating permit). Also see Comment Number 30. TechLaw comment #5 was not included in the November 2006 NOD because the landfill is expected, based on its design, to last 1000 years (see Comment Number 15). Additionally, although NMED can't predict the future, NMED must assume that the federal government will exist for the next 1000 years and will do whatever is necessary to protect human health and the environment, including maintaining the landfill cover. TechLaw comment #6 was not included in the NOD because the TechLaw reviewer initially misunderstood the conservative approach that was undertaken for cadmium in the FTM. The TechLaw reviewer was unaware of site characterization data that suggested that low levels of cadmium were present in subsurface soil along the west boundary of the landfill. Based on this characterization data, cadmium was modeled to have a larger waste thickness compared to most other constituents in the FTM. NMED consulted with the TechLaw reviewer about this situation, and it was agreed that this particular comment should not be included in the NOD. TechLaw comment #9 was not included in the 2006 NOD because NMED believes it would be best to address this issue as part of the Long-Term Monitoring and Maintenance Plan to be developed for the MWL. NMED agrees with TechLaw (and the Permittees) that a statistical approach needs to be developed to determine the significance of any monitoring results that exceed a trigger level. As mentioned preciously, the TechLaw comment concerning the "Black Box" issue was included as Comment #11, Part 2, of 2006 NOD. The "black box" issue concerned a lack of certain details in the FTM Report regarding the modeling methods (codes) used, data quality objectives, quality assurance, details regarding specific inputs and outputs for modeling runs, sensitivities of input parameters, and bias. The Permittees later addressed the "Black Box" issues to the satisfaction of the TechLaw reviewers and the NMED in their response to the 2006 NOD submitted on January 19, 2007.
14	Cover Design	The commenters state that the existing cover installed over the MWL is defective because it is not the required design.	Pending response from the Permittee to the NOD issued for the CMI Report, the landfill cover, as constructed, appears at least at this time to meet or exceed the approved design found in the CMI Plan. The ET cover design is appropriate for the geologic and climatic conditions that exist at the MWL. See also Comment Number 1.
15	Cover Longevity	The commenters state that the cover will not	The comment is not relevant to the CMI Report.

		be protective for the thousands of years required to protect the environment from long-lived radionuclides associated with some of the waste in the MWL.	See Comment Nubmers 3 and 14. Exposure to radioactivity constitutes the most significant hazard associated with radionuclides in the landfill. Workers and the public are protected from radioactivity because of the shielding effect of the landfill cover. The cover was designed to minimize maintenance, and is expected to last for a significant amount of time. For example, the cover averages 4.12 feet thick (or 1255.8 mm, which is in addition to the 1.25-feet thickness of the bio-barrier and up to 3 additional feet of subgrade). At an average erosion rate of 1 mm per year, the cover would last more than 1000 years even if no maintenance was actually performed to replace soil eroded from the cover.
16	Soil-Moisture Monitoring	The commenters argue that the existing soil moisture probes below the MWL are inadequate because they only monitor below a small number of the pits and trenches, they do not monitor continuously, and they do not monitor the breakthrough of moisture at the base of the dirt cover.	The October 10, 2008, NOD issued for the MWL CMI Plan noted that the deep soil moisture monitoring system already in place at the landfill could not be effectively used to measure the breakthrough of moisture through the landfill cover. During construction of the cover, the Permittees installed another monitoring system at the base of the cover to monitor for moisture breakthrough. Located in an arid environment, breakthrough events at the MWL will occur only rarely, and moisture will migrate slowly through soil. Few stations are actually needed to monitor for moisture as the amount of moisture infiltration and percolation would not be expected to vary significantly across the cover. Thus, monitoring continuously beneath all or most of the pits and trenches is unnecessary, and the newly constructed soil-moisture monitoring system should be adequate.
17	2006 NMED Report	The commenter states that the conclusions of the 2006 NMED report entitled *Evaluation of the Representativeness and Reliability of Groundwater Monitoring Well Data, Mixed Waste Landfill, Sandia National Laboratories* (by William P. Moats, David L. Mayerson and Brian L. Salem; referred to as the 2006 Report) are wrong for the following reasons. 1.) the evaluation of the water quality data was based on only four of the seven wells, 2.) the conclusions rely on the FTM rejected by the TechLaw report, 3.) the authors ignored the conclusions of a 1993 NMED report, 4.) the authors ignored findings in an NMED NOD issued in 1998 that described the MWL monitoring well network as being inadequate; and 5.) the scientific community including	The comment is not relevant to the CMI Report. The NMED disagrees with this comment and believes that groundwater data obtained from the older, now abandoned monitoring wells at the Mixed Waste Landfill (MWL) were generally reliable and representative of formation water quality as discussed in the cited NMED report: *Evaluation of the Representativeness and Reliability of Groundwater Monitoring Well Data, Mixed Waste Landfill, Sandia National Laboratories*. At the time the 2006 report was prepared, seven ground-water monitoring wells were located at the MWL (MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4, MWL-MW5, and MWL-MW6). Wells MWL-MW1, MWL-MW5 and MWL-MW6 were installed using the air-rotary casing hammer (ARCH) method. Well MWL-MW4 was drilled using sonic resonant technology; whereas, wells MWL-BW1, MWL-MW2 and MWL-MW3 were completed via the mud rotary drilling method. In the above mentioned report, groundwater data from the mud rotary wells (MWL-BW1, MWL-MW2, and MWl-MW3) were compared to corresponding data from wells completed by the other drilling methods (MWL-MW1 and MWL-MW4) and to background hydrochemistry data for the Kirtland Air Force Base area. The evaluation focused properly on the four wells where drilling fluids (and possible grout intrusion) were an issue. The results of this effort found that the mud rotary wells, in addition to the other wells at the MWL, yielded reliable and representative groundwater samples. The conclusions of the 2006 report do not rely on the FTM. The 2006 report only mentions the

		the EPA and the National Research Council (NRC), has rejected the method of using only the chemistry of groundwater samples to evaluate the ability of monitoring wells completed using bentonite drilling mud to provide reliable and representative water samples.	FTM with regard to the model's prediction that tritium, radon, volatile organic compounds, and cadmium are unlikely to affect (contaminate) groundwater in the future. Furthermore, TechLaw did not reject the FTM. See Comment Number 13. The authors of the 2006 report did not ignore information in the 1993 report and 1998 NOD. The groundwater monitoring issues raised in the 1993 report and the 1998 NOD had already been addressed by the Permittee. Additional monitoring wells have been installed at the MWL since 1998. See Comment Numbers 6, 8, 11, and 12. Regardless of whether the EPA or NRC accepts the conclusions of the 2006 report, the newest wells installed at the MWL in 2008 continue to demonstrate that the MWL has not caused groundwater to become contaminated. These wells were not completed using the mud rotary method, and did not involve the use of drilling mud.
18	Vapor Transport	The commenter states that the drying of soil composing a cover will allow vapor transport to occur more readily. The commenter cites a report by the National Academy of Sciences and a 2002 report by Tom Hakonson, Ph.D., Environmental Evaluation Services, LLC in support of this comment.	The comment is not relevant to the CMI Report. In general NMED agrees with the comment. However, the measured concentrations of contaminants in soil-vapor beneath the MWL are low and do not represent a threat to human health or the environment (see Comment Number 9).
19	EPA Region 6 OIG Report	The commenters state that a 2010 report by the U. S. Environmental Protection Agency (EPA) Office of Inspector General (OIG) found that EPA Region 6 had concerns about the MWL's effect on groundwater and the groundwater monitoring network. The commenter further states that the OIG found EPA's Region 6 withheld information from the public regarding the MWL monitoring wells through discontinuation of record keeping, misleading communications, and inappropriate classification. The commenter further states that new information presented to NMED by EPA Region 6 would have justified the application of different permit conditions at the time of issuance and constituted a cause for modification of the permit. The commenter also claims that NMED entered into an agreement with EPA Region 6 to withhold information and documentation	The comment is not relevant to the CMI Report. If EPA has any concerns about groundwater monitoring at the MWL, such concerns have not been passed on to the NMED. NMED has no comment on the Inspector General's Report except that it's the Department's understanding that EPA Region 6 disagrees with many of the findings of the report. There is no operating permit for the MWL to modify. See Comment Number 30. NMED does not have any agreement with the EPA or any other entity regarding the withholding of information from the public or any entity.

		from Citizen Action and the public regarding the groundwater monitoring network at the MWL.	
20	Waste Characterization	The commenter states that wastes at the MWL have not been adequately characterized.	The comment is not relevant to the CMI Report. For most old landfills, records of waste disposal are not available. Because some records were kept for the MWL, the types and quantities of wastes disposed of in the landfill are partially known. There are hundreds of waste types in the MWL that occur in small quantities, but most of these waste types have limited ability to migrate in the absence of water. The cover will minimize the amount of water than can move through the landfill and mobilize contaminants.
21	Waste Stabilization	The commenter claims that unsolidified, hazardous chemicals such as acids, solvents, trichloroethene, and carbon tetrachloride, were disposed of in the classified section of the MWL from 1959-1962, and that it was not until 1975 that SNL required liquid wastes to be solidified before being placed in the MWL.	The comment is not relevant to the CMI Report. Sampling and analysis of subsurface soil beneath the MWL indicate that such chemicals (or hazardous constituents thereof) have not migrated from the landfill in liquid form.
22	High-Level Waste	The commenter asserts that the MWL contains high-level radioactive wastes from nuclear reactor operations at the Annular Core Research Reactor, and that it is illegal to dispose of high-level waste at the MWL. The commenter further states that Pu-239, Americium-241 and Niobium-94 with long half-lives were disposed of in the MWL, and that these types of contaminants will remain a perpetual hazard to Albuquerque.	The comment is not relevant to the CMI Report. The NMED has no authority to regulate radioactive waste at a U. S. Department of Energy facility. However, NMED believes that the cover provides protection from radioactive waste that can't move in vapor form, such as Pu-239, Americium-241 and Niobium-94 (see Comment Number 1).
23	Soil-Gas Monitoring	The commenters believe that the proposed soil-gas monitoring well network is inadequate because it does not monitor below most or all of the pits and trenches.	The comment is not relevant to the CMI Report. Details of the soil-gas monitoring network will be addressed under the Long-Term Monitoring and Maintenance Plan (LTMMP). The revised LTMMP has not yet been submitted to the NMED. The original footprint of the MWL covers 2.6 acres. Soil-gas plumes will migrate chiefly along the path of least resistance. Because sediments with near horizontal orientation underlie the MWL, and some have hydraulic conductivities that are likely greater in the horizontal direction than the vertical direction, soil gas is expected to spread laterally as well as vertically through the vadose zone This was the case with the nearby Chemical Waste Landfill where geological conditions are similar and soil-gas concentrations prior to conducting soil-vapor extraction were once much higher on average than those found at the MWL. Any soil-gas plume at the MWL with concentrations high enough to pose an unacceptable risk to human health or the

			environment would spread laterally and would be detected by the deployment of a relatively small number of soil-vapor monitoring wells. Thus, it is not necessary to install soil-gas monitoring wells beneath all or most trenches and pits at the landfill.
24	WERC Review of MWL Corrective Measures Study	The commenters assert that the WERC panel was not informed of the existence of unreliable data from the groundwater monitoring well network at the MWL and contamination of the groundwater. They further state that references, such as the 1998 NOD were not provided to the WERC and that this constituted withholding of relevant facts about the landfill.	The comment is not relevant to the CMI Report. To the best of NMED's knowledge, the WERC had access to all groundwater and vadose-zone data and well construction information that existed at the time. NMED disagrees that data from the groundwater monitoring well network are unreliable, and that the MWL has contaminated groundwater (see Comment Numbers 12 and 17).
25	Design and Installation of New Wells	Three of the four newer groundwater monitoring wells were installed too deep to detect contamination and measure the elevation of the water table. The well screens are 30 ft in length rather than the EPA-required length of 10 ft. The three wells require replacement as soon as possible.	The comment is not relevant to the CMI Report. The newest monitoring wells (2008 wells) installed at the MWL substantively meet regulatory requirements under the New Mexico Hazardous Waste Management Regulations (20.4.1 NMAC), requirements pursuant to the Sandia Consent Order (April 29, 2004), and guidance issued by the U. S. Environmental Protection Agency (EPA). There is no EPA requirement that well screens must be 10-feet long. Well screens installed on all of the new wells at the MWL are 30-feet long. For each well, it was intended that 25 feet of each screen was to be constructed below the water table, and 5 feet of screen above the water table. Thus, 25 ft of each screen was to be in contact with saturated sediments. NMED allowed the use of longer screens in this case to allow for increased well life given that the water table beneath the MWL is dropping about 0.9 feet/year, and taking into consideration that monitoring for the last two decades demonstrates that the landfill has not caused groundwater contamination. As built conditions of the newest wells at the MWL indicate that the height of the water column above the bottom of the screen interval of each well is actually smaller than the intended 25 ft. Based on water level measurements obtained in October 2009, the water column height is 21.5, 7.91, 6.41, and 6.70 ft for MWL-BW2, MWL-MW7, MWL-MW8, and MWL- MW9, respectively. Thus, the saturated screen intervals for all three downgradient wells are actually less than 10 ft. The wells are expected to go dry sooner than originally anticipated because of the dropping water table, and will eventually need to be replaced with wells screened at deeper depths than is currently the case.
26	Monitoring of Uppermost Aquifer	The commenters state that a groundwater monitoring well network has not been installed in the uppermost aquifer as defined by RCRA and also as required by the April 29, 2004 Compliance Order on Consent.	The comment is not relevant to the CMI Report. Uppermost aquifer in this case means that part of the saturated zone beneath the MWL that is at or near the water table. The 2008 wells at the MWL and several of the now-abandoned older wells were installed with

			their screens spanning the water table. Thus, wells have been and are installed in the uppermost aquifer.
27	Hydrostratigraphic Units	The commenter states that there are two zones of saturation below the MWL that require networks of monitoring wells. A reliable network of monitoring wells was not installed in either of the two zones.	The comment is not relevant to the CMI Report. See Comment Number 26 concerning the uppermost zone of saturation and Comment 17 concerning the reliability of the monitoring well network. Because groundwater contamination is not present in the uppermost zone of saturation, there is no justification to install wells at deeper depths within the aquifer.
28	Sampling Methods	The commenter states that high-flow pumping methods are employed at wells MWL-MW1,MWL -MW2, MWL-MW3, MWL-MW4, MWL-MW7, MWL-MW8, MWL-MW9 and MWL-BW1 that causes the wells to be purged dry and water samples to become highly aerated. The commenter further states that samples were collected after purging up to a week later, and that this sampling method removes volatile and trace metal contaminants from the water samples.	The comment is not relevant to the CMI Report. Wells MWL-MW1, MWL-MW2, MWL-MW3, and MWL-BW1 have been abandoned. Several of the wells at the MWL are or were constructed such that their screens straddle the water table. The surface of the water contained in any given well is in contact with air. The formation water at the water table surrounding the wells is also in contact with air. No matter what sampling procedures are employed, some of the water that flows into the wells that are screened across the water table will have been exposed to air. Many of the wells at the MWL are low yield wells (will purge dry). There are no regulations or guidance that state that low yield wells are unacceptable. It is a standard EPA procedure to purge low yield wells dry, and then to collect water samples from them as soon as possible after they have sufficiently recovered. Low yield wells at the MWL in the past have sometimes taken days to recover after being purged dry. The fact that it took so much time for the wells to recover indicates that the groundwater flow into these wells was not turbulent, hence there is little concern that appreciable volatile organic compounds were stripped from the water samples due to turbulent flow. Additionally, the pumping and sampling procedures employed by the Permittees are appropriate, and in fact are a necessity given the natural conditions that exist at the MWL. The majority of the wells at the MWL are low yield wells because the saturated sediments that they intercept have low hydraulic conductivity (Ksat – Ksat is a physical property that essentially is a measure of how easy groundwater can flow through the aquifer). The NMED and EPA both recognize that low yield wells exist in the real world and sometimes that ideal sampling conditions can not be obtained. Because low yield wells are a reality, and contamination is not always located in high Ksat zones, the sampling of low yield wells is not prohibited by regulation and procedures for sampling them are found in EPA guidance.
29	Fate and Transport Model	The commenters state that the Fate and Transport Model (FTM) will be used to assess the performance of the long-term monitoring. The commenters further state that the FTM is	The comment is not relevant to the CMI Report. Monitoring of groundwater and the vadose zone will be conducted to assess the performance of the MWL – the NMED will not rely on the Fate and Transport Model or any other model in lieu of such monitoring.

		defective because groundwater below the MWL is presently contaminated with cadmium, chromium, nickel and nitrate, and probably PCE. The commenters also argue that the MWL may be contaminating groundwater with PCE to levels above the new EPA MCL of 0.05 µg/L.	Both the newly installed wells and the now-abandoned older wells at the MWL have demonstrated that the MWL has not caused any groundwater contamination. See also Comment Number 12. Thus, the fate and transport model has not been invalidated by any empirical data acquired since the model was developed. The EPA drinking-water MCL for PCE is 5µg/L, which is an enforceable standard. If the EPA has a MCL goal of 0.05 µg/L for PCE, such a goal is not a standard, and therefore is not enforceable (NMED is not aware that the EPA has such a goal). Regardless, PCE is not a groundwater contaminant at the MWL.
30	Regulatory frame work	The commenter asserts that the MWL has been improperly classified as a Solid Waste Management Unit (SWMU), and that the MWL is really a "regulated unit" by definition under 40 CFR §.264.90(a). The commenter further states that the regulations at 40 CFR § 270.1 (c) requires that owners and operators of landfills that received waste after July 26, 1982 must have post-closure permits, unless they demonstrate closure by removal or decontamination or obtain an enforceable document in lieu of a post-closure permit. Additionally, if a post-closure permit is required, the permit must address groundwater monitoring, unsaturated zone monitoring, corrective action and post closure care requirements. The commenter asserts that a post closure permit has not been submitted for the MWL.	The comment is not relevant to the CMI Report. A hazardous waste operating permit does not exist and has never existed for the MWL. There is only limited permit language that applies specifically to the MWL under Module IV (Hazardous and Solid Waste Amendments) of the SNL Hazardous Waste Operating Permit. The SNL Hazardous Waste Operating Permit was issued for container storage of hazardous waste in excess of 90 days at the SNL Hazardous Waste Management Facility. Module IV is the corrective-action portion of said operating permit. The language in the HSWA module about the MWL concerns selection and implementation of the remedy for the MWL and long-term monitoring. It contains nothing about the operation of the landfill because the landfill never operated under provisions of the New Mexico Hazardous Waste Act and the New Mexico Hazardous Waste Management Regulations. In hazardous waste permits, it is common for corrective action requirements to be included in a HSWA module or specific corrective-action chapter of container storage or treatment permits because owner/operators of such facilities must by regulation conduct corrective action even at sites at the facility other than the permitted unit as necessary to protect human health and the environment (see 20.4.1.500 NMAC incorporating 40 CFR § 264.101(a)). The MWL is regulated as a Solid Waste Management Unit (SWMU) subject to corrective action pursuant to 20.4.1.500 NMAC incorporating 40 CFR§ 264.101. Its status as a SWMU was established over two decades ago by the U. S. EPA. The MWL is not an operating unit and is not a regulated unit as defined under 20.4.1.500 NMAC incorporating 40 CFR § 264.90(a), and is not subject to the post-closure permitting requirements of 20.4.1.500 NMAC incorporating 40 CFR § 270.1(c). The Permittee is not required to submit a post closure permit application for the MWL. However, the long-term monitoring and maintenance plan (LTMMP) for the MWL, once completed, is planned to eventually become a part of SNL's Hazardous Waste Operating Permit due to the necessity for long-term controls for the landfill. The LTMMP will contain the same technical requirements for monitoring, inspection, and maintenance that would normally be included in a post-closure permit for a landfill. The LTMMP will be made available for public comment before it is finalized and implemented.
31	NMED Budget	The commenter expressed their opinion that	The comment is not relevant to the CMI Report.

		it is important that NMED's budget is not cut any further. In their opinion, budget constraints have affected NMED's ability to protect the health, welfare and environment for people in New Mexico.	The NMED's budget is controlled by the State's legislative's branch of government. The commenter should consider directing their comment to the State senator and representative for their district.
32	Human Receptors	The commenter states that downstream and downwind of the MWL are the village of Mountain View and the Pueblo of Isleta. The commenter further states that these culturally diverse communities are being impacted by contaminants that NMED has failed to mitigate, and that community reports of cancer are reminiscent of hotspot outbreaks.	The comment is not relevant to the CMI Report. The NMED strives to protect all citizens of New Mexico. The MWL does not pose a threat to citizens living in Mountain View, the Pueblo of Isleta, or any other community. NMED is not aware of any unusual occurrences or elevated frequencies of cancer in these communities.
33	Agency Effectiveness	The commenter alleges that actions of the NMED have raised uncertainty that hazardous waste rules are being enforced and that drinking water is being protected. The commenter also expressed their opinion that such actions have encouraged other governmental agencies to allow polluters to escape prosecution and that regulators have been ineffective and incompetent.	The comment is not relevant to the CMI Report. See Comment Number 12. NMED has vigorously enforced the New Mexico Hazardous Waste Management Regulations and has provided appropriate regulatory oversight to protect drinking-water resources in New Mexico.
34	Information Requests	The commenter states that the Albuquerque Bernalillo County Water Utility Authority used national security as an excuse to keep public documents from their organization (Citizens for Environmental Safeguards). The information sought by their organization concerned drinking-water production wells that are potentially impacted by 8 million gallons of jet fuel that has been released at a Kirtland Air Force Base site.	The comment is not relevant to the CMI Report. The comment concerns the Albuquerque Bernalillo County Water Utility Authority (WUA). The commenter should contact the WUA regarding this concern. NMED has considerable information on the Kirtland Air Force Base jet fuel spill (known as the Bulk Fuels Facility Spill). Much information about this fuel release is posted on the NMED's web site at: http://www.nmenv.state.nm.us/hwb/kafbperm.htm.

Volume III

TAB 17

Responses to NOD: Mixed Waste Landfill Corrective Measures Implementation Report, January 2010

From: SNL/Wagner
To: NMED/Kieling

Back of Tab 17

Note for Volume III, Tab 17:

Only the DOE/SNL responses to the "NMED Notice of Disapproval (NOD) dated May 20, 2011" are included herein. Revision 1 of the "Mixed Waste Landfill Corrective Measures Implementation Report" and the replacement pages included in this submission have been integrated accordingly, into "Mixed Waste Landfill Corrective Measures Implementation Report" (refer to Tab 12 of this volume).

National Nuclear Security Administration
Sandia Site Office
P. O. Box 5400
Albuquerque, NM 87185

ENTERED

AUG 11 2011

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

RECEIVED
AUG 2011
NMED Hazardous Waste Bureau

John E. Kieling
Acting Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Bldg. 1
Santa Fe, NM 87505

SUBJECT: Responses to the New Mexico Environment Department *Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Report, January 2010 Sandia National Laboratories, EPA ID NM5890110518, HWB-SNL-10-005*

REFERENCE: Wagner/Kieling Letter dated May 20, 2011, Subject: *Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Report, January 2010 Sandia National Laboratories, EPA ID NM5890110518, HWB-SNL-10-005*

Dear Mr. Kieling:

On behalf of the United States Department of Energy/National Nuclear Security Administration (DOE/NNSA), and Sandia Corporation (Sandia), DOE/NNSA is submitting responses to the comments provided in the referenced letter.

This Notice of Disapproval (NOD) Comment Response submittal contains two enclosures: a NOD Comment Response document (comb-bound) and replacement materials provided in a three-ring binder to update hardcopies of the Mixed Waste Landfill (MWL) Corrective Measures Implementation Report (CMIR). Electronic versions of the revised MWL CMIR (Sandia National Laboratories/New Mexico January 2010, Revision 1) and the NOD Comment Response document are provided on a compact disc.

Should you have any questions regarding this correspondence, please feel free to contact me at (505) 845-6036 or Joe Estrada of my staff at (505) 845-5326.

Sincerely,

Kimberly A Davis for

Patty Wagner
Manager

Enclosure

cc:
See Page 2

cc w/enclosure:
William Moats, NMED-HWB (via Certified Mail)
Laurie King, EPA, Region 6 (via Certified Mail)
Thomas Skibitski, NMED-OB, MS-1396
Barry Birch, NMED-OB, MS-1396
Mike Mitchell, SNL/NM, Org. 6234, MS-0718
Zimmerman Library, UNM
SNL ES&H Records Center, SNL/NM, Org.6234, MS-0718

cc w/o enclosure:
Robert Fleming, HQ/GTN, NA-173
Joanna Serra, HQ/FORS, NA-173
Amy Blumberg, SNL/NM, Org. 11100, MS-0141
Andrew Orrell, SNL/NM, Org. 6200, MS-0771
David Miller, SNL/NM, Org. 6234, MS-0718
John Cochran, SNL/NM, Org. 6234, MS-0719
Carolyn Daniel, SNL/NM, Org. 6234, MS-0718
Kimberly Davis, SSO/MO, MS-0184
Shirley Mondy, SSO/MO, MS-0184
Daniel Pellegrino, SSO/ESH, MS-0184
Carolyn Holloway, SSO/ESH, MS-0184
Michael McFadden, SSO/FP, MS-0184
Joe Estrada, SSO/FP, MS-0184

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Responses to the New Mexico Environment Department "Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Report, January 2010"**

Document author: **Michael Mitchell, Department 06234**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 8/3/11

S. Andrew Orrell, Director Date
Nuclear Energy & Fuel Cycle Programs
Center 6200
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ 8/11/11

Ms. Patty Wagner, Manager Date
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Sandia National Laboratories

Attachment 2

MWL CMI Report and CQA Report, Volume 1 & 2 Replacement Inserts, Replacement Pages, and Replacement CQA Report Volume 2 Compact Disc

This Attachment includes the following:

Replacement Inserts

- Cover sheets and spine inserts for the two original January 2010 MWL CMI Report binders
- Entire CMI Report and Appendix A CQA Report Volume 1 text (includes Cover and Title Pages for both reports)

Individual Replacement Pages

- Table 8 of CQA Report, Volume 1 (page 15 of 33 from tabbed "Table" section in back of report)
- Revised as-built drawings for CQA Report, Volume 1 (4 drawings for 2009 ET Cover in tabbed "As-Built Drawing" section in back of report)
- Figure 2-5 of Attachment 8, CQA Report, Volume 2 (only change to this separately bound volume of the report)

Replacement CD

- Appendix A, CQA Report Volume 2 CD that goes in the plastic sleeve in the back of the CQA Report, Volume 1

United States Department of Energy
Sandia Site Office

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.

Sandia National Laboratories
Albuquerque, New Mexico
August 2011

DOE/Sandia Responses to NMED's "Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Report, January 2010"

INTRODUCTION

This document responds to the comments received in a letter from the New Mexico Environment Department (NMED) to the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia) dated May 20, 2011 regarding the Mixed Waste Landfill (MWL) Corrective Measures Implementation Report for Sandia National Laboratories (SNL). The letter is entitled "Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Report, January 2010, Sandia National Laboratories", EPA ID NM5890110518, HWB-SNL-10-005.

The Corrective Measures Implementation (CMI) Report provides documentation that demonstrates the MWL evapotranspirative cover (i.e., ET Cover) was constructed in accordance with the specifications and requirements of the CMI Plan (SNL/NM November 2005). The CMI Report includes the stand alone MWL Alternative Cover Construction Quality Assurance (CQA) Report as Appendix A that was prepared by the CQA contractors responsible for independent third-party oversight of MWL ET Cover deployment. The Appendix A CQA Report is the comprehensive two-volume report that documents all aspects of MWL ET Cover deployment in accordance with CMI Plan requirements. Volume 1 of the CQA Report is included in the same binder as the CMI Report, along with as-built drawings, CQA verification survey plates, photographic logs, and a compact disc (CD) containing the CQA Report Volume 2 supporting attachments in electronic format. Volume 2 of the CQA Report is a separately bound volume; due to the size and nature of the information hard copies were only provided for the NMED and DOE/Sandia document repositories.

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.

This DOE/Sandia response package consists of the following components:

- Comment Response document (provided in comb-bound format), which includes:
  - Restatement of each of the eight NMED comments in boldface followed by the corresponding DOE/Sandia response in normal font.
  - Cross-reference table (Table 1) that tracks revisions made in the MWL CMI Report (main text and Appendix A CQA Report) relative to each NMED comment.
  - Attachment 1 that includes revised pages of the MWL CMI Report (main text and Appendix A CQA Report) in redline-strikeout format.

- Attachment 2 (provided in three-ring binder), which includes replacement covers, spines, and pages to revise existing hard copies of the MWL CMI Report (main text and Appendix A CQA Report):
  - Replacement cover sheets and spine inserts for the two original January 2010 MWL CMI Report binders.
  - Replacement insert for the MWL CMI Report, in its entirety.
  - Replacement insert for the MWL CQA Report, Volume 1, main text only.
  - Replacement Table 8 for the MWL CQA Report, Volume 1 (single replacement page for the tabbed "Table" section in Volume 1).
  - Four replacement drawings for the MWL CQA Report, Volume 1 (for the tabbed "As-Built Drawings" section, 2009 Alternative Cover, in Volume 1).
  - Replacement Figure 2-5, of Attachment 8, for the MWL CQA Report, Volume 2 (Note: this is the only replacement page for Volume 2 of the CQA Report).
  - Replacement CD for the disc titled, "Mixed Waste Landfill Corrective Measures Implementation Report, January 2010, Appendix A, Volume 2 – Attachments." The "Revision 1" replacement CD goes in the plastic sleeve located in the tabbed "Appendix A, Volume 2" section at the back of the original binder.

- A CD (provided in jewel case) with the revised MWL CMI Report (entire report, including Appendix A CQA Report Volumes 1 and 2) and this Notice of Disapproval (NOD) comment response document.

The revised MWL CMI Report retains the original January 2010 submittal date but is distinguished as "Revision 1" on the cover and title pages. All revised pages have "Revision 1" in the header or footer.

The revised 2009 ET Cover as-built drawings are provided to document the locations of two access gates in the perimeter security fence at the northern and southern ends of the MWL. The construction specifications for the northern access gate were shown, but the location within the perimeter fence was inadvertently left off the original drawings. DOE/Sandia requested NMED approval to install an additional access gate at the southern end of the site on April 21, 2011 to facilitate ET Cover maintenance, and NMED approved this request via email on April 28, 2011. Construction details for both gates and their location within the perimeter fence are provided on the revised as-built drawings for the 2009 ET Cover. There were no changes to the as-built drawing provided for the 2006 Subgrade.

Comments and Responses for the Mixed Waste Landfill Corrective Measures Implementation Report

1. Construction Quality Assurance (CQA) During Subgrade Layer Construction

The Corrective Measures Implementation (CMI) Report, Section 2.2, second paragraph, first sentence states: "During the 2006 Subgrade Construction phase, the CQA [Construction Quality Assurance] Team was responsible for all CQC [Construction Quality Control] data and CQA documentation requirements." Similarly, the first paragraph of Section 2.6 of Appendix A of the CQA Report states: "The CQA personnel roles and responsibilities were generally the same for both the 2006 and 2009 construction phases. However, some differences between the two construction phases reflect a more robust CQC and CQA program for the 2009 ET (Evapotranspiration) Cover Construction phase (i.e., construction of the Biointrusion, Native Soil, and Topsoil Layers)." The subsequent paragraph states "During the 2006 Subgrade Construction phase, the CQA Team was responsible for all CQC laboratory testing (i.e., Standard Proctor, Gradation, and Classification soil data), field testing (i.e., in-place density and moisture testing), as well as associated oversight of the testing laboratory."

The "more robust" quality assurance/quality control (QA/QC) implementation during the 2009 construction phase was actually more in accordance with the CMI Plan (CMIP) than the 2006 Subgrade Layer construction because the project requirements for independent QA testing of the Subgrade Layer were evidently not done in 2006. For example, Paragraph 3.3.4 (6) of Section 02200 Earthwork specification (Corrective Measures Implementation Plan [CMIP], Appendix A) indicates that "the Contractor shall perform field-testing of the compacted fill" and "the Contractor shall submit test results to the CQA Engineer and Operator for approval ... " Section 3.4.1 of this Specification states: "the Contractor shall be responsible for the performance of all pre-acceptance and quality control testing." However, the fourth bullet of Section 2.6.2 of the CQA Plan (Appendix B of the CMIP) states that "CQA testing will be conducted at a frequency of at least 5 percent (%) of that done by the Construction Contractor," which refers to testing by CQA Inspection personnel. Similarly, Section 5.1.2.3 of the CQA Plan states that "testing shall be performed at a minimum frequency of 5% of that done by the Construction Contractor" for the Subgrade Layer.

Similar language is also presented in the third paragraph of Section 4.0 of the CQA Report, where it is stated "In general, CQC and CQA data and documentation can be collected by either the Construction Team or the CQA Team or a combination of both." According to the CMIP Specifications and CQA Plan, this statement is not correct.

With regards to this issue, NMED notes reference to a different CQA Plan (May 2006) for the Subgrade Layer construction, but contends that a different CQA Plan should not diminish the project requirements of 5% CQA field testing for Subgrade Layer compaction and moisture content tests. Neither NMED conditional approval for the CMIP (December 2008), nor subsequent submittals (i.e., the CMIP replacement pages; Davis, February 2009) recognized a different CQA plan for the Subgrade Layer construction. However, NMED notes the efforts of the 2009 Contractor and CQA staff to re-condition, re-compact, and re-

test (as well as re-survey) the upper surface of the Subgrade Layer during the subsequent 2009 construction phase.

Therefore, the fact that the Permittees did not conduct QC testing of the Subgrade Layer by the Contractor, and 5% independent QA testing by CQA personnel, should be documented as a nonconformance. As part of the resolution of this comment (i.e., documentation of the nonconformance), revise as appropriate the CMI Report and the CQA Report (Appendix A of the CMI Report).

Response: The MWL CMI Report and CQA Report (Appendix A, Volume 1) have been revised to address documentation of the 2006 Subgrade in-place density and moisture field-testing program as a nonconformance, which is defined as a deviation from the CMIP specifications. In general, CQC versus CQA field tests were not clearly distinguished, and the CQA Team directed/performed all field testing. However, the number of field tests conducted exceeded the CMIP requirements. This is further clarified below.

As documented in the CMI Report (CQA Report, Appendix A, Volume 1, Section 2.0), the construction team for the 2006 Subgrade construction phase was comprised of on-site SNL/NM contractors (i.e., Shaw/GRAM, Inc.); this phase of work was not subcontracted to an outside construction company. For this reason, the decision was made to consolidate all Subgrade CQC and CQA field and laboratory testing under the direction of the CQA contractor, MKM Engineers, Inc., who functioned as a third party oversight contractor responsible for documenting and certifying all phases of Subgrade construction. The CQA Plan (SNL/NM May 2006) prepared by the CQA Team prior to Subgrade construction included the same testing requirements as the CMIP CQA Plan (Appendix B of CMIP) and was not the reason for the deviation from CMIP specifications.

The actual in-place density and moisture testing performed during Subgrade construction exceeded the CMIP specifications of 5 CQC tests per acre per lift plus at least 5% additional confirmatory CQA tests. Based upon the aerial extent of the twelve Subgrade lifts, only 48 CQC and 3 CQA field tests were required according to CMIP requirements (total of 51 tests). However, a total of 71 field tests were performed.

In the judgment of the CQA Engineers, there was no quality impact to the Subgrade of the MWL ET Cover, and therefore, no corrective action plan was required. The fact that the CQA Team performed/directed all CQC and CQA field testing represents a technically sound approach that was more conservative than required by the CMIP. The field testing performed exceeded the CMIP requirements by 20 tests. In addition, the thirteen 2009 re-testing results for the upper lift verified the Subgrade met CMIP density and moisture specifications approximately 3 years after Subgrade Layer completion.

Associated revisions to the CMI and CQA Reports are tracked in Table 1 and documented in redline-strikeout format in Attachment 1. Attachment 2 of this comment response document provides replacement pages, and revised text has been incorporated into the electronic version of the CMI Report (January 2010, Revision 1) provided on a CD.

2. <u>Hydraulic Conductivity Testing</u>

CQA Report, Section 4.3.1, Saturated Hydraulic Conductivity (ASTM Method D5856-95 [2007]): NMED agrees in general with the technical validity of the testing approach for hydraulic conductivity, and concurs that the results meet the performance specification of 4.6×10^{-4} centimeters per second (cm/s) or less. However, the sampling and testing approach do not appear to conform to the project Specifications, and a design change (Table 14) was not provided. It is evident that the Specifications in the CMIP intended for collection of *in situ* samples from the cover for hydraulic conductivity testing, rather than remolded samples (as was performed). Specifically, Paragraph 3.3.6(6) of the Section 02200 Earthwork specification states (regarding the Native Soil Layer):

Samples shall be obtained by means of a thin-walled sample tube or equivalent sampling device in a manner that minimizes disturbance to the lift and in the direction perpendicular to the plane of compaction. Samples shall be sealed and carefully stored to prevent drying during storage and transport. Hydraulic conductivity testing shall be performed in the laboratory according to ASTM specifications for rigid wall testing.

Clearly the intent of the Specification was not to use remolded samples, although there is some lack of clarity because the ASTM method was not specified, and because the term "rigid wall" was used in the Specifications.

See also the June 16, 2009, Quality Resolution Meeting minutes discussion of ASTM D-5084 flexible wall sample (undisturbed) vs. ASTM D-5856 rigid wall (remolded sample) hydraulic conductivity testing. Furthermore, it is not clear what test methods were used for the hydraulic conductivity results that were reported. Re-evaluate the hydraulic conductivity requirements and testing performed, and provide documentation of this matter as a nonconformance. Revise as appropriate the CMI Report and the CQA Report.

<u>Response:</u> The saturated hydraulic conductivity test method used (ASTM D5856-95) is stated in the CQA Report (Appendix A, Volume 1 of the CMI Report) in Section 4.3.1 *Laboratory Testing,* on page 39 and in footnote 2 of Table 8 *Mixed Waste Landfill 2009 ET Cover Construction, Saturated Hydraulic Conductivity CQC Laboratory Results*.

The ambiguity of the CMIP specifications with regards to saturated hydraulic conductivity testing was noted by the 2009 ET Cover construction project team and discussed during the referenced June 16, 2009 Quality Resolution Meeting. A considerable effort was made by the Construction Team, in coordination with SNL/NM project personnel and the CQA Team, researching saturated hydraulic conductivity testing options and the advantages and disadvantages associated with the two most appropriate ASTM methods. Based upon the physical properties of the native soil fill material and in the judgment of the CQA Engineer, ASTM D5084 flexible wall sample (undisturbed) and ASTM D5856-95 rigid wall (remolded sample) are both appropriate testing methods. After discussion that included input from the testing laboratory personnel at AMEC Earth and Environmental, Inc., all parties were in agreement that the ASTM D5856-95 rigid wall method was the best choice. The ASTM D5856-95 rigid wall method had two main advantages over the ASTM D5084 flexible wall method: 1) samples could be collected without compromising the integrity of the installed Native Soil Layer lift (i.e., without punching holes in the lift surface), and 2) compaction of the sample in the

laboratory could be controlled to accurately simulate compaction achieved in the field, especially considering the consistency of the native soil fill material. Although collection of an in situ, undisturbed sample in the field is a technically sound approach, the collection process is subject to variables that often result in some disturbance to the sampled material, which can affect the quality of the results.

The CMI Report has been revised to address this issue as a nonconformance. In the judgment of the CQA Engineer and project team, it was not possible to perform saturated hydraulic conductivity testing without some deviation from CMIP specifications. The method used was appropriate for the Native Soil Layer fill material and the results met the CMIP performance specification of 4.6×10^{-4} cm/s or less as noted in the NMED comment.

Associated revisions to the CMI and CQA Reports are tracked in Table 1 and documented in redline-strikeout format in Attachment 1. Attachment 2 of this comment response document provides replacement pages, and the revised text is incorporated into the electronic version of the CMI Report (January 2010, Revision 1) provided on a CD.

3. Equipment List.

CQA Report, Section 5.2.1, 2nd paragraph and bullet list: Provide a more detailed equipment list for the 2006 Subgrade Layer work. Note the detail provided in Table 13 for the 2009 construction phase; make and model number of the 2006 earthwork equipment (or other indication of size) should be provided at a minimum. As an example illustrating this need, CQA Report, Table 14, first line, states that a smaller roller was used for landfill surface compaction than specified: however, there are no details of the actual equipment used in 2006.

Response: The CQA Report (Appendix A of the CMI Report), Section 5.2.1, has been revised to provide the requested information. Associated revisions to the CQA Report are tracked in Table 1 and documented in redline-strikeout format in Attachment 1. Attachment 2 of this comment response document provides replacement pages, and the revised text has been incorporated into the electronic version of the CMI Report (January 2010, Revision 1) provided on a CD.

4. Stockpiled Volume of Native Soil

CQA Report, Section 5.4, second paragraph, third sentence reads as follows: "Soil fill stockpiled at the Borrow Pit in 2006 based on CMIP estimates was not sufficient to complete construction of the Native Soil and Topsoil Layers." NMED suggests changing this sentence to read: "The quantity of soil fill stockpiled at the Borrow Pit.... " to prevent potential confusion regarding the sufficiency of quality of the stockpiled material, which was adequate for soil fill.

Response: The CQA Report (Appendix A of the CMI Report) has been revised to make the suggested clarification. The associated revision to the CQA Report is tracked in Table 1 and documented in redline-strikeout format in Attachment 1. Attachment 2 of this comment response document provides the replacement page, and the revised text has been incorporated into the electronic version of the CMI Report (January 2010, Revision 1) provided on a CD.

5. Engineering Certification

CQA Report, Section 9: It seems odd that the certification of the subgrade is dated August 31, 2007, but also states that their original MKM Engineers, Inc. CQA Report "has been incorporated into this report," which appears to refer to the current 2010 CQA Report. NMED notes also that the 2009 CQA Engineer certified both the Subgrade Layer and the overlying ET Cover, which is appropriate given the re-testing of the Subgrade surface and oversight of the ET Cover construction.

Provide clarification of the engineering certification. It may be more appropriate to include a copy of the original CQA Engineer subgrade certification, without modifying it to conform to the format of the current report.

Response: The MWL ET Cover was deployed in two separate construction phases, the 2006 Subgrade and the 2009 ET Cover Construction phases, as described in the CMI Report (Section 1.3, page 1-3) and the CQA Report (Section 1.1 [page 21], Section 1.3 [pages 22-23], and Section 5.0 [page 47]). Section 1.3 of the CQA Report provides a detailed description of how the 2006 Subgrade construction was documented and certified in the Draft MWL Alternative Cover Subgrade CQA Report (MKM, August 2007), which was subsequently revised to incorporate the 2009 ET Cover construction activities and certification. The Draft Subgrade CQA Report was prepared and certified in 2007 because it was not known when NMED approval to proceed with ET Cover construction would be received, and when that approval was received, if the same CQA Engineer would be available.

As a result of the delay, a new construction team and CQA Team performed the 2009 ET Cover construction work. It was always the intent of DOE/Sandia to submit one final report to NMED (i.e., CMI Report) documenting installation of the ET Cover that included the required CQA Report certified by the CQA Engineer. In order to accomplish this, the 2007 Draft Subgrade CQA Report was updated to incorporate the 2009 ET Cover Construction activities. During preparation of the 2009 CMI and CQA Reports, Dr. Kelly Peil (certifying engineer for 2006 Subgrade) was consulted and the approach to revise the 2007 Draft Subgrade CQA Report and modify his 2007 certification statement was discussed. Dr. Peil concurred with the approach and, for completeness, DOE/Sandia retained his certification for the 2006 Subgrade effort.

Based upon this information, it is the position of DOE/Sandia that the 2007 certification presented in Chapter 9 of the CQA Report is appropriate. However, as requested in this NMED comment, DOE/Sandia are replacing the modified 2007 certification statement with the original, and adding an explanatory note at the bottom of the page to address the incorporation of the referenced "CQA subgrade preparation draft report" into the January 2010 CQA Report as described in Section 1.3, page 23.

Dr. Peil and the 2009 CQA Certifying Engineer, Mr. Donald T. Lopez, have reviewed this NOD comment response document and the associated revisions to the CMI and CQA Reports. Chapter 9 of the revised CQA Report (January 2010, Revision 1) includes an updated certification statement from Mr. Lopez as the CQA Certifying Engineer for the MWL ET Cover. The statement addresses the revisions made to the January 2010 report in response to NMED NOD comments dated May 20, 2011.

The associated revisions to the CQA Report are tracked in Table 1 and documented in redline-strikeout format in Attachment 1. As revised in Attachment 1, Dr. Peil's certification statement on page 75 of 79 reflects the original wording of the August 31, 2007 certification statement. Attachment 2 of this comment response document provides replacement pages for the revised certification statement, which have been incorporated into the electronic version of the CMI Report (January 2010, Revision 1) provided on a CD.

6. Hydraulic Conductivity Table

CQA Report, Table 8, 4th column: NMED suggest changing the title of the 4th column to "Sample" Compaction (to avoid confusion with in-place cover compaction) to better describe that the hydraulic conductivity tests were apparently performed on samples that were remolded in the laboratory. With the current column heading one might make the erroneous assumption that 90% compaction was not achieved at all test locations on the cover. Also, regarding Footnote 1, change "Minimum" to "Maximum" with regards to the specified comparison criteria for hydraulic conductivity results.

Response: The CQA Report (Appendix A of the CMI Report), Table 8 has been revised to make the suggested changes. The associated revision to the CQA Report is tracked in Table 1 and documented in redline-strikeout format in Attachment 1. Attachment 2 of this comment response document provides the replacement page, and the revised table is incorporated into the electronic version of the CMI Report (January 2010, Revision 1) provided on a CD.

7. Disposition of Grubbed Vegetation

Volume 2 of the CQA Report, Attachment 1, Record of Meeting for June 5, 2006: item 9 indicated "grubbed vegetation may contain tritium, and will be mulched and stored for placement with topsoil at a later time". Indicate whether the grubbed vegetation that was removed from the MWL surface in 2006 was tested. Indicate also if this vegetation contained tritium and the disposition of this material. Note the October 2, 2006 Record of Meeting, Item 2 which indicates "shredded brush will be stored for future reuse in covered containers." However, the material is not mentioned in the February 12, 2007 minutes which indicated the project would be mothballed and stabilized due to approval delays. The following statement is made in the CQA Report (Section 5.1, second paragraph, third sentence), but no backup was provided in the attachments: "The vegetation removed from the existing MWL surface and the perimeter area was shredded and containerized for future disposition. The material was sampled for radiological contamination and approved for reuse." Provide additional clarification and supporting documentation in the CMI Report concerning the management and disposition of the grubbed vegetation.

Response: Between October 5 and 16, 2006, one grab sample of a soil-vegetation mixture and one pinch sample of soil only were collected from each of the four piles of grubbed vegetation stockpiled at the MWL. The four sample pairs (8 total samples) were analyzed for gamma spectroscopy, tritium, gross alpha and gross beta. All sample results were reviewed and were below background activities, including the tritium results. The soil and vegetation were subsequently segregated and the vegetation was shredded and containerized in roll off containers (as shown in the 10/23/06 photograph in the CQA Report, Volume 1 Photographic Log). The original intent was to use this shredded vegetation to increase the organic content of the topsoil

material. However, due to the delay in NMED approval to proceed with ET Cover installation, the shredded vegetation was eventually disposed of at the Kirtland Air Force Base (KAFB) Landfill to allow the roll off containers to be used at other SNL locations. Segregated soil material was used to maintain the surface-water soil berm surrounding the MWL site. The October 2006 soil-vegetation grab sample radiological analytical results are maintained in the SNL Customer Funded Record Center.

The CQA Report (Appendix A of the CMI Report), Section 5.1, second paragraph, third sentence has been revised to clarify the disposition of the grubbed vegetation at the KAFB Landfill. This revision is tracked in Table 1 and documented in redline-strikeout format in Attachment 1. Attachment 2 of this comment response document provides the replacement page, and the revised text is incorporated into the electronic version of the CMI Report (January 2010, Revision 1) provided on a CD.

8. Monitoring Well Extension

CQA Report, Attachment 8, Figure 2-5, center of figure: "PVC Slip Coupling w/ Stainless Steel Screens" should read "PVC Slip Coupling w/Stainless Steel Screws".

Also in Attachment 8, Section 3, first bullet provides justification of the "double anchored" well resulting from not demolishing the original well pad. The Permittees should carefully monitor and observe the upper 10 feet of the interior casing during future sample events to monitor whether this arrangement causes damage to the well casing from potential settlement of underlying waste.

Response: The error in Figure 2-5 of Attachment 8 in the CQA Report (Appendix A of the CMI Report, Volume 2), has been corrected. The associated revision to the CQA Report is tracked in Table 1 and documented in redline-strikeout format in Attachment 1. Attachment 2 of this comment response document provides the replacement page, and the revised figure is incorporated into the electronic version of the CMI Report (January 2010, Revision 1) provided on both CDs.

In addition, DOE/Sandia will inspect the upper 10 feet of the interior casing during future sampling events to monitor whether this arrangement causes damage to the well casing from potential settlement of underlying waste.

Table 1
Mixed Waste Landfill Corrective Measures Implementation Report
Revisions Made in Accordance with the New Mexico Environment Department
Notice of Disapproval Comments Dated May 20, 2011

NOD Comment #	CMI Report Page Revisions	CQA Report, Volume 1 Page Revisions	CQA Report, Volume 2 Page Revisions
--	Cover and title pages, page i[1]	Appendix A cover page, report cover and title pages (pages 1 and 3), page 15[1]	No Change
1	ii, 1-9, 2-6	Pages 7, 16, 20, 41, 69 and 73	No Change
2	ii, 1-9, 2-6	Pages 7, 16, 20, 69, 70 and 73	No Change
3	No Change	Page 51	No Change
4	No Change	Page 59	No Change
5	No Change	Pages 75 and 76	No Change
6	No Change	Tables-Page 15 of 33	No Change
7	No Change	Page 49	No Change
8	No Change	No Change	Attachment 8, Page 2-8
NA	No Change	Tabbed section in back of report labeled "As-Built Drawings", Figure No. 1 – 4 depicting the 2009 As-Built Drawings[2]	No Change

Note: Revised CMI and CQA Report pages referenced above are provided in redline-strikeout format in Attachment 1 to document the changes made in response to NMED NOD comments #1 through 8.

[1] Changes made to the cover and title pages to include "Revision 1" following "January 2010." A brief note has been added to the beginning of the Executive Summaries to explain revision of the January 2010 document in response to the NMED NOD.

[2] Revised as-built drawings for the 2009 ET Cover are provided as part of this NOD Response to document the location of two access gates in the perimeter security fence at the northern and southern ends of the MWL not previously shown on the original drawings. These changes are not related to a specific NMED NOD comment and they are not provided in redline-strikeout format in Attachment 1.

CMI	Corrective Measures Implementation
CQA	Construction Quality Assurance
NA	Not applicable
NMED	New Mexico Environment Department
NOD	Notice of Disapproval

Attachment 1

Revisions to the MWL CMI Report in Redline-Strikeout Format

This Attachment Includes Revised Pages From:

- CMI Report, Main Text
- CMI Report, Appendix A - CQA Report, Volume 1, Main Text
- CMI Report, Appendix A, CQA Report, Volume 2, Attachments

Revised Pages in Redline-Strikeout Format
MWL CMI Report Main Text

Sandia National Laboratories

Sandia National Laboratories/New Mexico Environmental Restoration Project

MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION REPORT

JANUARY 2010

Revision 1

United States Department of Energy
Sandia Site Office

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

EXECUTIVE SUMMARY

This document represents a revision to the January 2010 Mixed Waste Landfill Corrective Measures Implementation Report in response to the New Mexico Environment Department Notice of Disapproval dated May 20, 2011.

Sandia National Laboratories/New Mexico (SNL/NM) is located within the boundaries of Kirtland Air Force Base, immediately south of the city of Albuquerque in Bernalillo County, New Mexico. Sandia Corporation (Sandia), a wholly owned subsidiary of Lockheed Martin Corporation, manages and operates SNL/NM for the U.S. Department of Energy (DOE). Sandia performs research and development in support of various energy, weapons, and national security programs. It also performs work for the U.S. Department of Defense, the U.S. Nuclear Regulatory Commission, and other government agencies.

The Mixed Waste Landfill (MWL) is located 4 miles south of SNL/NM central facilities and 5 miles southeast of the Albuquerque International Sunport. The MWL is a fenced, 2.6-acre Solid Waste Management Unit in the north-central portion of Technical Area 3 that was a disposal area for low-level radioactive and minor amounts of mixed waste from March 1959 through December 1988. Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies of activity (in 1988) were disposed of in the MWL. The New Mexico Environment Department (NMED) is authorized by the U.S. Environmental Protection Agency to implement and enforce the corrective action requirements for the MWL.

In this MWL Corrective Measures Implementation (CMI) Report, the DOE and Sandia demonstrate that the deployment of the MWL alternative evapotranspirative (ET) cover (hereafter referred to as the ET Cover) was performed in accordance with the requirements, specifications, and design drawings presented in the MWL Corrective Measures Implementation Plan (CMIP) (SNL/NM November 2005). The MWL ET Cover was deployed from October 2006 through September 2009 and consists of four main layers: compacted subgrade, biointrusion barrier, compacted native soil, and topsoil. The Subgrade varies in thickness from 0 to 3.3 feet, and the combined average thickness of the overlying ET Cover layers (Biointrusion, Native Soil, and Topsoil Layers) is 5.37 feet. The overall footprint of the ET Cover is 4.1 acres including side slopes. The ET Cover was constructed with approximately 33,000 cubic yards of soil fill and 6,800 cubic yards of rock (in-place, compacted volumes) that meet CMIP specifications based upon 113 laboratory tests (Standard Proctor, Gradation, Classification, and Saturated Hydraulic Conductivity), 271 field tests (in-place density and moisture), and visual inspections. All MWL ET Cover construction activities were observed, inspected, and documented by an independent third-party Construction Quality Assurance (CQA) contractor.

This MWL CMI Report meets the requirements stipulated in the NMED Final Order In the Matter of Request for a Class 3 Permit Modification for Corrective Measures for the MWL (Final Order) (NMED May 2005); the CMIP (SNL/NM November 2005); the SNL/NM Resource Conservation and Recovery Act Permit (as modified for the MWL after the Final Order); the Compliance Order on Consent (NMED April 2004); and the NMED conditional approval for the MWL CMIP (Bearzi December 2008). The MWL Alternative Cover CQA Report (Appendix A of this CMI Report) is certified by a New Mexico-registered Professional Engineer and provides all construction quality control and CQA data and documentation required to verify that the MWL ET Cover meets NMED requirements and the specifications of the CMIP.

On May 26, 2005, the Secretary of the NMED selected a vegetative soil cover with a biointrusion barrier (i.e., the ET cover) as the remedy for the MWL. The remedy selection was documented in the NMED Final Order for the MWL (NMED May 2005) that also required submittal within 180 days of a CMIP incorporating the selected remedy. The MWL CMIP (SNL/NM November 2005) was submitted to the NMED in November 2005 and outlines the deployment of the MWL ET Cover (Chapter 2.0), the regulatory basis (Chapter 3.0), MWL characteristics (Chapter 4.0), the technical basis for the cover (Chapter 5.0), the MWL alternative cover design (Chapter 6.0), and cover performance monitoring (Chapter 7.0). Appendices include Construction Specifications (Appendix A), a CQA Plan (Appendix B), and other supporting documentation. The MWL CMIP was conditionally approved by the NMED in December 2008 (Bearzi December 2008), and all conditions related to construction of the MWL ET Cover were addressed and incorporated into the CMIP through replacement pages (Davis February 2009).

Deployment of the MWL alternative ET Cover was conducted in two main phases. During the first phase in 2006, MWL Borrow Pit and Subgrade construction activities were conducted in preparation for ET Cover construction. Soil fill material was excavated, screened to 2-inch minus, and stockpiled at the MWL Borrow Pit from June through July 2006. Following the NMED approval in September 2006, Subgrade construction was performed from October through December 2006, and protective measures installed on the completed Subgrade surface in April 2007. After NMED conditional approval of the CMIP in December 2008 (Bearzi December 2008), the MWL ET Cover was constructed during the second phase, which took place from May through September 2009.

The MWL Alternative Cover CQA Report (Appendix A) is the comprehensive report that documents all aspects of MWL ET Cover deployment and addresses all CMI Report data and documentation requirements. All ET Cover materials and layers were approved by the CQA Engineer as specified in the CQA Plan in Appendix B of the CMIP (SNL/NM November 2005) prior to starting construction of the next layer. All nonconformances and design changes were identified; documented; resolved in consultation between the Sandia Project Staff, the Construction Team, and the CQA Team; and approved by the CQA Engineer. The design changes were implemented and resulted in a thicker, more conservative and protective MWL ET Cover.

Longer-term aspects of site revegetation, monitoring and maintenance, and institutional controls will be addressed in a revised MWL Long-Term Monitoring and Maintenance Plan that will be prepared and submitted to the NMED within 180 days of approval of this MWL CMI Report.

Construction phase CQA and CQC information. The resulting MWL Alternative Cover CQA Report (Appendix A) integrates NMED requirements, including a detailed summary of the construction activities, laboratory and field testing results, land surveying results, as-built drawings, quality assurance verification survey plates, a photographic record of the construction activities, and other CQA documentation (i.e., meetings, daily reports, inspection forms, and data and cover layer approvals).

For both the 2006 and 2009 construction phases, a representative of the CQA Team was at the construction site each workday to inspect and oversee construction activities, laboratory and field testing, and land surveying. The CQA inspections and oversight are documented in daily reports, inspection checklists/forms, and approval forms provided in the MWL Alternative Cover CQA Report (Appendix A). All ET Cover layers were approved by the CQA Engineer as stipulated by the CQA Plan in Appendix B of the CMIP (SNL/NM November 2005) prior to starting construction of the next layer. All nonconformances and design changes were identified, documented, and resolved in consultation between the Sandia Project Staff, the Construction Team, and the CQA Team. Overall, the design changes resulted in a thicker, more protective ET Cover and there were no adverse impacts to ET Cover quality as a result of the nonconformances and design changes.

Table 2-3
MWL CMI Report Requirements – Documentation Requirements Summary and Cross-Walk

Documentation Requirement	Location in the MWL Alternative Cover CQA Report (Appendix A)		Comments
	CQA Data	CQC Data	
Daily reports of construction activities	Described in Section 4.1 Reports in Attachment 3	NA	Daily Reports were the responsibility of the CQA Team. For 2009 ET Cover Construction phase, daily reports were completed by the Construction Team but not included in the CQA Report.
Documentation of equipment used	Described in Chapter 5.0, Table 13, and Daily Reports See comments for additional information	NA	Documentation of equipment used for the 2006 Subgrade Construction phase is documented in Daily Reports (Attachment 3) and Section 5.2.1. For 2009 ET Cover Construction phase, equipment used is documented in Daily Reports and Table 13, and described in Sections 5.2.2, 5.3.2, 5.3.3, 5.4, 5.5, and 5.6.
Inspection checklists/forms[1]	Described in Section 4.2 Forms in Attachments 4-6	NA	Receiving, Construction, and Testing Inspection Forms and related documentation were completed by the CQA Team.
Supporting documentation for laboratory and field testing[1]	Described in Section 4.3 Supporting documentation in Attachment 7	Described in Section 4.3 Supporting documentation in Attachment 7	Supporting documentation for all 2006 Subgrade and 2009 ET Cover laboratory and field testing is included in Attachment 7 and represents CQA documentation. See Table 2-2 for additional information on CQA and CQC laboratory and field testing.
As-Built Drawings	Described in Sections 2.5 and 4.4	Described in Section 2.5 and 4.4 Results in Table 12 and 2006 Subgrade As-Built Drawing and 2009 As-Built Drawings in tabbed section at end of report	For 2006 Subgrade Construction phase, all surveying was for CQC and documented in the 2006 Subgrade As-Built Drawing. For 2009 ET Cover Construction phase, the Construction Team performed all required field control and final surveying and prepared the final as-built drawings. The 2009 as-built drawings are complete, final drawings documenting the MWL ET Cover. See Table 2-2, "Land Survey Data," for more information.
Photographic records	Described in Section 4.5	NA	Photographic Logs for both 2006 and 2009 phases included in a tabbed section at end of the CQA Report.
CQA Engineer Approval of all Cover Layers, Design Changes, and Final Construction	Described in Sections 3.4, Chapters 7 and 9, and Tables 3 and 14	NA	Table 3 documents approval of all Cover Layers. Chapter 7.0 and Table 14 document all nonconformances and design changes. Attachment 2 provides approval documentation. MWL ET Cover construction is certified by a New Mexico-registered Professional Engineer in Chapter 9.0.

[1] All construction materials and the completed Subgrade and ET Cover Layers were approved by the CQA Engineer as documented in Section 3.4, Chapter 7.0, and Table 3; with supporting documentation in Attachments 1, 2, and 7.

CMI Corrective Measures Implementation
CQA Construction Quality Assurance
CQC Construction Quality Control
ET Evaporatranspirative
MWL Mixed Waste Landfill
NA Not applicable

Revised Pages in Redline-Strikeout Format
MWL CMI Report, Appendix A - CQA Report, Volume 1
Main Text and Table Section

APPENDIX A

Mixed Waste Landfill Alternative Cover Construction Quality Assurance Report January 2010 Revision 1

Volume 1 Main Text and Tabbed Sections

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Mixed Waste Landfill
Alternative Cover Construction
Quality Assurance Report

Submitted to

Sandia National Laboratories

P.O. Box 5800

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January 2010

Revision 1

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MIXED WASTE LANDFILL
ALTERNATIVE COVER
CONSTRUCTION QUALITY ASSURANCE REPORT

JANUARY 2010

Revision 1

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Executive Summary

This document represents a revision to the January 2010 Mixed Waste Landfill Alternative Cover Construction Quality Assurance Report in response to the New Mexico Environment Department Notice of Disapproval dated May 20, 2011.

Sandia National Laboratories/New Mexico (SNL/NM) is located within the boundaries of Kirtland Air Force Base (KAFB), immediately south of the city of Albuquerque in Bernalillo County, New Mexico. SNL/NM is owned by the U.S. Department of Energy (DOE) and managed and operated by Sandia Corporation (Sandia), a wholly owned subsidiary of Lockheed Martin Corporation. Sandia performs research and development in support of various energy, weapons, and national security programs. Sandia also performs work for the U.S. Department of Defense, the U.S. Nuclear Regulatory Commission, and other government agencies.

The Mixed Waste Landfill (MWL) at SNL/NM is designated as an Underground Radioactive Materials Area under DOE requirements and a Hazardous and Solid Waste Amendments Solid Waste Management Unit subject to New Mexico Environment Department (NMED) corrective action regulations as delegated by the U.S. Environmental Protection Agency (EPA). The NMED is authorized by the EPA to implement and enforce the corrective action requirements for the MWL. The MWL is located within the boundaries of KAFB on federal land controlled by the DOE. The MWL consists of two distinct disposal areas; the classified area in the northeast portion occupies 0.6 acres and the unclassified area occupies 2.0 acres. Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies of activity (at the time of disposal) were disposed of in the MWL from March 1959 through December 1988.

The MWL alternative evapotranspirative (ET) cover (hereafter referred to as the ET Cover) was deployed from October 2006 through September 2009 and consists of four main layers: compacted subgrade, biointrusion barrier, compacted native soil, and topsoil (Figure ES-1). The Subgrade varies in thickness from 0 to 3.3 feet, and the combined average thickness of the overlying ET Cover layers (Biointrusion, Native Soil, and Topsoil Layers) is 5.37 feet. The overall footprint of the ET Cover is 4.1 acres including side slopes. The ET Cover was constructed with approximately 33,000 cubic yards (cy) of soil fill and 6,800 cy of rock (in-place, compacted volumes) that meet the specifications provided in the MWL Corrective Measures Implementation Plan (CMIP) (SNL/NM, November 2005) based upon 113 laboratory tests (Standard Proctor, Gradation, Classification, and Saturated Hydraulic Conductivity), 271 field tests (in-place density and moisture), and visual inspections. All MWL ET Cover

construction activities were observed, inspected, and documented by an independent third-party Construction Quality Assurance (CQA) contractor.

This MWL Alternative Cover CQA Report documents the implementation of the MWL CMIP (SNL/NM, November 2005) that was conditionally approved by the NMED (Bearzi, December 2008) and addresses all requirements for the MWL Corrective Measures Implementation Report as defined in the NMED Final Order for the MWL (NMED, May 2005); the CMIP (SNL/NM, November 2005); the SNL/NM Resource Conservation and Recovery Act Permit (as modified for the MWL after the Final Order); the Compliance Order on Consent (NMED, April 2004); and the NMED conditional approval of the MWL CMIP (Bearzi, December 2008). The CMIP contains the Construction Specifications (Appendix A) and CQA Plan (Appendix B) that define the construction, design, and quality assurance requirements for construction of the MWL Alternative Cover (i.e., MWL ET Cover).

Deployment of the MWL ET Cover was conducted in two main construction phases, the 2006 Subgrade Construction and 2009 ET Cover Construction. The 2006 Subgrade Construction phase began on October 2, 2006, following the NMED approval received in September 2006 (Bearzi, September 2006), and was completed on April 11, 2007. This phase involved MWL Borrow Pit activities to generate soil fill material for cover construction, preparation of the existing disposal area surface, construction of the Subgrade, and installation of erosion control measures to protect the Subgrade surface while awaiting final NMED approval of the CMIP. The 2009 ET Cover Construction phase was performed from May 20 through September 3, 2009, and involved preparation of the Subgrade surface, construction of the ET Cover layers (Biointrusion, Native Soil, and Topsoil Layers) and site drainage features, installation of the administrative security fence, and site revegetation activities. Minor variances in construction and/or design specifications that did not adversely affect the quality of the cover were documented as nonconformances or design changes and approved by the CQA Engineer. Overall, the final MWL ET Cover as constructed provides a thicker, more protective ET Cover relative to the CMIP minimum design specifications. The completed ET Cover is shown schematically in Figure ES-1.

Third-party CQA services were provided by MKM Engineers, Inc. during the 2006 Subgrade Construction phase (under subcontract to URS Group, Inc. [URS]), and by URS during the 2009 ET Cover Construction phase. This report and the attachments provide the construction quality control and CQA data and documentation required to verify that the MWL ET Cover meets the construction and design specifications of the NMED-approved CMIP (SNL/NM, November

All MWL ET Cover construction activities were observed, inspected, and documented by an independent third-party CQA contractor.

Deployment of the MWL ET Cover is detailed in this MWL Alternative Cover CQA Report (Volumes 1 and 2), which incorporates all construction quality control (CQC) and CQA data and documentation requirements for the MWL Corrective Measures Implementation (CMI) Report as defined in the NMED Final Order for the MWL (NMED, May 2005); the CMIP (SNL/NM, November 2005); the SNL/NM Resource Conservation and Recovery Act (RCRA) Permit (as modified for the MWL after the Final Order); the Compliance Order on Consent (NMED, April 2004); and the NMED conditional approval of the MWL CMIP (Bearzi, December 2008).

Volume 1 includes the main text (Chapters 1.0 through 10.0) and tabbed sections located at the end of this report. Chapter 1.0 provides background information and the purpose and scope of this report. Chapter 2.0 presents the roles and responsibilities of the organizations, contractor teams, and key personnel. Chapter 3.0 presents project communications, the construction approval process, and related CQA documentation. The CQC and CQA programs that were implemented to test, control, and verify construction of the ET Cover according to the specifications and design drawings in the CMIP are presented in Chapter 4.0, along with the associated CQC and CQA data. Chapter 5.0 provides a detailed summary of the 2006 Subgrade and 2009 ET Cover Construction earthwork. Chapter 6.0 discusses the extension of groundwater monitoring well MWL-MW4 and the installation of two required soil-vapor monitoring wells; these tasks were completed in 2009 during installation of the ET Cover. Chapter 7.0 summarizes nonconformances and design changes (i.e., minor variances in construction and/or design specifications that do not affect the quality of the cover) to the CMIP specifications and design drawings. Chapters 8.0 and 9.0 provide the conclusions and CQA Engineering Certification of ET Cover construction, respectively. Report references are provided in Chapter 10.0. Tabbed sections at the end of Volume 1 include all tables, figures, as-built drawings, quality assurance (QA) verification survey plates, and photographic logs. Volume 2 contains Attachments 1 through 8 that include supporting CQC and CQA documentation. Volume 2 is provided in electronic format (PDF files) on a compact disc (CD) at the end of this report. Separately bound hard copies of the attachments in Volume 2 are available in the NMED Hazardous Waste Bureau document library (Santa Fe, New Mexico), the DOE/Sandia document repository (Public Reading Room, Zimmerman Library at the University of New Mexico, Albuquerque, New Mexico), and the SNL/NM Customer Funded Records Center (formerly known as the ES&H [Environment, Safety, and Health] and Security Records Center).

density and moisture readings were obtained to verify compaction of not less than 90 percent of the maximum dry density. After discussions with the SCR and Sandia Oversight, Construction Team, and CQA Team personnel, this approach was approved by the CQA Engineer for verification of a stable surface, rather than counting the number of passes over an area using a roller with a ballasted weight of 25 tons, as stipulated in Section 02200 in Appendix A of the CMIP (SNL/NM, November 2005). Due to moisture being added to the surface rather than mixed into the soil prior to placement, the optimum moisture content goal of +/- 2 percent could not be attained using either compaction method. However, the field-testing results provided a more quantitative method and verified adequate compaction of the existing surface.

The spatial extent of most Subgrade Construction phase lifts was highly variable due to the uneven existing surface, so many of the lifts were significantly smaller than 1 acre. Therefore, the number of tests per lift was generally less than five. The field test locations were selected to be representative of each lift and were surveyed, recorded on an inspection checklist, and plotted on maps. The actual in-place density and moisture testing performed during Subgrade construction exceeded CMIP specifications of 5 CQC tests per acre per lift plus at least 5% additional confirmatory CQA tests. Based upon the aerial extent of the twelve Subgrade lifts, only 48 CQC and 3 CQA tests were required based upon the CMIP requirements (total of 51 tests). However, a total of 71 field tests were performed. Figures 5 through 17 show the locations of all existing surface and Subgrade field tests, Table 9 summarizes the results, and Attachment 7 provides the associated field and laboratory documentation. Testing inspection forms completed in the field are included in Attachment 6.

For the 2006 Subgrade Construction phase field-testing program, the native soil fill material was tracked as it was sampled, hauled, and placed. The associated Proctor result for every 500 cy was used to support the in-place density and moisture field tests of that 500 cy of fill material as it was placed and tested. The Subgrade lifts were relatively small making this approach feasible, although verifying the Proctor result characterizing each 500 cy of fill material that was placed, compacted, and tested was challenging. In one situation, this approach could not be followed due to laboratory reporting delays. The CQA Engineer approved proceeding with the previous Proctor results because the physical properties of the native soil fill were consistent. As more Standard Proctor results became available it was evident that the Borrow Pit fill material was relatively uniform in terms of its geotechnical characteristics, especially after screening and stockpiling.

5.1 Existing Mixed Waste Landfill Surface

Preparation of the existing MWL surface was conducted as the first part of the 2006 Subgrade Construction phase. From October 2 through October 26, 2006, the security fence was removed and the MWL surface was cleared of vegetation. After clearing, the existing surface was graded, watered, compacted, and tested in preparation for the Subgrade Construction phase. As part of site preparation work, an area immediately south of the MWL was cleared and used as the staging area for the soil stockpile, the roll-off containers for waste and recyclable metal, the container for shredded vegetation, and equipment storage. The work area boundary was marked with a rope and signs to designate the radiation control area that was in effect for the 2006 Subgrade Construction phase. After completion of the Subgrade Construction phase, which involved placement of clean soil fill over the disposal area surface, the radiological posting of the MWL was changed to an Underground Radioactive Materials Area. This allowed the 2009 ET Cover Construction phase to proceed without formal radiological controls, although SNL/NM Radiological Control Technicians continued to be involved in the early construction phases to confirm clean operations.

Soil berms were constructed around the perimeter work area as a best management practice required by the project SWPPP for the control of storm water run-on and to control runoff from the site. The berms were inspected after each significant rainfall event (i.e., more than 0.5 inches) or semimonthly at a minimum, according to the project SWPPP requirements, and repairs were made as necessary. The existing administrative security fencing was removed and stockpiled on site for radiological clearance before disposal or recycling. The vegetation removed from the existing MWL surface and the perimeter area was shredded and containerized for future disposition. The material was sampled for radiological contamination, ~~and~~ approved for reuse, and disposed of at the KAFB Landfill. Any material on the surface larger than 2 inches was removed and stockpiled. One remaining concrete pad pit cover was reduced to rubble in place and backfilled with stockpiled soil.

The existing surface was uneven due to the previously backfilled disposal trenches. The surface was graded, compacted with a vibratory roller, and water was added using a water truck to complete existing surface preparation activities.

5.1.1 Existing Surface Laboratory and Field Testing

After the surface was graded and compacted, in-place field density and moisture testing were performed to verify compaction of not less than 90 percent of the maximum dry density. Standard Proctor soil testing to support the in-place density and moisture field testing was

The following equipment was used for 2006 Subgrade Construction phase earthwork:

- Dump trucks to haul the soil (Volvo WG 64)
- Two front-end loaders to haul and spread the soil in lifts (John Deere 644G)
- An excavator at the soil stockpile to mix the soil with water before placing it on the MWL surface (John Deere 240)
- A grader (John Deere 670) to spread the soil to the required thickness (grader later replaced with a tracked bulldozer [John Deere 650G])
- One water truck (2,000 gallon Ford F650) to moisture-condition the soil and to control dust in the work area
- One vibratory roller for compacting the soil lifts (Ingersoll Rand SD 70D, 8 ton gross weight, maximum centrifugal force 32,100 pounds)
- A skid steer to spread the soil in tight areas and around groundwater monitoring well MWL-MW4 (Caterpillar 246B)

The Subgrade was installed on top of the prepared existing surface using approximately 11,000 cy (loose) of native soil fill placed in a total of 12 lifts. The subgrade soil was placed in 8-inch loose, 6-inch compacted lifts beginning with the topographically lowest areas. In general, the lower northern side of the MWL was augmented to match the higher southern grade. The goal of the Subgrade Construction phase was to establish a surface over the MWL that mirrored the final CMIP design surface of the ET Cover (i.e., a broad, central crown or high area with a 2-percent east-to-west slope across most of the MWL).

The initial seven lifts were spatially limited and largely placed to bring depressions across the site to a level grade. Lifts 8 through 12 were placed in increasingly larger areas across the MWL. A total of 12 lifts were applied, with the total depth varying from a few inches to 40 inches (approximately 3.3 feet) at the lowest spots. To guide and control lift thickness across the area, the surveyors installed grade stakes marked in 8-inch thickness levels for each lift. Each lift was compacted to meet the CMIP specification of compaction of not less than 90 percent of the maximum dry density at +/- 2 percent of optimum moisture content, as determined by ASTM D698 (Standard Proctor testing) (ASTM, 2007a). Compaction with the vibratory roller resulted in an approximate 6-inch lift. The in-place, compacted volume of the Subgrade is approximately 7,700 cy indicating a compaction factor of approximately 30 percent.

The quantity of soil was tracked by the volume per loader bucket and the number of loads per day. A total volume of soil was recorded for each lift and the locations of each laboratory and

thickness of the Native Soil Layer. The thickness of this soil layer is not considered part of the Biointrusion Layer or the Native Soil Layer, both of which meet minimum thickness specifications of the CMIP without including this layer. Grid points and surrounding areas where the thin soil layer exceeded 3 inches were rechecked and adjusted using the JD 670 motor grader where feasible. If the soil layer could not be scraped and thinned without encountering the underlying rock, no further adjustment was made.

All grid points that were altered were resurveyed, and the final average thickness of the thin soil layer overlying the Biointrusion Layer was 0.25 feet (Table 12). Final approval of the thin soil layer occurred on June 17, 2009 (Section 3.4 and Table 3).

The final average thickness of the completed Biointrusion Layer was 1.25 feet, which equals the CMIP upper tolerance thickness. The complete volume of rock used for the Biointrusion Layer is estimated at 6,800 cy. The in-place surveyed volume is approximately 5,800 cy. The 1,000-cy discrepancy (approximately 15 percent reduction) is most likely attributable to the fact that the Subgrade surface elevation was lowered approximately 1 to 2 inches during the scarification process prior to installing the Biointrusion Layer rock material. Initial volume estimates of the received rock may have also been biased slightly high.

5.4 Native Soil Layer

Construction of the Native Soil Layer was conducted from June 16 through August 4, 2009. Construction started on the side slopes around the northern end of the MWL, which were built up in lifts to meet the 6 to 1 slope requirement from June 16 through June 22, 2009. Construction of the Native Soil Layer on the surface of the MWL started on June 18, 2009, after the thin soil layer overlying the Biointrusion Layer was approved on June 17, 2009 (Table 3). Construction of the side slopes around the northern end of the MWL and the first Native Soil lift (Wedge Lift 1) on the MWL surface proceeded concurrently from June 18 through June 22, 2009.

To support construction of the Native and Topsoil Layers, additional soil fill material was excavated, screened to 2-inch minus, and stockpiled at the Borrow Pit from June 12 to July 24, 2009. During this time period, the soil berm around the MWL site originally installed as part of the 2006 Subgrade Construction phase SWPPP was excavated, hauled to the Borrow Pit, and screened for use as native soil fill (a perimeter silt fence had been installed around the berm in late May 2009). The quantity of ~~S~~soil fill stockpiled at the Borrow Pit in 2006 based on CMIP estimates was not sufficient to complete construction of the Native Soil and Topsoil Layers. During the Quality Resolution Meeting held on July 14, 2009, estimates were finalized for

7.0 Cover Layer Approvals, Nonconformances, and Design Changes

Documentation associated with the 2009 Quality Resolution Meetings and ET Cover layer approval is summarized in Sections 3.3 and 3.4, Table 3, and Attachments 1 and 2. Based upon the final CQC survey data (Table 12) and 2009 as-built drawings (Figures No. 2 and 3 in tabbed section at the end of this report), the final ET Cover surface meets the 2-percent east-to-west surface design slope, and all side slopes meet or exceed (i.e., are flatter) than the 6 to 1 specification. All cover layers were approved prior to starting construction of the next layer as stipulated in the CMIP CQA Plan (SNL/NM, November 2005–Appendix B).

Consistent with the CMIP CQA Plan, nonconformances are defined as deviations or changes to construction and/or design specifications. If it is determined by the CQA Engineer that a nonconformance has ~~that have~~ an adverse impact on quality of the ET Cover, ~~and therefore require~~ a corrective action plan and documentation of corrective action implementation are also required. Design changes are minor variances from construction and/or design specifications that do not have an adverse impact on quality and therefore do not require corrective action. However, nonconformances and design changes must be documented.

Two nonconformances were identified. During the 2006 Subgrade construction phase, CQC versus CQA in-place density and moisture field tests were not clearly distinguished and the CQA Team directed/performed all of the field testing instead of the construction team performing/directing the required CQC tests. The actual in-place density and moisture testing performed during Subgrade construction exceeded the CMIP specifications of 5 CQC tests per acre per lift plus at least 5% additional confirmatory CQA tests. Based upon the aerial extent of the 12 Subgrade lifts, 48 CQC and 3 CQA field tests were required; however, a total of 71 field tests were performed. In the judgment of the CQA Engineers, the testing performed exceeded requirements and there was no quality impact to the Subgrade of the MWL ET Cover.

The second nonconformance occurred during the 2009 ET Cover construction phase and involved saturated hydraulic conductivity tests performed using the ASTM D-5856 rigid wall (remolded) method on the Native Soil Layer fill material. Although the term “rigid wall” is used twice in the CMIP construction specifications (Appendix A, Section 02200 Earthwork) and is a valid method for determining the saturated hydraulic conductivity in these types of soils, the intent of the CMIP specification appears to indicate the use of the ASTM D-5084 flexible wall (undisturbed) method. After discussion at the June 16, 2009 Quality Resolution Meeting, the

project team agreed that the ASTM D5856-95 rigid wall method was the best method for two main reasons: 1) samples could be collected without compromising the integrity of the installed Native Soil Layer lift (i.e., without punching holes in the lift surface), and 2) compaction of the sample in the laboratory could be controlled to accurately simulate compaction achieved in the field. In the judgment of the CQA Engineer there was no impact on the quality of the ET Cover and a corrective action plan was not required.

~~There were no ET Cover construction nonconformances.~~ All design changes are summarized in Table 14, along with a brief explanation of why they had no adverse quality impact. For both the 2006 Subgrade and 2009 ET Cover Construction phases, all technical issues and design changes were addressed by the respective project teams and resolved through a team approach in documented meetings and project-specific approval forms as discussed in Chapter 3.0. The project teams included Sandia Oversight, CQA Team, and Construction Team representatives. The design changes were approved by the CQA Engineer and did not result in an adverse impact on the quality of the final cover. In all instances, the implemented design changes had a neutral or positive impact on ET Cover quality.

For the 2006 Subgrade construction activities, the compaction and in-place density and moisture field-testing approach for the existing MWL surface, supported by Standard Proctor results, provided a more quantitative approach for verifying adequate compaction than the CMIP-specified approach of "counting 10 passes of a roller with ballasted weight of 25 tons and a minimum tire pressure of 90 psi." The overall relative uniformity of the Borrow Pit soil fill material, particularly after screening and stockpiling procedures, is demonstrated by the large number of Standard Proctor, Gradation, and Classification results collected throughout the 2006 and 2009 construction phases (Tables 4, 5, 6, and 7; Figure 20). These data support the conclusion that the existing MWL surface soil is very similar to the Borrow Pit soil. In addition, the data support the use of relatively few Proctors for the 2009 in-place density and moisture field-testing program, as well as the use of one Proctor to cover approximately 1,500 cy of soil fill during the 2006 Subgrade Construction phase field-testing program, as approved by the respective CQA Engineers.

On May 22, 2009, a Quality Resolution Meeting was held to discuss the 2009 existing Subgrade surface, which did not meet the 2-percent east-to-west surface design slope across the eastern side of the cover from the central portion to the southern end of the MWL (slopes ranged from 1.8 to 1.9 percent in this area). After evaluating the CQC survey data and discussing possible solutions, Sandia Oversight, Construction Team, and CQA Team representatives determined that

8.0 Conclusions

For the 2006 Subgrade Construction phase only, an independent MWL CQA Plan (SNL/NM, May 2006) was prepared that incorporated the regulatory guidance and design and specification requirements for the construction of the MWL cover as defined in the CMIP (SNL/NM, November 2005). For the 2009 ET Cover Construction phase, the CQA Plan in Appendix B of the CMIP (SNL/NM, November 2005) was used directly.

For both the 2006 and 2009 phases, a representative of the CQA team was at the site each workday to inspect and oversee construction activities and the field and laboratory testing. The results of the inspections and oversight are provided on the inspection forms, daily reports, and approval forms attached to this report. This report also presents a summary of the construction activities, CQC and CQA laboratory and field-testing results, CQC and CQA survey results, as-built drawings documenting cover construction, and photographic records of the activities.

All nonconformances and design changes are documented and were made in consultation between the Construction Team, Sandia Project Staff, and the CQA Team. These ~~Design~~ changes did not result in an adverse impact on the quality of the final cover~~, were not considered nonconformances,~~ and did not require corrective action. All cover layers were approved as stipulated by the CQA Plan in Appendix B of the CMIP (SNL/NM November 2005) prior to starting construction of the next layer, and all cover-related design changes resulted in a more protective cover. This report and the attachments provide the required documentation to verify that the MWL existing surface, Subgrade, ET Cover layers (Biointrusion, Native Soil, and Topsoil Layers), and site drainage features were prepared and installed in accordance with the CMIP (SNL/NM, November 2005) construction and design specifications. A New Mexico-registered Professional Engineer has certified that the MWL alternative cover construction was performed in accordance with the plans and specifications (Chapter 9.0).

9.0 Engineering Certification

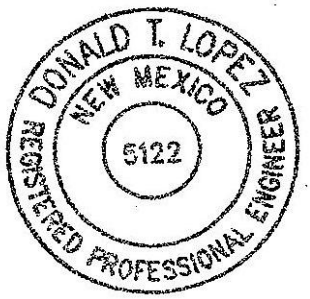
During construction of the ~~2006~~ s~~S~~ubgrade ~~installation~~, I have performed tasks required of the CQA Engineer in accordance with the CQA Plan for the MWL Alternative Cover construction at ~~SNL/NM (SNL/NM, May 2006)~~Sandia National Laboratories, New Mexico. I certify that the MWL s~~S~~ubgrade has been prepared and constructed in accordance with construction plans and specifications ~~provided in the MWL CMIP (SNL/NM, November 2005)~~ and the MWL Cover Construction Quality Assurance Plan. I certify that to the best of my knowledge the ~~"MWL Alternative Cover Construction, Subgrade, Draft Quality Assurance Report" (MKM, August 2007), which has been incorporated into this report,~~CQA subgrade preparation draft report accurately documents the CQA activities conducted under my responsible charge as the CQA Engineer.

Kelly M. Peil, PhD, P.E. Title: CQA Certifying Engineer
MKM Engineers, Inc. Date: August 31, 2007

State: New Mexico Registration No. 9718

Note: The certification statement above pertains to the 2006 Subgrade Construction effort only. The CQA subgrade preparation draft report referenced in the statement above was incorporated into this January 2010 CQA Report as explained in Section 1.3

During the construction of the 2009 ET Cover, I have performed tasks required of the CQA Engineer in accordance with the CQA Plan in Appendix B of the MWL CMIP (SNL/NM, November 2005). I was also involved in an oversight role during the 2006 Subgrade Construction phase and have reviewed the associated CQC and CQA data and documentation. I certify that both the 2006 Subgrade and the 2009 ET Cover for the MWL have been prepared and constructed in accordance with the construction plans, drawings, and specifications contained in the MWL CMIP (SNL/NM, November 2005), including Appendix A (MWL Landfill Alternative Cover Construction Specifications Revision 2 [July 29, 2005]) and Appendix B (CQA Plan). I certify that to the best of my knowledge this MWL Alternative Cover CQA Report, as revised to address NMED comments provided on May 20, 2011, accurately documents the construction, CQC, and CQA activities conducted under my responsible charge as the CQA Certifying Engineer.



Donald T. Lopez, PE
URS Group. Inc.

Title: CQA Certifying Engineer
Date: ~~January 14, 2010~~July 12, 2011

State: New Mexico

Registration No. 5122

Table 8
Mixed Waste Landfill 2009 ET Cover Construction
Saturated Hydraulic Conductivity CQC Laboratory Results

Sample Description	Location	Date Sampled	Sample Compaction	Average Saturated Hydraulic Conductivity[1] (K_{sat}) in cm/s[2]
Native Soil Wedge Lift 1	Grid Block 8	6/19/2009	90.0%	**4.02E-04**
Native Soil Wedge Lift 2	Grid Block 11	6/22/2009	89.0%	**3.58E-05**
Native Soil Lift 3-1	Collected Prior to Placement	6/17/2009	90.2%	**1.59E-06**
Native Soil Lift 3-2	Collected Prior to Placement	6/17/2009	89.7%	**1.81E-06**
Native Soil Lift 3-3	Collected Prior to Placement	6/17/2009	91.0%	**1.98E-06**
Native Soil Lift 4	Grid Block 2	6/30/2009	84.6%	**2.52E-04**
Native Soil Lift 4	Grid Block 6	6/30/2009	81.2%	**1.87E-04**
Native Soil Lift 4	Grid Block 9	6/30/2009	89.8%	**2.14E-04**
Native Soil Lift 5	Grid Block 1	7/9/2009	90.0%	**2.66E-04**
Native Soil Lift 5	Grid Block 4 Retest	7/8/2009	95.3%	**1.43E-04**
Native Soil Lift 5	Grid Block 8 Retest	7/8/2009	94.6%	**1.63E-04**
Native Soil Lift 6-1	Grid Block 3	7/16/2009	90.2%	**3.05E-04**
Native Soil Lift 6-2	Grid Block 6	7/16/2009	90.3%	**3.51E-04**
Native Soil Lift 6-3	Grid Block 12	7/16/2009	89.5%	**2.55E-04**
Native Soil Lift 7	Grid Block 1 Retest	7/20/2009	94.8%	**2.18E-04**
Native Soil Lift 7	Grid Block 5 Retest	7/20/2009	94.8%	**1.87E-04**
Native Soil Lift 7	Grid Block 13	7/22/2009	89.5%	**2.50E-04**
Native Soil Lift 8	Grid Block 2	7/27/2009	90.4%	**1.22E-06**
Native Soil Lift 8	Grid Block 7	7/27/2009	90.0%	**1.23E-06**
Native Soil Lift 8	Grid Block 9	7/27/2009	90.0%	**1.36E-06**
Average			**90.2%**	**1.62E-04**
Geometric Mean			**90.2%**	**4.72E-05**
Median			**90.0%**	**1.87E-04**

[1] ~~Minimum~~ Maximum Value is 4.6E-04.
[2] Tests were performed using ASTM D5856 Rigid Wall Method.
CQC = Construction Quality Control
ET = Evapotranspirative

Revised Pages in Redline-Strikeout Format
MWL CMI Report, Appendix A - CQA Report, Volume 2
Attachment 8

APPENDIX A

Mixed Waste Landfill Alternative Cover Construction Quality Assurance Report January 2010 Revision 1

Volume 2 Attachments

(provided electronically on compact disc)

Attachments in Volume 2 of Appendix A are provided in electronic format (PDF files) on a CD. Separately bound hard copies of Volume 2 are available in the NMED Hazardous Waste Bureau document library (Santa Fe, New Mexico); the DOE/Sandia document repository (Public Reading Room, Zimmerman Library at the University of New Mexico, Albuquerque, New Mexico); and the SNL/NM Customer Funded Records Center (formerly known as the ES&H and Security Records Center).

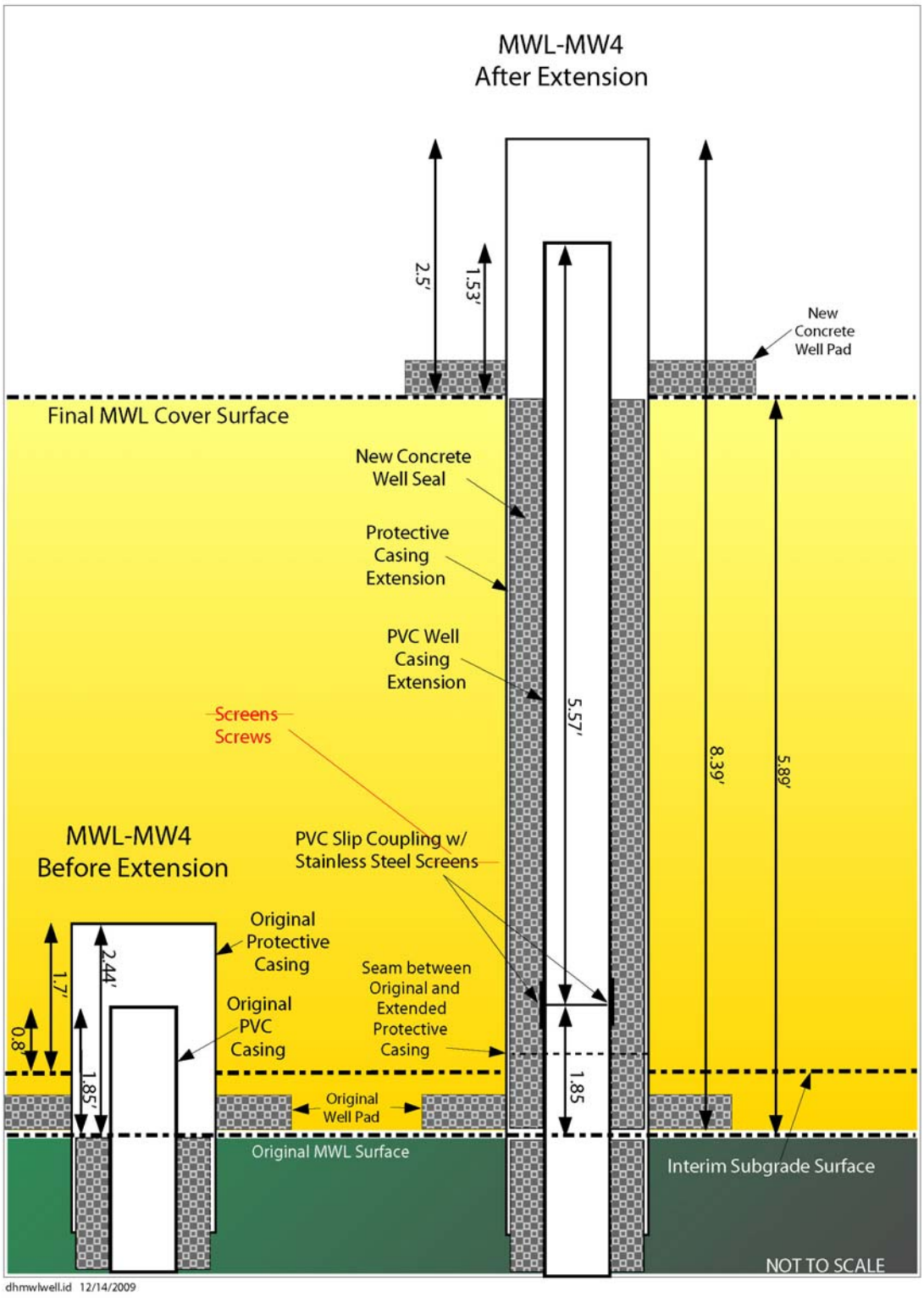


Figure 2-5
Schematic MWL-MW4 PVC Well Casing and Protective Surface Casing Extension Diagram

Attachment 2

[Replacement Inserts and Pages Provided in Hard Copy Only]

MWL CMI Report and CQA Report, Volume 1 & 2 Replacement Inserts, Replacement Pages, and Replacement CQA Report Volume 2 Compact Disc

This Attachment includes the following:

Replacement Inserts

- Cover sheets and spine inserts for the two original January 2010 MWL CMI Report binders
- Entire CMI Report and Appendix A CQA Report Volume 1 text (includes Cover and Title Pages for both reports)

Individual Replacement Pages

- Table 8 of CQA Report, Volume 1 (page 15 of 33 from tabbed "Table" section in back of report)
- Revised as-built drawings for CQA Report, Volume 1 (4 drawings for 2009 ET Cover in tabbed "As-Built Drawing" section in back of report)
- Figure 2-5 of Attachment 8, CQA Report, Volume 2 (only change to this separately bound volume of the report)

Replacement CD

- Appendix A, CQA Report Volume 2 CD that goes in the plastic sleeve in the back of the CQA Report, Volume 1

United States Department of Energy
Sandia Site Office

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Volume III

TAB 18

Notice of Approval: Mixed Waste Landfill Corrective Measures Implementation Report, January 2010

From: NMED/Kieling
To: SNL/Wagner

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NEW MEXICO
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BUTCH TONGATE
Acting Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

October 14, 2011

Patty Wagner
Manager
U. S. Department of Energy
NNSA/Sandia Site Office
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

S. Andrew Orrell
Director
Nuclear Energy & Fuel Cycle Programs
Sandia National Laboratories
P.O. Box 5800, MS 0771
Albuquerque, NM 87185-0771

RE: NOTICE OF APPROVAL
MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION REPORT, JANUARY 2010
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-10-005

Dear Ms. Wagner and Mr. Orrell:

The New Mexico Environment Department (NMED) has reviewed the U. S. Department of Energy's response to the Notice of Disapproval (NOD) issued May 20, 2011, for the *Mixed Waste Landfill Corrective Measures Implementation Report*, dated January 2010, and submitted January 26, 2010, by the U. S. Department of Energy on behalf of itself and Sandia Corporation (collectively, the Permittees). The Permittee's response to the NOD was submitted to the NMED on August 20, 2011. The subject report, as amended by that response, is hereby approved.

The Permittees must submit a Long-Term Monitoring and Maintenance Plan (LTMMP) for the Mixed Waste Landfill within 180 days of the date of this letter. Upon NMED approval of the LTMMP, the first five-year period for re-evaluating the feasibility of excavation and analyzing the effectiveness of the remedy, required under the Secretary's Final Order of May 26, 2005, will begin. This will allow for monitoring data to be acquired under the LTMMP to be available for the purpose of conducting the evaluation.

If you have any questions regarding this matter, please contact Mr. William Moats of my staff at (505) 222-9551.

Sincerely,

John E. Kieling
Acting Chief
Hazardous Waste Bureau

cc: J. Davis, NMED RPD
W. Moats, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
J. Cochran, SNL, MS 0719
C. Holloway, DOE, MS 0184
File: SNL 2011 and Reading
SNL-10-005

Sandia National Laboratories

Justification for Class 3 Permit Modification
Corrective Action Complete with Controls
Solid Waste Management Unit 76
Mixed Waste Landfill

October 2014

Volume IV of VIII
Corrective Measures Implementation Report
Attachments

Environmental Restoration Operations

U.S. DEPARTMENT OF ENERGY

United States Department of Energy
Sandia Field Office

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Justification for Class 3 Permit Modification, Mixed Waste Landfill
Volume IV Corrective Measures Implementation Report – Attachments
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Tab	Description	From	To	Date	Number of Pages
1	Mixed Waste Landfill Corrective Measures Implementation Report, January 2010 (Appendix A, Volume 2, only)	SNL/ Wagner	NMED/ Bearzi	01/26/2010	1114

Mixed Waste Landfill – Justification Binder Index

Date	From	To	Description	Volume	Tab	Number of Pages
VOLUME I: CLASS 3 PERMIT MODIFICATION FOR CORRECTIVE MEASURES, FINAL ORDER, AND CORRECTIVE MEASURES IMPLEMENTATION PLAN						
Class 3 Permit Modification for Corrective Measures and Final Order						
05/26/2005	State of NM/ Curry	DOE/Sandia	Final Order in the Matter of Request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill No. HWB 04-11(M)	I	1	6
08/02/2005	NMED/Kieling	SNL/Wagner	Remedy Decision and Class 3 Permit Modification Request to Incorporate into RCRA Permit Corrective Measures for Mixed Waste Landfill (SWMU 76)	I	2	50
Corrective Measures Implementation Plan						
09/07/2005	NMED/Bearzi	SNL/Wagner	Time Extension Request Approval Regarding Mixed Waste Landfill Corrective Measures Implementation Plan and Report, August 4, 2005	I	3	2
11/03/2005	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Corrective Measures Implementation Plan November 2005	I	4	370
12/09/2005	NMED/Kieling	Interested Citizen	Notice of Public Comment Period for Mixed Waste Landfill Corrective Measures Implementation Work Plan, November 2005 (Including Fate and Transport Model)	I	5	6
04/24/2006	SNL/Wagner	NMED/Bearzi	Response to Public Comments Regarding The Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005	I	6	40
05/04/2006	NMED/Kieling	Interested Citizen	Notice of Public Dialogue on the Corrective Measures Implementation Plan for the Mixed Waste Landfill, November 2005	I	7	4
05/25/2006	NMED/Kieling	SNL/Wagner	Notice of 14 Day Public Comment Period for the Mixed Waste Landfill Corrective Measures Implementation Work Plan, November 2005	I	8	8
11/20/2006	NMED/Bearzi	SNL/Wagner	NOD (Part 1 and 2 Comments): Mixed Waste Landfill Corrective Measures Implementation Work Plan November 2005, and Requirement for Soil-Vapor Sampling and Analysis Plan	I	9	8
11/21/2006	NMED/Kieling	Interested Citizen	NMED Responses to Public Comments on the Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005	I	10	62
11/2006	NMED/ Moats et. al	Interested Citizen	Evaluation of the Representativeness and Reliability of Groundwater Monitoring Well Data, Mixed Waste Landfill (referenced as part of 11/21/2006 NMED Responses to Public Comments on Corrective Measures Implementation Plan)	I	11	90

Mixed Waste Landfill – Justification Binder Index (Continued)

Date	From	To	Description	Volume	Tab	Number of Pages
12/21/2006	SNL/Wagner	NMED/Bearzi	DOE/Sandia Responses to NOD Part 1 Comments and Submittal of Soil-Vapor Sampling and Analysis Plan: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005	I	12	92
01/19/2007	SNL/Wagner	NMED/Bearzi	DOE/Sandia Responses to the NOD Part 2 Comments: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005 (Includes submittal of the 2nd Edition of Appendix E, SAND2007-0170)	I	13	36
10/10/2008	NMED/Bearzi	SNL/Wagner	Second NOD: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005	I	14	8
11/26/2008	SNL/Davis	NMED/Bearzi	DOE/Sandia Responses to Second NOD: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005	I	15	16
12/22/2008	NMED/Bearzi	SNL/Davis	Conditional Approval: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005	I	16	4
02/12/2009	SNL/Davis	NMED/Bearzi	Replacement Pages for the Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005.	I	17	6
VOLUME II: CORRECTIVE MEASURES IMPLEMENTATION PLAN – SOIL-VAPOR INVESTIGATION AND SUBGRADE PREPARATION						
Corrective Measures Implementation Plan – Soil-Vapor Investigation						
12/21/2006	SNL/Wagner	NMED/Bearzi	Soil-Vapor Sampling and Analysis Plan for Soil-Vapor Volatile Organic Compounds, Tritium, and Radon at the Mixed Waste Landfill	II	1	24
02/05/2007	NMED/Kieling	Interested Citizen	NMED Notice of Public Comment Period on Mixed Waste Landfill Soil-Vapor Sampling and Analysis Plan	II	2	6
04/13/2007	NMED/Kieling	Interested Citizen	Notice of Public Dialogue on the Mixed Waste Landfill Soil-Vapor Sampling and Analysis Plan	II	3	4
02/14/2008	NMED/Bearzi	SNL/Wagner	Response to Public Comment and Approval with Modifications Soil-Vapor Sampling and Analysis Plan for the Mixed Waste Landfill	II	4	4
02/15/2008	NMED/Kieling	Interested Party	Notice of Approval and Response to Public Comment on Soil-Vapor Sampling and Analysis Plan for Mixed Waste Landfill	II	5	24
07/10/2008	SNL/Wagner	NMED/Bearzi	Request for Deadline Extension of Investigation Report Soil-Vapor Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill	II	6	4
07/25/2008	NMED/Bearzi	SNL/Wagner	Time Extension Request to Submit Soil-Vapor Investigation Report Mixed Waste Landfill, Letter of July 10, 2008	II	7	2
08/26/2008	SNL/Wagner	NMED/Bearzi	Investigation Report on the Soil-Vapor Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill, August 2008	II	8	288

Mixed Waste Landfill – Justification Binder Index (Continued)

Date	From	To	Description	Volume	Tab	Number of Pages
09/26/2008	NMED/Bearzi	SNL/Wagner	Notice of Approval: Investigation Report on the Soil-Vapor Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill, August 2008	II	9	2
Corrective Measures Implementation Plan – Subgrade Preparation						
07/12/2006	SNL/Wagner	NMED/Curry	Notification of Current and Planned Field Work at the Mixed Waste Landfill	II	10	2
09/18/2006	NMED/Bearzi	SNL/Wagner	Fence Removal and Subgrade Preparation, Mixed Waste Landfill	II	11	2
03/13/2007	SNL/Wagner	NMED/Bearzi	Notification of Precautionary Measures to Prevent Damage to the Mixed Waste Landfill Subgrade Pending Installation of the Cover	II	12	4
03/23/2007	NMED/Bearzi	SNL/Wagner	Mixed Waste Landfill Corrective Measures Implementation Plan, Letter of March 13, 2007	II	13	2
08/10/2007	SNL/Wagner	NMED/Bearzi	Extension Request for Submittal of Burn Site Corrective Measures Evaluation Report and Mixed Waste Landfill Corrective Measures Implementation Report	II	14	4
08/23/2007	NMED/Bearzi	SNL/Wagner	Extension Request for Submittal of Burn Site Corrective Measures Evaluation Report and Mixed Waste Landfill Corrective Measures Implementation Report	II	15	2
Volume III: Corrective Measures Implementation and Report						
Corrective Measures Implementation						
04/10/2009	SNL/Davis	NMED/Bearzi	Notification of Execution of the Mixed Waste Landfill Corrective Measures Implementation Plan Beginning on May 14, 2009	III	1	4
09/04/2009	SNL/Wagner	NMED/Bearzi	Notification Concerning the Schedule and Approach for Supplemental Watering of the Mixed Waste Landfill ET Cover	III	2	4
09/30/2009	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Quarterly Progress Report ET Cover Project May-July 2009	III	3	80
11/18/2009	NMED/Bearzi	SNL/Davis	NMED Response: Mixed Waste Landfill Quarterly Progress Report ET Cover Construction Project May- July 2009	III	4	2
12/21/2009	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Quarterly Progress Report ET Cover Construction Project August-October 2009	III	5	38
04/08/2010	NMED/Bearzi	SNL/Wagner	NMED Response: Mixed Waste Landfill Quarterly Progress Report ET Cover Project August-October 2009	III	6	2
03/23/2011	SNL/Wagner	NMED/Bearzi	Request for Approval to Implement Supplemental Watering Activities for the Mixed Waste Landfill ET Cover	III	7	4

Mixed Waste Landfill – Justification Binder Index (Continued)

Date	From	To	Description	Volume	Tab	Number of Pages
04/01/2011	NMED/Bearzi	SNL/Wagner	Notice of Approval: Request to Conduct Supplemental Watering and Cover Maintenance Activities Mixed Waste Landfill	III	8	2
04/28/2011	NMED/Moats	SNL/Cochran	Email from William Moats Dated 4/28/11 Notice of Approval Request to Install Access Gate at South End of Mixed Waste Landfill	III	9	2
12/09/2013	SNL/Todd	NMED/ Cobrain	Environmental Restoration Operations Reclamation of the Mixed Waste Landfill Borrow Pit	III	10	12
06/26/2014	NMED/Kieling	SNL/ Beausoleil	Reclamation of the Mixed Waste Landfill Borrow Pit, Letter of December 9, 2013	III	11	2
Corrective Measures Implementation Report						
01/26/2010	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	12	272
11/29/2010	NMED/Kieling	Interested Citizen	Notice of Public Comment Period for Sandia National Laboratories Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	13	6
01/28/2011	NMED/Kieling	Interested Citizen	Extension of Public Comment Period for Sandia National Laboratories Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	14	2
05/20/2011	NMED/Kieling	SNL/Wagner	NOD: Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	15	6
05/20/2011	NMED/Kieling	SNL/Wagner	NMED Response to Public Comments Regarding the Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	16	16
08/11/2011	SNL/Wagner	NMED/Kieling	Responses to NOD: Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	17	48
10/14/2011	NMED/Kieling	SNL/Wagner	Notice of Approval Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	18	2
VOLUME IV: CORRECTIVE MEASURES IMPLEMENTATION REPORT – ATTACHMENTS						
01/26/2010	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Corrective Measures Implementation Report, January 2010 (Appendix A, Volume 2, only)	IV	1	1114
VOLUME V: LONG-TERM MONITORING AND MAINTENANCE PLAN						
09/25/2007	SNL/Wagner	NMED/Bearzi	Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, September 2007	V	1	304
10/31/2007	NMED/Kieling	NMED/Kieling	Notice of Public Comment Period for Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan, September 2007	V	2	6

Mixed Waste Landfill – Justification Binder Index (Continued)

Date	From	To	Description	Volume	Tab	Number of Pages
12/17/2007	NMED/Kieling	SNL/Wagner	Extension of the Public Comment Period on the Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, September 2007	V	3	4
12/07/2011	SNL/Wagner	NMED/Kieling	Withdrawal of the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan Submitted in September 2007	V	4	4
12/21/2011	NMED/Kieling	SNL/Wagner	Withdrawal of Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan, September 2007	V	5	4
03/23/2012	SNL/Sena	NMED/Kieling	Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, March 2012	V	6	278
09/14/2012	NMED/Kieling	Interested Person	Notice of Public Comment Period and Public Dialogue Meeting for the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan, March 2012	V	7	6
11/19/2012	NMED/Kieling	SNL/ Beausoleil	Extension of the Public Comment Period on the Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, March 2012	V	8	4
12/18/2012	NMED/Kieling	SNL/ Beausoleil	Extension of the Public Comment Period on the Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, March 2012	V	9	4
01/08/2014	NMED/Blaine	SNL/ Beausoleil	Notice of Approval: Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan, March 2012	V	10	2
01/15/2014	SNL/ Beausoleil	NMED/Kieling	Work Plan for the Installation of 3 Soil-Vapor Monitoring Wells at the Mixed Waste Landfill	V	11	18
02/14/2014	NMED/Blaine	SNL/ Beausoleil	Notice of Approval: Work Plan for the Installation of 3 Soil-Vapor Monitoring Wells at the Mixed Waste Landfill	V	12	2
06/18/2014	SNL/Todd	NMED/ Cobrain	Mixed Waste Landfill Annual Long-Term Monitoring and Maintenance Report, January - March 2014, June 2014	V	13	68
08/06/2014	NMED/Kieling	SNL/ Beausoleil	Notice of Approval: Mixed Waste Landfill Annual Long-Term Monitoring & Maintenance Report, January - March 2014, June 2014	V	14	2
09/10/2014	SNL/Todd	NMED/Kieling	Mixed Waste Landfill FLUTe™ Soil-Vapor Monitoring Well Installation Report, September 2014	V	15	96
09/25/2014	NMED/Kieling	SNL/ Beausoleil	Notice of Approval: Mixed Waste Landfill FLUTe™ Soil-Vapor Monitoring Well Installation Report, September 2014	V	16	2
VOLUME VI: LONG-TERM MONITORING AND MAINTENANCE PLAN – REFERENCE DOCUMENTS						
03/06/2014	SNL/Todd	NMED/Kieling	Submittal of Reference Documents Cited in the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan	VI	1	780
07/09/2014	SNL/Todd	NMED/Kieling	Submittal of Updated Reference Documents Cited in the Mixed Waste Landfill Long-Term Monitoring & Maintenance Plan	VI	2	310

Mixed Waste Landfill – Justification Binder Index (Continued)

Date	From	To	Description	Volume	Tab	Number of Pages
08/04/2014	NMED/Kieling	SNL/ Beausoleil	NMED Receipt of Submittal of Updated Reference Documents Cited in the Mixed Waste Landfill Long-Term Monitoring & Maintenance Plan	VI	3	2
VOLUME VII: ANNUAL GROUNDWATER MONITORING REPORTS						
01/30/2006	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Annual Groundwater Monitoring Report, April 2005	VII	1	56
12/13/2006	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Annual Groundwater Monitoring Report, April 2006 Sampling Event	VII	2	50
02/21/2008	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Annual Groundwater Monitoring Report, Spring 2007 Sampling Event	VII	3	80
05/27/2009	SNL/Davis	NMED/Bearzi	Mixed Waste Landfill Annual Groundwater Monitoring Report, Calendar Year 2008	VII	4	112
10/29/2009	NMED/Bearzi	SNL/Davis	NOD: Mixed Waste Landfill Groundwater Monitoring Report, Calendar Year 2008	VII	5	4
12/23/2009	SNL/Wagner	NMED/Bearzi	Responses to NOD: Mixed Waste Landfill Groundwater Monitoring Report, Calendar Year 2008	VII	6	18
06/07/2010	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Groundwater Monitoring Report, Calendar Year 2009	VII	7	144
06/07/2010	NMED/Bearzi	SNL/Wagner	Notice of Approval: Responses to NOD Issued for Mixed Waste Landfill Groundwater Monitoring Report, Calendar Year 2008	VII	8	2
11/09/2010	NMED/Bearzi	SNL/Wagner	Notice of Approval: Mixed Waste Landfill Groundwater Monitoring Report Calendar Year 2009	VII	9	2
09/30/2011	SNL/Wagner	NMED/Kieling	Mixed Waste Landfill Groundwater Monitoring Report, Calendar Year 2010	VII	10	116
08/16/2012	SNL/ Beausoleil	NMED/Kieling	Mixed Waste Landfill Chapter 4 Excerpted from the Annual Groundwater Monitoring Report, Calendar Year 2011	VII	11	102
10/24/2013	SNL/ Beausoleil	NMED/Kieling	Mixed Waste Landfill Chapter 4 Excerpted from the Annual Groundwater Monitoring Report, Calendar Year 2012	VII	12	94
9/24/2014	SNL/ Beausoleil	NMED/Kieling	Mixed Waste Landfill Chapter 4 Excerpted from the Annual Groundwater Monitoring Report, Calendar Year 2013	VII	13	96
VOLUME VIII: GROUNDWATER MONITORING WELL DOCUMENTS AND GROUNDWATER STUDIES						
Groundwater Monitoring Well Documents						
03/23/2007	NMED/Bearzi	SNL/Wagner	Replacement of Mixed Waste Landfill Groundwater Monitoring Well MWL-BW1	VIII	1	2

Mixed Waste Landfill – Justification Binder Index (Continued)

Date	From	To	Description	Volume	Tab	Number of Pages
04/17/2007	SNL/Wagner	NMED/Bearzi	Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2	VIII	2	22
06/19/2007	NMED/Bearzi	SNL/Wagner	NOD: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2	VIII	3	4
07/02/2007	NMED/Bearzi	SNL/Wagner	Replacement of Mixed Waste Landfill Groundwater Monitoring Wells MWL-MW1 and MWL-MW3	VIII	4	2
08/03/2007	SNL/Wagner	NMED/Bearzi	Response to NOD: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1; Installation of Well MWL-BW2, April 9, 2007; and Submittal of Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1; Installation of Well MWL-BW2, Revision 1	VIII	5	32
08/10/2007	SNL/Wagner	NMED/Bearzi	Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Wells MWL-MW1 and MWL-MW-3; Installation of Wells MWL-MW7 and MWL-MW8	VIII	6	24
10/10/2007	NMED/Bearzi	SNL/Wagner	Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2, Revision 1	VIII	7	2
10/12/2007	NMED/Bearzi	SNL/Wagner	Correction for Notice of Approval Dated October 10, 2007 Regarding Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2,	VIII	8	2
10/30/2007	NMED/Bearzi	SNL/Wagner	Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Wells MWL-MW1 and MWL-MW3; Installation of Wells MWL-MW7 and MWL-MW8	VIII	9	2
12/05/2007	SNL/Wagner	NMED/Bearzi	Response to October 30, 2007 Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Wells MWL-MW1 and MWL-MW3; Installation of Wells MWL-MW7 and MWL-MW8	VIII	10	6
02/12/2008	NMED/Bearzi	SNL/Wagner	Location of Monitoring Wells MWL-MW7 and MWL-MW8	VIII	11	2
03/06/2008	SNL/Wagner	NMED/Bearzi	Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-MW2 Installation of Well MWL-MW9	VIII	12	20
03/21/2008	NMED/Bearzi	SNL/Wagner	Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-MW2, Installation of Well MWL-MW9	VIII	13	2
04/23/2008	SNL/Wagner	NMED/Bearzi	Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2	VIII	14	62

Mixed Waste Landfill – Justification Binder Index (Continued)

Date	From	To	Description	Volume	Tab	Number of Pages
08/25/2008	NMED/Bearzi	SNL/Wagner	Notice of Disapproval: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2	VIII	15	4
09/23/2008	SNL/Davis	NMED/Bearzi	Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Wells MWL-MW1, MWL-MW2, MWL-MW3, Installation of Wells MWL-MW7, MWL-MW8, MWL-MW9	VIII	16	150
10/03/2008	SNL/Davis	NMED/Bearzi	Responses to NOD: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2	VIII	17	14
10/31/2008	NMED/Bearzi	SNL/Wagner	Notice of Approval: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2	VIII	18	2
01/15/2009	NMED/Bearzi	SNL/Davis	Notice of Approval: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Wells MWL-MW1, MWL-MW2, MWL-MW3, Installation of Wells MWL-MW7, MWL-MW8, MWL-MW9	VIII	19	2
Groundwater Studies						
04/30/2010	NMED/Bearzi	SNL/Wagner	Toluene Detections in Groundwater Samples from Mixed Waste Landfill	VIII	20	2
05/21/2010	SNL/Wagner	NMED/Bearzi	Extension Request for the Toluene Investigation Report Required for the Mixed Waste Landfill	VIII	21	4
06/04/2010	NMED/Bearzi	SNL/Wagner	Approval of Extension Request for Toluene Investigation Report Mixed Waste Landfill, May 21, 2010	VIII	22	2
08/18/2010	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Toluene Investigation Report, August 2010	VIII	23	236
09/28/2010	NMED/Bearzi	SNL/Wagner	NOD: Mixed Waste Landfill Toluene Investigation Report August 2010	VIII	24	2
10/14/2010	SNL/Wagner	NMED/Bearzi	Response to September 28, 2010, NMED comments on the Mixed Waste Landfill Toluene Investigation Report	VIII	25	142
01/13/2011	NMED/Bearzi	SNL/Wagner	Notice of Approval: Mixed Waste Landfill Toluene Investigation Report, Revised October 2010	VIII	26	2
05/20/2014	SNL/Todd	NMED/Kieling	Mixed Waste Landfill Groundwater Monitoring Report - Monitoring Well MWL -MW4 Metals Data – Calendar Year 2013	VIII	27	44
07/24/2014	NMED/Kieling	SNL/ Beausoleil	Mixed Waste Landfill Groundwater Monitoring Report – Monitoring Well MWL-MW4 Metals Data – Calendar Year 2013, May 2014 (NMED Recommendations Letter)	VIII	28	2

Volume IV

TAB 1

Mixed Waste Landfill Corrective Measures Implementation Report,

January 2010 (Appendix A, Volume 2)

From: SNL/Wagner
To: NMED/Bearzi

Back of Tab 1

Sandia National Laboratories

Sandia National Laboratories/New Mexico Environmental Restoration Project

MIXED WASTE LANDFILL CORRECTIVE MEASURES IMPLEMENTATION REPORT

JANUARY 2010
Revision 1

APPENDIX A
VOLUME 2 – ATTACHMENTS

United States Department of Energy
Sandia Site Office

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

APPENDIX A

Mixed Waste Landfill Alternative Cover
Construction Quality Assurance Report
January 2010
Revision 1

Volume 2
Attachments

List of Attachments

Attachment	*Title*
1	Record of Meetings and Approvals
	2006 Meetings
	2009 Meetings
2	CQA Submittals and Approvals
	2009 QA Submittal Cover Pages
	2009 Cover Layer Approval Forms
3	Daily Quality Control Reports
	2006 Daily Quality Control Reports
	2009 Daily Quality Control Reports
4	Receiving Inspection Forms and Documentation
	2005 Biointrusion Rock
	2009 Biointrusion Rock
	2009 Aggregate
	2009 Seed and Mulch
	2009 Seed Bag Labels
5	Construction Inspection Forms
	2006 Construction Inspection Forms
	2009 Construction Inspection Forms
6	Testing Inspection Forms
	2006 Testing Inspection Forms
	2009 Testing Inspection Forms
7	Laboratory and Field Test Results and Supporting Data
	2006 Standard Proctor, Gradation, and Classification Tests
	2006 Density and Moisture Tests
	2009 Standard Proctor, Gradation, and Classification Tests
	2009 Density and Moisture Tests
	2009 Saturated Hydraulic Conductivity Tests
8	Summary Report for the Extension of Monitoring Well MWL-MW4 at the Mixed Waste Landfill

ATTACHMENT 1

Record of Meetings and Approvals

2006 Meetings

RECORD OF MEETING

DATE: 6-5-06 JOB NAME: SNL MWL Subgrade Construction JOB NO.: 06-22-0011

RECORDED BY: Kelly Peil and Corey Woods

ATTENDANCE (Name and Company):

(Attendance log attached to this meeting record)

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez

Project file

MAIN SUBJECT OF MEETING: Pre-construction Meeting

ITEMS DISCUSSED: Meeting agenda attached to this meeting record. Items discussed include:

Joe Fritts:

1) Presented project organization charts (attached to this meeting record).
2) The COA Fugitive Emissions Permits (2) covers the two borrow areas to be used for collection of subgrade cover material.
3) The Excavation Permit is complete and includes the two borrow areas. It was noted that some of the areas will be undisturbed and the personnel should watch for unusual items.
4) The Stormwater Permit should be approved this week.

Tim Goering:

5) Presented a site history
6) Discussed the Corrective Measures Implementation Plan (CMIP), which is awaiting approval by NMED. Reviewed the design drawing and specifications contained in the CMIP. Stated the reason for a partial construction contract thru the subgrade only is the possibility of NMED changing the cover design for the layers above the subgrade.
7) The existing contaminant of concern is tritium which is currently measured below action levels. The activities will be monitored by RCT staff until the concern can be mitigated.
8) The security fence around the classified area of the MWL will be removed for the subgrade work and the Sandia security staff will be more involved until another fence is constructed. A security plan will describe the required procedures for personnel.

9) The grubbed vegetation may contain tritium and will be mulched and stored for placement with the topsoil at a later time.

Dick Fate:

10) As Sandia's responsible manager for the project, Dick reminded the team that the MWL is the last of the 268 ER sites for remediation at Sandia. The project will be visited by DOE and NMED and what they see could influence the completion schedule for the site. The key concern for the project is the team's safety.

Don Schofield:

11) The schedule for the subgrade work was developed from past experience of similar work and has a completion of Dec 12, 2006. If the total cover was installed without unscheduled delays the completion would be June 14, 2007 (not including demob and the final report).

Ben Martinez:

12) Presented a map of the haul route from the borrow areas to the MWL soil stockpile area. The route will require coordination with the security base of operations and the short sled track personnel.

13) The total quantity of material to be moved and the number of miles for the trucks was presented.

14) Will start the soil excavation and screening as early as this week.

Anthony Martinez:

15) Alternate H&S Officer will be Dave Ransbarger.

16) Will have daily tailgate meetings to discuss hazards, proper PPE, days events.

17) Presented map of evacuation route, Sandia Medical Clinic, and muster areas.

18) Will have site radios for everyone which are used for emergency notice.

19) Emergency contact information will be posted inside the trailer.

20) Everyday sign in and out sheet for personnel on location.

21) Weather information will be printed daily; shut-downs for high winds and lightning.

22) Copy of site HASP is available for reading and signing for verification of training.

23) Air and noise monitoring instruments will be used to determine the need for PPE.

24) Personnel should be aware of high risk for grass fires caused by vehicles. Extinguishers are available in all vehicles and the office trailers.

Kelly Peil:

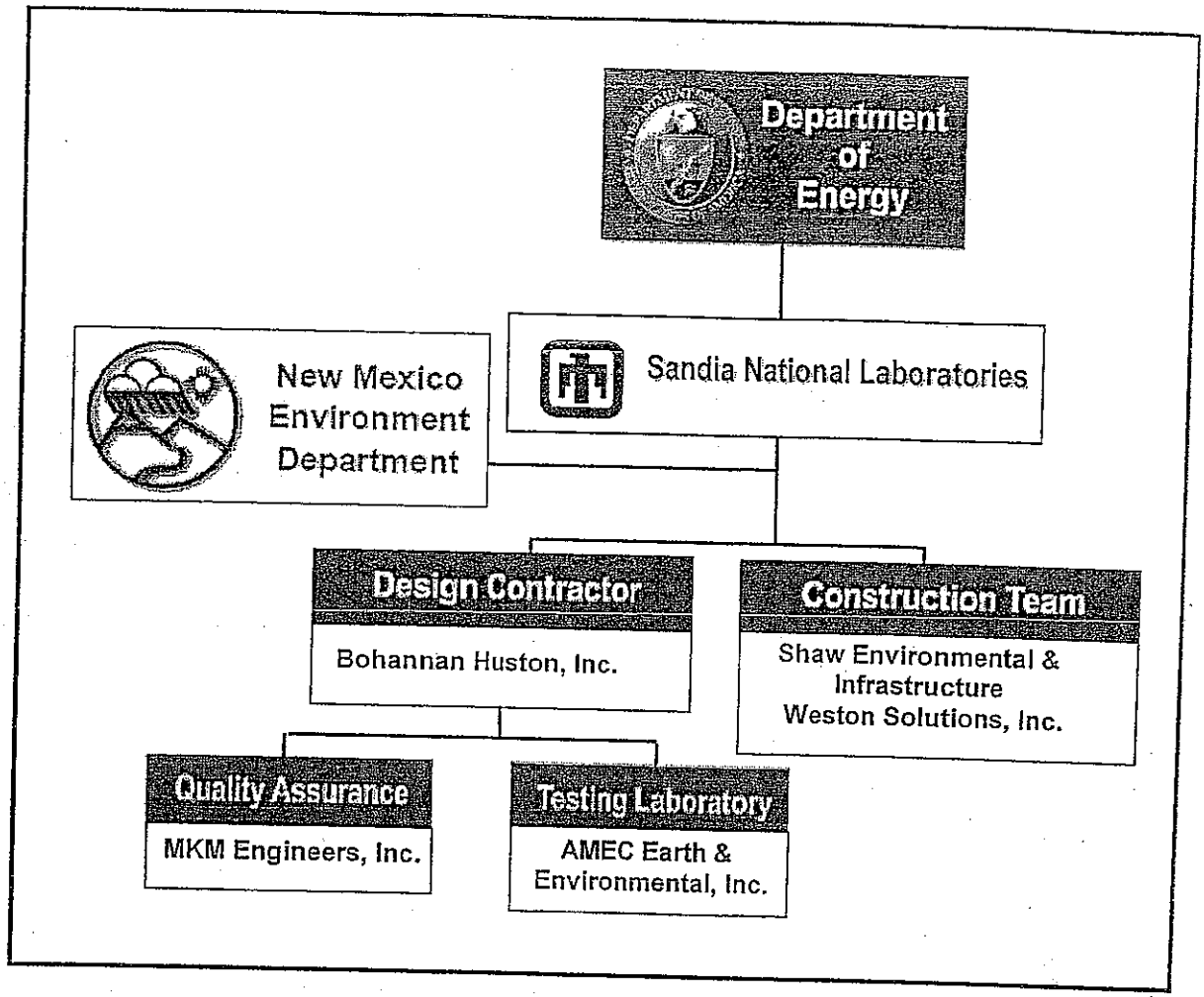
25) Reviewed the CQA Plan to present the major areas of:

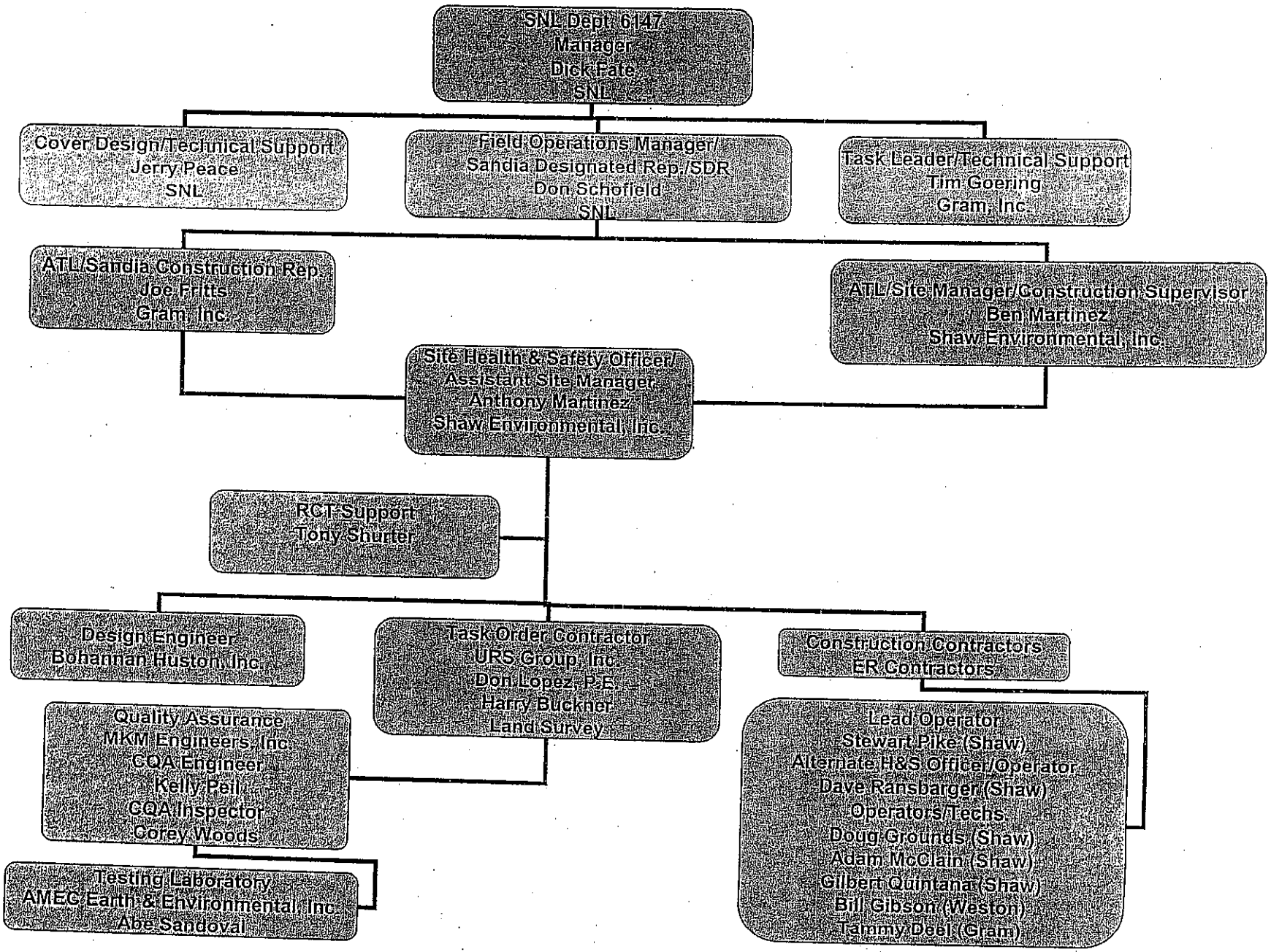
- The Plan purpose and objectives
- The qualifications and responsibilities of each project team entity
- The importance of Team communication and the documentation of meetings and decisions
- The inspection checklists for the various project activities and tests
- The importance of everyone reading the ten project specifications
- Reporting of nonconformances and the corrective actions
- Documentation of the project.

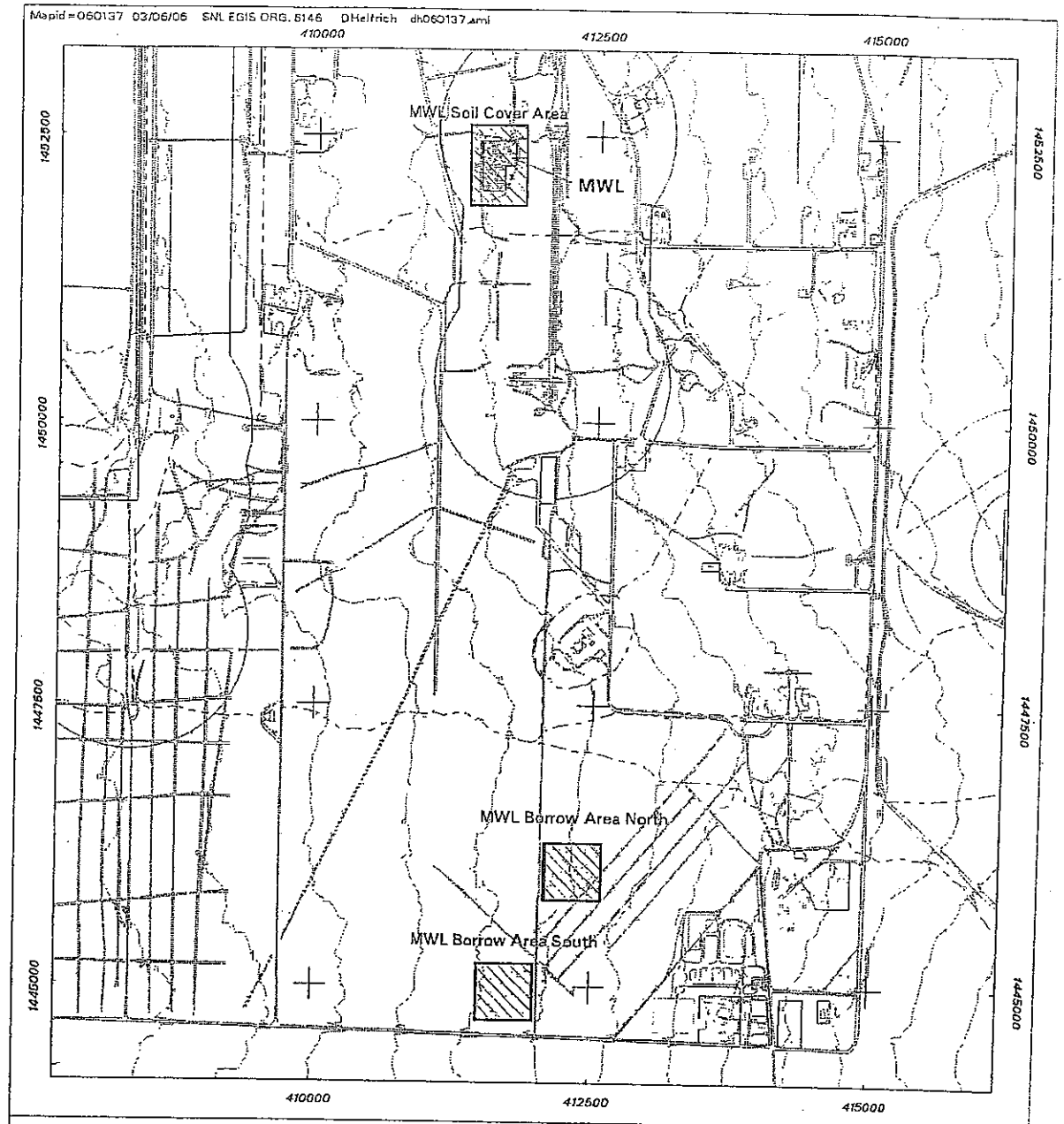
MWL SUBGRADE START-UP MEETING

JUNE 5, 2006
0900
AGENDA

WELCOME AND ORGANIZATION	Joe
COA FUGITIVE EMISSIONS PERMIT	Joe
EXCAVATION PERMIT	Joe
REVIEW SITE HISTORY DESIGN DRAWINGS	Tim
MGR COMMENTS	Dick
SCHEDULE	Don
STRATEGY BY THE NUMBERS HAUL ROUTE ETC	Ben
HASP	Anthony
CONSTRUCTION QUALITY ASSURANCE PLAN	Kelly


Department of Energy
New Mexico Environment Department
Sandia National Laboratories
Design Contractor
Bohannan Huston, Inc.
Construction Team
Shaw Environmental & Infrastructure
Weston Solutions, Inc.
Quality Assurance
MKM Engineers, Inc.
Testing Laboratory
AMEC Earth & Environmental, Inc.


SNL Dept. 6147
Manager
Dick Fate
SNL
Cover Design/Technical Support
Jerry Peace
SNL
Field Operations Manager/
Sandia Designated Rep./SDR
Don Schofield
SNL
Task Leader/Technical Support
Tim Goering
Gram, Inc.
ATL/Sandia Construction Rep.
Joe Fritts
Gram, Inc.
ATL/Site Manager/Construction Supervisor
Ben Martinez
Shaw Environmental, Inc.
Site Health & Safety Officer/
Assistant Site Manager
Anthony Martinez
Shaw Environmental, Inc.
RCT Support
Tony Shurter
Design Engineer
Bohannan Huston, Inc.
Task Order Contractor
URS Group, Inc.
Don Lopez, P.E.
Harry Buckner
Land Survey
Construction Contractors
ER Contractors
Quality Assurance
MKM Engineers, Inc.
CQA Engineer
Kelly Peil
CQA Inspector
Corey Woods
Lead Operator
Stewart Pike (Shaw)
Alternate H&S Officer/Operator
Dave Ransbarger (Shaw)
Operators/Techs.
Dougg Grounds (Shaw)
Adam McClain (Shaw)
Gilbert Quintana (Shaw)
Bill Gibson (Weston)
Tammy Deel (Gram)
Testing Laboratory
AMEC Earth & Environmental, Inc.
Abe Sandoval



Legend

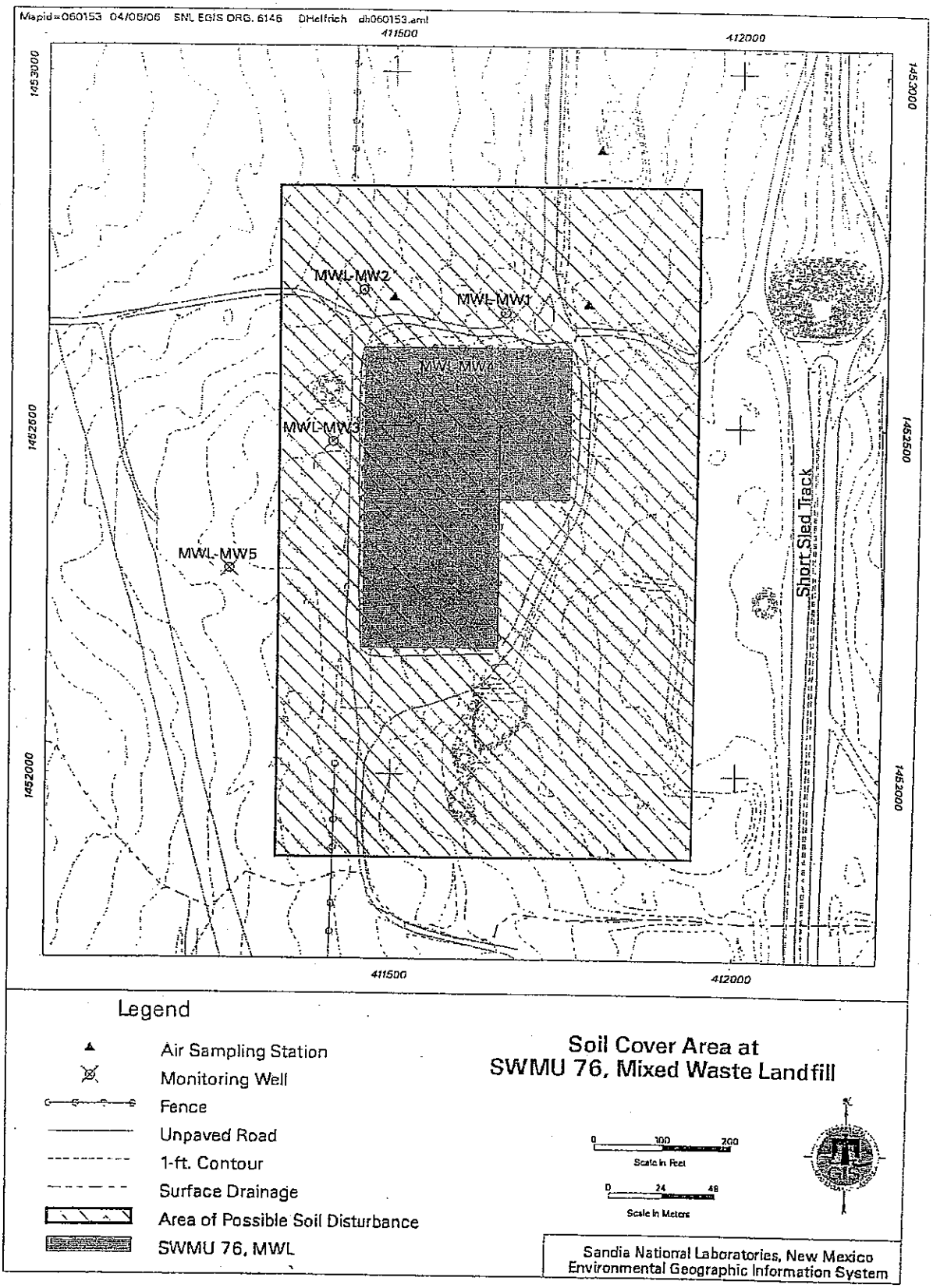
- Surface Drainage
- Road
- 10-ft. Contour
- Other SWMU Boundary
- Area of Possible Soil Disturbance
- SWMU 76, MWL

Soil Cover Area and Borrow Pit Areas for SWMU 76, Mixed Waste Landfill

0 700 1400
Scale in Feet

0 168 336
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System


Mapid=060153 04/05/06 SNL EGIS ORG. 6146 DHelfrich dh060153.aml
411500
412000
1453000
1452500
1452000
MWL-MW2
MWL-MW1
MWL-MW4
MWL-MW3
MWL-MW5
Short Sled Track
Legend
Air Sampling Station
Monitoring Well
Fence
Unpaved Road
1-ft. Contour
Surface Drainage
Area of Possible Soil Disturbance
SWMU 76, MWL
Soil Cover Area at
SWMU 76, Mixed Waste Landfill
0 100 200
Scale in Feet
0 24 48
Scale in Meters
Sandia National Laboratories, New Mexico
Environmental Geographic Information System

ALBUQUERQUE ENVIRONMENTAL HEALTH DEPARTMENT - AIR QUALITY DIVISION (DEPARTMENT)
11850 SUNSET GARDENS SW - ALBUQUERQUE, NEW MEXICO 87121
(505) 768 - 1930 (VOICE) (505) 768 - 2482 (TTY) (505) 768 - 1977 (FAX)

APPLICATION FOR A FUGITIVE DUST CONTROL PERMIT IN BERNALILLO COUNTY
ALBUQUERQUE - BERNALILLO COUNTY AIR QUALITY CONTROL BOARD REGULATION 20.11.20 NMAC
[CONSTRUCTION PERMIT FOR SURFACE DISTURBANCE/DEMOLITION (NON-PROGRAMMATIC)]

DIVISION RECEIPT STAMP BELOW THIS LINE

EFFECTIVE DATE OF THIS FORM: 3/1/04

COPY

SUBMITTAL DATE/TIME 8/13/04

RECEIVED BY Felicia

PERMIT # 348-10-2925 CAA
10-348-2925

PERMIT APPLICATION - PART A. - PROJECT INFORMATION AND GENERAL ACTIVITIES (20.11.20.15) (PRINT OR TYPE)

1. PROJECT NAME Tech Area III Borrow Site Cell No. 1

2. PROJECT LOCATION Sandia National Laboratories Tech Area III

SUBMIT AS AN ATTACHMENT TO THIS APPLICATION, AT MINIMUM, AN (8 ½" X 11" OR 11" X 17") SITE MAP OR PLAT OF PROJECT LOCATION

3. PROJECT STREET ADDRESS (if available) Not Applicable - See Map

4. MAJOR CROSS STREETS OR INTERSECTION NEARBY Not Applicable - See Map

UNIFORM PROPERTY CODE(S) (required information): Not Applicable

5. LATITUDE/LONGITUDE (if available): NORTH 34° 58' 20.26" WEST 106 ° 32' 33.78"

7. UNIVERSAL TRANSVERSE MERCATOR (UTM Coordinates), if available: ask Jeremy NORTHING EASTING

8. SCOPE OF PROJECT (check all that apply): ☐NEW BUILDING(s) CONSTRUCTION ☐SUBDIVISION DEVELOPMENT ☐UTILITY IMPROVEMENTS
☐STRUCTURE DEMOLITION/RENOVATION ☐ROADWAY DEVELOPMENT X OTHER (please describe) Borrow Site Concrete & Asphalt Accumulation

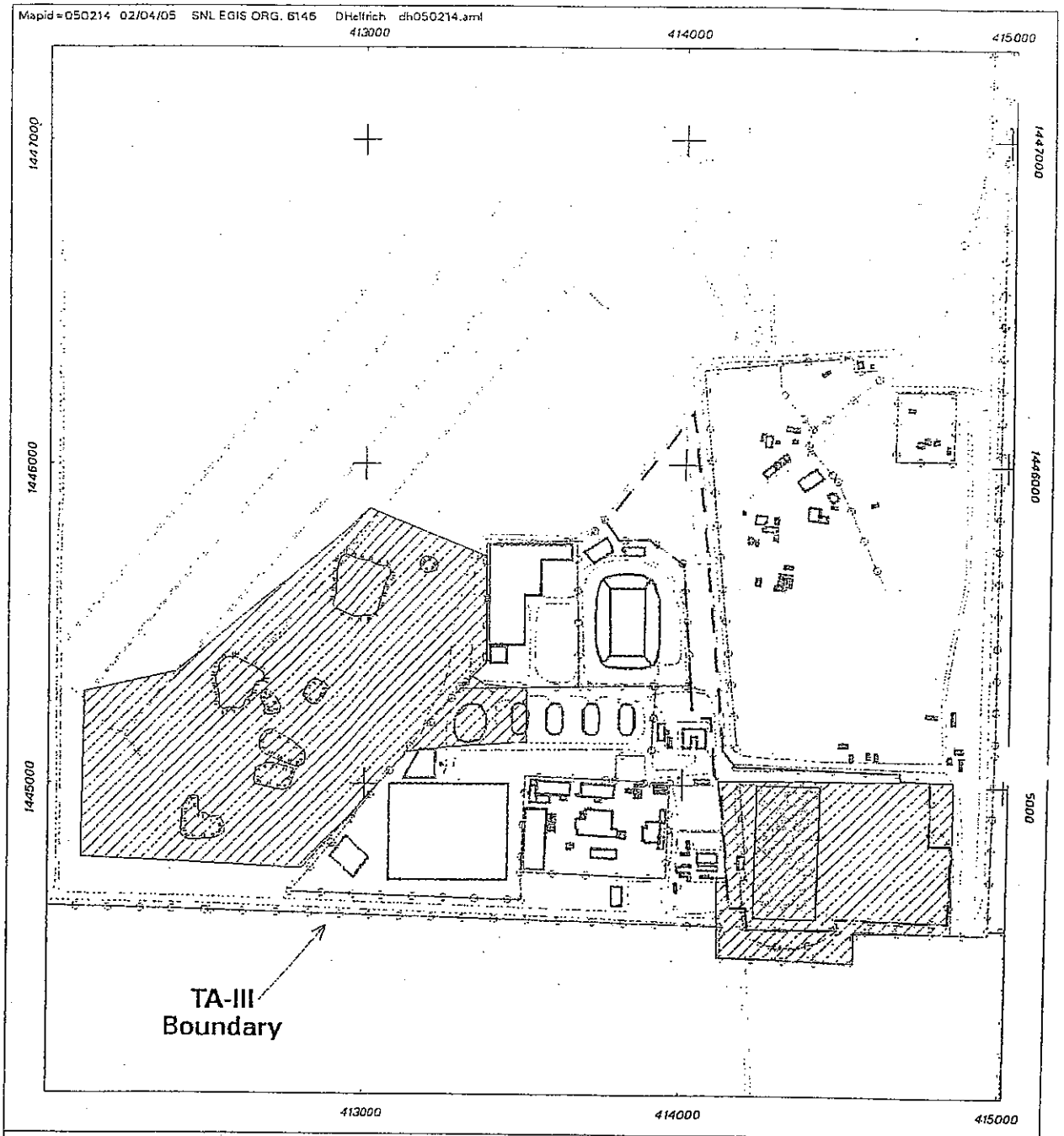
9. ACTIVE OPERATIONS (check all that apply): X SURFACE DISTURBANCE X BULK MATERIAL HAULING OR HANDLING ☐UNPAVED ROADS
☐PAVED ROADS ☐UTILITY REMOVAL/INSTALLATIONS ☐STRUCTURE DEMOLITION/RENOVATION ☐MILLING/GRINDING/CUTTING OF SURFACES
☐OTHER (please describe)

10. TOTAL AREA TO BE DISTURBED (acres or square feet) 17.5 acres; ft², or, FOR DEMOLITION: TOTAL CUBIC FEET ft³

NOTE: A FUGITIVE DUST CONTROL PERMIT APPLICATION IS REQUIRED FOR A BUILDING DEMOLITION PROJECT OF OVER 75,000 FT³ AND MUST BE RECEIVED BY THE DEPARTMENT 10 BUSINESS DAYS BEFORE THE ANTICIPATED PROJECT START DATE. ASBESTOS NOTIFICATION FOR DEMOLITION/RENOVATION OF ANY COMMERCIAL BUILDING, RESIDENTIAL BUILDING OF 5 OR MORE DWELLINGS, OR RESIDENTIAL STRUCTURE TO BE DEMOLISHED TO BUILD A NON-RESIDENTIAL STRUCTURE MUST BE RECEIVED BY THE DEPARTMENT, USING A SEPARATE FORM, 10 WORKING DAYS BEFORE THE ANTICIPATED PROJECT START DATE. BUILDING DEMOLITIONS IN BERNALILLO COUNTY REQUIRE DEPARTMENT SIGNATURES FOR PROPER DUST CONTROL AND ASBESTOS NOTIFICATION BEFORE A DEMOLITION PERMIT WILL BE ISSUED BY THE CITY OR COUNTY (20.11.20.22).

11. A FUGITIVE DUST CONTROL PERMIT APPLICATION, FOR TOTAL AREA TO BE DISTURBED OF ¾ ACRE UP TO 25 ACRES, MUST BE RECEIVED BY THE AIR QUALITY DIVISION 10 BUSINESS DAYS BEFORE THE ANTICIPATED PROJECT START DATE. A FUGITIVE DUST CONTROL PERMIT APPLICATION, FOR TOTAL AREA TO BE DISTURBED OF MORE THAN 25 ACRES, MUST BE RECEIVED BY THE AIR QUALITY DIVISION 20 BUSINESS DAYS BEFORE THE ANTICIPATED PROJECT START DATE. ANTICIPATED PROJECT START DATE IS: ~~08/06/2004~~ 9/1/04 9/1/06

AN APPROVED FUGITIVE DUST CONTROL PERMIT SHALL BE VALID FOR 1 YEAR FROM THE DATE OF APPROVAL BY THE DEPARTMENT OR THE ANTICIPATED PROJECT COMPLETION DATE, WHICHEVER IS LONGER, BUT NO MORE THAN 5 YEARS. IF THE SCOPE OF PROJECT, PROJECT ACTIVITIES, EXPIRATION DATE, TOTAL AREA TO BE DISTURBED, OR PROPOSED CONTROL MEASURE CHANGE IN ANY MANNER THAT ARE DETERMINED BY THE DEPARTMENT TO REQUIRE ADDITIONAL CONDITIONS, THEN A NEW FUGITIVE DUST CONTROL PERMIT SHALL BE REQUIRED.



Legend

- Borrow Pit Piles
- Fence
- Paved & Unpaved Road
- CWL Operational Boundary
- Building / Structure
- Chemical Waste Landfill
- Area of Possible Penetration

CWL Penetration Permit Boundaries

0 250 500
Scale in Feet

0 60 120
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information Syster

EXCAVATION PERMIT NUMBER: 0502-264

This Section Completed by Requestor

Requestor: Joe Fritts | Org./Company: 6146 | Date: 2/15/05

Telephone: 845-8703 | Project/Task or Service Order #: 7221.02.02.03

Proposed Start Date: 3/7/05 | Proposed Completion Date: 7/29/05

Task | Soil Excavation ☐ | Asphalt Removal ☐ | Sidewalk Removal ☐ | Other (see description) ☒

Location, Depth, and Description of Work: (site drawings required with this request)

An engineered soil cover will be placed over a remediated landfill (CWL) near the SE corner of TA III. Attached map indicates the affected area. Dirt from borrow piles (west side of map) will be moved to the east side of the map. Questions to Joe Fritts at 845-8703. SWSite 14.

Investigation Results

Utilities have been identified in the area of work. If yes, composite drawings MUST BE ATTACHED — YES ☐ NO ☒

Operations are on or near an Environmentally Sensitive Site. If yes, a Jobsite Hazard Evaluation MUST BE ATTACHED. — YES ☒ NO ☒

ER Reviewer: Emit Vmata 2/16/05

☐ Drawings
☒ FGIS

Drawing #s:

Utilities Identified / Spotted

Date Spotting Requested:

☐ Power Distribution ☐ Chiller Distribution ☐ Storm Drain Lines ☐ Other (see description)
☐ Gas Distribution ☐ Water Distribution ☐ Communication Lines ☐ Sanitary Sewer Lines
☐ Steam Distribution

Exercise caution when excavating, as unknown or uncharted utilities may exist. Wear personal protective equipment as appropriate. Electrically rated gloves and eye protection are required for jack hammering and saw cutting operations. Dielectrically tested boots are required for saw cutting operations. Verify location of utilities by hand digging or potholing within 5 feet of spotted utilities.

Mechanical Spotter's Comments: NO KNOWN MECH. UTILITIES LOCATED

Spotter's Name & Initials: JH & MF Date:

Electrical Spotter's Comments: NO POWER DETECTED
USE CAUTION

Spotter's Name & Initials: MV Date:

NOTICE TO PROCEED

(Not valid without signature of Utility Coordinator, Excavation Coordinator & Authorizing Supervisor)

List all attachments:

Utility Coordinator's Signature: [signature] Phone # 844-9992 Date: 2/22/05

SNL Excavation Coordinator: Phone # Date:

Supervisor Authorizing Excavation: Phone # Date:

Permit not VALID if Reverse Side is not Copied

EXCAVATION PERMIT

Supervisor Authorizing Excavation: _____ Phone # _____ Date: _____

1. This permit is task specific (see side one).
2. This permit is required for each excavation activity over 12 inches or any excavation beneath concrete sidewalks or asphalt.
3. This permit is valid from the proposed start date to the proposed completion date. **Excavator is responsible for maintaining spotter's marks after permit is issued.** *Request a Re-Spot if spotter's marks are not clearly visible.*
4. This permit and all attachments **MUST BE KEPT AT THE EXCAVATION SITE** during excavation activities.
5. This permit is not intended to be a complete work release document. Other documents or attachments may be required (e.g. Job-site Hazard Evaluation, ER Site work release) prior to work.

Caution – SNL has taken reasonable steps to identify hidden hazards prior to excavation activities necessary to complete the assigned work. The possibility exists, however, that unidentified hazards may be encountered. To mitigate risk, the Excavator is responsible for completing a site investigation utilizing methods that would not penetrate hidden hazards (e.g. visual inspection) prior to performing excavation activities identified on this permit, and using appropriate caution when utility locations cannot be identified.

Personnel assigned this activity must wear the appropriate Personal Protective Equipment and use equipment that is in good working order and properly grounded.

SUSPEND WORK!!!

Any and all personnel working under this permit are authorized and required to stop any activity if:

- Conditions differ from those that have been investigated
- Unusual odors are discovered during excavation activities
- Soils are stained
- Buried debris or visible signs of contamination are observed
- There is any question about the validity of this permit or accuracy of the spotting or utility location

Notify the SNL Excavation Coordinator (e.g. Construction Observer) immediately for instructions.

Obtain an excavation permit for any of the following activities:

1. Digging, saw cutting, drilling, coring, or trenching into soil, concrete sidewalks, or asphalt to a depth greater than 12 inches or into soil beneath concrete sidewalks or asphalt.
2. Excavation into subsurface soil in buildings beneath slabs.
3. Scraping, blading, or excavation of any area previously undisturbed or that appears to be undisturbed, such as areas covered with native vegetation, and blading or improvements to previously unimproved roads or paths.

System Contacts:

EMERGENCY	911 or 845-0911 for cellular phones
Power distribution and perimeter lighting	844-3477
Communications	284-2009
Gas, steam, water, and sanitary/storm sewers	844-3222
Off-hour emergencies	844-8881 or 844-3842
Environmental Restoration	845-0836

RECORD OF MEETING

DATE: 6-21-06 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Kelly Pell and Corey Woods

ATTENDANCE :

Don Schofield Tim Goering

Joe Fritts Ben Martinez

Anthony Martinez Members of field crew

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez

Project file

MAIN SUBJECT OF MEETING: Progress Meeting

ITEMS DISCUSSED: Meeting agenda will be standard for each meeting. Items discussed include:

1) The QC staff will record and distribute the minutes of the Progress Meetings.
2) The SWPPP was approved and two items are required at the borrow pits.
    a. A vehicle entrance and exit will be constructed at each borrow pit used.
    b. A berm will be constructed to prevent strom water from exiting the pit. The drawings and notes for the berms were misleading and unclear. Joe has the action to clarify the design requirements with the SWPPP contractor. It was decided to construct the berms with the available caliche material.
    c. The following day Joe found that there were mistakes in the design of the berms; they will only be on the down stream side and the dimensions of the berms was clarified to be much smaller than initially indicated.
3) To date 1200 cyds of soil had been screened.
4) The initial water allowance will not be adequate for the summer and Tim will pursue the change to the allowance. Water usage is being recorded by the water truck operator.
5) Ben or Anthony will print the notifications for work stopage due to wind, lightning, and heat.
6) Future Progress Meetings will be held on Mondays at 1:00 pm at the CWL building.

RECORD OF MEETING

DATE: 6-26-06 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Kelly Peil and Corey Woods

ATTENDANCE :

Don Schofield Tim Goering

Joe Fritts Ben Martinez

Anthony Martinez Dick Fate

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez

Project file

MAIN SUBJECT OF MEETING: Progress Meeting

ITEMS DISCUSSED: Standard meeting agenda was used. Items discussed include:

1) Corrections to the SWPPP borrow pit berm design were made; the size was decreased per the text, there will be no rock layer or straw mat over the berm.
2) The SWPPP features and work area will be inspected per the requirements, the inspector will be Joe Fritts or his designee, the rainfall will be recorded, and the forms will be filed as records.
3) The gravel for the borrow pit entrance/exit drives is on order.
4) Recent samples and analyses by the Sandia lab and Severn Trent indicated no tritium in the borrow area soils. These results will be filed as records.
5) Don Schofield will conduct weekly inspections of the work areas as requested by the Sandia Construction Safety Advisory Board. The results will be used by the Board to watch for trends in performance. The inspection reports will be filed as records for the project.
6) The CMIP referenced quarterly progress reports prepared by Sandia for NMED. Dick Fate will develop the format and prepare the reports.
7) The water usage allowance was increased to over one million gallons.
8) Anthony stated that daily safety briefing begin at 7:30 am.
9) Corey will request AMEC to take samples of the screened soil by gradation testing. Dave Ransbarger and Corey will coordinate the photographic record log.
10) Next meetings will be Wednesday, July 5 at 1:30 pm at the CWL building.

RECORD OF MEETING

DATE: 7-5-06 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Kelly Pell and Corey Woods

ATTENDANCE :

Don Schofield — Tim Goering

Joe Fritts — Ben Martinez

Anthony Martinez — Dick Fate

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez

Project file

MAIN SUBJECT OF MEETING: Progress Meeting

ITEMS DISCUSSED: Standard meeting agenda was used. Items discussed include:

1) The SWPPP borrow pit berm was completed and has performed as designed during the recent two rain events.
2) The SWPPP features and work area were inspected by Joe Fritts after the two rainfall events of at least 0.5 inches.
3) The borrow pit entrance/exit pad was constructed and is operational.
4) Approximately 2600 cyds of soil has been excavated, screened and stock piled.
5) The soil stabilization solution (MgCl) tank was delivered and will be set-up next week.
6) There have been no safety issues.
7) The RWP has been signed and the RCT will begin attending the progress meetings when activities begin at the MWL site.
8) The CMIP referenced quarterly progress reports prepared by Sandia for NMED have been investigated by Tim Goering and he will continue to pursue if the MWL can be included with the standard quarterly ER reports or if a separate submittal needs to be prepared for NMED.
9) Corey will request AMEC to take samples of the screened soil for gradation testing next week.
10) Dick Fate reported that the presentation to NMED last week went well. Sandia will submit a letter stating the reasons why the total MWL cover should be constructed without a break in the schedule.
11) Next meeting will be Monday, July 17 at 1:30 pm at the CWL building.

MKM

RECORD OF MEETING

DATE: 7-17-06 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Kelly Peil

ATTENDANCE :

Don Schofield Tim Goering

Joe Fritts Ben Martinez

Tony Shurter Johnny Ethridge

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez

Project file

MAIN SUBJECT OF MEETING: Progress Meeting #5

ITEMS DISCUSSED: Standard meeting agenda was used. Items discussed include:

1) Approximately 6550 cyds of soil has been excavated, screened and stockpiled as of the meeting time. A total of 8750 cyds will be stockpiled by COB this Thursday and this task will be complete.
2) The soil stabilization solution (MgCl) tank has been placed, bermed and filled with solution.
3) Action by Don: have the screen relocated to the soil staging area at MWL. The existing soil stockpile will be screened for use in the berm around the staging area.
4) Action by Don and Ben: mark the corners of the soil staging area on the south of MWL.
5) Action by Don: check with facilities concerning the maintenance of the haul road while soil movement of the soil is undereway.
6) Action by Don: order radiological posting signs for the MWL area.
7) Action by Tony: collect soil samples around the MWL buffer zone for baseline data on any radiological contaminants.
8) Next weeks schedule will include the screening of the soil staging area berm material, clearing of the staging area, and identification and marking of the area. The hauling of the subgrade material from the borrow pit to the staging area will begin the first week of August.
9) AMEC collected screened soil samples for gradation testing.
10) There have been no safety issues.

11) Dick Fate conducted an audit last week of the safety tailgate meeting and the project work environment. The report will be filed.

12) It was determined that the CMIP referenced quarterly progress reports prepared by Sandia for NMED are not required until the work on the MWL cover begins.

13) Action by Joe: notify the biologists to perform a review of the MWL area for potential iimportant bird habitat areas.

14) Tony delivered the site copies of the approved RWPs. The permits are effective when the existing MWL fence in removed (aprox Sep 6th). Training on the RWPs will be conducted before that date.

15) Next meeting will be Monday, July 24 at 1:30 pm at the CWL building.

JULY 17 2006 MWL MANAGERS MEETING AGENDA

ATTENDEES: Scho, Joe, Tim, Anthony, Ben, Kelly

AGENDA

PROGRESS AT SITE	Ben
SAFETY	Anthony
QA	Kelly

ADDITIONS TO AGENDA

NEXT MEETING

ACTION ITEMS

RECORD OF MEETING

DATE: 7-24-06 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Kelly Peil and Corey Woods

ATTENDANCE :

Don Schofield Dick Fate

Joe Fritts Ben Martinez

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez

Project file

MAIN SUBJECT OF MEETING: Progress Meeting #6

ITEMS DISCUSSED: Standard meeting agenda was used. Items discussed include:

1) Approximately 8600 cyds of soil has been excavated, screened, stockpiled and is ready to be transported to the MWL staging area.
2) Action completed by Joe: a biologist will review the MWL area for potential important bird nesting areas this week.
3) Action completed by Don: the screen was relocated to the soil staging area at MWL and the existing soil stockpile is being screened for use in the berm around the staging area.
4) Action completed by Don and Ben: the corners of the MWL area and the soil staging area have been located and marked.
5) Action completed by Don: Sandia facilities agreed that we would maintain the haul road while soil movement is undereway.
6) Action completed by Don: radiological posting signs for the MWL area will be ordered this week.
7) Action completed by Tony Shurter: some soil samples were collected last week and the remaining ones will be this week for baseline data on any radiological contaminants around the MWL buffer zone.
8) The three dump trucks arrive this week for the hauling of the subgrade material from the borrow pit to the staging area.
9) Action by Don: to check on the safety requirements for a truck driver working only in non-rad areas.

10) There have been no safety issues.

11) The excavation permit has been approved.

12) The attorneys for DOE, Sandia, and NMED have decided that the Citizens Action lawsuit against NMED does not affect the decision to construct the final cover on the MWL.

13) The Construction Team will begin preparatory work for removing the existing MWL security fence. Action by Don: review the CMI for the method of removing the fence posts and leaving the footers.

14) Next meeting will be Monday, July 31 at 1:30 pm at the CWL building.

JULY 24 2006 MWL MANAGERS MEETING AGENDA

ATTENDEES: Scho, Joe, ~~Anthony~~, Ben, Kelly, Correy, Tony, Dick

AGENDA

PROGRESS AT SITE	Ben
SAFETY	Anthony
PERMIT STATUS	Joe
QA	Kelly

ADDITIONS TO AGENDA

Dick Fate - Cover

NEXT MEETING

ACTION ITEMS

RECORD OF MEETING

DATE: 7-31-06 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Kelly Peil

ATTENDANCE :

Don Schofield	Dick Fate	Tim Goering
Joe Fritts	Anthony Martinez	

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez

Project file

MAIN SUBJECT OF MEETING: Progress Meeting #7

ITEMS DISCUSSED: Standard meeting agenda was used. Items discussed include:

1) Started hauling soil from the borrow area to the MWL staging area.
2) Fuel tank was installed and bermed and the staff was trained in its use.
3) A biologist reviewed the area around the MWL footprint and cleared the area for potential important bird nesting areas.
4) The soil staging area at MWL was cleared, the existing soil stockpile was screened, and 500 cyds of the soil was used to construct berms on three sides of the staging area. Approx 960 cyds of soil remains.
5) The Construction Team and Don will move temporary trailers to the MWL area for worker meeting and break space.
6) The radiological posting signs for the MWL area were ordered.
7) The remaining soil samples were collected for baseline data on any radiological contaminants around the MWL buffer zone. Data should be available late this week.
8) Action by Don: to acquire DOE "No Tresspassing" signs for the fence.
9) There have been no safety issues.
10) The Security Plan has been approved. The projects participants need to abide by several requirements when the existing fence is removed.
11) The existing MWL security fence will be removed by pulling the posts from the ground and cutting the metal from the concrete footers above ground.
12) Next meeting will be Monday, August 7 at 1:30 pm at the CWL building.

RECORD OF MEETING

DATE: 8-7-06 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Kelly Peil & Corey Woods

ATTENDANCE :

Dick Fate Tim Goering Joe Fritts Anthony Martinez

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez

Project file

MAIN SUBJECT OF MEETING: Progress Meeting #8

ITEMS DISCUSSED: Standard meeting agenda was used. Items discussed include:

1) Hauled 1592 cyds of soil from the borrow area to the MWL staging area last week.
2) Fuel tank now filled and ready to use.
3) BMPs were inspected after significant rain and everything was in good shape.
4) Action by Don: DOE "No Tresspassing" signs will be relocated from the existing fence, when it is removed, to the new fence.
5) Safety meetings have increased attention to foot and vehicle traffic along the haul route.
6) Staff from NMED will visit the site on August 8th for a progress review.
7) Next meeting will be Monday, August 14 at 1:30 pm at the CWL building.

AUGUST 7 2006 MWL MANAGERS MEETING AGENDA

ATTENDEES: Joe, Anthony, Kelly, Correy, ~~Tony~~, Dick, Tim

AGENDA

PROGRESS AT SITE Anthony

SAFETY Anthony

NMED VISIT Tim

ADDITIONS TO AGENDA

NEXT MEETING

ACTION ITEMS

RECORD OF MEETING

DATE: 8-14-06 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Kelly Peil & Corey Woods

ATTENDANCE :

Ben Martinez Tim Goering Joe Fritts Anthony Martinez

Don Schofield

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez

Project file

MAIN SUBJECT OF MEETING: Progress Meeting #9

ITEMS DISCUSSED: Standard meeting agenda was used. Items discussed include:

1) Hauled approx. 3400 cyds of soil in first two weeks from the borrow area to the MWL staging area.
2) Rains for past two weeks have effected the schedule. Several SWPPP inspections have been required and the BMPs have worked well.
3) A MWL site trailer has been found and work at the site will begin with electrical, clearing and pad construction for the trailer, storage units, and parking.
4) There have been no safety concerns.
5) Staff from NMED visited the site on August 8th for a status/information review and left with a positive impression of the ongoing work, the site appearance, and the bio-barrier rock.
6) Next meeting will be Monday, August 21 at 1:30 pm at the CWL building.

AUGUST 14 2006 MWL MANAGERS MEETING AGENDA

ATTENDEES: Joe, Ben, Scho, Anthony, Kelly, Correy, Tony, Tim

AGENDA

PROGRESS AT SITE Ben

SAFETY Anthony

NMED VISIT RESULTS Tim/Joe

ADDITIONS TO AGENDA

NEXT MEETING

ACTION ITEMS

RECORD OF MEETING

DATE: 8-22-06____ JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Corey Woods

ATTENDANCE :

Ben Martinez Joe Fritts Anthony Martinez

Don Schofield

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez

Project file _____

MAIN SUBJECT OF MEETING: Progress Meeting #10 _____

ITEMS DISCUSSED: Standard meeting agenda was used. Items discussed include:

1) Hauling screened soil to the MWL has been put on hold due to continuing rains that have flooded the stockpile area and haul roads. Personnel have been repairing roads around the site and along the haul route.
2) Several SWPPP inspections have been required. Overall, BMPs have held well; however, the berm around the stockpile area has been breached twice. Repairs to the berm have been completed.
3) Setup of the MWL site trailer has been put on hold due to the high cost electrical hookup. Work will continue on moving storage units and establishing a parking area.
4) There have been no safety concerns.
5) Next meeting will be Thursday, August 31 at 11:00 am at the CWL building.

AUGUST 22 2006 MWL MANAGERS MEETING AGENDA

ATTENDEES: Joe, Ben, Scho, Anthony, Kelly, Correy, Tim

AGENDA

PROGRESS AT SITE Ben

SAFETY Anthony

SWPPP INSPECTIONS Joe

ADDITIONS TO AGENDA

NEXT MEETING

ACTION ITEMS

RECORD OF MEETING

DATE: 8-31-06 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Kelly Peil & Corey Woods

ATTENDANCE :

Ben Martinez Joe Fritts Anthony Martinez

Don Schofield Brian Foskett

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez

Project file

MAIN SUBJECT OF MEETING: Progress Meeting #11

ITEMS DISCUSSED: Standard meeting agenda was used. Items discussed include:

1) Hauled approx. 7300 cyds of soil as of August 30th from the borrow area to the MWL staging area and are close to the original schedule even with the rain delays.
2) The electrical costs for the site trailer were reduced, therefore, the trailer will be installed and will not need a generator.
3) A list of site work was discussed for next weeks activities.
4) There have been no safety concerns.
5) Brian Foskett will be the site RCT when Tony Shurter is unavailable.
6) A numbering system and log of each fence post will be utilized when they are removed and surveyed for rad contamination.
7) The next meeting will be a training session for all site staff and include the RWP, Security Plan, site layout, logistics, HASP, access, and other required details. The meeting will be Monday, September 11 at 10:00 am at the CWL building.

AUGUST 31 2006 MWL MANAGERS MEETING AGENDA

ATTENDEES: Joe, Ben, Scho, Anthony, Kelly, Correy, ~~Tim~~ Brian F.

AGENDA

PROGRESS AT SITE Ben

TAKIN DOWN THE FENCE All

SAFETY Anthony

ADDITIONS TO AGENDA

NEXT MEETING

ACTION ITEMS

8/31

DOCUMENT EXISTING LANDMARKS - Helitack completed

TRAILER PAD - Gravel will be placed and trailer for walkways after delivery

PERSONEL EXIT/ENTRANCE

TRAILER, CONNEX - Trailer to arrive Tuesday, connexes on site

DECON PAD

RELOCATE WATER TOWER - Facilities to complete next week

ROLLOFFS

P/U INSTALL WATER HOSE - P/U'd, needs to be installed

INSTALL TPOSTS/ROPE - T-posts installed, rope not

RAD/NO TRESPASSING SIGNS - signs ordered, not put up

PERIMETER ROAD - completed, needs some work (grading/compaction)

NOTIFY SECURITY - Tim will notify (Planned week of 9/11) Fence removal

BIO SURVEY - To be completed next week.

Geophysical Survey - Contract not yet in place, planned for late September

RECORD OF MEETING

DATE: 9-26-06 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Kelly Peil & Corey Woods

ATTENDANCE : See attached attendance list

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez

Project file

MAIN SUBJECT OF MEETING: Training to prepare for MWL fence removal and site clear and grub; Meeting #12

ITEMS DISCUSSED: The staff currently working on the MWL subgrade project was in attendance for the training. New staff will be trained as required. Items reviewed and discussed include:

1) Sandia ER reorganization: New Division number 6791. Line Manager is David R. Miller and the Program Manager is Paul Freshour. The Division has new ES&H and Security Managers.
2) Security Plan: Implementation of the Plan begins immediately when work starts to remove the existing MWL site fence. Tim Goering reviewed the Plan using the attached key elements list. A copy of the Plan is available in the MWL site office.
3) Health and Safety Plan: Anthony Martinez reviewed the attached Task Hazard Analysis for the fence removal operation. The HASP and the THA are available in the MWL site office.
4) Radiological Work Plans: Tony Shurter presented the two RWPs; one is required if a rad situation is encountered; the second RWP is for the currently scheduled eight project tasks. The RWP describes the PPE requirements, release procedures for fence or other material, percautions for existing surface penetration limits, daily signature of RWP required, and incidental workers require an escort.
5) Waste Management Plan: Craig Wood highlighted the following items; PPE is deposited in marked drums and tested for Rad contamination before disposal, water for decon needs to be collected and tested before disposal, any fuel spills need to be reported, and batteries for disposal are hazardous and are disposed in marked containers.
6) Corrective Measures Implementation Plan: The November 2005 Plan is the Work Plan for the project. Appendix A contains the construction specifications and should be reviewed by the staff. Appendix B is the Construction Quality Assurance Plan which was updated with the May

2006 version (bound separately). Two testing and surveying procedures were stressed for the existing surface: AMEC should not penetrate the surface when using the nuclear gage for soil density measurements; the surveyors will pre-mark the stakes for six inches and not drive the stakes into the surface any further than that mark.

7) The fence removal should begin on October 2nd.

Attachments:

Agenda

Attendance list

Key elements of the Security Plan

Task Hazard Analysis for fence removal

MWL TAKE DOWN THE FENCE MEETING

September 26, 2006
0900
ITEMS TO COVER

SECURITY PLAN	Tim
HASP	Anthony
RWP	Tony
WASTE MANAGEMENT PLAN	Joe/Craig
CMI PLAN/OVERVIEW	Scho

Site Entry Log

Training Session

Date 9/26/06 (Tuesday)

Organization	Name	Signature	Purpose of Visit	In	Out
103281	Tony Shuster		RCT	0900	
10328I	BRIAN FOSKETT		RCT	0900	
MKM	Corey Woods		Training	0900	
MKM	Kelly Pelt		Training	0900	
SHAW 6791	BEN MARTINEZ		TRAINING	0900	
SHAW 6791	STEWART PIKE		TRAINING	0900	
SHAW 6791	ANTHONY MARTINEZ		TRAINING	0900	
SHAW 6791	DOUG GROUNDS		TRAINING	0900	
10333	CRAIG WOOD		TRAINING	0900	
6791	Stacy Griffith		Training	0910	
6791	DON SCHOFIELD		" "	0900	
6791	Joe Frith		TRAINING	0900	
6791	Tim Goeing		Training	0900	
			Training	0900	

Key Elements of the MWL Security Plan for Subgrade Preparation and Cover Construction Activities

1. Random Protective Force (Security) Patrols

2. MWL team must have continuous access to SNL Protective Force via cell phones, radios, or other communication devices during the duration of the field project. If security issues arise, notify Protective Force immediately.

3. DOE SSO requires that during all phases of construction, SNL protective force (PF), SNL physical security and DOE SSO Safeguards and Security must be notified prior to construction activities at the landfill.

4. All keys must be removed from the heavy equipment at the end of the work day, and either secured or removed from site.

5. If NMED has not approved the MWL Cover by April 30, 2007, SNL is required to immediately construct a 44" high barbed wire fence and access control gate around the landfill perimeter.

6. A Q-Cleared Individual will be required to be onsite at all times during operational hours when uncleared workers are working within the landfill boundaries.

7. Security Clearances not required for workers, as no classified materials will be encountered.

8. DOE standard badges must be worn at all times unless prohibited because of PPE.

9. Signage
   - DOE signs prohibiting trespassing will be posted around the perimeter.
   - Radiological postings around the perimeter to alert personnel to the presence of radiological hazards.

10. Security Incidents
    - Must comply with the reporting requirements for Incidents of Security Concern as outlined in CPR 400.3.7
    - Report incidents using the Security Incident Management Program (SIMP) incident reporting pager **(540-2382)**

11. The MWL Point of Contact (POC) will maintain a signed copy of the Security Plan and have it readily available during field operations on site.
    MWL Security POC – Scho
    Alternate POC – Ben

12. The original signed plan shall be retained by Physical Security (4213). If necessary, an annual review of the Security Plan will be conducted by Physical Security (4213).

Task Hazard Analysis — Mixed Waste Landfill fence removal operation.

Description of Activity — (1) Remove barbwire, t-posts, chain link fence, fence posts, and any other hardware required to dismantle the MWL fence. (2) Remove concrete from fence posts and place concrete in a separate roll off to be released by an RCT if needed. (3) Label/ number fence posts and hardware to be released by the RCT in accordance with the RWP in order to have a systematic approach to what has been swiped and what hasn't. (4) Place fencing material and hardware that has been cleared by an RCT into the metal only roll offs on the south end of the site boundary for recycle. (5) Once the fence has been removed the crew can begin grubbing the top layer of the MWL. (The crew may be required to use a chop saw or similar method to remove the concrete from the fence posts.)

Equipment Required:

- Heavy Equipment – forklift, front loader, road grader, skid steer
- Vehicles – pick-up trucks, trailers.
- Hand Tools – shovels, wrenches, hammers, screw drivers, chop saw
- Safety Equipment- Traffic control equipment, two-way radios, orange safety vests, face shield, fire extinguishers, eye wash station, Level D PPE (see section 4.0 in the HASP).

Level of Protection: Level D PPE (see Section 4.0 for detailed discussion of PPE).

Potential Hazard	Hazard Rating*	Control
Chemical •Fuel	Low	There are no chemical hazards anticipated. Fuel for heavy equipment is stored on site. Fire extinguishers are available in the fuel storage areas and the crew will be briefed on the location of fuel, fire extinguisher location and proper procedures at the daily safety briefings.
Physical • Heat stress • Sunburn	Medium	Workers will be aware and briefed through tailgate safety meeting on heat stress and sunburn hazards. Adequate break and rest areas will be provided. Sunscreen will be provided. Frequent

• Noise • Heavy Equipment • Lifting Injury • Pinching/crushing injury • Slips, trips, falls • Fire • Electrical hazards • Direct skin contact with the soil in the MWL boundary		water/hydration breaks will be required. Pace of work will be consistent with PPE requirements and site conditions. Operators will wear hearing protection when they are around any power tools or heavy equipment. Only qualified operators will operate heavy equipment. Equipment will be inspected daily and seat belts will be worn at all times. No one is allowed to walk or work under a suspended load of any kind. Hard hats will be worn for any overhead work. Orange safety vests will be worn at all times when personal is around heavy equipment. Proper lifting techniques will be taught and reinforced through daily tailgate meetings. Work areas will be inspected daily and slip-trip-fall hazards will be eliminated where possible. Safe work practices will be established and followed when fueling equipment and when conducting any general site maintenance. Any new tasks will be discussed at the daily tailgate briefings before performing any work. Water will be used to help control airborne dust. Eating, drinking and smoking will be administratively controlled throughout the operation and conducted only in designated areas. Personal hygiene and an adequate break schedule will be followed to prevent worker fatigue. Crew will wear the proper PPE and be required to follow all guidelines outlined in the RWP. RAD II will be required for all site workers.
Radiological	Low	Potential for tritium below ground level. All work will be conducted in accordance with the RWP. RAD Worker II is required for all working personnel.
Explosive	N/A	There are no explosive hazards anticipated.
Biological • Snakes • Rodents • Insects	Low	Noise and the fence removal operation will not be conducive to snakes, rodents or insects. Work areas will be kept clean and places of refuge for biological hazards eliminated where possible. Worker awareness will be maintained through tailgate safety briefings.

*Based on Probability and Severity

Potential Offsite Impacts

1. Increased Noise- no off site impact anticipated. Personnel will be required to wear hearing protection in and around heavy equipment and power tools.
2. Increased Traffic- most vehicle and heavy equipment traffic related to the MWL fence removal operation will be limited to the typical transportation routes used for the work. If necessary, local traffic will be re-directed.
3. Utility outages- no off-site impact anticipated.
4. Dust- suppress dust with water as necessary. Use magnesium chloride/water mixture as appropriate to maintain soil stockpiles and local road surfaces. Fence removal and topsoil grubbing operations will be terminated if dust suppression techniques are not adequate to prevent offsite dust releases due to wind that adversely impacts on-site or off-site personnel.
5. Fire- Task Leader, SSO, or designee will communicate with local facility Points of Contact and initiate emergency response plan if necessary.

RECORD OF MEETING

DATE: 10-2-06 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Kelly Pell & Corey Woods

ATTENDANCE :

Ben Martinez	Joe Fritts	Anthony Martinez	Tim Goering
Don Schofield	Brian Foskett	Tony Shurter	Stacy Griffith

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez

Project file

MAIN SUBJECT OF MEETING: Progress Meeting #13

ITEMS DISCUSSED: Standard meeting agenda was used. Items discussed include:

1) Tony Shurter surveyed the MWL non-classified fence on Friday and cleared it for disposal. The fencing material was removed from the posts Monday morning and loaded into the disposal containers.
2) The plan for the remainder of the week was to remove the fence material from the posts in the middle of the site; remove the posts; survey posts for clearance; start clear/grub of non-classified area. A screen and chipper will be located at the site to separate the grubbbed material from the soil and rocks. The scredded brush will be stored for future reuse in covered containers.
3) Action by Tony: Soil samples from the site will be collected for laboratory analysis at Sandia.
4) At least one concrete slab exists within the classified area. After the fence is removed the slab(s) will be removed to view the potential settling under the slab. The concrete will be broken and disposed in the pit under the slab.
5) There have been no safety concerns. The PPE requirements will be in effect when the fence post work begins.
6) Action by Stacy: The monitoring wells around the MWL will have a video crew scheduled for the week of Oct 16th. Stacy will coordinate the effort..
7) Action by Tony and Tim: Because of the evidence of very low concentrations of cesium 137 in biota samples at the MWL, a plant will be excavated and separated for analysis to develop a data base of rad uptake.

8) The metal from the middle fence and the classified area fence will be separated for disposal relative to the DOE metal moritorium rules.

9) A sample of the stock piled borrow material for the sub-grade will be collected for procter analysis. A sample of the existing surface soil will be collected and surveyed by Tony before release to AMEC for a procter analysis.

10) The next meeting will be Monday, October 9 at 1:00 pm at the MWL building.

OCTOBER 2, 2006 MWL MANAGERS MEETING AGENDA

ATTENDEES: Joe, Ben, Scho, Anthony, Kelly, Corey, Tim, Tony, Stacy

AGENDA

PROGRESS AT SITE Ben

SAFETY Anthony

ADDITIONS TO AGENDA

Video of wells
Cs-137

NEXT MEETING

ACTION ITEMS

MKM

RECORD OF MEETING

DATE: 10-10-06 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Kelly Peil & Corey Woods

ATTENDANCE :

Ben Martinez	Joe Fritts	Anthony Martinez	Don Lopez
Don Schofield	Harry Buchner	Tony Shurter	Paula Schuh

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez

Project file

MAIN SUBJECT OF MEETING: Progress Meeting #14

ITEMS DISCUSSED: Standard meeting agenda was used. Items discussed include:

1) The unclassified area of the MWL has all fence removed; the posts are on the ground waiting the rad survey results for release. The area has been cleared of vegetation. The piles of vegetation will be screened to remove rocks and schredded before storing in a container for future use as mulch.
2) The removal of the classified area fence will begin this week. A manlift will be used to reach the top strands of barbed wire. The wire will be rad surveyed before release for disposal.
3) Soil samples from the site were collected for laboratory analysis at Sandia and the results should be available this week. The rad data to date has been at background or below.
4) There have been no safety concerns.
5) The very low concentrations of cesium 137 in previous biota samples at the MWL are severals orders of magnitude below a health risk, therefore no further samples will be taken.
6) A sample of the stock piled borrow material for the sub-grade and a sample of the existing surface soil was collected and surveyed for release to AMEC for a procter analysis.
7) A decision on the concrete slab disposition within the classified area will be made later in the week.
8) The next meeting will be Thursday, October 19 at 11:00 am at the CWL building.

OCTOBER 10, 2006 MWL MANAGERS MEETING AGENDA

ATTENDEES: Joe, Ben, Scho, Anthony, Kelly, Corey, Bryan, Tony, Don, Paula, Harry

AGENDA

PROGRESS AT SITE Fence removal Grubbing Shredding	Ben
STATE AUDIT	Scho
RAD PRO ISSUES	Tony
SOIL SAMPLING	Corey
SAFETY	Anthony

ADDITIONS TO AGENDA

NEXT MEETING

ACTION ITEMS

SECTION 02110

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Work Included

The Contractor shall furnish all materials, labor, tools, and equipment, and shall perform clearing and grubbing during construction activities in accordance with this specification and as shown on the design drawings.

1.1.2 Related Work Specified Elsewhere

1) Temporary Diversion and Control of Water during Construction shall be in accordance with Section 01563 of these specifications.

2) Trenching, Backfilling, and Compaction shall be in accordance with Section 02221 of these specifications.

3) Reclamation Seeding and Mulching shall be in accordance with Section 02930 of these specifications.

1.1.3 Work to be performed by the Operator and/or the CQA Engineer:

1) Review and approve submittals as required for this specification.

2) Designate items that require salvage, storage, reuse, and/or relocation.

3) Perform final inspection and confirm acceptance of clearing and grubbing.

4) In addition to inspection by the Contractor, the Operator and/or the CQA Engineer may inspect work for compliance with the requirements of this specification.

1.2 SUBMITTALS

1.2.1 Procedures, Certifications, and Records

The Contractor shall submit test results in accordance with the requirements of this specification and the MWL CQA Plan to the Operator and/or the CQA Engineer as soon as this information is available so that the Operator and/or the CQA Engineer can

review work for compliance with the requirements of this specification and make CQA decisions in real-time.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIAL REQUIREMENTS

2.1.1 All equipment and tools used by the Contractor to perform the work shall be subject to inspection by the Operator before the work is started and shall be maintained in satisfactory working condition by the Contractor at all times.

2.1.2 The Contractor's equipment shall have the capability to perform the indicated clearing and grubbing specified herein.

2.1.3 The Contractor shall ensure that all equipment used for clearing and grubbing work is fitted with appropriate safety devices that comply with all applicable Federal laws and the MWL Health and Safety Plan, and that will adequately protect equipment operators and minimize exposure of site workers and others.

2.2 ITEMS SALVAGED FOR REUSE, STORAGE, OR RELOCATION

The Operator will designate items that require reuse, storage, or relocation.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Site Inspection

The Contractor shall inspect the site to determine the nature, location, size, and extent of vegetative material, debris, and obstructions to be removed or preserved, as specified herein.

3.1.2 Traffic

The Contractor shall conduct clearing and grubbing operations to ensure minimum interference with roads, walks, and adjacent facilities. The Contractor shall not close or obstruct roads, walks, or adjacent operational facilities without written permission from the Operator.

3.1.3 Protection of Existing Structures and Facilities

The Contractor shall provide protection necessary to prevent damage to the existing structures and facilities which are to remain in place. The Contractor shall restore or replace damaged property to original condition, or to the satisfaction of the Operator.

Items damaged in removal shall be repaired and refinished, or replaced by the Contractor with new matching items as required by the Operator.

3.1.4 Salvageable Items

Items damaged in removal shall be repaired, refinished, or replaced by the Contractor with new matching items as required by the Operator. The Contractor shall save and protect from construction damage all vegetative materials (shrubs, grass, and other vegetation) beyond the limits of the required clearing and grubbing. The Contractor shall restore or replace damaged vegetative materials to the conditions as required by the Operator, in accordance with Section 02930 of these specifications.

3.1.5 Protection of Monuments and Other Permanent Surface Features

The Contractor shall locate and mark existing monuments, monitoring wells, stanchions, and markers before construction operations commence and shall protect such items during construction. The Contractor shall restore or replace damaged items to original condition as required by the Operator.

3.2 CLEARING AND GRUBBING

3.2.1 Clearing and Grubbing

The Contractor shall clear the site of shrubs, vegetation, rocks and debris as required within the limits of the landfill cover, laydown and stockpile areas south of the MWL. Roots exceeding 1 inch in dimension, as well as rocks and other debris exceeding 2 inches in dimension in the top 6 inches of the existing site grade shall be removed by hand or mechanical means. Removal methods shall minimize the disturbance of soils below 6 inches in depth. Clearing and grubbing shall conform to the Radiological Work Permit (RWP).

3.2.2 Reclamation Seeding and Mulching

The Contractor shall seed and mulch disturbed areas in accordance with Section 02930 of these specifications.

3.3 DISPOSAL OF WASTE AND DEBRIS MATERIALS

3.3.1 Organic Material

Organic materials, including grass, shrubs, stumps, roots, and other organic debris removed due to clearing activities, shall be transported by the Contractor to a stockpile/disposal site designated by the Operator. The stockpile/disposal site shall be located within ¼ mile of the project area. Organic material shall be stockpiled or disposed of as directed by the Operator.

3.3.2 Disposal

The Contractor shall remove all materials not designated for relocation, reuse, or salvage. These materials shall be disposed of or stockpiled as directed by the Operator.

3.4 DAMAGED AREAS

The Contractor shall confine clearing and grubbing operations to within those areas required for cover construction or as directed by the Operator. Any areas outside the designated areas that are damaged or disturbed by the Contractor's operations shall be reclaimed by the Contractor. Reclamation shall be in accordance with Section 02930 of these specifications.

3.5 ACCEPTANCE

Clearing and grubbing not in accordance with the requirements of this specification shall be repaired and/or replaced by the Contractor at the Contractor's expense. The Contractor shall submit a description of the repair and/or replacement methods to the Operator for approval before use. Acceptance criteria for repaired and/or replaced clearing and grubbing shall be in accordance with the requirements of this specification.

END OF SECTION

MKM

RECORD OF MEETING

DATE: 10-19-06 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Kelly Pell & Corey Woods

ATTENDANCE :

Ben Martinez Joe Fritts Anthony Martinez Don Lopez Tim Goering

Don Schofield Bryan Foskett Paula Schuh Dick Fate

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez

Project file

MAIN SUBJECT OF MEETING: Progress Meeting #15

ITEMS DISCUSSED: Standard meeting agenda was used. Items discussed include:

1) The total MWL fence is removed and the majority of the metal will be picked-up by Ace Recycling. A small portion of the classified area fence structure and concrete footers will be disposed as waste in a landfill.
2) The total area has been cleared of vegetation. The final piles of vegetation will be screened to remove rocks and schredded. The 20 cyd roll-off container will be full; the screened soil will be returned to the surface.
3) A classified area pit concrete cover was broken inplace, covered with soil to level, and compacted; one other pit sinkhole was filled, leveled, and compacted.
4) The activities for next week include walking the area to remove debris larger than two inches, compact the site to at least 90%, AMEC test the area for compaction results, the surveyors stake the area for subgrade lift markers, and a geophysics crew run a survey of the classified area.
5) The RCTs will survey the area to potenially clear it for the release from the RWP PPE requirements.
6) There have been no safety concerns.
7) A QA/QC audit was conducted by the QC Engineer to check performance versus the construction specifications. The work was in conformance.
8) The next meeting will be Wednesday, November 1 at 11:00 am at the MWL building.

MKM

MKM Engineers, Inc.

Safe, Quality Work Performed With Pride

- *Turnkey Environmental*
- *Unexploded Ordnance*
- *Radiological Services*

October 23, 2006

Mr. Don Schofield, Task Leader
Sandia National Laboratories
P.O. Box 5800, MS 1088
Albuquerque, NM 87185-1088

Dear Don:

This letter is the result of the internal audit conducted October 16, 2006 at the Sandia National Laboratories Mixed Waste Landfill Subgrade Project site. There are no findings or corrective action reports.

The purpose of the internal audit was to ensure that the applicable construction specifications and project quality and safety procedures and protocols were being followed. From my surveillance and assessment the experience of the staff is obvious in the performance of the site work and the reporting of the results. The entire staff is aware of the safety aspects while working under a radiological work permit and around heavy equipment. The daily morning staff briefings are key to preparing everyone for their duties and responsibilities.

The audit checklist used for the audit and the resulting observations is attached as a record of the items covered. The list included requirements from the Construction Quality Assurance Plan (CQA) and the Construction Specifications that were applicable for the stage of the project at the time of the audit. A few of the observations are mentioned in the following paragraph.

The CQA states that specific documents would be available at the site, and they are easily accessible for the staff and visitors. The field forms, logs, and reports were clear, concise, and complete. The daily maintenance of the data will be beneficial for the final report preparation. The temporary diversion and storm water control (Spec 01563) requirements have been closely monitored and the BMPs maintained even with record rainfalls. The fence removal and the clearing and grubbing (Spec 02110) were performed efficiently, safely, and in accordance with the specification. The plan for the existing surface compaction (Spec 02200) will include a modification to the specification which will enhance the documentation of the compaction by taking field measurements. The plan for the grades, lines, and levels work (Spec 02210) will assist with the proper placement of subgrade material to meet the requirements of the specification

6000 Uptown Blvd., NE, Suite 490, Albuquerque, NM 87110 Phone: (505) 881-0123 Fax (505) 881-3005
www.mkmengineers.com

Again, the staff expertise was obvious in the quality of their reporting, their concern for safety, concern for equipment, and concern for quality performance. Management should continue to encourage the staff that they are the key to a safe and quality finished product.

Sincerely,

Kelly M. Peil

Kelly M. Peil, PhD, PE
QC Engineer

Cc: Joe Fritts
Project File

Attachment: Checklist

Audit Checklist

Audit Reference Number: 01
Date of Audit: October 16, 2006

Subject: Sandia MWL Subgrade Project
Auditor: Kelly Peil

Item	Requirement & Reference	Audit Question	Compliance Yes	Compliance No	Observation/Finding	Person Contacted
1	Availability of CMIP with specifications (Nov 05) on site (CQA 1.1)	Are copies of specifications and the current version of the CMIP in site office	X		A binder at MWL contains the documents required at the site.	Ben Martinez
2	Availability of CQAP, Security Plan, and HASP on site (CQA 4.0)	Is the CQA with inspection checklists, Security Plan, HASP with THAs and signatures, MSDS, emerg contact info available at the site	X		All items listed in question are in the site office.	Ben Martinez
3	Provide continuing training to maintain job proficiency (CQA 4.0)	Evidence of daily safety and quality briefings	X		Briefing for today was prepared, reviewed and signatures for all present. The previous briefings are retained in a binder.	Joe Fritts and Anthony Martinez
4	Provide continuing training to maintain job proficiency (CQA 4.0)	Is instrumentation available for air and noise monitoring to control PPE; calibration records	X		Air monitoring not required because the physical rad sample results have been below requirements to monitor; a dust monitor and noise monitor are used with the readings retained along with the instrument calibration forms	Tony Shurter and Anthony Martinez

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Item	Requirement & Reference	Audit Question	Compliance Yes	Compliance No	Observation/Finding	Person Contacted
5	Continual improvement review and audit (CQA 2.3)	Evidence of past SNL personnel audits of project activities; weekly safety board inspection notes	X		Email concerning audits by Dick Fate in the file. Safety board inspection notes in Don Schofield's file	Joe Fritts and Don Schofield
6	Project plan, schedule, and resources for the work (CQA 4.0)	Is the plan and schedule up-to-date; are resources available for the work	X		Project schedule is up-to-date and posted; the schedule ties to the CMIP; the labor and equipment resources are adequate for the required work	Don Schofield
7	Applicable permits available (CQA 4.0)	Is the excavation permit current (July 24) and on site; RWP signatures daily	X		The excavation permit is effective thru Dec 06; the RWP is signed daily by those accessing the landfill	Joe Fritts
8	Site storm water control (Spec 01563)	Is the storm water diverted around the construction area; are SWPPP inspection forms complete and filed	X		The SWPPP BMP is a berm around the work site; the inspection records are complete and filed	Joe Fritts
9	Site storm water control (Spec 01563)	Inspect the BMPs for needed repairs	X		The berm was breached during the summer heavy rain events; it was repaired and is in good shape now	Joe Fritts

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10	Clearing and grubbing (Spec 02110)	Inspect equipment storage area and safety of equipment for operators			I couldn't get on the landfill; item will be inspected by the QC inspector as part of duties	Joe Fritts
11	Clearing and grubbing (Spec 02110)	Inspect the MWL surface for rocks and debris; inspect MW-4 for protection; inspect the perimeter and organic storage area			See above; QC inspector will inspect surface and MW-4; the perimeter will be staked and cleared later; the shredded vegetation is stored in a covered metal roll-off container	Joe Fritts
12	Earthwork (Spec 02200)	Check compaction equipment to be used for the existing surface; agreement on change to spec for compaction versus field tests	X		A smooth drum, vibrating roller will be used for compaction; this spec will be modified with field density tests to determine compaction	Don Schofield
13	Earthwork (Spec 02200)	Tests results for subgrade material is in file; ensure no subgrade placement until compaction results are known	X		The surface permeability tests were projected from near-by field tests; no placement of subgrade will occur until results of surface compaction are available	Tim Goering and Ben Martinez

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Item	Requirement & Reference	Audit Question	Compliance Yes	Compliance No	Observation/Finding	Person Contacted
14	Grades, Lines, & Levels (Spec 02210)	Plan for survey of existing surface before subgrade is placed and between lifts	X		Survey crew will begin after compaction results are known; each lift will be surveyed; total depth of subgrade will vary from 40 inches to 2 inches	Ben Martinez
16	Removal of existing fences (CQA 5.1) and THA	Review plan to separate concrete from posts; inspect waste management (separation, labels, quantities, disposal receipts)	X		Posts were cut from the concrete powered cutters; the rad data clears the posts and concrete for disposal or recycle; the metal is separated into roll-offs for recycle and labeled as such; the metal recycler will receipt the material	Joe Fritts
17	Documentation (CQA 8.0)	Ensure logs and photos are used to document work details, quantities, nonconformances, resolutions, and comments concerning quality and safety	X		Photos are taken and stored on a CD; Ben's log is the official record of work activities and details; there have been no nonconformances noted to date	Joe Fritts

RECORD OF MEETING

DATE: 11-1-06 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Kelly Peil & Corey Woods

ATTENDANCE :

Ben Martinez Joe Fritts Anthony Martinez Don Lopez Tim Goering

Don Schofield Harry Buckner Stacy Griffith

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez

Project file

MAIN SUBJECT OF MEETING: Progress Meeting #16

ITEMS DISCUSSED: Standard meeting agenda was used. Items discussed include:

1) The subgrade soil is being applied to the lower north and north east corner in eight inch lifts to level the site.
2) The surveyors have had difficulty locating the site with relation to the control points. The past information was not clear or verifiable. The site grid will be completed when the controls can be verified.
3) The geophysical survey of the classified area was completed.
4) Samples of the subgrade soil have been taken for proctor testing and we are awaiting the results from AMEC. The field density tests on the individual lifts have been above the specification requirements.
5) The RCTs surveyed the area and released it from the RWP PPE requirements. Everyone must fisked out of the site.
6) There have been no safety concerns.
7) Acquisition of the crushed rock for the cover soil will continue inorder to have it ready for the amoring layer or stockpiled for the final cover.
8) The next meeting will be Thrusday, November 16 at 11:00 am at the CWL building.

November 1, 2006 MWL MANAGERS MEETING AGENDA

ATTENDEES: Joe, Ben, Scho, Tim, Anthony, Kelly, Corey, Don, Harry, Stacy?

AGENDA

PROGRESS AT SITE	Ben/Stewart
SURVEY STATUS	Harry
QA	Corey/Kelly
RAD PRO ISSUES	Tony/Bryan
SAFETY	Anthony
STATUS OF COVER	Scho

ADDITIONS TO AGENDA

Gravel Delivery

NEXT MEETING

ACTION ITEMS

RECORD OF MEETING

DATE: 11-16-06 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Kelly Peil & Corey Woods

ATTENDANCE :

Ben Martinez Joe Fritts Anthony Martinez Jerry Peace Tim Goering

Don Schofield Harry Buckner Stacy Griffith

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez

Project file

MAIN SUBJECT OF MEETING: Progress Meeting #17

ITEMS DISCUSSED: Standard meeting agenda was used. Items discussed include:

1) The subgrade soil is placement is in lift 11 which will cover most of the footprint. It should be complete Nov 21. Lift 12 will be the final lift and should be completed the week of Dec 4.
2) The site grid stakes were marked for all lifts and were extremely helpful for the proper placement.
3) The old soil pile at the MWL was from excavation of some of the trenches. It will only be used for fill in the peremeter areas. A sample will be taken for analysis for chemical constituents.
4) Proctors and field density and moisture tests have been taken on a regular basis and the results have been within specification.
5) There have been no safety concerns.
6) There has been no news from NMED or DOE on the continuation of the project past the subgrade, therefore, the work will shift from the MWL site to the borrow area the week of Dec 11. Soil will be screened and stockpiled at the borrow area. The work will continue to the seasonal break and resume in early January. The acquisition of the crushed rock for the cover soil is on hold.
7) The next meeting will be scheduled later.

November 16, 2006 MWL MANAGERS MEETING AGENDA

ATTENDEES: Joe, Ben, Scho, Tim, Anthony, Kelly, Corey, Don, Harry Stacy, Jerry Peace, Tony Shuster

AGENDA

PROGRESS AT SITE Ben

SOILS

QA Corey/Kelly

SAFETY Anthony

ADDITIONS TO AGENDA

NEXT MEETING

ACTION ITEMS

RECORD OF MEETING

DATE: 12-12-06 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Corey Woods

ATTENDANCE : Ben Martinez Joe Fritts Tim Goering
Harry Buckner Anthony Martinez

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez
Project file

MAIN SUBJECT OF MEETING: Progress Meeting #18 to discuss project work hold

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ITEMS DISCUSSED:

1) Progress – approximately ½-way through Lift 12. Currently out of screened soil. Crew is screening additional soil, could take another 1,800-2,000 cubic yards. Sandia Facilities personnel scheduled to haul additional screened soil from the borrow area to the site Wednesday and Thursday.
2) Lift 12 will cover monitor well on west side of MWL, compactor will stay correct distance away from the well during compaction.
3) AMEC is backlogged, currently taking at least 1 week to return proctor results.

MKM

RECORD OF MEETING

DATE: 02-12-07 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Kelly Peil

ATTENDANCE : Ben Martinez Joe Fritts Tim Goering Don Schofield
Don Lopez Paula Schuh

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez
Project file

MAIN SUBJECT OF MEETING: Progress Meeting #19 to discuss project work hold

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ITEMS DISCUSSED:

1) The MWL project is awaiting decision to proceed with total cover. Without the decision the project will be on hold at the completion of the subgrade soil placement. This meeting was to discuss activities to stabilize the site for six months.
2) One concern was protection of the subgrade layer from wind and water erosion. Both a gravel layer and straw blankets were considered and the straw blanket was selected.
3) The rilling on portions of the subgrade layer will be repaired and the blankets placed and secured.
4) A portion of the drainage swales around the MWL will be constructed to catch and direct surface water away from the site. The main areas of concern will be the NE and SE corners.
5) Weekly inspections of the site will be conducted and documented. This also includes the required SWPPP inspections.
6) A Construction Quality Assurance Report will be prepared to cover the activities through the completion of the subgrade layer.
7) Further meetings will be scheduled as needed.

RECORD OF MEETING

DATE: 02-26-07 JOB NAME: SNL MWL Subgrade Construction JOB NO: 06-22-0011

RECORDED BY: Kelly Peil and Corey Woods

ATTENDANCE : Ben Martinez Joe Fritts Tim Goering Don Schofield
Don Lopez Paula Schuh

ROUTE TO: Don Schofield, Joe Fritts, Ben Martinez, Anthony Martinez
Project file

MAIN SUBJECT OF MEETING: Progress Meeting #20

ITEMS DISCUSSED: Standard meeting agenda was used. Items discussed include:

1) Soil excavation and screening continues at the borrow area. The stock pile now contains an estimated 11,200 cuyds.
2) The Sandia procurement process is in progress to acquire approximately 300 rolls of erosion control blankets and staples for the subgrade surface protection.
3) Sandia is drafting a letter to NMED to update the status of the MWL project and the erosion protection measures to be taken while awaiting the cover decision.
4) Sandia requested two letters from QC concerning the acceptability of the straw blankets and the reasons to leave the blankets in place under the bio-barrier.
5) QC will work with Joe Fritts to prepare an inspection form to use for the biweekly inspections of the MWL site while on hold status.
6) The URS survey team completed the surface topo and the location markers for the drainage swale corners.
7) The vegetation specification may be updated to incorporate seasonal variation in seeds.
8) Further meetings will be scheduled as needed.

February 26, 2007 MWL MANAGERS MEETING AGENDA

ATTENDEES: Joe, Ben, Tim, Don, Kelly, Corey, Paula

AGENDA

PROGRESS AT SITE screening	Ben
EROSION PROTECTION MATTING	All
SITE INSPECTION CHECKLIST	Joe
SAFETY	Anthony

ADDITIONS TO AGENDA

Surveying

NEXT MEETING

ACTION ITEMS

2009 Meetings

URS

MEETING MINUTES

Sandia Mixed Waste Landfill – Corrective Measures Implementation
Job #: 24342640

Title: Kickoff Meeting
Date: 30 April, 2009
Time: 10:00 AM – 11:15 AM
Location: Sandia IPOC, Room 2156
Conducted By: Sandia Personnel

ATTENDEES:

NAME	COMPANY	PHONE	EMAIL
Paul Molina	URS Field QA	505-855-7498	Paul_Molina@urscorp.com
Harry Buckner	URS Survey QA	505-855-7574	Harry_Buckner@urscorp.com
Don Lopez	PM, CQA	505-855-7440	Don_Lopez@urscorp.com
Marshall Nay	URS QA	505-855-7485	Marshall_Nay@urscorp.com
Chris Edgman	EDI Con. PM	505-341-3578	CEdgmon@edi-nm.com
Don Schofield	SNL SDR	505-844-4088	
Mateo Aragon	SNL Contracting Officer		
Jerry Peace	SNL Senior Tech Leader		
Mike Mitchell	SNL Project Tech Lead		
Emily Wright	SNL Safety		
Dan Kwiecinski	AMEC – Senior PM Geo Tech.	505-821-1801	Dan.kwiecinski@amec.com

BIOINTRUSION BARRIER:

- "Engineering Judgment", is to be used while installing the Biointrusion Barrier. (See email from Don Schofield to Don Lopez dated 03/30/2009 attached)
- There are no provisions for a test section located in specifications.
- The Biointrusion Barrier rock was not in the original concept. It was later added to meet NMED requirements.

- ISSUE: Difficulty filling the voids between the rocks for the Biointrusion Barrier. Sandia has requested for "Engineering Judgment" to be used to determine that this has in fact been achieved. Potential solutions:

    - Place a layer of native soil between the rock and compacted sub-grade. Place the rock on top of the native soil and use a dozer to compact the rock into the native soil. A second layer of native soil is to be placed on the rock to fill the remaining voids. A dozer will then be used to compact the Biointrusion layer and fill the voids with additional native soil. After compaction, wetting the Biointrusion layer to increase the density of the native soil was discussed. Wetting the Biointrusion layer will also help by prepping for the next layer (native soil layer). A final decision to employ a wet layer has not been made.

    - A suggestion was made by Don Lopez to layout a small area (test section) of the Biointrusion Barrier prior to laying out the entire surface. From the test section, URS will be able to determine if the compaction methods in place are sufficient. This will prevent delays and rework. EDI was tasked with the responsibility of providing the test section required in order to determine if compaction methods are adequate. This suggestion was supported by all attendees.

    - A suggestion was made by Don Lopez to coordinate the use of a large diameter density test for the Biointrusion Barrier. A decision by Sandia and the team will be made at the appropriate time during construction.

VOLUME OF SOIL:

- Don Schofield is concerned the volume of soil available is insufficient to complete the entire project. Don Schofield would prefer to stay in Borrow Pit #1 to avoid delays due to SWPPP requirements.

- URS surveying QA was tasked with determining the volume of soil currently available in Borrow Pit #1. SNL would like to have the assignment completed in the next 30 days. The sooner the better.

- Borings may be performed in Borrow Pit #1 to determine how much usable soil is available before the caliche layer is reached. The caliche layer may be usable if it is blended with native soil to meet Specifications. Further investigation to be conducted.

EQUIPMENT:

- Cell phones are permitted in Tech Area III, however, they can not have picture taking capabilities. Black Berry's are permitted.

- EDI is going to be in charge of managing the photo file. A single dedicated camera will be provided to EDI by Sandia. All team members may use this camera. A scissor lift complete with safety rail for taking elevated photos will also be provided by Sandia for documentation of project progress.

- All other cameras are not permitted in Tech Area III

- Personal computers are permitted without wireless capability.

SAFETY/TRAINING:

- Training requirements are part of the mobilization process. All training requirements will be submitted to Don Lopez, URS CQA Engineer, by Mike Mitchell of SNL.

- Three (3) Sandia training courses estimated.

- Site specific training to be determined.

- Two (2) safety tailgate meetings will be conducted per day during the construction phase. One in the morning and one in the afternoon after lunch.

- A modified SNL provided project specific Health and Safety Plan is anticipated to be ready for distribution early next week.

CONSTRUCTION:

- Construction work schedule: Mon-Fri. 7:00 AM -5:00 PM

QUALITY:

- The CQA report is to be developed throughout the duration of the project. Additional time may not be provided for the CQA report at the conclusion of the project.

- Pictures and descriptions (photo log) are to be incorporated into the CQA report.

- A meeting with the QA surveyor and construction surveyor is required in the near future.

MISCELLANEOUS:

- Kickoff meeting at the site is scheduled day before construction.

- No sticker or decal is required on vehicle to get on base. Only a contractors badge is required.

***NEXT MEETING: MAY 6, 2009; Bldg. 823; 10:00 AM*

- This will be the readiness review. Release of Notice-To-Proceed is anticipated shortly thereafter pending a successful outcome of the readiness review.

"Schofield, Donald P"
<dpschof@sandia.gov>

03/30/2009 10:02 AM

To "'Don_Lopez@URSCorp.com'" <Don_Lopez@URSCorp.com>
cc
Subject FW: BioIntrusion Layer Compaction

From: Peace, Jerry L
Sent: Monday, March 23, 2009 12:44 PM
To: Aragon, Mateo
Cc: Schofield, Donald P; Mitchell, Mike M
Subject: BioIntrusion Layer Compaction

Mateo,
Regarding the discussion the evaluation team had about proper filling of voids and effective compaction of the soil within the voids, SNL will need to rely on what is often referred to as "Engineering Judgment" exercised by the QA / QC engineer and the project manager. Compaction of soil within voids in a rock matrix is very difficult. Whether one deploys the rock comprising the biointrusion layer in one single or two lifts, the infilling and compaction of soil will be difficult to accomplish, difficult to measure, and difficult to prove. The QA / QC engineer will need to be present to observe the operation to determine whether the contractor fills the voids and compacts the soil adequately. This will be a judgment or opinion made in accordance with the QA / QC engineer's sound engineering reasoning and experience. Once the rock is locked into place, only dynamic compaction techniques will be effective in compacting the soil, and even then to a limited extent. Nonetheless over time, the soil within the voids will reach optimum compaction due to mechanical and hydraulic action. Jerry

END OF MEETING NOTES

URS

MEETING MINUTES

Sandia Mixed Waste Landfill – Corrective Measures Implementation
Job #: 24342640

Title: Readiness Review
Date: 06 May, 2009
Time: 10:00 AM – 12:15 PM
Location: Sandia Bldg 823,
Conducted By: Sandia Personnel

** **NOTE:** THIS MEETING WAS THE READINESS REVIEW FOR STAGING AND MOBILIZATION TO THE FIELD. THERE WILL BE AN ADDITIONAL READINESS REVIEW FOR OPERATIONS. ***

****NOTE: (9/24/09):** THE SECOND READINESS REVIEW FOR OPERATIONS OCCURRED ON 5/19/09 IN THE FIELD AS REQUIRED. URS WAS NOT PRESENT FOR THIS MEETING.

ATTENDEES:

NAME	COMPANY
Paul Molina	URS Field QA
Harry Buckner	URS Survey QA
Don Lopez	PM, CQA
Marshall Nay	URS QA
Chris Edgman	EDI Con. PM
Don Schofield	SNL SDR
Mateo Aragon	SNL Contracting Officer
Jerry Peace	SNL Senior Tech Leader
Mike Mitchell	SNL Project Tech Lead
Emily Wright	SNL Safety
Dan Kwiecinski	AMEC – Senior PM Geo Tech.

MWL ET COVER CONSTRUCTION PROJECT PRE-MOB CHECKLIST

Please see attached

- Any work done outside of the footprint (outside of fence) will require a Q-Clearance representative to be present to be able to address any issues in real time.

- There will be an Authorized Access List established to identify personnel that are approved to work on the site w/o escort. People with the authority to add people to the list are to be determined at a later date.

- Equipment calibrations will be done by AMEC.

- Two Nuclear Density measurement calibrations and a copy of the results will be provided to Sandia.

- Construction Safety and Security Plan (CSSP) is to be signed today (05/06/2009).

- Sandia has suggested pushing two Geo-Probes through the Biointrusion Barrier to test the under layer of MWL once construction is complete. This may be difficult because of the structural integrity of the Biointrusion Layer. Also, the penetrations may jeopardize the integrity of the Biointrusion Barrier. The Geo Probes are to be discussed more in the near future. Perhaps an engineered sleeve could be provided to accommodate the two Geo-Probes(Please see attached diagram of the Cover Cross Section)

- In the first meeting (Kickoff Meeting) the Spill Prevention Control and Countermeasures Plan (SPCC) was discussed. In this meeting, only the Storm Water Pollution Prevention Plan (SWPPP) was discussed. Both are probably needed for this project. As an example, the heavy construction equipment that will operate on the site will require refueling on-site during the daily work shift (7:00 AM – 5:00 PM). Thus there will be diesel, gasoline and lubricating oil dispensing equipment.

- The fuel supply mobile storage for heavy equipment is to be stored off site when construction is not in progress. The off-site storage location currently being considered is the Sandia Motor Pool.

LOW HAZARD OPERATIONS CHECKLIST

- The handout used for the Sandia "Corporate" Level readiness review was recalled due to an editorial error. It will be corrected and re-issued. The error was administrative in nature and had no impact on project progress.

- Safety Training will be covered extensively throughout the duration of the project.

MISCELLANEOUS

- Please see preliminary schedule also attached.

- Please see Conditional Notice To Proceed also attached.

END OF MEETING NOTES

URS

MEETING MINUTES

Sandia Mixed Waste Landfill – Corrective Measures Implementation
Job #: 24342640

Title: Kickoff Meeting
Date: 19 May, 2009
Time: 10:00 AM – 11:15 AM
Location: Tech Area III, Sandia Mixed Waste Landfill
Conducted By: Sandia Personnel

ATTENDEES:
URS was not present for this meeting; however, all Sandia and EDi Construction personnel were present as required by the CMIP.

Please see attached.

TOOL RR-02-T – Startup/Restart Review for Standard Industrial Hazard and Low Hazard Operations Checklist

Operation: SNL/NM MWL ET Cover Project Operational Readiness *(facility/activity)*	Location: TA III mixed waste landfill
Check one: New Facility ☐ New Activity ☒ RW 5/14/09 Restart of Facility/Activity ☒ ~~Restart~~ w/out RW Modification to Existing Facility/Activity ☐	

	Yes	No	N/A
Was the Standard Industrial Hazard Review (SR) or Low Hazard Review (LR) planned according to Chapter 3 or 4 of the Safety Basis Manual?	☒	☐	☐

A. AUTHORIZATION BASIS/WORK PLANNING *	Yes	No	N/A
1. Is a current Primary Hazard Screening (PHS) (and Hazards Analysis [HA], if necessary) complete and approved for this facility/activity?	☒	☐	☐
2. Is a current Hazards Aggregation Rollup Process (HARP) document (if necessary) complete and approved for this facility?	☐	☐	☒
3. Are workers aware of hazards and controls described in the PHS/HA?	☒	☐	☐
4. Have interfaces with other organizations been communicated and negotiated (such as nearby operations, ES&H, Facilities Org.)?	☒	☐	☐
5. Have activity-or facility-specific controls been implemented (e.g., equipment in place and working)?	☒	☐	☐
6. Have lessons learned from projects/activities/facilities with similar hazards been evaluated?	☒	☐	☐
B. TRAINING *	**Yes**	**No**	**N/A**
1. Have workers (authorized users, Members of the Workforce, contractors, subcontractors) completed required training?	☒	☐	☐
C. TECHNICAL WORK DOCUMENTS (TWDs) *	**Yes**	**No**	**N/A**
1. Have TWDs been developed, and have workers read and signed them as authorized users?	☒	☐	☐
2. Are TWDs available to workers (preferably at the work site)?	☒	☐	☐

3. If more than one TWD is to be used, has the set of TWDs been reviewed for adequacy and consistency?	☐	☐	☒
4. Are controls implemented (e.g., administrative, engineering, personal protective equipment [PPE])?	☒	☐	☐

D. WORK ENVIRONMENT *	Yes	No	N/A
1. Are adequate signs in place and legible?	☒	☐	☐
2. Are practices to handle waste management issues in place?	☒	☐	☐
3. Are workers aware of hazards and controls associated with adjacent operations?	☒	☒ 5/4/09	☐

E. EQUIPMENT AND MAINTENANCE *	Yes	No	N/A
1. For startup of a new operation/facility, is the construction and equipment in accordance with design criteria?	☒	☐	☐
2. Has maintenance and calibration of line-owned equipment performed?	☒	☐	☐
3. Are required safety monitoring devices installed and operational?	☐	☐	☒

F. EMERGENCY PREPAREDNESS *	Yes	No	N/A
1. Are emergency plans/procedures in place?	☒	☐	☐
2. Are the local emergency plans/procedures coordinated with the corporate Emergency Plan?	☒	☐	☐
3. Is emergency equipment in place?	☒	☐	☐
4. Have emergency response personnel been notified of operations that may present unusual hazards or a special need for response?	☒	☐	☐
5. Have personnel been trained in emergency planning?	☒	☐	☐

G. ADDITIONAL CRITERIA FOR RESTARTING OPERATIONS	Yes	No	N/A
1. Have actions been taken to address problems that caused or contributed to the need for a restart?	☐	☐	☒

☒ Check here if additional readiness criteria are attached.

List the subject areas of the additional criteria (such as forklifts, electrical):
Heavy equipment

CHRISTOPHER M. TIMM	Christopher M. Timm	AMEC	5/19/09
CHRIS EDGMON	CE	ED i	5/19/09
KRISTY KIMMERLE	KK	NORTHROP	5/19/09
Kenneth Hale	Kenneth Hale	AMEC	5/19/09

Persons who participated in this readiness review:

Name Don Osen	**Org.** 6765	**Name** Don Schofield	**Org.** 4133
Name Michael R. Nelson	**Org.** 6765	**Name**	**Org.**

Verification of Readiness:

☐ This operation has successfully passed the review

☐ This operation has **NOT** passed the review at this time

Reviewer	**Org.**	**Date**
David L. Wright	6790	5/19/09
ES&H Coordinator (for Low Hazard ONLY)	**Org.**	**Date**
David R. Nill	6765	5/19/09
Approving Manager	**Org.**	**Date**

Questions on this tool? Contact Subject Matter Expert: Caren Wenner

MWL ET COVER CONSTRUCTION PROJECT
MOBILIZATION CHECKLIST FOR OPERATIONAL READINESS
MAY 19, 2009

TASK	STATUS	CSSP CROSS-REFERENCE & NOTES
Follow On Items from May 6 RR Meeting	Complete	See attached list with status information
Site Access List on site	Complete	Per MWL Security Plan
Personnel Badging	Ongoing	Per RFQ 27881, all site personnel currently badged. More will phase in over time.
Site Preparation		
Office Trailers and Storage Units	Complete	Per Section 5.2
Site Utilities Marked – Dig Permit Signed	Complete	Per Section 5.2 and May 6 Mting. Photos taken of utility markings in field.
Equipment on site and inspected (MWL and Borrow Pit)	Complete	Per Section 5.2. Craig Hauber completed 5/14/
Permits, CMIP, and CSSP on site	Complete	Per Section 5.2.1 - see list of plans & permits below
Site Boundary Rope & Signs	Complete	Per Section 5.2 and 5.3, Warning/No Trespassing & Rad signs. Finish 5/19.
Removal of Barbed Wire Fence & Notification to Security	Complete	Per Section 5.3 and Security Plan. Security notified 5/18, fence down by 5/20.
SWPPP BMPs	Complete	Per Section 5.2 and includes perimeter silt fencing and drive off pad
Fuel and Maintenance Vehicle Placarding, Signage, and Staging Area	Complete	Per Section 11.10 – per inspection by Craig Hauber on 5/11.
Site Access Control - Visitor Log, Sign In, Safety Briefing, and Escort Protocol	Complete	Per Section 6.3, sign posted at site entrance "Visitors Must Sign In at Office Trailer"
Extension of MW4 Surface Casing	In Progress	Currently scheduled for May 27
3-Foot Diameter Fence around MW4	In Progress	Per Section 5.6.1 – will be completed after MW4 casing extended
Initial Traffic Control Plan – Measures & Map	Complete	Per Section 5.5, map will be posted and haul routes/work areas defined
Site Control Plan & Communications Established	Complete	Two Way Radios operational & on site, cell phone #s distributed to site workers per Chapter 9 and Sections 5.5.1 and 9.3
Preliminary Photo Documentation and Land Survey	In Progress	Prelim "before start" photos complete, land survey ongoing.
Training, Emergency Equipment & Procedures		
Training completed and verified with documentation on site – AHAs for initial tasks reviewed with site workers	Complete	Per Chapters 6, 7, and 8 - includes Medical Monitoring (Chapter 8) and all site personnel reading and signing the CSSP
PPE & Associated Training	Complete	Per Chapter 7
Pre-Emergency Planning with TA 3 and SNL/NM Emergency Operations	Complete	Per May 6 Readiness Review and Sections 5.5.1 and 10.2
Emergency Procedures, Contact List, Route Map and Directions to Medical Facilities Posted in Office Trailer & Communicated to Site Workers	Complete	Per Chapter 10, Sections 10.6 & 10.11 – post Figure 10.1 and Tables 10.1, 10.3, and 10.4 in Office Trailer

MWL ET COVER CONSTRUCTION PROJECT
MOBILIZATION CHECKLIST FOR OPERATIONAL READINESS
MAY 19, 2009

TASK	STATUS	CSSP CROSS-REFERENCE & NOTES
Fire Extinguisher, Emergency Contact List, Route Map and Directions to Medical Facilities in all site vehicles	Complete	Table 10.1 is the Emergency Contact List. Tables 10.3 & 10.4 provide directions to Lovelace Urgent Care & Hospital, and Figure 10.1 is map to Lovelace Medical facilities.
Evacuation Route and Assembly Point Map Posted in Office Trailer	Complete	Per Section 10.8
Emergency Equipment and Supplies	Complete	Per Sections 7.6, 10.9, 10.14, and Table 10.2
Fire Extinguishers	Complete	Per Section 10.9.2
Water supply, toilet facilities, and hand wash station	Complete	Per Section 11.16
Notifications		
Radiation Protection notification for Start of Subgrade Layer work	Complete	Per Section 4.7 Heavy equipment to be used on the Subgrade Layer will be surveyed prior to and after work
Radiation Protection notification when neutron probe will be brought on and removed from the site	Complete	Per Section 4.7 RCT will survey neutron probes at their discretion
Field Work Schedule Update to NMED & DOE	Complete	General Project Requirement
Permits & Plans Maintained On Site		
Contract Specific Safety Plan (CSSP)	On Site	
MWL CMIP	On Site	
MWL Site Security Plan	On Site	
EDi Corporate Environmental HASP	On Site	Revision 10
NEPA	On Site	SNA09-0150
BIO-SURVEY	On Site	May 8.
EXCAVATION PERMIT	On Site	#0902-085
SWPPP	On Site	Permit # NMR150000
FUGITIVE DUST CONTROL PERMIT	On Site	#10-683-4160 through -4162
MWL SURFACE H2O DISCHARGE	On Site	4/27/09 #09-16
PHS	On Site	3/17/09-SNL09A00039-001
HOT WORK PERMIT	On Site	Needed for MW4 Extension work
SNL/NM APPROVAL PAPERWORK FOR EDI TEAM TWO-WAY RADIOS	On Site	

MWL ET COVER CONSTRUCTION PROJECT
MAY 6, 2009 READINESS REVIEW MEETING
FOLLOW-UP ITEMS

1. Don Schofield (SDR) will issue a Conditional Notice to Proceed to the EDI Team for mobilization tasks as defined in the Contract Request for Quotation (RFQ) and Contract Specific Safety Plan (CSSP) based upon the results of the May 6, 2009 Readiness Review.
   Completed May 7, 2009

2. Operational readiness (i.e., readiness to proceed with ET Cover Field Work) will be verified through a follow-on Readiness Review that will document completion of these follow-up items (listed in this document) and implementation/completion of mobilization tasks per the project RFQ and CSSP.
   Mike Mitchell will develop the mobilization task/activity checklist and coordinate the follow-on Readiness Review ***Completed May 14, 2009***
   - Upon completion of this follow-on meeting, Emily Wright will update Corporate Readiness Review documentation and Don Schofield will issue the final NTP
     To be completed after May 19 meeting

3. David Miller will contact Jeff Cherry and Sheldon Tieszen to make them aware of the MWL ET Cover Construction work and schedule. David will discuss TA 3 Emergency Response coordination and follow up with the MWL Project Team. Any actions the Project Team will need to take will be defined, completed, and documented.
   Completed May 11, 2009, with subsequent and ongoing follow-up with Randey Colgrove

4. The Project Team will coordinate with Sandia's Emergency Operations to notify them of the MWL ET Cover Construction Project activities, schedule, and location.
   Completed May 19, 2009 with site visit from SNL ICs
5. A Site Access List will be compiled per the MWL Security Plan and maintained on site. Project personnel with "pen and ink change authority" will be identified.
   Completed May15, 2009
6. Neutron Probe calibration records will be requested from AMEC and maintained on site in the project files.
   Completed May 11, 2009
7. Security will be notified when the Fuel and Maintenance Vehicle is mobilized to the site and informed that it will be stored during non-working hours at Building 9925 in the fenced equipment storage yard.
   Completed May 11, 2009
8. The required Bio-Survey will be completed on May 8, 2009.
   Completed May 8, 2009
9. Electronic copies of the CSSP signature pages will be provided to Steve Farmer, Chris Edgmon, Vicki Maranville, and Emily Wright.
   Completed May 7, 2009
10. Electronic copies of the Readiness Review Meeting sign-up sheet will be provided to Chris Edgmon, Vicki Maranville, Emily Wright, Mateo Aragon, and Don Lopez.
    Completed May 7, 2009
11. The Corporate Readiness Review Form documenting the May 6, 2009 meeting will be revised per Fran Nimick's suggestions, finalized, and distribute to David Miller, Don Schofield, Emily Wright, Mateo Aragon, and Chris Edgmon.
    Completed May 7, 2009
12. Provide MWL ET Cover Construction Quality Assurance Plan (Appendix B of the MWL CMIP) to Fran Nimick, who will forward the document of a required Corporate Quality Assurance review as required by the Corporate Work Controls Process.
    Completed May 7, 2009
13. Obtain appropriate signatures on the SNL/NM Excavation Permit.
    Completed May 11, 2009

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **APPROVAL OF EXISTING SUBGRADE**
Date: 22 May, 2009
Quality Resolution #: 001
Layer: Existing Subgrade
Location: Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade Surface

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Jerome Sanchez	ASCI
Don Lopez	URS
Marshall Nay	URS
Chris Edgman	EDI
Don Schofield	SNL SDR
Kenneth Hale	AMEC
Mike Mitchell	SNL Project Tech Lead

FIELD DENSITY AND MOISTURE TEST (CONSTRUCTION)

- Field density test were taken at thirteen different locations by AMEC representative Miguel Chavez. The Existing Subgrade Layer surface was divided into thirteen grids. A density/moisture test was performed at random locations within each of the thirteen grids. Survey data was collected on all testing locations.

- All thirteen moisture/density tests met the MWL specification requirements and were approved by Don Lopez, CQA Engineer.

FIELD DENSITY AND MOISTURE TEST (CQA)

- Six CQA tests were taken by AMEC for URS. The AMEC representative for the CQA was Robert Carr. A firewall is setup between AMEC representatives Robert Carr and Miguel Chavez to prevent any conflict of interest. Robert Carr was instructed to perform his density/moisture tests within an approximate 3-foot radius of every other QC test performed by Miguel Chavez. Density test locations and elevations were collected and plotted by the EDi surveyor.

- All six CQA moisture and density tests met the MWL specifications requirements and were approved by Don Lopez.

- Don Lopez has approved the MWL Existing Surface. Construction of the Biointrusion Layer may now begin.

- The Existing Subgrade constructed in 2006 has been cleared of vegetation and remnant erosion matting, compacted, and tested in accordance with the CMIP. The Existing Subgrade is approved for construction of the Biointrusion Layer.

- Quality control survey indicates some parts of the Existing Sugbrade surface do not meet the 2.0% east-to-west design slope. The slope will be adjusted during construction of the overlaying layers.

- Side slopes are steeper than 6:1 around the north end of the MWL. 6:1 side slopes will be established during construction of the Native Soil and Top Soil Layers.

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **BIOINTRUSION CONSTRUCTION FIELD TESTS AND THICKNESS VERIFICATION**
Quality Resolution #: 002
Date: 26 May, 2009
Layer: Biointrusion Layer
Location: Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Harry Buckner	URS
Don Lopez	URS
Marshall Nay	URS
Chris Edgman	EDI
Don Schofield	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Christopher Timm	AMEC

BIOINTRUSION CONSTRUCTION FIELD TESTS

I.

1. ***Biointrusion Test Area I (as discussed in CSSP)***

Please see CSSP (page 37) for procedure I description.

The test area consisted of two truckloads of dry, screened loose soil distributed over an approximate 20 x 20-feet area. Using a builder's level, the thickness of the test loose soil layer was determined to be 6-to-8-inch as specified in the CSSP. The soil was initially spread using a motor grader, but EDi later switched to a dozer in an attempt to reduce the soil compaction.

The Biointrusion rock was then placed onto the 6-to-8-inch loose soil layer. The Biointrusion rock was spread to an approximate thickness of 1.0-foot or slightly less. A dozer then compacted the rock in an attempt to push the rock down into the soil layer. After several passes with the dozer, Don Lopez (URS CQA) was not convinced that the

Biointrusion rock was being pressed down through the loose soil layer to the existing Subgrade Layer. This raised concerns of the possibility of future settling due to the layer of sand between the Subgrade Layer and the Biointrusion Layer. It was determined this procedure was not adequate to meet Specification Section 02115 located in the CMIP.

II.

1. ***Biointrusion Test Area II***

After it was determined that the procedure described above in Test Area I was ineffective, a second test area was created using the tracks of the dozer to scarify the existing Subgrade Surface. It was determined the tracks of the dozer created a texture, which was ideal for the Biointrusion Rock placement. The scarified surface had enough loose soil to fill some of the voids in the rock, as well as create a grooved pattern, which made it easy for the rock to fall into place and interlock. The rock was compacted with the dozer a minimum of four times. Loose, screened soil was then placed over the rock layer and worked into the voids by spreading with the dozer. This method proved to be very effective. (See below for updated Biointrusion installation procedure).

2. ***The Following is the Updated Biointrusion Layer Installation Procedure:***

The Biointrusion layer will be constructed in compliance with the CMIP, Specification Section 02115. The following is the procedure recommended by Don Lopez PE (URS CQA Engineer) for the Biointrusion Layer:

The rock used for the Biointrusion Layer will continue to be the rock acquired by SNL. The rock is located at the former Bulk Waste Staging Area in TA 3.

The EDi Team will scarify the Existing Subgrade Surface using the tracks of a dozer. A minimum of four passes with the dozer tracks is required across the existing Subgrade Surface. Once the Subgrade Surface has been prepared, the Biointrusion Rock may be spread across the scarified surface. The rock layer will then be compacted with a minimum of four passes by the dozer to ensure compaction and interlocking of the rock. Compaction shall be performed until rocks are firmly locked into place. The entire Biointrusion Rock Layer Surface must be completed, surveyed, and approved before any further construction may take place.

Once the rock layer is compacted in place and approved, additional dry loose soil will be placed over the surface. A dozer will then spread the loose soil across the rock surface and work the loose soil into the voids. The soil will then be compacted with a minimum of four passes with the vibratory roller. After this is completed and approved, water will be applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content.

MISCELLANEOUS

- There was a discussion about extending the Biointrusion Barrier past the toe of the existing Subgrade Layer. It was determined that it is not necessary to extend the Biointrusion Barrier past the toe.

- The current slope is approximately 1.8% from East to West in lieu of the 2.0% as specified. The slope will be adjusted to the specified 2.0% during the course of construction. It will be corrected during the Native Soil Layer as apposed to the Biointrusion Barrier due to material availability and ease of construction.

- The method of constructing the Biointrusion described in the CSSP (Page 37) was determined to be insufficient by Don Lopez PE URS CQA Engineer and will not be used for this project.
- The Biointrusion rock previously purchased and stockpiled in the Former Bulk Waste Staging Area TA-3 is approved for use on the MWL cover.

- No soil may be placed in the Biointrusion voids prior to approval of Biointrusion Layer thickness

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: ***QC SURVEY AND QA VERIFICATION SURVEY COORDINATION***
Quality Resolution #: 003
Date: 01 June, 2009
Layer: Biointrusion
Location: Tech Area III; Sandia Mixed Waste Landfill; Existing Subgrade Layer

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Harry Buckner	URS
Don Lopez	URS
Marshall Nay	URS
Chris Edgman	EDI
Don Schofield	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Christopher Timm	AMEC
Jerome Sanchez	ASCI

QC/QA SURVEY COORDINATION

- Jerome (EDi QC survey rep.) was not sure how URS was going to perform the QA check. Jerome was instructed to use the 50-foot grid created for the Existing Subgrade. Jerome is to take elevations of the Biointrusion Barrier Layer at the exact locations he took elevations on the Existing Subgrade.

- Harry Buckner will do his QA survey on the exact same locations using the 50-foot grid system. Harry Buckner will do the CQA survey check on Friday (06/05/09) or Monday (06/08/09) depending on the status of the Biointrusion Layer. Harry will use the method described above to check the thickness of the Biointrusion Rock Barrier.

- The 50-foot grid system created will be used throughout the duration of the project to confirm the thickness and slopes of the cover.

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **BIOINTRUSION ROCK VOLUME AND THICKNESS**
Date: 04 June, 2009
Quality Resolution #: 004
Layer: Biointrusion
Location: Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Don Lopez	URS
Marshall Nay and Harry Buckner	URS
Chris Edgman	EDI
Don Schofield	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Christopher Timm	AMEC
Jerome Sanchez	ASCI

BIOINTRUSION ROCK VOLUME SHORTAGE

- There is not going to be enough rock in the Former Bulk Waste Staging Area, TA III, to complete the Biointrusion layer.

- The original rock was purchased at the San Lazarus Gulch in the San Lazarus Gulch in the San Pedro Mountains (San Pedro rock). Ben Martinez (Sandia) contacted San Pedro Rock and was informed that there is more of the same rock available; however, it has more fines in it then the original rock. Don Lopez requested a sample of the proposed rock to be collected and taken to AMEC for a sieve analysis to determine if the proposed rock will meet the Contract Specifications.

- Don Lopez will make his decision to approve/disapprove the additional Biointrusion rock based on visual inspection/Engineering Judgment.

BIOINTRUSION THICKNESS

- Harry Buckner (URS) will begin the QA survey on Friday (06/05/09). Harry will begin his survey on the south end of the MWL and proceed north. Harry

will convert the survey data collected into a usable format on Saturday (06/06/09) to determine the Biointrusion Layer thickness. URS intends to provide EDi with approval/disapproval of at least the south portion of the Biointrusion Layer Monday morning. Any survey not completed on Friday will be collected on Monday.

- There was a discussion over the "actual thickness" of the Biointrusion Layer compared to the "computed thickness". The computed Biointrusion Layer thickness is determined by comparing the elevation of the Existing Subgrade to the elevation of the Biointrusion Layer. However, the rock is being placed onto a scarified surface, not the surveyed Existing Subgrade, which allows the rock to push down into the Existing Subgrade approximately 1-to-2 inches. This causes the actual thickness to be greater then what the computed thickness derived from survey data is showing. Don Lopez has decided to accept a computed Biointrusion Layer thickness of 11-inches to compensate for the above.

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **QA VERIFICATION SURVEY & APPROVAL FOR SOIL PLACEMENT ON THE BIOINTRUSION LAYER SURFACE**
Date: 05 June, 2009
Quality Resolution #: 005
Layer: Biointrusion Layer
Location: Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Harry Buckner	URS
Don Lopez	URS
Chris Edgman	EDI
Don Schofield	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Christopher Timm	AMEC
Jerome Sanchez	ASCI

QA VERIFICATION SURVEY

- Harry Buckner (URS) and Paul Molina (URS) conducted the QA survey on the south end of the MWL. The survey data collected will be converted into a usable format to determine the Biointrusion Layer thickness. URS intends to provide EDi with approval/disapproval of at least the south end of the Biointrusion Layer. Additional QA Survey will be conducted on Monday (6/8/09).

- Four Points on the southwest slope did not pass the 1-foot minimum thickness requirement (See results attached). EDi will need to place more rock on this section. URS will then recheck the survey at these four spots.

LOOSE SOIL PLACEMENT APPROVAL

- The south portion of the Biointrusion Layer is approved with the exception of four grid point locations on the west slope which are less than the 1.0' minimum thickness requirement. The south portion is approved for the placement of soil into the voids except for the west slope grid points which must be corrected, resurveyed, and approved.

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **QA VERIFICATION SURVEY & APPROVAL FOR SOIL PLACEMENT ON THE BIOINTRUSION LAYER SURFACE**
Date: 09 June, 2009
Quality Resolution #: 006
Layer: Biointrusion Layer
Location: Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Harry Buckner	URS
Don Lopez	URS
Chris Edgman	EDI
Don Schofield	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Jon Schermerhorn	AMEC
Jerome Sanchez	ASCI

QA VERIFICATION SURVEY & LOOSE SOIL PLACEMENT APPROVAL

- The northwest portion of the Biointrusion Layer is approved with the exception of two locations on the north slope which were too thick. The northwest portion is approved for the placement of soil into the voids except for the north slope, which must be corrected, resurveyed, and approved at the two locations.

- The four locations on the west slope of the Biointrusion Layer at the south end that required additional rock has been corrected, resurveyed, and are now approved. The west slope was approved for the placement of soil into the voids on 6/09/09.

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **BIOINTRUSION LAYER EAST-TO-WEST SURFACE DESIGN SLOPE**
Date: 10 June, 2009
Quality Resolution #: 007
Layer: Biointrusion Layer
Location: Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Don Lopez	URS
Chris Edgman	EDI
Don Schofield	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Jon Schermerhorn	AMEC
Jerome Sanchez	ASCI

THIN SOIL LAYER

- The Biointrusion Layer (without the soil in the voids) may be a difficult layer to use as a new datum due to irregularities in the rock. Also, the rock is being pushed flat when the soil is placed and spread with a dozer into the voids and then compacted with a vibrating, smooth drum roller. Because of rock being pushed flat under the soil, we would not know the exact elevation of the rock after the sand has been placed and compacted. A better datum may be to use the Biointrusion Layer after the voids have been filled with loose soil and compacted with the vibrating, smooth drum roller. The loose soil makes a thin soil layer above the rock, which may be a better surface to create a starting datum for the Native Soil Layer.

BIOINTRUSION SIDE AND 6:1 SLOPE CORRECTIONS

- It was decided that to make the corrections for the 2.0% surface slope and 6:1 side slopes during the Native Soil Layer because of construction constraints due to the Biointrusion rock. It will be very difficult to adjust the Biointrusion rock surface to meet the specifications. As of now, the surface slopes are approximately at an average of 1.8%. Correcting the slope with the first couple of Native Soil Lifts will give us a better idea of how much material we are going to be short. It will also be a much easier material to adjust to the specification requirements.

BIOINTRUSION SURVEY

- Most of the Biointrusion Layer thickness was within the specified thickness. There were a couple of points on the orange corner post that were high. These points are going to be corrected for the final QA survey on Friday.

MISCELLANEOUS

- We are expecting information from Jerry Peace regarding the Biointrusion Rock. This information is to be incorporated into the final report.

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **QA VERIFICATION SURVEY & APPROVAL FOR SOIL PLACEMENT ON THE BIOINTRUSION SURFACE**
Date: 15 June, 2009
Quality Resolution #: 008
Layer: Biointrusion Layer
Location: Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Marshall Nay and Harry Buckner	URS
Don Lopez	URS
Chris Edgman	EDI
Don Schofield	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Jon Schermerhorn	AMEC
Jerome Sanchez	ASCI

QA VERIFICATION SURVEY & LOOSE SOIL PLACEMENT APPROVAL

- The northeast portion of the MWL Biointrusion Layer is approved for the placement of soil into the voids.

- The two locations on the north slope of the Biointrusion Layer that were too thick have been corrected, resurveyed, and were approved. The north slope is now approved for the placement of soil into the voids.

- The entire Biointrusion Layer is now approved. Approval includes thickness, side slopes, and surface slope. Side slopes are steeper than 6:1 but will be adjusted during construction of the Native Soil Layer. The east-to-west surface slope is less than 2.0% in some areas consistent with the Existing Subgrade and will also be adjusted during the construction of the Native Soil Layer.

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **BIOINTRUSION AND THIN SOIL LAYER THICKNESS, CONSTRUCTION OF NATIVE SOIL LAYER, ESTABLISHING A NEW DATUM FOR THE 2.0% EAST-TO-WEST SURFACE DESIGN SLOPE, ESTABLISHING THE 6:1 SIDE SLOPES, AND K-SAT TESTING**
Date: 16 June, 2009
Quality Resolution #: 009
Layer: Thin Soil layer and Native Soil Layer
Location: Tech Area III, Sandia Mixed Waste Landfill

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Marshall Nay	URS
Don Lopez	URS
Chris Edgman	EDI
Don Schofield and Ben Martinez	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Jon Schermerhorn	AMEC
Jerome Sanchez and Vladimir Jirik	ASCI

THIN SOIL LAYER (NEW DATUM) AND EDi SURVEY

- Vladimir Jirik (Subcontractor Survey for EDi) attended today's meeting to discuss potential solutions for construction of the Native Soil Layer. There is currently an approximate 3-inch or less (nominal) compacted thin soil layer from the loose soil that was worked into the Biointrusion voids. The thin soil layer creates a better surface to build the Native Soil Layer on due to the irregularities of the Biointrusion Rock. Vladimir Jirik is going to verify the nominal 3-inch thickness via survey CADD software. This thin soil layer will be the new construction datum. Vladimir has also been asked to create a topographic survey of the current existing surface (thin soil layer). This topographic survey will be based on the same 50-foot grid previously used on the Existing Subgrade and Biointrusion Layer. The topographic survey will show the current elevations as well as the slope across the MWL surface. There will also be section cuts to show the difference in the current existing slope and a projected 2.0% slope to meet the

contract specifications. Based off of this data, an approach will be determined to continue the construction of the Native Soil Layer.

NATIVE SOIL LAYER CONSTRUCTION

- Vladimir Jirik made a suggestion to bring the Native Soil up as a flat surface rather than correct the 2.0% slope on the final lift. This has already been discussed and is not the preferred method due to foreseeing soil shortages. It is also believed it is better to start correcting for the 2.0% slope as soon as possible due to deviations in elevation in the Subgrade, which have continued through the Biointrusion Layer. Vladimir also suggested reverting back to the contract design for the remainder of the project. This is not ideal to use because the contract design does not fit exactly with what the existing conditions are. A final decision will be made based off of the survey data expected tomorrow.

- As of now, URS is not going to do a QA survey on the MWL until the 2-1/2-foot Native Soil Layer is complete. URS will do QA density/moisture tests every 6-inch lift as specified in the CMIP.

- It appears that we are not going to be able to correct the slope to 2.0% on the first lift of Native Soil due to the thickness requirements in the CMIP (8-inch loose, 6-inch compacted). The 2.0% slope will probably need to be made up incrementally with multiple lifts. To be discussed more when additional survey information is received tomorrow (06/17/09).

- EDi will begin adjusting the slopes of the MWL to 6:1 as specified on the north, east, and west slopes during the Native Soil Layer. The lifts will be placed in 8-inch loose, 6-inch compacted lifts as specified. Density/Moisture testing will be conducted after the completion of two 6-inch lifts. The Density/Moisture tests will be performed by driving the stake down and testing at 6-inches. The stake will then be driven an additional 6-inches (12-inch total) to test the first 6-inch Native Soil Lift. A random location will be chosen on each side (north, east, west) to be tested (3 locations; 6 test) per 12-inch lift. URS will perform random QA density/moisture tests to verify the results obtained by EDi. This procedure of adding the 6:1 slope is significantly adding to the size of the MWL.

SOIL VOLUME SHORTAGES

- The actual size of the MWL is greater then the 2.6-acre originally anticipated. The larger cover footprint due to the thicker Biointrusion Layer and resulting side slopes is anticipated to result in a shortage of screened soil fill. The actual size of the MWL as of now is approximately 3.05 acres. Additional soil can be extracted from the Borrow Area, however, the exact amount is not known. Additional testing may need to be conducted in the Borrow Area to determine the depth of the Calichie layer.

BIOINTRUSION LAYER THICKNESS

- Marshall Nay calculated an average on the thickness of the Biointrusion Rock Layer. The nominal thickness is approximately1.29-feet, which is very close to the 1.25-foot maximum specified in the CMIP.

K-sat TESTING

- Specification section 02200 requires a hydraulic conductivity testing on each Native Soil Layer lift (8-inch loose, 6-inch compacted). No ASTM Standard was specifically called out in the Specifications and there are a couple of test to choose from:
  - The first test, ASTM D-5084, is a flexible wall hydraulic conductivity test. This test requires an "undisturbed" compacted sample to be taken in the field. The sample is then taken back to the lab to determine the hydraulic properties.
  - The second test, ASTM-5856, is a rigid wall hydraulic conductivity test. This test requires a sample to be taken from the field and returned to the lab. The sample is then compacted and tested at the lab. This test will take 3-5 days and is the most appropriate method based upon the CMIP and a team evaluation of the K-Sat testing logistics and alternatives.

- During the pre-bid there was discussion concerning the potential for delay in schedule due to the hydraulic conductivity testing. The bidding contractors concern was they could control the moisture content and the density in the soil, however, because they are required to use the soil pre-determined by Sandia, they would not have control over the outcome of the hydraulic conductivity test. As a solution, Sandia agreed to not delay the project due to hydraulic conductivity testing.

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **QC SURVEY OF THIN SOIL LAYER OVERLAYING THE BIOINTRUSION LAYER AND 2.0% SURFACE DESIGN SLOPE CORRECTION**
Date: 17 June, 2009
Quality Resolution #: 010
Layer: Thin Soil Layer
Location: Tech Area III, Sandia Mixed Waste Landfill

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Marshall Nay	URS
Don Lopez	URS
Chris Edgman	EDI
Don Schofield	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Jon Schermerhorn	AMEC
Jerome Sanchez and Marcus Cordova	ASCI

THIN SOIL LAYER APPROVAL

- A meeting was held with Sandia, EDi, and URS to discuss the construction of the Native Soil Layer. The topographic survey depicting the current existing conditions was provided by Vladimir Jirik (EDi surveyor). The Topographic map shows existing elevations, the thickness of the thin soil layer covering the Biointrusion Layer, section cuts of existing slopes, and the projected 2.0% slope.

- After reviewing the topographic survey, it was determined the thin soil layer filling the Biointrusion voids was a nominal 3.0" thickness. It was determined that this was an acceptable thickness.

- The 3.0-inch nominal thickness thin soil layer is approved and is now the new construction datum.

2.0% SURFACE DESIGN SLOPE CORRECTION

- After reviewing the survey, it was determined imperfections in the Biointrusion Layer that had been inherited by the low areas in the Existing Subgrade Layer were still present. Grid Blocks 7, 8, and 11 have low areas that require additional

Native Soil material in order to achieve the 2.0% slope required across the MWL from east to west. Because of the maximum 8-inch loose, 6-inch compacted soil constraint in the CMIP, the difference in thickness will need to be constructed in two individual "wedge lifts". Each of the wedge lifts thickness will be within the specified requirements and will receive moisture/density testing as required. Once the slope is corrected using the wedge lifts, the additional lifts (Lifts 3 through 8) will be placed in uniform 6-inch compacted lifts across the entire surface to achieve the 30.0-inch minimum requirement.

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **APPROVAL OF WEDGE LIFTS 1 & 2 AND NATIVE SOIL LIFTS #3 AND #4 (POLISHING LIFTS)**
Date: 22 June, 2009
Quality Resolution #: 011
Layer: Native Soil Layer
Location: Tech Area III, Sandia Mixed Waste Landfill

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Marshall Nay	URS
Don Lopez	URS
Chris Edgman	EDI
Don Schofield	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Jon Schermerhorn	AMEC
Marcus Cordova	ASCI

APPROVAL OF WEDGE LIFTS 1 & 2

- Wedge Lifts 1 and 2 were constructed, tapered, spatially limited lifts to achieve the 2.0% east-to-west design slope. They were constructed and tested in accordance with the CMIP. The slope of the surface still has a couple of areas that do not meet the 2.0% design slope requirement. The 2.0% design slope requirement will be achieved with Native Soil Polishing Lifts 3 and 4.

- Wedge Lifts 1 and 2 are approved based upon CQA Engineer review of construction team QC survey data (topographic map and profiles).

CONSTRUCTION OF NATIVE SOIL "POLISHING LIFTS" 3 & 4

- Chris Edgman (EDi) received an updated topographic map with section cuts of the MWL, which includes the installation of the Native Soil Wedge Lifts 1 and 2. The maps and section cuts were reviewed to discuss how construction of the Native Soil Layer should continue:

- After reviewing the new topographic map it was determined there are still slopes that do not meet the 2.0% requirement. The Native Soil Layer was brought up into

the specified tolerance, however, after reviewing the section cuts there are still some areas that are below the 2.0% grade line that will need correction. EDi proposed correcting these low areas during the third lift of Native Soil. The third lift will fill the low areas with approx 3-to-6-inches of soil while placing only a thin layer of soil, if any, on the areas with higher elevations. This will create a flat surface at approximately 2.0% across the entire MWL. Because soil will only be placed in the low areas, it is not sufficient to perform Density/Moisture tests on all 13 grids. Only the areas that receive enough soil (approximately 4-inch minimum) will be tested. The areas that do not receive enough soil to test during the third lift will be tested during the fourth lift.

- After the third lift is tested and approved, the fourth lift will begin. The fourth lift will also be a thin lift (less then 6-inches) to prevent the areas that received a small amount of soil in the third lift, but not enough soil to test, from exceeding the 6-inch maximum thickness specification constraint. The fourth lift will also be used to "fine-tune" the 2.0% slope. After the fourth lift, the Native Soil remaining lifts (5 through 8) will be constructed and tested in consistent 6-inch lifts at the 2.0% slope. EDi will provide Marshall Nay with a copy of the Topographic Survey Data after the fourth lift (See Appendix A).

PROCTORS

- Discussion on identifying which proctor is to be used for different locations on the MWL occurred. There is currently a range of proctor maximum densities and optimum moisture content from 112.2-to-119.1 pcf and 10.3-to-14.4% respectively. Marshall Nay (URS) calculated the average of all of the current proctors. Marshall received an average maximum density and optimum moisture content of 116.0 pcf and 12.3% respectively. Jon Schermerhorn (AMEC) conducted field proctors as the two wedge lifts were being placed and received a maximum density and optimum moisture content of 115.7 pcf and 12.6 respectively. Both Marshall and Jon acquired similar results, which supported the Density/Moisture tests results.

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **REVIEW OF SIEVE RESULTS FOR AVAILABLE 3/8-INCH CRUSHED GRAVEL TO ADMIX WITH TOPSOIL FILL MATERIAL**
Date: 25 June, 2009
Quality Resolution #: 012
Layer: Topsoil Layer
Location: Tech Area III, Sandia Mixed Waste Landfill

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Marshall Nay	URS
Don Lopez	URS
Chris Edgman	EDI
Don Schofield	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Jon Schermerhorn	AMEC
Marcus Cordova	ASCI

3/8-INCH CRUSHED GRAVEL

- Edgewood Aggregate may not be able to provide enough crushed gravel to meet the current schedule. Edgewood Aggregate is providing the 3/8-inch crushed gravel previously approved for the Topsoil Layer. EDi is resubmitting the Crushed Gravel from Fisher as an alternative to the crushed gravel previously approved by Edgewood Aggregate (See Submittals #1 and #8). EDi is proposing to use crushed gravel from both Edgewood aggregate and Fisher. A new sample of the Fisher aggregate was provided yesterday and contains similar physical properties as the previously approved Edgewood aggregate.

- EDi plans to mix the 3/8-inch crushed gravel available by Edgewood Aggregate with the 3/8-inch crushed gravel from Fisher.

- Approximately 2,300-tons of crushed gravel will be needed.

- No available aggregate met specifications for % passing through the #4 sieve. An aggregate was selected and approved using engineering judgment. Marshall Nay (URS) has approved the Fisher 3/8-inch crushed gravel today in lieu of Don Lopez.

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **QC SURVEY RESULTS FOR POLISHING LIFTS 3 AND 4**
Date: 30 June, 2009
Quality Resolution #: 013
Layer: Native Soil Layer
Location: Tech Area III, Sandia Mixed Waste Landfill

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Marshall Nay	URS
Don Lopez	URS
Chris Edgman	EDI
Don Schofield	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Jon Schermerhorn	AMEC
Marcus Cordova	ASCI

APPROVAL OF POLISHING LIFTS 3 AND 4

- Polishing Lifts 3 and 4 were constructed across the cover surface but with variable thickness to complete the adjustment required to establish the 2.0% east-to-west surface design slope. They were constructed and tested in accordance with the CMIP. Polishing Lifts 3 and 4 are approved.

- Polishing Lifts 3 and 4 are approved based upon review of Construction Team QC survey data (topographic map and profiles).

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **LIFT #5 LOW AREA**
Date: 01 July, 2009
Quality Resolution #: 014
Layer: Native Soil Layer
Location: Tech Area III, Sandia Mixed Waste Landfill

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Marshall Nay	URS
Don Lopez	URS
Chris Edgman	EDI
Don Schofield	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Jon Schermerhorn	AMEC
Marcus Cordova	ASCI

CORRECTION OF LIFT #5

- A location on the corner of Grid Bock 7 was located which requires a fill of 0.90-feet to achieve the proper elevation. 0.45-feet of Native Soil was placed yesterday (06/30/09) at this location. This location will receive Density/Moisture testing today. An additional 0.45-foot of Native Soil will then be placed to achieve the 0.90-feet required. The second lift of 0.45-feet will be tested with the remainder of Native Soil Lift #5 as required in the CMIP.

- The first 0.45-feet layer placed yesterday was tested for moisture and density, but failed. The area was reworked, recompacted, and retested. The Moisture/Density test was then successful. The second 0.45-feet layer was then placed (to account for the 0.9-feet thickness). EDi performed a Moisture/Density test in this location which also passed.

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **SOIL FILL MATERIAL SHORFALL – QA REVIEW OF EDi SOIL VOLUME ESTIMATES FOR ADDITIONAL MATERIAL NEEDED**
Date: 14 July, 2009
Quality Resolution #: 015
Layer: Native & Topsoil Layers
Location: Tech Area III, Sandia Mixed Waste Landfill

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Marshall Nay	URS
Don Lopez	URS
Chris Edgman	EDI
Don Schofield and Ben Martinez	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Jon Schermerhorn	AMEC
Marcus Cordova	ASCI

SOIL FILL MATERIAL SHORFALL – QA REVIEW OF EDi SOIL VOLUME ESTIMATES FOR ADDITIONAL MATERIAL NEEDED

- Due to the MWL surface area being larger than initially anticipated, additional Native Soil and Topsoil is required. Sandia has requested EDi provide a proposal for the additional volumes/cost to complete the MWL. Sandia has also requested URS provide a third party analysis of the volumes/cost to complete the MWL. The volumes/cost provided by URS shall be used to verify the proposal provided by EDi to Sandia.

- EDi provided Sandia with a proposal of 9,615-CY of additional Native Soil and 1,590-CY of additional Topsoil for the completion of the MWL. URS provided an independent review of the additional soil volumes required using two methods (free-body diagram and construction history data). Both methods were close to the results obtained by EDi. URS informed Sandia that EDi's estimate for additional volume calculations are accurate

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **NATIVE SOIL LAYER QA AND QC VERIFICATION SURVEYS**
Date: 30 July, 2009
Quality Resolution #: 016
Layer: Native Soil Layer
Location: Tech Area III, Sandia Mixed Waste Landfill

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Marshall Nay	URS
Don Lopez	URS
Chris Edgman	EDI
Don Schofield and Ben Martinez	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Jon Schermerhorn	AMEC
Jerome Sanchez	ASCI

NATIVE SOIL LAYER QA AND QC VERIFICATION SURVEY

- The Native Soil Layer was constructed and tested in accordance with the CMIP with the exception of 9 locations which were below the 30-inch thickness requirement. The Native Soil Layer is approved for the placement of the Topsoil Layer with the exception of the 9 low locations. The 9 locations must be corrected, resurveyed, and approved prior to the placement of the Topsoil Layer.

- The 9 locations requiring additional soil were identified through review of both the QC and QA survey results, and likely represent high spots in the underlying Biointrusion Layer.

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **NATIVE SOIL LAYER FINAL QA AND QC VERIFICATION SURVEYS**
Date: 04 August, 2009
Quality Resolution #: 017
Layer: Native Soil Layer
Location: Tech Area III, Sandia Mixed Waste Landfill

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Marshall Nay and Harry Buckner	URS
Don Lopez	URS
Chris Edgman	EDI
Don Schofield	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Jon Schermerhorn	AMEC

APPROVAL OF NATIVE SOIL LAYER

- The 9 locations previously identified as low areas have been corrected, resurveyed, and are approved. The Native Soil Layer was constructed and tested in accordance with the CMIP and is approved for the placement of the Topsoil Layer.

- Native Soil Layer thickness, 2.0% east-to-west surface design slope, and 6:1 side slopes are approved based upon the QA verification survey and review of the Construction Team QC survey data (topographic map and profiles).

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **TOPSOIL LAYER QA AND QC VERIFICATION SURVEYS**
Date: 12 August, 2009
Quality Resolution #: 018
Layer: Topsoil Layer
Location: Tech Area III, Sandia Mixed Waste Landfill

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Marshall Nay and Harry Buckner	URS
Don Lopez	URS
Chris Edgman	EDI
Don Schofield	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Jon Schermerhorn	AMEC
Marcus Cordova	ASCI

TOPSOIL LAYER QA AND QC VERIFICATION SURVEYS

- The Topsoil Layer was constructed in accordance with the CMIP. Thickness, 2.0% east-to-west surface design slope, and 6:1 side slopes verified and meet specifications. The Topsoil layer is approved.

- Topsoil Layer thickness, 2.0% east-to-west surface design slope, and 6:1 side slopes are approved based upon the QA verification survey and review of the Construction Team QC survey data (topographic map and profiles).

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **SEED AND MULCH MATERIAL INSPECTIONS AND ELIMINATION OF STARTER FERTILIZER**
Date: 19 August, 2009
Quality Resolution #: 019
Layer: Seed and Mulch
Location: Tech Area III, Sandia Mixed Waste Landfill

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Marshall Nay	URS
Don Lopez	URS
Chris Edgman	EDI
Don Schofield	SNL/4133
Mike Mitchell	SNL/GRAM
John Davidson	North Wind Inc.
Kenneth Hale	AMEC
Jon Schermerhorn	AMEC

SEED AND MULCH APPROVAL

- Native Grass Seed was delivered and stored in the conex to keep dry. Seed and Mulch was approved by Don Lopez today.

- Elimination of fertilizer was approved today.

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **INCREASED SEEDING RATE AND APPLICATION METHOD**
Date: 25 August, 2009
Quality Resolution #: 020
Layer: Seed, Fertilizer, and Mulch
Location: Tech Area III, Sandia Mixed Waste Landfill

ATTENDEES:

NAME	COMPANY
Harry Buckner and Paul Molina	URS
Marshall Nay	URS
Don Lopez	URS
Chris Edgman	EDI
Don Schofield	SNL/4133
Mike Mitchell	SNL/GRAM
Kenneth Hale	AMEC
Jon Schermerhorn	AMEC

INCREASED SEEDING RATE AND APPLICATION METHOD APPROVAL

- CMIP modification for reclamation seeding and mulching is approved.
- Hand broadcasting used in addition to drill seeding to minimize compaction of the Topsoil Layer by minimizing the number of passes required by the tractor pulling the drill seeder. Additional passes would have been necessary to accommodate the increase of seeding rate.
- Fertilizer not used based upon recommendation from Sandia Staff Biologist. Fertilizer used late in the growing season can make plants more susceptible to frost damage.

END OF MEETING NOTES

URS

QUALITY RESOLUTION MEETING MINUTES

Sandia Mixed Waste Landfill
Job #: 24342640

Title: **INSPECTION AND APPROVAL OF THE SEEDING AND MULCH**
Date: 02 September, 2009
Quality Resolution #: 021
Layer: Seed, Fertilizer, and Mulch
Location: Tech Area III, Sandia Mixed Waste Landfill

ATTENDEES:

NAME	COMPANY
Paul Molina	URS
Marshall Nay	URS
Don Lopez	URS
Chris Edgman	EDI
Don Schofield	SNL/4133
Mike Mitchell	SNL/GRAM
Kenneth Hale	AMEC
Jon Schermerhorn	AMEC

INSPECTION AND APPROVAL OF THE SEEDING AND MULCH

- The placement of seed and mulch is approved based on visual inspection.

END OF MEETING NOTES

ATTACHMENT 2

CQA Submittals and Approvals

2009 QA Submittal Cover Pages

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL CONSTRUCTION COVER PROJECT Date 6-2-2009
Contract # PO# 903677
Submittal # 001
New ☒ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) DON LOPEZ - URS CORPORATION
Submitted by (name/company) CHRIS EDSMON - EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	3/8" CRUSHED GRAVEL	THE TOPSOIL LAYER SHALL BE ADMIXED WITH 3/8", CRUSHED GRAVEL 25 PERCENT BY VOLUME BEFORE PLACING & GRADING SECTION 02200-4 2.1.2 FILL #4	☒	☐	☐	
			☐	☐	☐	
			☐	☐	☐	
			☐	☐	☐	
			☐	☐	☐	
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			☐	☐	☐	
			☐	☐	☐	
			☐	☐	☐	

Date June 2, 2009 Name/Title Donald T. Lopez PE Signature Donald T. Lopez
URS NM CQA Engineer

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

A TOTAL OF THREE (3) SAMPLES WERE COLLECTED FROM THREE DIFFERENT VENDORS. PLEASE FIND ATTACHED THE SIEVE ANALYSIS PERFORMED BY AMEC FOR EACH OF THE THREE VENDORS.

#1 - DUKE CITY AGGREGATE
#2 - FISHER INDUSTRIES (SEE NOTE BELOW)
#3 - EDGEWOOD AGGREGATE

NOTE - EDI HAS ONLY RECEIVED THE INITIAL RESULTS, EDI WILL PROVIDE THE COMPLETE PACKAGE ONCE RECEIVED FROM AMEC.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 6-10-09
Contract # PO# 903627
Submittal # 002
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Field Density Gridline #5	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
02	Field Density Gridline #9	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
03	Field Density Gridline #12	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
04	Field Density Gridline #11	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
05	Field Density Gridline #8	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
06	Field Density Gridline #3	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
07	Field Density Gridline #2	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
08	Field Density Gridline #7	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
09	Field Density Gridline #6	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
10	Field Density Gridline #1	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
11	Field Density Gridline #4	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
12	Field Density Gridline #10	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
13	Field Density Gridline #13	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	

Date June 10, 09 Name/Title Donald T. Lopez PE Signature

URS NM C&A Engr.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 5 field density tests per acre stated in Section 2200-9 3.4.2 and Table 3.1. Thirteen samples were collected from the 2.6 acre landfill. Please see attached map for grid layout.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 6-11-09
Contract # PO# 903627
Submittal # 003
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Native Fill Material # 4	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
02	Native Fill Material # 5	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
03	Native Fill Material # 6	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
04	Native Fill Material # 7	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
05	Native Fill Material # 9	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date June 12, 09 Name/Title Donald T. Capek PE URS NM CQA Engineer Signature Donald T. Capek

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the Native Soil Borrow material at a frequency of 1/500 cubic yards stated in Section 2200-9 3.4.2 and Table 3.1.

5 samples (Items 1 to 5) were collected from the native soil borrow pile.

Please see attached map for sample locations.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 6-16-09
Contract # PO# 903627
Submittal # 004
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Native Fill Material # 1	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☑	☐	☐	m
02	Native Fill Material # 2	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☑	☐	☐	m
03	Native Fill Material # 3	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☑	☐	☐	m
04			☐	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date 16 June 09 Name/Title Marshall Nay PE URS for Don Lopez, CQA Engr Signature Marshall W. Nay PE

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the Native Soil Borrow material at a frequency of 1/500 cubic yards stated in Section 2200-9 3.4.2 and Table 3.1.

3 samples (Items 1 to 3) were collected from the native soil borrow pile.

Please see attached map for sample locations.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 6-17-09
Contract # PO# 903627
Submittal # 005
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Top Soil # 1	Top Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☑	☐	☐	
02	Top Soil # 2	Top Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☑	☐	☐	
03	Top Soil # 3	Top Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☑	☐	☐	
04	Top Soil # 4	Top Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☑	☐	☐	
05	Top Soil # 5	Top Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☑	☐	☐	
06	Top Soil # 6	Top Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☑	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date 18 June 09 Name/Title MNP, URS for Don Lopez - CQA Signature Marshall Ray

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the Top Soil Borrow material at a frequency of 1/500 cubic yards stated in Section 2200-9 3.4.2 and Table 3.1.

6 samples (Items 1 to 6) were collected from the native soil borrow pile.

Please see attached map for sample locations.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 6-17-09
Contract # PO# 903627
Submittal # 006
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Native Fill Material # 9	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☑	☐	☐	
02	Native Fill Material # 10	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☑	☐	☐	
03	Native Fill Material # 11	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☐	☐	☑	
04	Native Fill Material # 12	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☑	☐	☐	
05	Native Fill Material # 13	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☑	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date 18 June 09 Name/Title Marshall W. Nay Signature Marshall Nay
for Don Lopez CQA Engineer

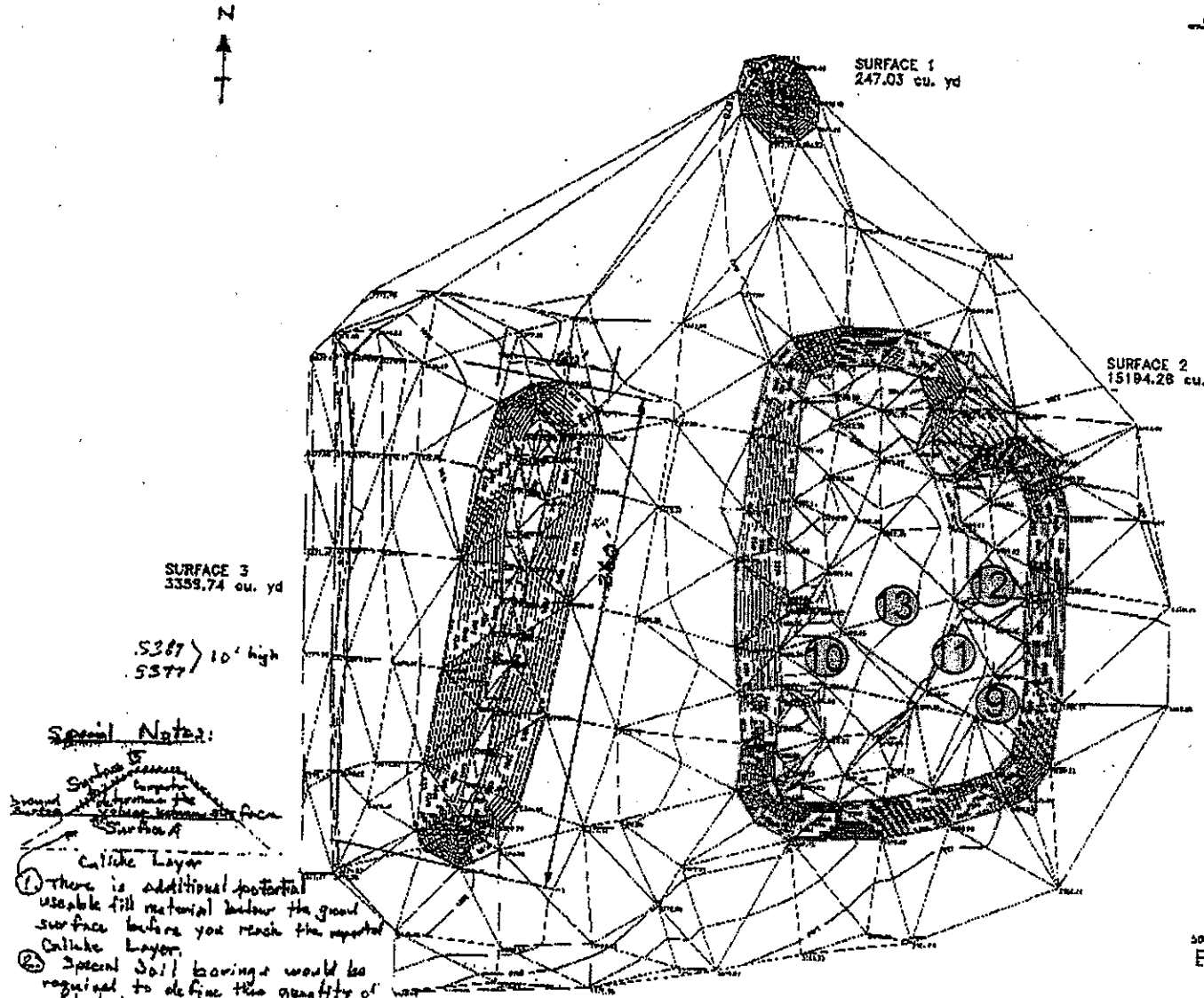
MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the Native Soil Borrow material at a frequency of 1/500 cubic yards stated in Section 2200-9 3.4.2 and Table 3.1.

5 samples (Items 1 to 5) were collected from the native soil borrow pile.

Please see attached map for sample locations.



Approximate Methods - Surface 3

Goal is to check order of magnitude of production numbers.

Cross Section Area:

$2[(240)(.5)(2.5)] + (60)(10) = 360$ SF

240 + 120 ↓ end rounding factor

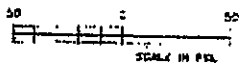
Length 260'(.98) = 255 : 91,800 cf

Divide by $\frac{27 \text{ cf}}{\text{cy}}$ = 3400 CY

- The Stinday Volume using Approx Methods is about 3400 CY. If I reduced my End Rounding Factor to 0.97, the results are: 3366 CY.
- The computer, using Micro S.ft INROADS software reports 3360 CY.
- The results are very close.

Special Notes:

1. There is additional potential usable fill material below the ground surface before you reach the reported Caliche Layer.
2. Special Soil borings would be required to define the quantity of [illegible]



MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 6-22-09
Contract # PO# 903627
Submittal # 007
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Survey Data	Survey Data of fill depths needed for wedge lift to make 2% slope across cover.	☑	☐	☐	M
02		Last Item	☐	☐	☐	
03			☐	☐	☐	
04			☐	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date 23 June Name/Title Marshall Nay, URS for Don Lopez, PE, Project CQA Signature Marshall Nay

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires the cover to have a 2% East to West. EDi plans to do a "wedge lift" on the East side of the landfill cover to meet the 2% requirement. The survey data shows the fill depths needed to meet the 2 % grade. See attached for site layout.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 6-24-09
Contract # PO# 903627
Submittal # 008
New ☐ Resubmittal ☑
If resubmittal, prev. submittal # 001

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	3/8" Crush Gravel	Crushed Gravel for top soil lift. Section 02200-4 2.1.2 Fill # 4	☑	☐	☐	
02			☐	☐	☐	
03			☐	☐	☐	
04			☐	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date 25 June 09 Name/Title Marshall Nay, URS For Don Lopez, PE, CQA Engineer Signature Marshall Nay

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires the top soil material contain 3/8" crushed gravel, 25 % by volume. In previous submittal, Edgewood Aggregates was approved. Edgewood Aggregates may not be able to produce enough gravel to meet the current schedule. As a potential alternate to the Edgewood Aggregate, EDi would like to use Fisher Industries if needed to maintain the current schedule. The Fisher aggregate is being resubmitted for approval.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-2-09
Contract # PO# 903627
Submittal # 009
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Native Fill Material # 14	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
02	Native Fill Material # 15	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
03	Native Fill Material # 16	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
04	Native Fill Material # 17	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
05	Native Fill Material # 18	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date July 6, 09 Name/Title Randal T. Loy PE CQA Engineer URS NM Signature Randal T. Loy

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the Native Soil Borrow material at a frequency of 1/500 cubic yards stated in Section 2200-9 3.4.2 and Table 3.1.

5 samples (Items 1 to 5) were collected from the native soil borrow pile.

Please see attached map for sample locations.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-02-09
Contract # PO# 903627
Submittal # 010
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Field Density North Slope Lift 2	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
02	Field Density North Slope Lift 1	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
03	Field Density East Slope Lift 2	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
04	Field Density East Slope Lift 1	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
05	Field Density West Slope Lift 2	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
06	Field Density West Slope Lift 1	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
07	Field Density East Slope Lift 4	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
08	Field Density East Slope Lift 3	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
09	Field Density West Slope Lift 4	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
10	Field Density West Slope Lift 3	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
11	Field Density North Slope Lift 4	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
12	Field Density North Slope Lift 3	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
13	Field Density North Slope Lift 6	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
14	Field Density North Slope Lift 5	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
15	Field Density Dog Leg Lift 2	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
16	Field Density Dog Leg Lift 1	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
17	Field Density West Slope Lift 6	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
18	Field Density West Slope Lift 5	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
19	Field Density East Slope Lift 6	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
20	Field Density East Slope Lift 5	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
21	Field Density North Slope Lift 8	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
22	Field Density North Slope Lift 7	Sub Grade Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
23			☐	☐	☐	
24			☐	☐	☐	
25			☐	☐	☐	
26			☐	☐	☐	

Date July 6, 09 Name/Title DONALD T. COPEZ PE Signature

CQA Engineer
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the native soil at a frequency of 5 field density tests per acre stated in Section 2200-9 3.4.2 and Table 3.1. The CMIP does not mention testing the slopes, however it was agreed that the North, East, and West slopes would be tested at a single random spot on every lift. This submittal is for the 6 lifts on the west and east slopes and the 8 on the north slope.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-2-09
Contract # PO# 903627
Submittal # 011
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Field Density Grid Block #7	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
02	Field Density Grid Block #8	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
03	Field Density Grid Block #11	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
04			☐	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date July 6, 2009 Name/Title DONALD T. LOPEZ PE Signature Donald T. Lopez
CQA Engineer
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 5 field density tests per acre stated in Section 2200-9 3.4.2 and Table 3.1. Compaction tests were performed in the three grid blocks needed for the wedge lift to make the 2 % slope. The wedge lift was not discussed in the CMIP but it is considered a native soil lift and hence. tested.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-2-09
Contract # PO# 903627
Submittal # 012
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Field Density Grid Block #11	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
02	Field Density Grid Block # 7	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
03	Field Density Grid Block #8	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
04			☐	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date July 6, 2009 Name/Title DONALD T. COPELAND PE Signature Donald T. Copeland
CQA Engineer
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 5 field density tests per acre stated in Section 2200-9 3.4.2 and Table 3.1. Compaction tests were performed in the three grid blocks needed for the second wedge lift to make the 2 % slope. The wedge lift was not discussed in the CMIP but it is considered a native soil lift and hence. tested.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project Date 7-2-09
Contract # PO# 903627
Submittal # 013
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Field Density Grid Block # 2	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
02	Field Density Grid Block # 1	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
03	Field Density Grid Block # 8	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
04	Field Density Grid Block # 6	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date July 6, 2009 Name/Title DONALD T. LOPEZ Signature Donald T. Lopez
CQA Engineer
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 5 field density tests per acre stated in Section 2200-9 3.4.2 and Table 3.1. Compaction tests were performed in the four grid blocks needed for the lift 3. Lift 3 is only a 3 inch lift. There were some low areas that needed to be lifted up. In these areas the lift was thick enough to be tested. The four grid blocks are the locations with deeper fill amounts.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-10-09
Contract # PO# 903627
Submittal # 014 OK
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Lift 3 Grid Block # 11 SE	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
02	Lift 3 Grid Block # 11 NE	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
03	Lift 4 Grid Block # 1	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
04	Lift 4 Grid Block # 2	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
05	Lift 4 Grid Block # 3	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
06	Lift 4 Grid Block # 4	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
07	Lift 4 Grid Block # 5	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
08	Lift 4 Grid Block # 10	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
09	Lift 4 Grid Block # 9	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
10	Lift 4 Grid Block # 8	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
11	Lift 4 Grid Block # 7	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
12	Lift 4 Grid Block # 6	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
13			☒	☐	☐	

Date July 13, 09 Name/Title Donald T. Lopez PE Signature Donald T. Lopez PE
URS NM
CQA Engineer

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 5 field density tests per acre stated in Section 2200-9 3.4.2 and Table 3.1. Compaction tests were performed in 2 locations in grid block 11 in lift 3. The tests in grid block eleven were performed in two areas that had higher fill amounts. Ten tests were performed on lift 4 in grid blocks 1 to 10. The CMIP requires that the minimum compaction allowed is 90% and the moisture is plus or minus 2 % of the optimal moisture.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-10-09
Contract # PO# 903627
Submittal # 015 OK
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Lift 4 Grid Block # 13	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☑	☐	☐	
02	Lift 4 Grid Block # 12	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☑	☐	☐	
03	Lift 4 Grid Block # 11	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☑	☐	☐	
04			☐	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date July 13, 09 Name/Title Donald T. Copez PE Signature Donald T. Copez PE
URS NM
CQA Engineer

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 5 field density tests per acre stated in Section 2200-9 3.4.2 and Table 3.1. Density and moisture tests were performed in grid blocks 11, 12, and 13 in lift 4. The CMIP requires that the minimum compaction allowed is 90% and the moisture is plus or minus 2 % of the optimal moisture.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-10-09
Contract # PO# 903627
Submittal # 016
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Lift 5 Grid Block # 13	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
02	Lift 5 Grid Block # 12	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
03	Lift 5 Grid Block # 11	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
04	Lift 5Grid Block # 7	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☒	☐	Retest
05	Lift 5 Grid Block # 7, Re-test East Edge SE	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date July 14, 09 Name/Title Donald T. Lopez PE Signature
URS NM
CQA Engineer

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 5 field density tests per acre stated in Section 2200-9 3.4.2 and Table 3.1. Density and moisture tests were performed in grid blocks 11, 12, 13, and 7 in lift 5. Grid block 7 needed to be tested twice due to a low area that would need more than six inches. The first test in grid block 7 failed on moisture. The area was watered and re-compacted. The re-test in grid block 7 passed. Grid block 7 will be tested a second time when grid blocks 6 and 8 are tested during the full lift. The CMIP requires that the minimum compaction allowed is 90% and the moisture is plus or minus 2 % of the optimal moisture.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-10-09
Contract # PO# 903627
Submittal # 017
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Native Fill Material Berm 1	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
02	Native Fill Material Berm 2	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
03	Native Fill Material Berm 3	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
04			☐	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date July 13, 09 Name/Title Donald T. Lopez PE
URS NM
CQA Engineer
Signature Donald T. Lopez

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the Native Soil Borrow material at a frequency of 1/500 cubic yards stated in Section 2200-9 3.4.2 and Table 3.1. 3 samples (Items 1 to 5) were collected from the 1400 cubic yards of SWPPP berm material hauled from the MWL to the borrow area.

OK

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-10-09
Contract # PO# 903627
Submittal # 018
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Lift 5 Grid Block # 10	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
02	Lift 5 Grid Block # 9	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
03	Lift 5 Grid Block # 8	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
04	Lift 5 Grid Block # 7	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
05	Lift 5 Grid Block # 6	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date 7/14/09 Name/Title Donald T. Cyrus PE Signature Donald T. Cyrus

URS NM

CQA Engineer

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 5 field density tests per acre stated in Section 2200-9 3.4.2 and Table 3.1. Density and moisture tests were performed in grid blocks 6, 7, 8, 9, 10 in lift 5. All of the tests passed. The CMIP requires that the minimum compaction allowed is 90% and the moisture is plus or minus 2 % of the optimal moisture.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-16-09
Contract # PO# 903627
Submittal # 019
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Lift 5 Grid Block # 5 Re-test	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
02	Lift 5 Grid Block # 4 Re-test	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
03	Lift 5 Grid Block # 3 Re-test	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
04	Lift 5 Grid Block # 2 Re-test	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
05	Lift 5 Grid Block # 1 Re-test	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date July 17, 09 Name/Title Donald T. Lopez PE Signature Donald T. Lopez
URS NM
CQA Engineer

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 5 field density tests per acre stated in Section 2200-9 3.4.2 and Table 3.1. Density and moisture tests were performed in grid blocks 1, 2, 3, 4, and 5 in lift 5. The CMIP requires that the minimum compaction allowed is 90% and the moisture is plus or minus 2 % of the optimal moisture. In the first test, 3 of the 5 grid blocks failed. The entire grid was ripped, watered, and reworked. The results of the failed tests are included and the results of the re-tests are included for approval.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-20-09
Contract # PO# 903627
Submittal # 020
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

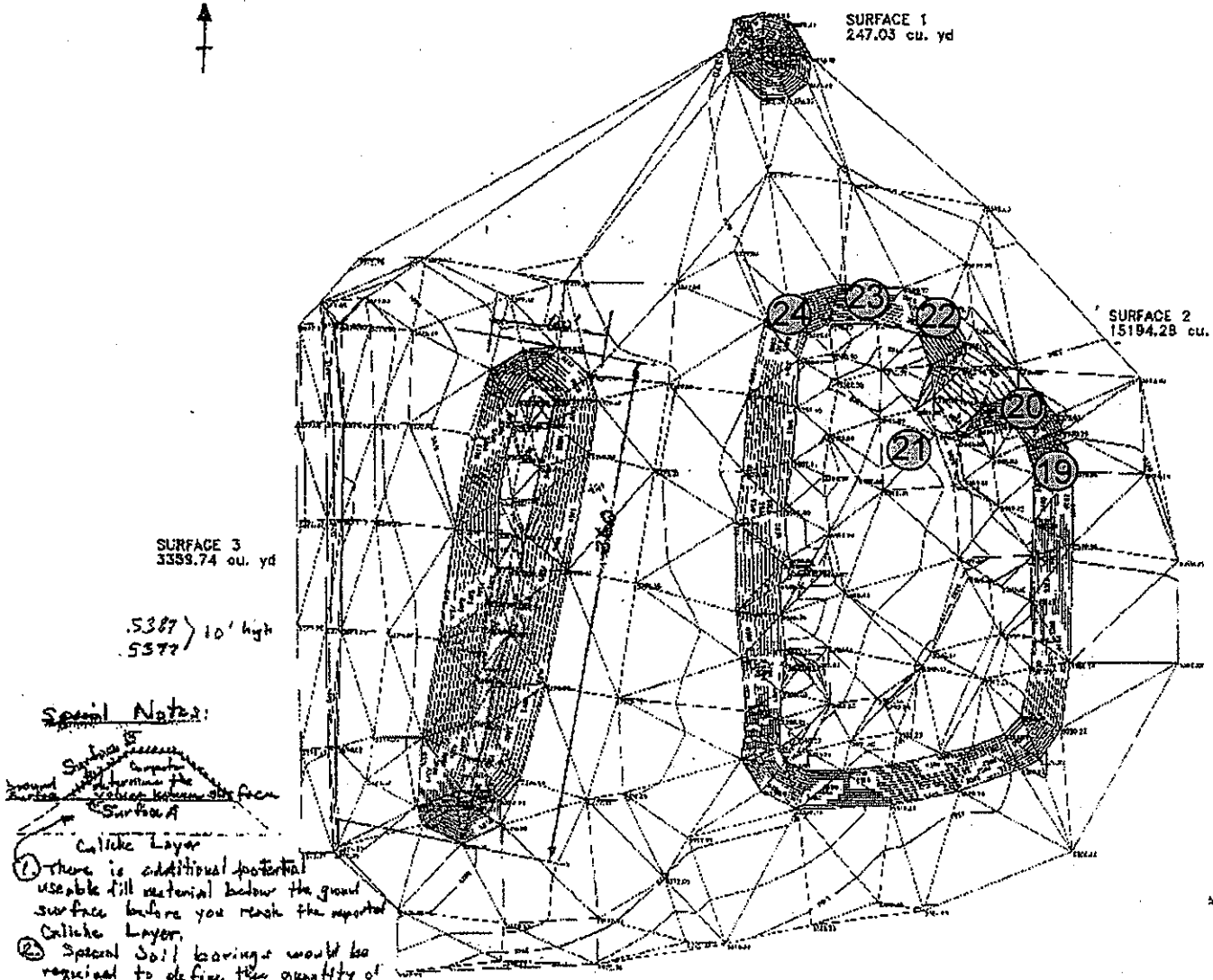
To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Native Fill Material # 19	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
02	Native Fill Material # 20	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
03	Native Fill Material # 21	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
04	Native Fill Material # 22	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
05	Native Fill Material # 23	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
06	Native Fill Material # 24	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date July 20, 2009 Name/Title Donald T. Lopez PE Signature

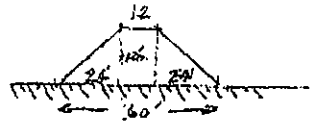
URS NM
CQA Engineer



.5387 } 10' high
.5377

Approximate Methods - Surface 3

Goal is to check order of magnitude of production numbers.



Cross Section Area:

$2\left[\left(\frac{1}{2}(10)(10)\right)+(10)(10)\right] = 360$ SF

240 + 120 ← end rounding factor

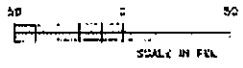
Length: 260'(.98) = 255' : 91,800 CF

Divide by $27 \frac{CF}{CY}$ = 3400 CY

- The Sliding Volume using Approx Methods is about 3400 CY. If I reduced my End Rounding Factor to 0.97, the results are: 3366 CY.
- The computer, using Micro Soft INROADS software reports: 3360 CY.
- The results are very close.

Special Notes:

1. There is additional potential useable fill material below the ground surface before you reach the reported Caliche Layer.
2. Special Soil bearings would be required to define the quantity of unsuitable [illegible] soil



Submittal 20

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

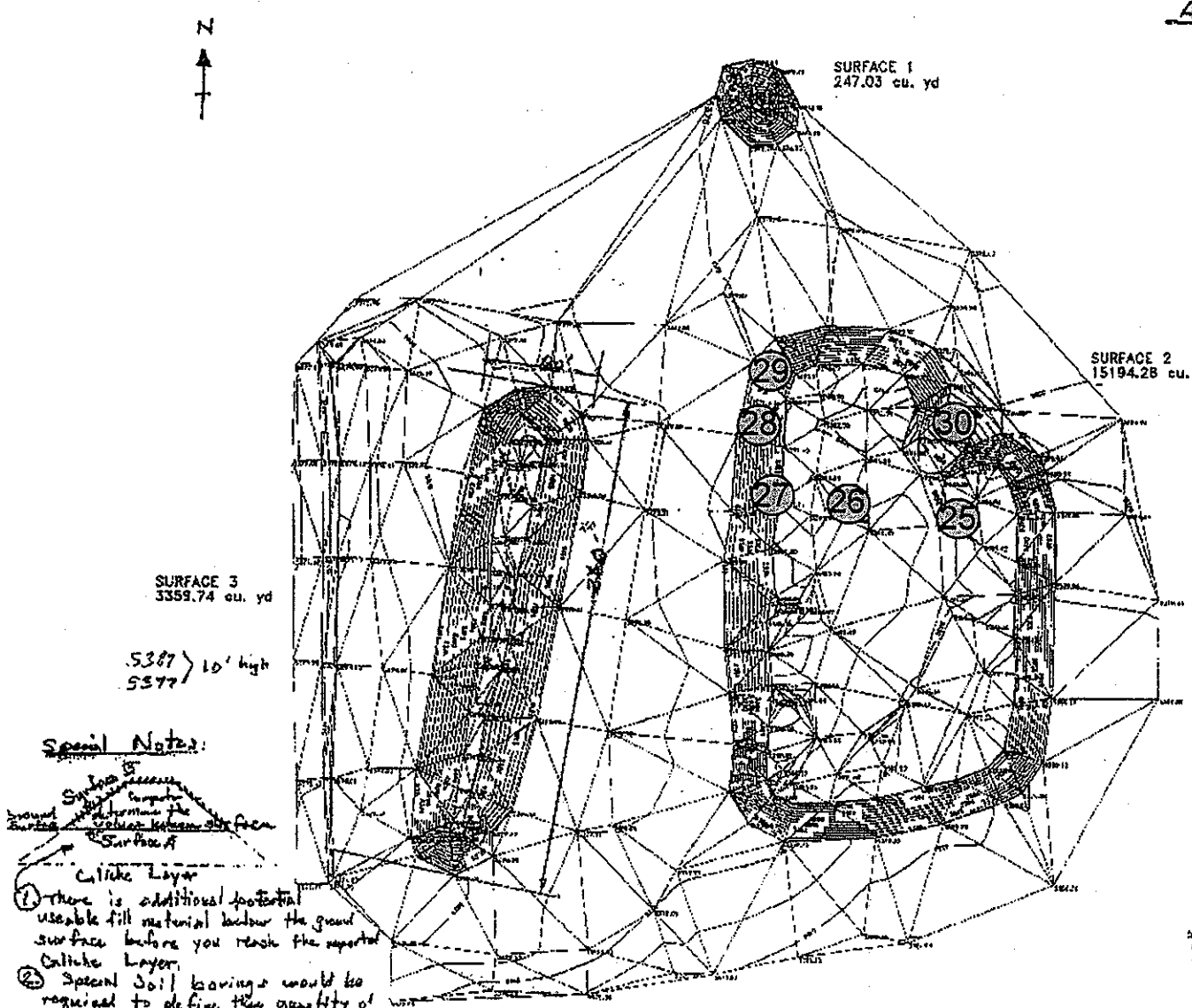
Date 7-20-09
Contract # PO# 903627
Submittal # 021
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Native Fill Material # 25	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
02	Native Fill Material # 26	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
03	Native Fill Material # 27	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
04	Native Fill Material # 28	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
05	Native Fill Material # 29	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
06	Native Fill Material # 30	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

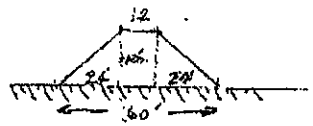
Date July 20, 2009 Name/Title Donald T. Lopez PE Signature
URS NM
CQA Engineer



5387 } 10' high
5377

Approximate Methods - Surface 3

Goal is to check order of magnitude of production numbers.



Cross Section Area:

$2[(24)(10)\frac{1}{2}] + (12)(10) = 360$ SF

240 + 120 ← end rounding factor

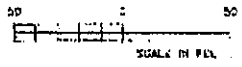
Length: 260'(.98) = 255' .91, 80 ea Lp

Divide by $\frac{27 \text{ SF}}{\text{CY}}$ = 3400 CY

- The Stinking Volume using Approx Methods is about 3400 CY. If I reduced my End Rounding Factor to 0.97, the results are: 3363 CY.
- The computer, using Micro Soft INROADS software reports: 3360 CY.
- The results are very close.

Special Notes:

1. There is additional potential useable fill material between the ground surface before you reach the reported Caliche Layer.
2. Special Soil borings would be required to define the quantity of material ... Caliche



Submittal 21

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the Native Soil Borrow material at a frequency of 1/500 cubic yards stated in Section 2200-9 3.4.2 and Table 3.1.

6 samples (Items 1 to 6) were collected from the native soil borrow pile.

Please see attached map for sample locations.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-22-09
Contract # PO# 903627
Submittal # 022
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Native Fill Material Berm 4	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
02	Native Fill Material Berm 5	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
03	SNL MWL 071009-7 ~~Top Soil Material 7~~ JRJ	Top Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
04	SNL MWL 071009-8 JRJ ~~Top Soil Material 8~~	Top Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
05	SNL MWL 071009-9 ~~Top Soil Material 9~~	Top Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date 07/23/09 Name/Title Donald T. Lopez PE Signature
CQA Engineer
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the Native Soil Borrow material at a frequency of 1/500 cubic yards stated in Section 2200-9 3.4.2 and Table 3.1.

2 samples (Items 1 and 2) were collected from the excavated and screened material on the west side of the borrow area and from the north side of the borrow area. The samples were taken for material needed for the additional material needed to complete the native soil lifts.

3 samples (Items 3, 4, and 5) are top soil samples excavated and screened from the west edge of the borrow area. This material was added to the existing top soil pile to be blended with the $^{3}/_{8}$" gravel.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the Native Soil Borrow material at a frequency of 1/500 cubic yards stated in Section 2200-9 3.4.2 and Table 3.1.

6 samples (Items 1 to 6) were collected from the native soil borrow pile.

Please see attached map for sample locations.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-22-09
Contract # PO# 903627
Submittal # 023
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Native Fill Material Berm 6	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
02	Native Fill Material Berm 7	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
03	Native Fill Material Berm 8	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
04	SNL MWL 071409-10 ~~Top Soil Material 10~~	Top Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date 07/23/09 Name/Title Donald T. Lopez PE Signature Donald T. L
CQA Engineer
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the Native Soil Borrow material at a frequency of 1/500 cubic yards stated in Section 2200-9 3.4.2 and Table 3.1.

3 samples (Items 1 to 3) were collected from the excavated and screened material on the north west side of the borrow area and from the north side of the borrow area. The samples were taken for material needed for the additional material needed to complete the native soil lifts.

1 sample (Items 4) is a top soil sample excavated and screened from the west edge of the borrow area. This material was added to the existing top soil pile to be blended with the $^{3}/_{8}$" gravel.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-22-09
Contract # PO# 903627
Submittal # 024
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Lift 6 Grid Block # 13	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☑	☐	☐	
02	Lift 6 Grid Block # 12	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☑	☐	☐	
03	Lift 6 Grid Block # 11	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☑	☐	☐	
04			☐	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date 07/23/09 Name/Title Donald T. Lopez PE Signature Donald T. L
CQA Engineer
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 5 field density tests per acre stated in Section 2200-9 3.4.2 and Table 3.1. Density and moisture tests were performed in grid blocks 11, 12, and 13 for lift 6 The CMIP requires that the minimum compaction allowed is 90% and the moisture is plus or minus 2 % of the optimal moisture. All tests passed the specifications.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-22-09
Contract # PO# 903627
Submittal # 025
New ☐ Resubmittal ☑
If resubmittal, prev. submittal # 006

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Native Fill Material 11	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☑	☐	☐	
02			☐	☐	☐	
03			☐	☐	☐	
04			☐	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date 07/23/09 Name/Title Donald T. Capek PE Signature Donald T. Capek
COA Engineer
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the Native Soil Borrow material at a frequency of 1/500 cubic yards stated in Section 2200-9 3.4.2 and Table 3.1. This sample has been submitted and approved, however it was missing screen number 40. The sample was re-tested with the # 40 screen.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-23-09
Contract # PO# 903627
Submittal # 026
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials	
01	Lift 6 Grid Block # 10	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
02	Lift 6 MW-4	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☐	☒	☐		Retested
03	Lift 6 Grid Block # 8	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
04	Lift 6 Grid Block # 7	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
05	Lift 6 Grid Block # 6	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
06	Lift 6 Grid Block # 1	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
07	Lift 6 Grid Block # 2	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
08	Lift 6 Grid Block # 3	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
09	Lift 6 Grid Block # 4	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
10	Lift 6 Grid Block # 5	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
11	Lift 6 Grid Block # 9	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
12		NA	☒	☐	☐		
13			☐	☐	☐		

Date 7/23/09 Name/Title Donald T. Lopez PE Signature Donald T. Lopez
CQA Engineer
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 5 field density tests per acre stated in Section 2200-9 3.4.2 and Table 3.1. The CMIP requires that the minimum compaction allowed is 90% and the moisture is plus or minus 2 % of the optimal moisture.

11 tests were performed covering grid blocks 1 to 10 and one around the hand compacted area around MW-4. All grid block tests passed the specifications. The hand compacted area around MW-4 did not pass. The moisture was too high. The area will be re-tested on Monday July 20.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-23-09
Contract # PO# 903627
Submittal # 027
New ☑ Resubmittal ☐
If resubmittal, prev. submittal #

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Lift 6 MW-4 Re-test	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☒	☐	
02			☐	☐	☐	
03			☐	☐	☐	
04						
05						
06						
07						
08						
09						
10						
11						
12			☐	☐	☐	
13			☐	☐	☐	

Don Approval. Don L. Recommend approval now. Have sorted out the sample taxonomy they are using. "01 is the first of a test sequence, the second 01-8 is the first time to the Job site for a particular day to do a test. If they made a second trip to the site the number would be 01-2.
Their number 01-1 is the first test they did on 21 July and it was a retest of 02-1 from 17 July.

Date 07/23/09 Name/Title Donald T. Lopez PE CQA Engr. URS NM Signature Donald T. Lopez

Approved 08/07/09

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 5 field density tests per acre stated in Section 2200-9 3.4.2 and Table 3.1. The CMIP requires that the minimum compaction allowed is 90% and the moisture is plus or minus 2 % of the optimal moisture.

The density and moisture test was performed in the hand compacted area around MW-4 on Friday. The area was re-compacted and re-tested on Monday July 20. The re-test passed the moisture and density test.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-23-09
Contract # PO# 903627
Submittal # 028
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Lift 7 Grid Block # 11	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
02	Lift 7 Grid Block # 12	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
03	Lift 7 Grid Block # 13	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
04	Lift 7 Grid Block # 10	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
05	Lift 7 Grid Block # 9	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
06	Lift 7 Grid Block # 8	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
07	Lift 7 Grid Block # 7	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
08	Lift 7 Grid Block # 6	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date 7/23/09 Name/Title Donald T. Lopez PE Signature

CQA Engineer
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 5 field density tests per acre stated in Section 2200-9 3.4.2 and Table 3.1. The CMIP requires that the minimum compaction allowed is 90% and the moisture is plus or minus 2 % of the optimal moisture.

8 density and moisture tests were performed on Lift 7 covering grid blocks 6 to 13.

All tests passed the specifications.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 7-28-09
Contract # PO# 903627
Submittal # 029
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Attch. Page 1.

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Wedge Lift 2, Grid Block # 11	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☐	☐	☒	
02	Lift 4, Grid Block # 2	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☐	☐	☒	
03	Lift 4, Grid Block # 6	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☐	☐	☒	
04			☐	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date _____ Name/Title _____ Signature _____

4 Aug

Doyle I concur.

I've looked at these again. They all meet the CMP spec of less than 4.6×10^{-4} cm/sec.

However, these samples should be tested at 90% max dry density. They weren't. They were tested at 81 → 89%. I think it makes a difference. If you test at 90% you should be able to achieve 10^{-5} values.

Recommend "conditional approval" until all sample results are in and that they are tested at 90%.

Recommend "Conditional Approval" See my "Note" memo. OK Doyle. Marshall Day PE

Marshall Day

Donald T. [illegible] PE
C&A Engineer
URS NM

CONDITIONALLY APPROVED
August 6, 2009

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 1saturated hydraulic conductivity test per acre per lift stated in Section 2200-9 3.4.2 and Table 3.1. The CMIP requires that the hydraulic conductivity be conducted according to ASTM specification for rigid wall testing, ASTM 5856. The samples shall have a maximum hydraulic conductivity of 4.6×10^{-4}. Item 1 is a sample from wedge lift 2. Items 2 and 3 are samples from lift 4. All samples have hydraulic conductivities passing the required specifications.

Recommend OK
Approval

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 8-4-09
Contract # PO# 903627
Submittal # 030
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Lift 7 Grid Block # 1	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
02	Lift 7 Grid Block # 2	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
03	Lift 7 Grid Block # 3	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
04	Lift 7 Grid Block # 4	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
05	Lift 7 Grid Block # 5	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date August 6, 09 Name/Title Donald T. Lopez PE Signature Donald T. Lopez
CQA Engineer
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 5 field density tests per acre stated in Section 2200-9 3.4.2 and Table 3.1. The CMIP requires that the minimum compaction allowed is 90% and the moisture is plus or minus 2 % of the optimal moisture.

5 density and moisture tests were performed on Lift 7 in covering grid blocks 1 to 5.

All tests passed the specifications.

Recommend ck
approval

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 8-4-09
Contract # PO# 903627
Submittal # 031
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Lift 8 Grid Block # 11	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
02	Lift 8 Grid Block # 12	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
03	Lift 8 Grid Block # 13	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
04			☐	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date August 6, 09 Name/Title Donald T. Lopez PE Signature Donald T. Lopez
CQA Engineer
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 5 field density tests per acre stated in Section 2200-9 3.4.2 and Table 3.1. The CMIP requires that the minimum compaction allowed is 90% and the moisture is plus or minus 2 % of the optimal moisture.

3 density and moisture tests were performed on Lift 8 in covering grid blocks 11 to 13.

All tests passed the specifications.

A.n Donald

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 8-4-09
Contract # PO# 903627
Submittal # 032
New ☑ Resubmittal ☐
If resubmittal, prev. submittal #

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials	
01	Lift 8 Grid Block # 10	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☒	☐		See note
02	Lift 8 MW # 4	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☒	☐		"
03	Lift 8 Grid Block # 9	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		"
04	Lift 8 Grid Block # 8	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☒	☐		"
05	Lift 8 Grid Block # 7	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
06	Lift 8 Grid Block # 6	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
07	Lift 8 Grid Block # 1	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
08	Lift 8 Grid Block # 2	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
09	Lift 8 Grid Block # 3	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
10	Lift 8 Grid Block # 4	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
11	Lift 8 Grid Block # 5	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
12	Lift 8 Grid Block # 8 Re-Test	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
13	Lift 8 Grid Block # 10 Re-Test	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		
14	Lift 8 MW # 4	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐		

Date August 6, 2009 Name/Title Donald T. Lopez PE Signature Donald T. Lopez

2e Approved August 7, 2009 C&A Engineer URS NM

Don

I concur.

Recommend approval of all except ~~#1~~, #2 & #4. Their moisture contents fell below the minimum.

To their credit, they redid these three problem areas and then retested and all passed.

Good on them.

BB PE

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 5 field density tests per acre stated in Section 2200-9 3.4.2 and Table 3.1. The CMIP requires that the minimum compaction allowed is 90% and the moisture is plus or minus 2 % of the optimal moisture.

Eleven density and moisture tests were performed on Lift 8 in covering grid blocks 1 to 10 and the hand compacted area around MW # 4. Three of the of the moistures failed the specifications, Items 01, 02, and 04. Items 12, 13 and 14 are the re-tests performed on the areas after they were watered and re-compacted.

Recommend Approval

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 8-6-09
Contract # PO# 903627
Submittal # 033
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Native Fill Material Berm 9	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
02	Native Fill Material Berm 10	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
03	Native Fill Material Berm 11	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
04	Native Fill Material Berm 12	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
05	Native Fill Material Berm 13	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
06	Native Fill Material Berm 14	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
07	Native Fill Material Berm 15	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
08	Native Fill Material Berm 16	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date August 7, 09 Name/Title Donald T. Lopez PE Signature

CQA Engineer
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the Native Soil Borrow material at a frequency of 1/500 cubic yards stated in Section 2200-9 3.4.2 and Table 3.1. 8 samples (Items 1 to 8) were collected from the excavated and screened material on the north west side of the borrow area and from the north side of the borrow area. The samples were taken for additional material needed to complete the native soil lifts.

Recommend OK for approval.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 8-4-09
Contract # PO# 903627
Submittal # 034
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Native Fill Material Berm 17	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
02	Native Fill Material Berm 18	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
03	Native Fill Material Berm 19	Native Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
04			☐	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date August 6, 09 Name/Title Donald T. Capen PE Signature

COA Engr.
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the Native Soil Borrow material at a frequency of 1/500 cubic yards stated in Section 2200-9 3.4.2 and Table 3.1. One sample (Items 1) was collected from the excavated and screened material on the south west corner of the borrow area berm. Item 2 was collected from material around the former top soil pile. Item 3 was collected from the south central part of the borrow area. The samples were taken for additional material needed to complete the native soil lifts.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 8-4-09
Contract # PO# 903627
Submittal # 035
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Top Soil Material 11	Top Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☐	☐	☒	
02	Top Soil Material 12	Top Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☐	☐	☒	
03			☐	☐	☒	
04			☐	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Don I concur.
Recommend conditional disapproval until a time when all the data can be presented. There may have been a software error.

Carol T. [signature] PE
C&A Engineer
URS New Mexico

Date ___

ature _____

CONDITIONALLY APPROVED.
August 6, 2009

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the Native Soil Borrow material at a frequency of 1/500 cubic yards stated in Section 2200-9 3.4.2 and Table 3.1. Items 1 and 2 were collected from the excavated and screened material on the west side of the borrow area .The samples were taken for the additional material needed to complete the native soil lifts. This material was added to the existing top soil pile to be blended with the $^{3}/_{8}$" gravel.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 8-6-09
Contract # PO# 903627
Submittal # 036
New ☐ Resubmittal ☑
If resubmittal, prev. submittal # 035

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	SNL MWL 071609-11 ~~Top Soil Material 11~~	Top Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
02	SNL MWL 071609-12 ~~Top Soil Material 12~~	Top Soil Testing of Borrow Material SECTION 02200-9 3.4.2 Fill and Borrow Area Testing	☒	☐	☐	
			☐	☐	☐	
			☐	☐	☐	
			☐	☐	☐	
			☐	☐	☐	
			☐	☐	☐	
			☐	☐	☐	
			☐	☐	☐	
			☐	☐	☐	
			☐	☐	☐	
			☐	☐	☐	

6 August

Don on DE

When they orginally submitted, they attributed the specimens as "Native Soil". The specimen actually is "Top Soil" and the test results satisfy CMIP criteria. Recommend approval.

Marchant Mey

Date August 7, 09 Name/Title Donald T. Lopez PE Signature Donald T. Lopez
CQA Engineer
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the Top Soil Borrow material at a frequency of 1/500 cubic yards stated in Section 2200-9 3.4.2 and Table 3.1. Items 1 and 2 were collected from the excavated and screened material on the west side of the borrow area .The samples were taken for the additional material needed to complete the top soil lift. This material was added to the existing top soil pile to be blended with the $^{3}/_{8}$" gravel.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 8-7-09
Contract # PO# 903627
Submittal # 037
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Lift ~~1-01~~ 3-01 JRS	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
02	Lift ~~1-02~~ 3-02 JRS	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
03	Lift ~~1-03~~ 3-03 JRS	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
04			☐	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date August 7, 09 Name/Title Donald T. Lopez PE CQA Engineer URS New Mexico Signature Donald T. Lopez

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 1saturated hydraulic conductivity test per acre per lift stated in Section 2200-9 3.4.2 and Table 3.1. The CMIP requires that the hydraulic conductivity be conducted according to ASTM specification for rigid wall testing, ASTM 5856. The samples shall have a maximum hydraulic conductivity of 4.6×10^{-4}. Items 1, 2, and 3 are samples collected prior to the native soil lifts intended to cover the entire MWL cover. Items 1, 2, and 3 are hydraulic conductivity samples submitted for lift 3. All samples have hydraulic conductivities passing the required specifications.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 8-12-09
Contract # PO# 903627
Submittal # 038
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	~~Lift 5-01~~ ED: Lift 5 GB 1	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
02	~~Lift 5-02~~ ED: NS Lift 5 GB 4	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☐	☒*	☐	
03	~~Lift 5-03~~ ED: NS Lift 5 GB 8	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☐	☒*	☐	
04	~~Lift 6-01~~ ED: NS Lift 6 GB 3	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
05	~~Lift 6-02~~ ED: NS Lift 6 GB 6	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
06	~~Lift 6-03~~ ED: NS Lift 6 GB 12	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
07	~~Lift 7-01~~ ED: NS Lift 7 GB 1	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☐	☒*	☐	
08	~~Lift 7-02~~ ED: NS Lift 7 GB 5	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☐	☒*	☐	
09	~~Lift 7-03~~ ED: NS Lift 7 GB 13	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
10			☐	☐	☐	
11	* Please retest at 95%		☐	☐	☐	
12	D 698	Proctor.	☐	☐	☐	
13			☐	☐	☐	

Date August 27, 09 Name/Title Donald T. Lopez PE Signature Donald T. Lopez
CQA Engineer
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 1saturated hydraulic conductivity test per acre per lift stated in Section 2200-9 3.4.2 and Table 3.1. The CMIP requires that the hydraulic conductivity be conducted according to ASTM specification for rigid wall testing, ASTM 5856. The samples shall have a maximum hydraulic conductivity of 4.6×10^{-4}. Items 1-3 are from lift 5, items 4-6 are from lift 6, and items 7-9 are from lift 7. Four of the nine items are faster than 4.6×10^{-4} but are still in the 10^{-4} range.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 8-18-09
Contract # PO# 903627
Submittal # 039
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Wedge Lift-01- GB 8	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
02	Lift 4- GB 9	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
03			☐	☐	☐	
04			☐	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date August 27, 09 Name/Title Donald T. Lopez PE Signature Donald T. Lopez
CQA Engineer
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 1saturated hydraulic conductivity test per acre per lift stated in Section 2200-9 3.4.2 and Table 3.1. The CMIP requires that the hydraulic conductivity be conducted according to ASTM specification for rigid wall testing, ASTM 5856. The samples shall have a maximum hydraulic conductivity of 4.6×10^{-4}. Both items were compacted to 90 percent using a standard proctor. Item 1 is from the first wedge lift and in grid block 8. Item 2 is from Lift 4 in grid block 9. Both samples passed the required hydraulic conductivity requirements.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 8-18-09
Contract # PO# 903627
Submittal # 040
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	Seed Mixture	Reclamation seeding and mulching SECTION 02930-2 2.2.1 Seed Mix for Cover	☑	☐	☐	
02	Seed Mixture	Reclamation seeding and mulching SECTION 02930-2 2.2.1 Seed Mix for Cover	☑	☐	☐	
03			☐	☐	☐	
04			☐	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date August 19, 2009 Name/Title Donald T. Lopez CQA Engineer URS NM Signature Donald T. Lopez

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires the seed mixture for the cover and reclaimed areas contain Galleta grass at 8.0 lbs/acre, Black grama at 6.0 lbs/acre, Spike dropseed at 3.0 lbs/acre, and Ring Muhly at 3.0 lbs/acre for a total of 20 lbs/acre. Sandia approved a modification to the CMIP in regards to the revegitation specifications at the request of SNL's staff biologist. The modification to the CMIP calls for an increase in the seeding rate to 80 pounds of seed mix per acre, four times the rate stated in the CMIP. Item 1 is the seed mixture from the supplier. Item 2 is from the landscaper and is a copy of the tag on the seed bag.

"Schofield, Donald P" <dpschof@sandia.gov>

"Schofield, Donald P"
<dpschof@sandia.gov>
08/05/2009 09:59 AM

To "Don_Lopez@URSCorp.com"
<Don_Lopez@URSCorp.com>
cc "Mitchell, Mike M" <mmmitch@sandia.gov>
Subject CMIP Reveg Modification

This is the modification that John is referring to. MW Hay

Mr. Lopez - Sandia National Laboratories (SNL) is approving a modification to the Mixed Waste Landfill (MWL) Corrective Measures Implementation Plan (CMIP) with regards to the revegitation specifications. These modifications come at the request of SNL's staff biologist, and are:

- uniform seeding rate of 80 pounds seed mix per acre (4x CMIP).
- no fertilizer added due to timing (August) of seeding.
- supplemental watering to assist seed germination and root development.

Please incorporate these modifications into URS's CQA effort. Thank you, Donald P Schofield.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 8-19-09
Contract # PO# 903627
Submittal # 041
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	~~NS Lift 8-1~~ EDi NS Lift 8 GB-12	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing SND	☒	☐	☐	
02	~~NS Lift 8-2~~ EDi NS Lift 8 GB-7	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing SND	☒	☐	☐	
03	~~NS Lift 8-3~~ EDi NS Lift 8 GB-9	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing SND	☒	☐	☐	

Data on DCPE

Data looks good - compaction on all 3 > 90%

Recommend your approval.

No.	Location	% of D698 Proctor	K_{sat}
1	NS Lift 8-1	90.4	1.22 E-06
2	NS Lift 8-2	90.0	1.23 E-06
3	NS Lift 8-3	90.0	1.36 E-06

M W Tay

Date August 24, 09 Name/Title Donald T. Lopez PE Signature Donald T. Lopez
CQA Engineer
URS NM

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 1saturated hydraulic conductivity test per acre per lift stated in Section 2200-9 3.4.2 and Table 3.1. The CMIP requires that the hydraulic conductivity be conducted according to ASTM specification for rigid wall testing, ASTM 5856. The samples shall have a maximum hydraulic conductivity of 4.6×10^{-4}. All items were compacted to 90 percent using a standard proctor All items are samples collected from lift 8 on the cover. See map for sample locations. All samples passed the required hydraulic conductivity requirements.

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM

Project Name SNL MWL Construction Cover Project

Date 8-26-09
Contract # PO# 903627
Submittal # 042
New ☑ Resubmittal ☐
If resubmittal, prev. submittal # _____

To (name/SNL Dept.) Don Lopez - URS Corporation

Submitted by (name/company) Chris Edgmon / EDi

Item #	Item	Description (type, model #, catalog #, mfg., etc.)	Approved	Dis-approved	See reverse	Initials
01	~~NS Lift 5-2~~ ED: NS Lift 5 GB-4 Retest 3rd	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
02	NS Lift 5-3 ED: NS Lift 5 GB-8 Retest 3rd	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
03	NS Lift 7-1 ED: NS Lift 7 GB-1 Retest 3rd	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
04	NS Lift 7-2 ED: NS Lift 7 GB 5 Retest 3rd	Native Soil Field Testing of compacted Fill SECTION 02200-9 3.4 Testing	☒	☐	☐	
05			☐	☐	☐	
06			☐	☐	☐	
07			☐	☐	☐	
08			☐	☐	☐	
09			☐	☐	☐	
10			☐	☐	☐	
11			☐	☐	☐	
12			☐	☐	☐	
13			☐	☐	☐	

Date August 27, 09 Name/Title Donald T. Lopez PE CQA Engineer URS NM Signature Donald T. Lopez

MA-01
MATERIAL APPROVAL FORM
MATERIAL APPROVAL SUBMITTAL FORM (Page 2)

COMMENTS (include Item #)

The Mixed Waste Landfill Corrective Measures Implementations Plan requires testing of the subgrade material at a frequency of 1saturated hydraulic conductivity test per acre per lift stated in Section 2200-9 3.4.2 and Table 3.1. The CMIP requires that the hydraulic conductivity be conducted according to ASTM specification for rigid wall testing, ASTM 5856. The samples shall have a maximum hydraulic conductivity of 4.6×10^{-4}. All items were previously compacted to 90 percent using a standard proctor. The samples did not meet the required hydraulic conductivity values and were re-tested using 95% compaction which is more accurate to field conditions on the cover. All samples passed the required hydraulic conductivity requirements.

2009 Cover Layer Approval Forms

MIXED WASTE LANDFILL APPROVAL FORM

URS

AP #: 001 **DATE: 05/22/09**

Attention: **Don Schofield**
Sandia National Laboratories
P.O. Box 5800 MS 1125
Albuquerque, NM
87185

URS Corporation
6501 Americas Parkway NE, Ste 900
Albuquerque, NM 87110-6367
(505) 855-7500

Subject: **Existing Subgrade Approval** URS Project No. 24343640

Item No.	Layer	Description
1.	Existing Subgrade	Existing Subgrade approval for construction.

☒ Approved, conforms to CMIP ☐ Conditionally Approved ☐ Declined, does not conform to CMIP

Remarks:

1. The Existing Subgrade constructed in 2006 has been cleared of vegetation and remnant erosion matting, compacted, and tested in accordance with the CMIP. The Existing Subgrade is approved for construction of the Biointrusion Layer.
2. Quality control survey indicates some parts of the Existing Sugbrade surface do not meet the 2.0% east-to-west design slope. The slope will be adjusted during construction of the overlaying layers.
3. Side slopes are steeper than 6:1 around the north end of the MWL. 6:1 side slopes will be established during construction of the Native Soil and Top Soil Layers.

Attachments:

None

URS Corporation

Approved By: Donald T. Lopez 5/22/09

Donald T. Lopez, P.E. Date:

CQA Engineer

MIXED WASTE LANDFILL APPROVAL FORM

URS

AP #: 002 DATE: 05/26/09

Attention: **Don Schofield**
Sandia National Laboratories
P.O. Box 5800 MS 1125
Albuquerque, NM
87185

URS Corporation
6501 Americas Parkway NE, Ste 900
Albuquerque, NM 87110-6367
(505) 855-7500

Subject: **Biointrusion Layer** URS Project No. 24343640

Item No.	Layer	Description
1.	Biointrusion Layer	Biointrusion rock approval
2.	Biointrusion Layer	Biointrusion rock installation procedure
3	Biointrusion Layer	Biointrusion Thickness Verification Requirement

☒ Approved, conforms to CMIP ☐ Conditionally Approved ☐ Declined, does not conform to CMIP

Remarks:

1. The Biointrusion rock previously purchased and stockpiled in the Former Bulk Waste Staging Area TA-3 is approved for use on the MWL cover.
2. The revised procedure for installation of the Biointrusion Layer is approved. Please see attached for revised method.
3. No soil may be placed in the Biointrusion voids prior to approval of Biointrusion Layer thickness.

Attachments: 1. Revised Biointrusion Layer installation procedure described in 5/26/09 Daily Summary Report.

URS Corporation

Approved By: Donald T. Lopez 5/26/09

Donald T. Lopez, P.E. Date:
CQA Engineer

URS

Don Lopez/Albuquerque/URSCorp
05/27/2009 09:04 AM

To dpschof@sandia.gov
cc Cedgmon@edi-nm.com, Paul Molina/Albuquerque/URSCorp@URSCorp
bcc Mandy Scarberry/Albuquerque/URSCorp@URSCorp; Marshall Nay/Albuquerque/URSCorp@URSCorp
Subject May 26, 2009 URS CQA Daily report and URS CQA approval of Test Method no. II for installation of the Mixed Waste Landfill Biointrusion Layer

Don, and Mixed Waste Landfill Team, Attached to this E-mail is the URS CQA Mixed Waste Landfill Construction Daily Report for May 26, 2009. My CQA Engineer approval of Biointrusion test area method no.II for installation of the Biointrusion layer is described in the daily report and is my direction to the Sandia Mixed Waste Landfill Team by copy of this E-mail.

Please let me know if you need any additional information. 20090526_SMWL DSR_Biointrusion Test Layer.doc

DONALD T. LOPEZ, PE
PRINCIPAL CIVIL/GEOTECHNICAL ENGINEER
INFRASTRUCTURE GROUP LEADER
6501 AMERICAS PARKWAY NE, SUITE 900
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DAILY SUMMARY REPORT (final draft)

DATE: 5/26/09 (Tuesday)
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): Slightly Cloudy, good conditions (58 deg)
WEATHER (PM): Slightly Cloudy, good conditions (72 deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- The test section for the Biointrusion Layer was executed today. The initial test procedure discussed in the Construction Site Safety Plan (CSSP, page 37) was determined to be unsuccessful. A second method for the installation of the Biointrusion Barrier was derived and was successful (See below ***Biointrusion Test Area II*** for details).

LOCATION OF CONSTRUCTION

1. Tech Are III, Sandia Mixed Waste Landfill, Existing Subgrade.
2. Former Bulk Waste Staging Area, TA 3, (Biointrusion Rock Location)
3. Borrow Pit, (Pre-screened Soil Stockpile)

LIST OF PERSONNEL:

Please see Appendix C for sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:00 – 7:30 AM
   Attendees: See attached sign in sheet.
   Issues:
   a. The test Biointrusion procedure to be followed.

2. Description: Biointrusion Barrier Procedure Briefing
   Time: 9:45-10:15 PM
   Attendees: See attached sign in sheet.
   Issues:
   a. Discussion of responsibilities and measures that needed to be taken into consideration to have a successful Biointrusion Test.

3. Description: Afternoon Safety Briefing
   Time: 1:00-1:18 PM
   Attendees: See attached sign in sheet.
   Issues:
   a. Rock Delivery: The procedure for continuing with the delivery of rock.
   b. Safety: Proper ear protection and the truck routes needed ensure safety.
   c. Construction: The procedure for continuing the placement of Biointrusion barrier rock.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Biointrusion Test Area I (as discussed in CSSP)***
Please see CSSP (page 37) for procedure description.

The test area consisted of two truckloads of dry, screened loose soil distributed over an approximate 20'x20' area. Using a builder's level, the thickness of the test loose soil layer was determined to be 6-to-8 inches as specified in the CSSP. The soil was initially spread using a motor grader, but EDi later switched to a dozer in an attempt to reduce the soil compaction.

The Biointrusion rock was then placed onto the 6-to-8 inch loose soil layer. The Biointrusion rock was spread to an approximate thickness of 1.0-foot or slightly less. A dozer then compacted the rock in an attempt to push the rock down into the soil layer. After several passes with the dozer, Don Lopez (URS CQA) was not convinced the Biointrusion rock was being pressed down through the loose soil layer to the existing Subgrade Layer. This raised concerns of the possibility of future settling due to the layer of sand between the Subgrade Layer and the Biointrusion Layer. It was determined this procedure was not adequate to meet Specification Section 02115 located in the CMIP.

B. ISSUES/COMMENTS:

1. There was a discussion about extending the Biointrusion Barrier past the toe of the existing Subgrade Layer. It was determined that it is not necessary to extend the Biointrusion Barrier past the toe.
2. The current slope is approximately 1.8% from East to West in lieu of the 2.0% as specified. The slope will be adjusted to the specified 2.0% during the course of construction. It will be corrected during the Native Soil Layer apposed to the Biointrusion Barrier due to material availability and ease of construction.
3. The method of constructing the Biointrusion described in the CSSP (Page 37) was determined to be insufficient by Don Lopez PE URS CQA Engineer.

C. EQUIPMENT USED (See Appendix B for Equipment Description)

1. Grader
2. Dozer
3. Dump Trucks
4. Loader

D. EQUIPMENT CALIBRATION CERTIFICATES

1. NA

E. STATUS:

1. This procedure was ineffective and was canceled. A new method was derived and used as described below.

F. PICTURES OBTAINED:

1. Pictures of this procedure were collected and filed: 24342640_06 Project Deliverables_Field Photos.

II.

A. TASK DESCRIPTION: ***Biointrusion Test Area II***

After it was determined the procedure described above in Test Area I was ineffective, a second test area was created using the tracks of the Dozer to scarify the existing Subgrade Surface. It was determined the tracks of the dozer created a texture, which was ideal for the Biointrusion Rock placement. The scarified surface had enough loose soil to fill some of the voids in the rock, as well as create a grooved pattern, which made it easy for the rock to fall into place and interlock. The rock was compacted with the dozer a minimum of four times. Loose, screened soil was then placed over the rock layer and worked into the voids using a vibratory roller. This method proved to be very effective. (See below for updated Biointrusion installation procedure)

The Following is the Updated Biointrusion Layer Installation Procedure:

The Biointrusion layer will be constructed in compliance with the CMIP, Specification Section 02115. The following is the procedure recommended by Don Lopez PE (URS CQA Engineer) for the Biointrusion Layer:

The rock used for the Biointrusion Layer will continue to be the rock acquired by SNL. The rock is located at the former Bulk Waste Staging Area in TA 3.

The EDI Team will scarify the Existing Subgrade Surface using the tracks of a dozer. A minimum of 4 passes with the dozer tracks is required across the existing Subgrade Surface. Once the Subgrade Surface has been prepared, the Biointrusion Rock may be spread across the scarified surface. The rock layer will then be compacted with a minimum of 4 passes by the dozer to ensure compaction and interlocking of the rock. Compaction shall be performed until rocks are firmly locked into place. The entire Biointrusion Rock Layer Surface must be completed, surveyed, and approved before any further construction may take place.

Once the rock layer is compacted in place and approved, additional dry loose soil will be placed over the surface. A dozer will then spread the loose soil across the rock surface and a vibrating, smooth drum roller will be used to work the loose soil into the voids. A minimum of 4 passes with the vibratory roller is required. After this is completed and approved, water will be applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content (-2 to +2 percent).

END

B. ISSUES/COMMENTS

1. After the Test Method II was determined to be affective, it was applied for the remainder of the day to the South side of the MWL. Approximately 300-CY of the Biointrusion layer was installed.
2. Water was not applied to the Biointrusion Layer to fill voids today.
3. No survey was performed today. The survey team should be out tomorrow for as-built conditions and elevation confirmations for the Biointrusion Layer.
4. Crushed rock used for the Biointrusion Layer did meet specifications by method of visual inspection.
5. No heavy equipment was operated around the monitoring wells.

C. EQUPMENT USED (See Appendix B for Equipment Description):
1. Dozer
2. Dump Trucks
3. Vibrator, Smooth Drum Roller

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. NA

F. STATUS:
1. Approximately 300 CY of the Biointrusion Layer was installed today (20 Truck Loads @ approx 15 CY/truck). See dwg_05/26/09_Construction_01.
2. Approximately 90 CY of the Loose, dry soil for the voids was installed in test pad (6 truck loads @ approx 15 CY/truck). This was only for the test pad and will not be continued until the Biointrusion Rock Layer is completed and approved.
3. Water was not applied to the Biointrusion Layer today.

G. PICTURES
1. Pictures of this procedure were collected and filed: 24342640_06 Project Deliverables_Field Photos.

INSPECTION CHECKLISTS REQUIRED
1. 1. Biointrusion Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 05/27/09)
1. Continue installation of the Biointrusion Barrier.
2. Raise Well

MIXED WASTE LANDFILL APPROVAL FORM

URS

AP #: 003 DATE: 06/05/09

Attention: **Don Schofield**
Sandia National Laboratories
P.O. Box 5800 MS 1125
Albuquerque, NM
87185

URS Corporation
6501 Americas Parkway NE, Ste 900
Albuquerque, NM 87110-6367
(505) 855-7500

Subject: **Biointrusion Rock Thickness (South)** URS Project No. 24343640

Item No.	Layer	Description
1.	Biointrusion Layer	South Biointrusion Layer Thickness

☐ Approved, conforms to CMIP ☒ Conditionally Approved ☐ Declined, does not conform to CMIP

Remarks:
1. The south portion of the Biointrusion Layer is approved with the exception of four grid point locations on the west slope which are less than the 1.0' minimum thickness requirement. The south portion is approved for the placement of soil into the voids except for the west slope grid points which must be corrected, resurveyed, and approved.

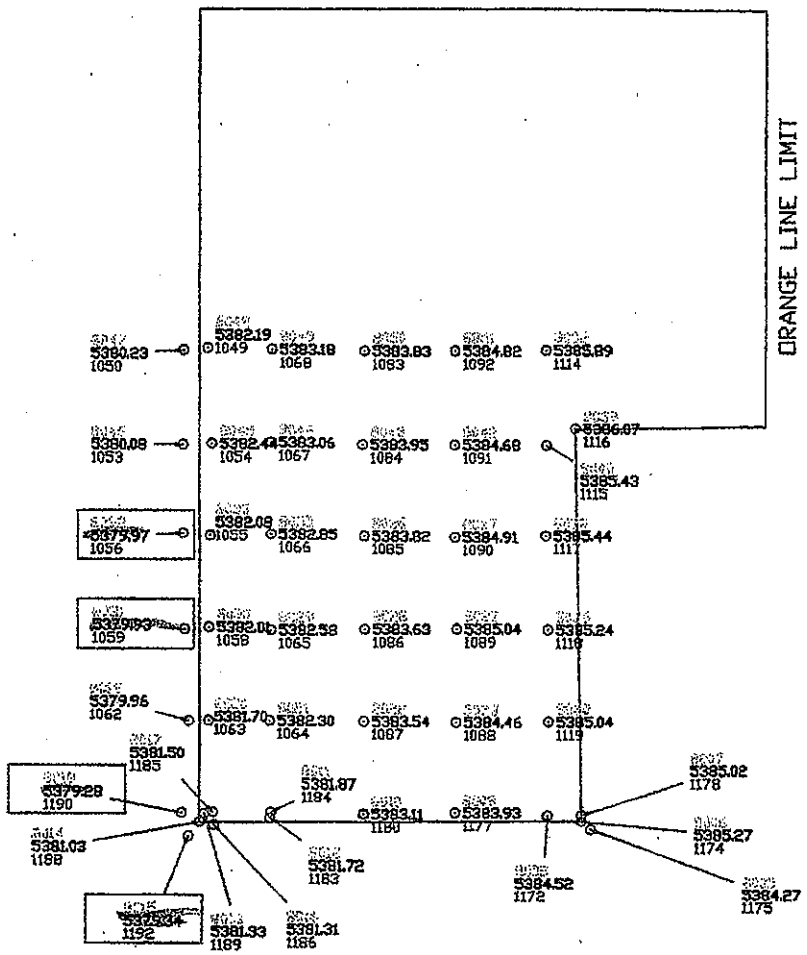
Attachments:
1. South portion Biointrusion QA survey locations.

URS Corporation

Approved By: Donald T. Lopez, P.E. 06/05/09
CQA Engineer Date:

MWL BIOINTRUSION LAYER				URS PROJECT 24342640				6/6/2009								
COMPARISON OF "EXIST SFC FROM ABQ SURVEY" TO "MWL South Bio Int Layer Shots 6-5-2009"																
	ASCI SUBGRADE SHOTS					URS BIOINTRUSION LAYER QA SHOTS (6-5-2009)						DELTAS	(MIN ΔELEV VALUE = 11" = 0.92 FT)			
POINT	NORTH	EAST	ELEV	DESC		POINT	NORTH	EAST	ELEV	DESC		ΔPOINT	ΔNORTH	ΔEAST	ΔDIST	ΔELEV
1049	1452939	411599.7	5381.12	4-NG		8048	1452939	411599.4	5382.195	1049		0	-0.11	0.23	0.25	-1.07
1050	1452938	411586.2	5378.91	4-NG		8047	1452938	411586.6	5380.229	1050		0	0.46	-0.39	0.60	-1.32
1053	1452887	411586.8	5379.01	4-NG		8046	1452887	411586.3	5380.082	1053		0	-0.03	0.56	0.56	-1.07
1054	1452888	411601.6	5381.2	4-NG		8045	1452888	411601.9	5382.44	1054		0	-0.07	-0.27	0.28	-1.24
1055	1452839	411601.2	5380.98	4-NG		8033	1452839	411601	5382.083	1055		0	0.06	0.14	0.15	-1.10
1056	1452840	411586.5	5379.53	4-NG		8032	1452840	411586.6	5379.966	1056		0	0.04	-0.14	0.15	[illegible]
1058	1452789	411600.8	5380.64	4-NG		8030	1452789	411600.5	5382.009	1058		0	-0.25	0.30	0.39	-1.37
1059	1452788	411587.3	5379.3	4-NG		8031	1452788	411587.3	5379.934	1059		0	0.03	-0.05	0.05	[illegible]
1062	1452739	411589.1	5378.93	4-NG		8019	1452739	411589.5	5379.957	1062		0	-0.05	-0.39	0.39	-1.03
1063	1452739	411600.2	5380.35	4-NG		8020	1452739	411600.3	5381.704	1063		0	-0.12	-0.07	0.13	-1.35
1064	1452739	411633	5381.28	4-NG		8021	1452739	411633.1	5382.3	1064		0	-0.17	-0.13	0.22	-1.02
1065	1452788	411633.6	5381.27	4-NG		8029	1452788	411633.8	5382.576	1065		0	-0.06	-0.18	0.19	-1.31
1066	1452839	411633.7	5381.78	4-NG		8035	1452839	411633.9	5382.846	1066		0	-0.11	-0.10	0.15	-1.07
1067	1452889	411633.6	5381.76	4-NG		8044	1452889	411633.6	5383.064	1067		0	0.13	0.00	0.13	-1.30
1068	1452939	411633.8	5381.86	4-NG		8049	1452939	411634.1	5383.179	1068		0	0.08	-0.30	0.31	-1.33
1083	1452938	411684.3	5382.71	4-NG		8050	1452938	411684.3	5383.827	1083		0	0.10	0.08	0.13	-1.12
1084	1452888	411683.4	5382.76	4-NG		8043	1452888	411683.3	5383.946	1084		0	-0.02	0.13	0.13	-1.19
1085	1452838	411684.1	5382.73	4-NG		8036	1452839	411684.2	5383.821	1085		0	-0.15	-0.13	0.20	-1.09
1086	1452788	411684.4	5382.4	4-NG		8028	1452789	411684.6	5383.626	1086		0	-0.18	-0.24	0.30	-1.23
1087	1452739	411684.3	5382	4-NG		8022	1452739	411684.2	5383.537	1087		0	-0.23	0.05	0.24	-1.54
1088	1452739	411734.3	5382.97	4-NG		8023	1452739	411734.3	5384.459	1088		0	-0.01	-0.05	0.05	-1.49
1089	1452789	411734.3	5383.14	4-NG		8027	1452789	411734.5	5385.041	1089		0	0.13	-0.20	0.24	-1.90
1090	1452838	411733.3	5383.53	4-NG		8037	1452838	411733.4	5384.909	1090		0	-0.14	-0.10	0.17	-1.38
1091	1452888	411733.4	5383.58	4-NG		8042	1452888	411733.4	5384.68	1091		0	0.16	0.09	0.19	-1.10
1092	1452938	411733.1	5383.55	4-NG		8051	1452938	411733.4	5384.821	1092		0	0.02	-0.31	0.31	-1.27
1114	1452939	411783	5384.75	4-NG		8052	1452939	411782.7	5385.888	1114		0	0.26	0.29	0.38	-1.14
1115	1452888	411783.4	5384.28	4-NG		8040	1452888	411783.1	5385.43	1115		0	0.16	0.25	0.30	-1.15
1116	1452897	411798.6	5384.56	ORANGE		8039	1452897	411798.7	5386.089	1116		0	-0.31	-0.16	0.35	-1.51
1117	1452839	411782.7	5384.19	4-NG		8038	1452839	411782.8	5385.441	1117		0	-0.16	-0.07	0.17	-1.25
1118	1452789	411783.8	5383.98	4-NG		8026	1452789	411784	5385.237	1118		0	0.21	-0.14	0.25	-1.26
1119	1452739	411784.4	5383.87	4-NG		8024	1452739	411784.4	5385.041	1119		0	-0.03	-0.01	0.03	-1.17
1172	1452688	411784.2	5383.51	4-NG		8008	1452688	411784.2	5384.519	1172		0	0.14	0.03	0.14	-1.01
1174	1452685	411802.5	5383.5	ORANGE		8006	1452685	411802.6	5385.269	1174		0	0.15	-0.19	0.24	-1.77
1175	1452681	411807.5	5383.13	4-NG		8005	1452681	411807.6	5384.265	1175		0	-0.13	-0.13	0.18	-1.14
1177	1452690	411733.9	5382.56	4-NG		8009	1452690	411734	5383.932	1177		0	-0.01	-0.12	0.12	-1.37
1178	1452689	411802.7	5383.65	4-NG		8007	1452689	411802.6	5385.02	1178		0	0.10	0.08	0.13	-1.37
1180	1452689	411684.7	5381.4	4-NG		8010	1452689	411684.3	5383.114	1180		0	0.20	0.38	0.42	-1.71
1183	1452686	411633.5	5380.58	4-NG		8012	1452687	411633.6	5381.723	1183		0	-0.01	-0.18	0.18	-1.14
1184	1452689	411634.3	5380.56	4-NG		8011	1452690	411634.2	5381.872	1184		0	-0.22	0.10	0.24	-1.31
1185	1452690	411602.9	5380.03	4-NG		8017	1452690	411602.9	5381.497	1185		0	0.04	0.00	0.04	-1.47
1186	1452682	411603.2	5379.95	4-NG		8016	1452683	411603.4	5381.305	1186		0	-0.43	-0.22	0.48	-1.36
1188	1452684	411595.5	5379.48	ORANGE		8014	1452684	411595.8	5381.033	1188		0	-0.13	-0.35	0.38	-1.55
1189	1452689	411597.7	5379.82	4-NG		8013	1452689	411598.3	5381.331	1189		0	0.68	-0.54	0.86	-1.51
1190	1452689	411586.2	5378.58	4-NG		8018	1452689	411586.1	5379.276	1190		0	-0.31	0.07	0.31	[illegible]
1192	1452677	411590.1	5378.59	4-NG		8015	1452677	411589.9	5379.34	1192		0	0.16	0.24	0.28	[illegible]

MWL BIOINTRUSTION LAYER
QA SHOTS 6-5-2009



MIXED WASTE LANDFILL APPROVAL FORM

URS

AP #: 004 **DATE:** 06/08/09

Attention: **Don Schofield**
Sandia National Laboratories
P.O. Box 5800 MS 1125
Albuquerque, NM
87185

URS Corporation
6501 Americas Parkway NE, Ste 900
Albuquerque, NM 87110-6367
(505) 855-7500

Subject: **Additional Biointrusion Rock** URS Project No. 24343640

Item No.	Layer	Description
1.	Biointrusion Layer	Additional rock needed to complete construction of the Biointrusion Layer.

☒ Approved, conforms to CMIP ☐ Conditionally Approved ☐ Declined, does not conform to CMIP

Remarks:
1. After a visual inspection of the first delivered load and confirmation from the supplier that this rock is from the same stockpiles as the 2005 rock purchased by Sandia, the additional rock for the Biointrusion Layer is approved.

Attachments:

None

URS Corporation

Approved By: Donald T. Lopez 06/08/09

Donald T. Lopez, P.E. Date:

CQA Engineer

MIXED WASTE LANDFILL APPROVAL FORM

URS

AP #: 005 **DATE:** 06/09/09

Attention: **Don Schofield**
Sandia National Laboratories
P.O. Box 5800 MS 1125
Albuquerque, NM
87185

URS Corporation
6501 Americas Parkway NE, Ste 900
Albuquerque, NM 87110-6367
(505) 855-7500

Subject: **Biointrusion Rock Thickness (Northwest)** **URS Project No.** 24343640

Item No.	Layer	Description
1.	Biointrusion Layer	Northwest Biointrusion Layer Thickness
2.	Biointrusion Layer	South Biointrusion Layer Thickness Correction (four locations)

☐ Approved, conforms to CMIP ☒ Conditionally Approved ☐ Declined, does not conform to CMIP

Remarks:

1. The northwest portion of the Biointrusion Layer is approved with the exception of two locations on the north slope which were too thick. The northwest portion is approved for the placement of soil into the voids except for the north slope, which must be corrected, resurveyed, and approved at the two locations.
2. The four locations on the west slope of the Biointrusion Layer at the south end that required additional rock have been corrected, resurveyed, and are now approved. The west slope was approved for the placement of soil into the voids on 6/09/09.

Attachments:

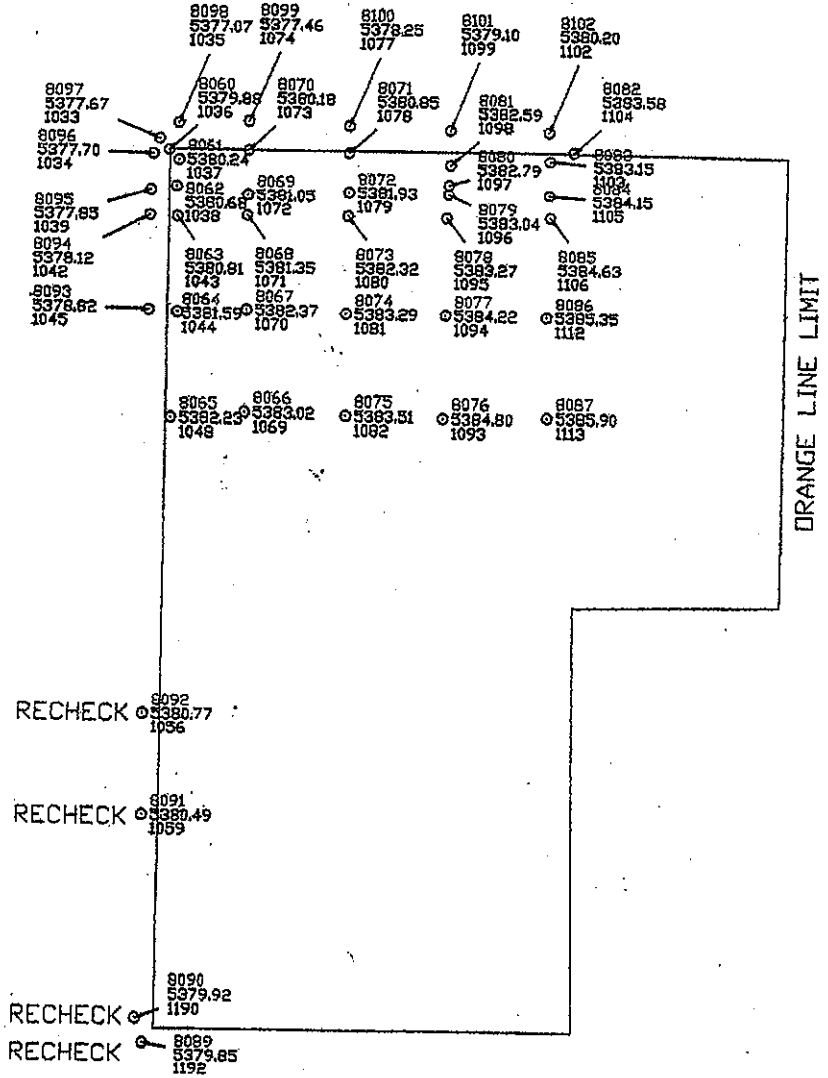
1. Northwest Biointrusion QA survey locations with four west slope location corrections.

URS Corporation

Approved By: Donald T. Lopez 06/09/09

Donald T. Lopez, P.E. Date:
CQA Engineer

MWL BIOI. TRUSTION LAYER
QA SHOTS 6-8-2009



WL BIOINTRUSION LAYER | URS PROJECT 24342640 | 6/8/2009

COMPARISON OF "EXIST SFC FROM ABQ SURVEY" TO "MWL South Bio Int Layer Shots 6-8-2009"

	ASCI SUBGRADE SHOTS					URS BIOINTRUSION LAYER QA SHOTS (6-8-2009)					DELTAS (MIN ΔELEV VALUE = 11" = 0.92 FT)				
POINT	NORTH	EAST	ELEV	DESC		POINT	NORTH	EAST	ELEV	DESC	ΔPOINT	ΔNORTH	ΔEAST	ΔDIST	ΔELEV
1033	1453125.877	411589.695	5375.93	4-NG		8097	1453125.96	411589.649	5377.67	1033	0	-0.08	0.05	0.09	-1.74
1034	1453118.152	411586.2652	5376.15	4-NG		8096	1453118.18	411586.573	5377.7	1034	0	-0.02	-0.31	0.31	-1.55
1035	1453133.576	411598.6233	5376.01	4-NG		8098	1453134	411598.77	5377.068	1035	0	-0.42	-0.15	0.44	-1.06
1036	1453120.656	411594.5462	5377.47	ORANGE		8060	1453120.31	411594.343	5379.877	1036	0	0.34	0.20	0.40	-2.41
1037	1453116.253	411599.3789	5378.75	4-NG		8061	1453115.27	411599.316	5380.239	1037	0	-0.01	0.06	0.06	-1.49
1038	1453101.434	411598.4945	5379.18	4-NG		8062	1453101.84	411598.369	5380.684	1038	0	-0.41	0.13	0.42	-1.50
1039	1453100.301	411585.8953	5376.49	4-NG		8095	1453099.77	411585.664	5377.854	1039	0	0.53	0.23	0.58	-1.36
1042	1453087.052	411585.7231	5376.67	4-NG		8094	1453086.81	411585.413	5378.12	1042	0	0.24	0.31	0.39	-1.45
1043	1453086.652	411599.5111	5379.49	4-NG		8063	1453086.39	411598.955	5380.808	1043	0	0.26	0.56	0.61	-1.32
1044	1453037.789	411599.7667	5380.16	4-NG		8064	1453037.81	411599.883	5381.587	1044	0	-0.02	-0.12	0.12	-1.43
1045	1453038.654	411585.7589	5377.65	4-NG		8093	1453038.67	411585.805	5378.816	1045	0	-0.01	-0.05	0.05	-1.17
1048	1452985.805	411597.2513	5380.74	4-NG		8065	1452985.99	411597.474	5382.235	1048	0	-0.08	-0.22	0.24	-1.49
1069	1452989.02	411633.8955	5381.65	4-NG		8066	1452989.19	411633.832	5383.02	1069	0	-0.17	0.06	0.19	-1.37
1070	1453039.615	411634.2786	5380.88	4-NG		8067	1453039.37	411634.024	5382.371	1070	0	0.24	0.25	0.35	-1.49
1071	1453087.525	411633.2208	5380.15	4-NG		8068	1453087.51	411633.52	5381.346	1071	0	0.02	-0.30	0.30	-1.20
1072	1453098.407	411633.2068	5379.89	4-NG		8069	1453098.09	411633.595	5381.047	1072	0	0.32	-0.39	0.50	-1.16
1073	1453121.203	411633.1296	5378.82	4-NG		8070	1453120.91	411633.551	5380.183	1073	0	0.29	-0.42	0.51	-1.36
1074	1453135.631	411633.0617	5376.2	4-NG		8099	1453135.47	411633.506	5377.462	1074	0	0.16	-0.44	0.47	-1.26
1077	1453133.88	411683.207	5377.09	4-NG		8100	1453133.95	411683.296	5378.248	1077	0	-0.07	-0.09	0.11	-1.16
1078	1453119.978	411683.4251	5379.31	4-NG		8071	1453120.17	411683.395	5380.847	1078	0	-0.19	0.03	0.20	-1.54
1079	1453100.037	411683.65	5380.53	4-NG		8072	1453100.08	411683.655	5381.926	1079	0	-0.04	-0.01	0.04	-1.40
1080	1453087.998	411683.5577	5380.94	4-NG		8073	1453088.03	411683.424	5382.32	1080	0	-0.03	0.13	0.14	-1.38
1081	1453038.446	411683.4116	5382.03	4-NG		8074	1453038.25	411683.461	5383.287	1081	0	0.20	-0.05	0.21	-1.26
1082	1452988.346	411684.2255	5382.47	4-NG		8075	1452988.31	411684.105	5383.514	1082	0	0.04	0.12	0.13	-1.04
1093	1452987.8	411732.4728	5383.43	4-NG		8076	1452987.81	411732.657	5384.798	1093	0	0.09	-0.18	0.21	-1.37
1094	1453038.326	411733.0576	5382.97	4-NG		8077	1453038.35	411733.048	5384.216	1094	0	-0.03	0.01	0.03	-1.25
1095	1453088.196	411732.5428	5381.97	4-NG		8078	1453087.95	411732.624	5383.265	1095	0	0.25	-0.08	0.26	-1.30
1096	1453099.821	411733.3841	5381.79	4-NG		8079	1453099.97	411733.446	5383.036	1096	0	-0.15	-0.06	0.16	-1.25
1097	1453104.646	411733.6868	5381.6	4-NG		8080	1453104.71	411733.51	5382.791	1097	0	-0.07	0.18	0.19	-1.19
1098	1453116.013	411733.8539	5380.84	4-NG		8081	1453114.96	411734.082	5382.585	1098	0	0.06	-0.23	0.24	-1.74
1099	1453132.795	411733.4958	5377.69	4-NG		8101	1453132.67	411733.614	5379.1	1099	0	0.13	-0.12	0.17	-1.41
1102	1453132.772	411782.9083	5376.68	4-NG		8102	1453132.37	411782.772	5380.2	1102	0	0.40	0.14	0.42	-1.52
1103	1453117.638	411784.1682	5381.61	4-NG		8083	1453117.63	411783.726	5383.151	1103	0	0.01	0.44	0.44	-1.54
1104	1453121.962	411795.0732	5380.99	ORANGE		8082	1453122.42	411795.3	5383.577	1104	0	-0.46	-0.23	0.51	-2.59
1105	1453100.319	411783.3915	5382.73	4-NG		8084	1453100.18	411783.505	5384.152	1105	0	0.14	-0.11	0.18	-1.42
1106	1453088.965	411783.8353	5383.08	4-NG		8085	1453088.85	411784.211	5384.628	1106	0	0.12	-0.38	0.39	-1.55
1112	1453038.061	411783.604	5384.18	4-NG		8086	1453038.1	411783.411	5385.35	1112	0	-0.04	0.09	0.10	-1.17
1113	1452988.713	411784.3371	5384.8	4-NG		8087	1452988.91	411784.492	5385.904	1113	0	-0.19	-0.15	0.25	-1.10

RECHECKS OF 6-5-2009 BIOINTRUSION LAYER QA SHOTS WITH INSUFFICIENT FILL, AFTER REWORK BY EDI

1192	1452676.76	411590.118	5378.59	4-NG		8089	1452676.67	411590.124	5379.854	1192	0	0.09	-0.01	0.09	-1.26
1190	1452688.844	411586.1968	5378.58	4-NG		8090	1452688.81	411586.207	5379.922	1190	0	0.04	-0.01	0.04	-1.34
1059	1452788.213	411587.2638	5379.3	4-NG		8091	1452788.46	411587.369	5380.494	1059	0	-0.24	-0.11	0.26	-1.19
1056	1452839.657	411586.4579	5379.53	4-NG		8092	1452839.86	411586.695	5380.771	1056	0	-0.19	-0.24	0.31	-1.24

MIXED WASTE LANDFILL APPROVAL FORM

URS

AP #: 006 DATE: 06/15/09

Attention: **Don Schofield**
Sandia National Laboratories
P.O. Box 5800 MS 1125
Albuquerque, NM
87185

URS Corporation
6501 Americas Parkway NE, Ste 900
Albuquerque, NM 87110-6367
(505) 855-7500

Subject: **Biointrusion Rock Thickness (Northeast)** URS Project No. 24343640

Item No.	Layer	Description
1.	Biointrusion Layer	Northeast Biointrusion Layer Thickness
2.	Biointrusion Layer	Northwest Biointrusion Layer Thickness Correction (two locations)

☒ Approved, conforms to CMIP ☐ Conditionally Approved ☐ Declined, does not conform to CMIP

Remarks:

1. The northeast portion of the MWL Biointrusion Layer is approved for the placement of soil into the voids.
2. The two locations on the north slope of the Biointrusion Layer that were too thick have been corrected, resurveyed, and were approved. The north slope is now approved for the placement of soil into the voids.
3. The entire Biointrusion Layer is now approved. Approval includes thickness, side slopes, and surface slope. Side slopes are steeper than 6:1 but will be adjusted during construction of the Native Soil Layer. The east-to-west surface slope is less than 2.0% in some areas consistent with the Existing Subgrade and, will also be adjuste during the construction of the Native Soil Layer.

Attachments:

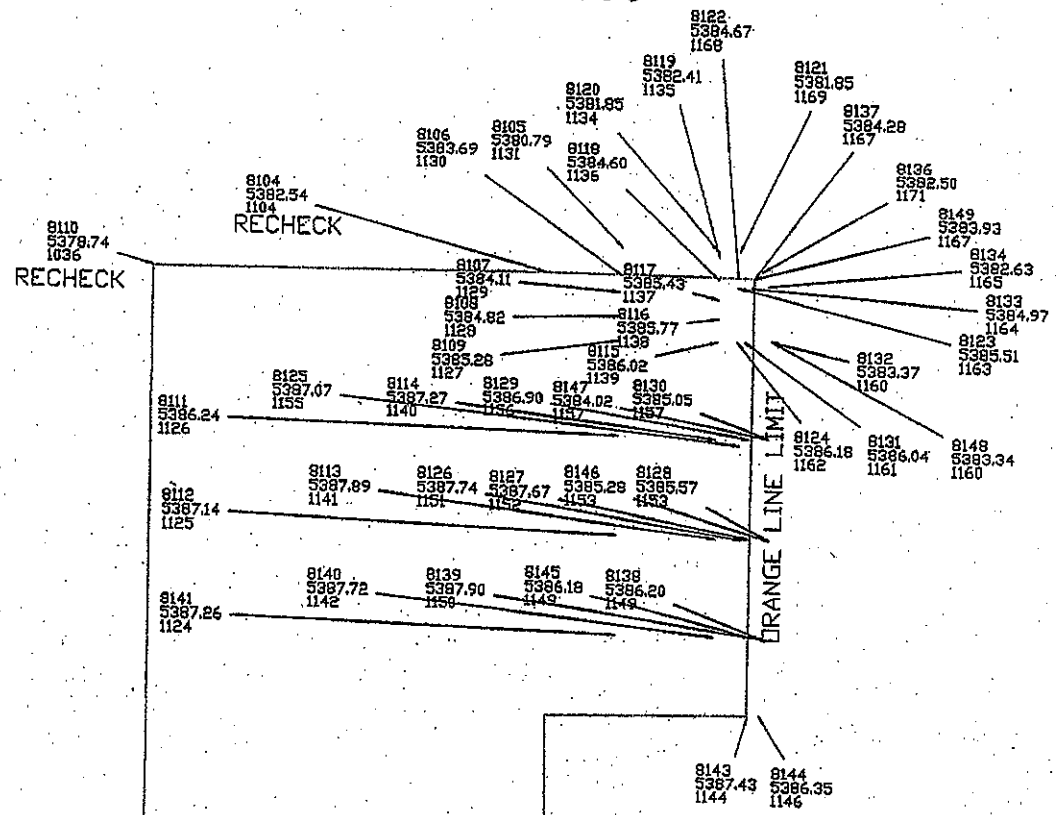
1. Northeast Biointrusion QA survey locations with two north slope location corrections.
2. QC survey results for the thickness of the Biointrusion Layer.

URS Corporation

Approved By: Donald T. Lopez 06/15/09

Donald T. Lopez, P.E. Date:
CQA Engineer

MWL BIOINTRUSTION LAYER
QA SHOTS 6-12-2009



MW[illegible]USION LAYER | URS PROJECT 24342640 | 6/12/

COMPARISON OF "EXIST SFC FROM ABQ SURVEY" TO "MWL South Bio Int Layer Shots 6-12-2009"

	ASCI SUBGRADE SHOTS				URS BIOINTRUSION LAYER QA SHOTS (6-12-2009)					DELTAS	(MIN ΔELEV VALUE = 11" = 0.92 FT)			
POINT	NORTH	EAST	ELEV	DESC	POINT	NORTH	EAST	ELEV	DESC	ΔPOINT	ΔNORTH	ΔEAST	ΔDIST	ΔELEV
1124	1452939.026	411833.6637	5385.9	4-NG	8141	1452939.29	411833.337	5387.26	1124	0	-0.26	0.33	0.42	-1.36
1125	1452989.189	411833.5512	5385.76	4-NG	8112	1452989.29	411833.412	5387.14	1125	0	-0.10	0.14	0.17	-1.38
1126	1453039.314	411833.19	5385.06	4-NG	8111	1453039.29	411833.297	5386.242	1126	0	0.02	-0.11	0.11	-1.18
1127	1453088.317	411832.2798	5383.83	4-NG	8109	1453088.11	411832.972	5385.278	1127	0	0.21	0.31	0.37	-1.45
1128	1453100.391	411833.4304	5383.46	4-NG	8108	1453100.32	411833.806	5384.822	1128	0	0.07	-0.38	0.38	-1.36
1129	1453113.132	411833.1039	5383.01	4-NG	8107	1453112.67	411832.849	5384.11	1129	0	0.46	0.25	0.53	-1.10
1130	1453121.368	411833.5607	5382.4	4-NG	8106	1453121.32	411833.981	5383.686	1130	0	0.03	-0.42	0.42	-1.29
1131	1453135.895	411833.7511	5379.67	4-NG	8105	1453135.77	411834.088	5380.79	1131	0	0.13	-0.34	0.36	-1.12
1134	1453134.579	411883.1349	5380.53	4-NG	8120	1453134.65	411882.965	5381.848	1134	0	-0.07	0.17	0.18	-1.32
1135	1453131.752	411883.3186	5380.77	4-NG	8119	1453131.86	411883.669	5382.411	1135	0	-0.10	-0.35	0.37	-1.64
1136	1453120.302	411883.4675	5383.5	4-NG	8118	1453120.16	411883.477	5384.601	1136	0	0.15	-0.01	0.15	-1.10
1137	1453109.785	411883.2126	5384.35	4-NG	8117	1453109.69	411883.563	5385.428	1137	0	0.09	-0.35	0.36	-1.08
1138	1453100.145	411883.358	5384.55	4-NG	8116	1453099.95	411883.533	5385.771	1138	0	0.20	-0.17	0.26	-1.22
1139	1453086.832	411883.1046	5384.83	4-NG	8115	1453086.53	411883.269	5386.021	1139	0	0.30	-0.16	0.34	-1.19
1140	1453038.207	411882.9216	5386.02	4-NG	8114	1453038.27	411883.099	5387.269	1140	0	-0.06	-0.18	0.19	-1.25
1141	1452988.635	411883.9412	5386.37	4-NG	8113	1452988.55	411883.744	5387.892	1141	0	0.08	0.20	0.21	-1.52
1142	1452939.171	411883.3497	5386.36	4-NG	8140	1452939.21	411883.519	5387.722	1142	0	-0.04	-0.17	0.17	-1.36
1144	1452898.76	411901.3566	5386.36	ORANGE	8143	1452898.3	411901.713	5387.427	1144	0	0.46	-0.36	0.58	-1.07
1146	1452898.468	411907.7035	5385.1	4-NG	8144	1452898.73	411907.422	5386.365	1146	0	-0.26	0.28	0.38	-1.25
1149	1452938.008	411911.2063	5384.87	4-NG	8145	1452937.71	411911.062	5386.175	1149	0	0.30	0.14	0.33	-1.31
1150	1452939.585	411901.9983	5386.6	4-NG	8139	1452939.47	411902.186	5387.895	1150	0	0.11	-0.20	0.23	-1.30
1151	1452988.397	411896.6222	5386.54	4-NG	8126	1452988.12	411896.796	5387.736	1151	0	0.28	-0.17	0.33	-1.20
1152	1452988.604	411901.0696	5386.21	4-NG	8127	1452988.66	411901.319	5387.666	1152	0	0.15	-0.25	0.29	-1.46
1153	1452988.43	411910.8432	5383.92	4-NG	8146	1452988.25	411911.071	5385.278	1153	0	0.18	-0.23	0.29	-1.36
1155	1453035.805	411894.8683	5386.01	4-NG	8125	1453035.65	411894.915	5387.075	1155	0	-0.04	-0.05	0.06	-1.06
1156	1453039.173	411899.5522	5385.61	4-NG	8129	1453038.89	411899.714	5386.899	1156	0	0.28	-0.16	0.33	-1.29
1157	1453039.75	411909.6592	5382.69	4-NG	8147	1453039.17	411909.98	5384.024	1157	0	0.58	-0.32	0.66	-1.33
1160	1453089.313	411910.4099	5381.93	4-NG	8148	1453089.25	411910.813	5383.337	1160	0	0.07	-0.40	0.41	-1.41
1161	1453088.86	411896.9209	5384.82	4-NG	8131	1453088.7	411897.058	5386.042	1161	0	-0.05	-0.14	0.14	-1.22
1162	1453088.945	411892.8175	5384.87	4-NG	8124	1453088.71	411893.062	5386.183	1162	0	0.24	-0.24	0.34	-1.31
1163	1453116.124	411893.3831	5384.35	4-NG	8123	1453116.21	411893.188	5385.506	1163	0	-0.09	0.20	0.21	-1.16
1164	1453116.194	411899.8777	5383.64	4-NG	8133	1453116.08	411900.122	5384.969	1164	0	0.11	-0.24	0.27	-1.33
1165	1453117.016	411908.6893	5381.45	4-NG	8134	1453117	411908.606	5382.625	1165	0	0.02	0.08	0.09	-1.18
1167	1453121.172	411901.2358	5382.58	ORANGE	8149	1453120.93	411901.138	5383.93	1167	0	0.24	0.10	0.26	-1.35
1168	1453121.079	411893.3291	5383.66	4-NG	8122	1453120.99	411893.339	5384.673	1168	0	0.09	-0.01	0.09	-1.11
1169	1453134.471	411894.1187	5380.78	4-NG	8121	1453134.41	411893.91	5381.849	1169	0	0.06	0.21	0.22	-1.07
1171	1453124.658	411905.1898	5381.2	4-NG	8136	1453124.61	411905.369	5382.499	1171	0	0.05	-0.18	0.19	-1.30

RECHECKS OF 6-8-2009 BIOINTRUSION LAYER QA SHOTS WITH OVER-FILL, AFTER REWORK BY EDI

1036	1453120.655	411594.5462	5377.47	ORANGE	8110	1453121.17	411594.534	5378.739	1036	0	-0.51	0.01	0.51	-1.27
1104	1453121.962	411795.0732	5380.99	ORANGE	8104	1453122.29	411795.186	5382.536	1104	0	-0.33	-0.11	0.35	-1.55

BIOINTRUSION LAYER			
Construction QC Survey Results			
Grid #	**Pt. #**	**Elev.**	**Δ Total**
A1	1747	5380.75	1.26
A2	1755	5381.28	1.13
A3	1758	5382.26	1.32
A4	1761	5383.18	1.21
A5	1770	5384.54	1.46
A6	1806	5385.11	1.28
A7	1820	5386.03	1.20
B1	1777	5381.49	1.33
B2	1754	5382.13	1.25
B3	1759	5383.32	1.29
B4	1760	5384.17	1.20
B5	1769	5385.46	1.28
B6	1805	5386.18	1.12
B7	1821	5387.19	1.17
C1	1778	5382.24	1.50
C2	1746	5382.86	1.21
C3	1711	5383.75	1.28
C4	1712	5384.70	1.27
C5	1713	5385.88	1.08
C6	1835	5386.97	1.21
C7	1834	5387.66	1.29
D1	1719	5382.38	1.26
D2	1710	5383.13	1.28
D3	1709	5383.83	1.12
D4	1708	5384.80	1.25
D5	1707	5385.78	1.03
D6	1847	5387.17	1.27
D7	1837	5387.64	1.28
E1	1717	5382.43	1.23
E2	1702	5383.05	1.29
E3	1703	5383.98	1.21
E4	1704	5384.69	1.11
E5	1705	5385.45	1.17
E5.1	1706	5385.79	1.23
E6	1846.00	5386.17	1.41
E7	1845.00	5386.91	1.84
F1	1716.00	5382.09	1.11
F2	1701.00	5382.85	1.07
F3	1700.00	5383.8	1.07
F4	1699.00	5384.81	1.28
F5	1698.00	5385.41	1.22
G1	1715.00	5381.97	1.33
G2	1692.00	5382.51	1.24
G3	1749.00	5383.72	1.32
G4	1748.00	5384.4	1.26
G5	1695.00	5385.21	1.23
H1	1714.00	5381.73	1.38
H2	1691.00	5382.33	1.05
H3	1768.00	5383.44	1.44
H4	1766.00	5384.42	1.45
H5	1688.00	5384.94	1.07
I1	1750.00	5381.09	1.27
I2	1751.00	5381.87	1.31
I3	1683.00	5382.73	1.33
I4	1767.00	5383.89	1.33
I5	1685.00	5384.58	1.07
		Average =	**1.25**

MIXED WASTE LANDFILL APPROVAL FORM

URS

AP #: 007 **DATE: 06/17/09**

Attention: **Don Schofield**
Sandia National Laboratories
P.O. Box 5800 MS 1125
Albuquerque, NM
87185

URS Corporation
6501 Americas Parkway NE, Ste 900
Albuquerque, NM 87110-6367
(505) 855-7500

Subject: **3.0-inch Thin Soil Layer** URS Project No. 24343640

Item No.	Layer	Description
1.	Thin Soil Layer	3.0-inch nominal thickness Thin Soil Layer.

☒ Approved ☐ Conditionally Approved ☐ Declined, does not conform to CMIP

Remarks: 1. The 3.0-inch nominal thickness Thin Soil Layer is approved.

Attachments: 1. Thin soil layer thickness verification.

URS Corporation

Approved By: Donald T. Lopez 06/17/09

Donald T. Lopez, P.E. / Marsha A. Nay PHA, PE Date:
CQA Engineer

THIN SOIL LAYER			
Construction QC Survey Results			
Grid #	Elev.	Pt.#	Δ Total (ft)
A1	5380.94	1905	0.19
A2	5381.54	1904	0.26
A3	5382.43	1903	0.17
A4	5383.46	1923	0.28
A5	5384.78	1929	0.24
A6	5385.40	1940	0.29
A7	5386.35	1955	0.32
B1	5381.74	1900	0.25
B2	5382.39	1921	0.26
B3	5383.51	1901	0.19
B4	5384.47	1902	0.30
B5	5385.61	1928	0.15
B6	5386.39	1939	0.21
B7	5387.26	1950	0.07
C1	5382.38	1898	0.14
C2	5383.15	1920	0.29
C3	5384.05	1897	0.30
C4	5384.94	1896	0.24
C5	5386.01	1895	0.13
C6	5387.26	1938	0.29
C7	5387.96	1949	0.30
D1	5382.59	1889	0.21
D2	5383.35	1892	0.22
D3	5384.07	1891	0.24
D4	5385.08	1893	0.28
D5	5386.01	1894	0.23
D6	5387.35	1931	0.18
D7	5387.94	1953	0.30
E1	5382.71	1882	0.28
E2	5383.20	1886	0.15
E3	5384.24	1883	0.26
E4	5384.97	1884	0.28
E5	5385.75	1885	0.30
E5.1	5386.09	1933	0.30

Grid #	Elev.	Pt.#	Δ Total (ft)
F1	5382.34	1887	0.25
F2	5383.11	1880	0.26
F3	5384.09	1879	0.29
F4	5384.89	1878	0.08
F5	5385.67	1877	0.26
G1	5382.25	1868	0.28
G2	5382.75	1871	0.24
G3	5383.92	1872	0.20
G4	5384.99	1873	0.59
G5	5385.54	1874	0.33
H1	5382.02	1866	0.29
H2	5382.62	1869	0.29
H3	5383.74	1864	0.30
H4	5384.68	1865	0.26
H5	5385.28	1863	0.34
I1	5381.34	1853	0.25
I2	5382.07	1855	0.20
I3	5382.99	1857	0.26
I4	5384.14	1861	0.25
I5	5384.78	1859	0.20
		Average =	0.25

MIXED WASTE LANDFILL APPROVAL FORM

URS

AP #: 008 DATE: 06/22/09

Attention: **Don Schofield**
Sandia National Laboratories
P.O. Box 5800 MS 1125
Albuquerque, NM
87185

URS Corporation
6501 Americas Parkway NE, Ste 900
Albuquerque, NM 87110-6367
(505) 855-7500

Subject: **Wedge Lifts 1 & 2 Approval** URS Project No. 24343640

Item No.	Layer	Description
1.	Native Soil Layer	Wedge Lifts 1 and 2 approval

☒ Approved, conforms to CMIP ☐ Conditionally Approved ☐ Declined, does not conform to CMIP

Remarks:

1. Wedge Lifts 1 and 2 were constructed, tapered, spatially limited lifts to achieve the 2.0% east-to-west design slope. They were constructed and tested in accordance with the CMIP. The slope of the surface still has a couple of areas that do not meet the 2.0% design slope requirement. The 2.0% design slope requirement will be achieved with Native Soil Polishing Lifts 3 and 4.
2. Wedge Lifts 1 and 2 are approved based upon CQA Engineer review of construction team QC survey data (topographic map and profiles).

Attachments:

None

URS Corporation

Approved By: Donald T. Lopez 06/22/09

Donald T. Lopez, P.E. / Marshall Nay, PHD, PE Date:
CQA Engineer

MIXED WASTE LANDFILL APPROVAL FORM

URS

AP #: 009 DATE: 06/30/09

Attention: **Don Schofield**
Sandia National Laboratories
P.O. Box 5800 MS 1125
Albuquerque, NM
87185

URS Corporation
6501 Americas Parkway NE, Ste 900
Albuquerque, NM 87110-6367
(505) 855-7500

Subject: **Wedge Lifts 3 & 4 Approval** URS Project No. 24343640

Item No.	Layer	Description
1.	Native Soil Layer	Polishing Lifts 3 and 4 approval

☒ Approved, conforms to CMIP ☐ Conditionally Approved ☐ Declined, does not conform to CMIP

Remarks:

1. Polishing Lifts 3 and 4 were constructed across the cover surface but with variable thickness to complete the adjustment required to establish the 2.0% east-to-west surface design slope. They were constructed and teste in accordance with the CMIP. Polishing Lifts 3 and 4 are approved.
2. Polishing Lifts 3 and 4 are approved based upon review of Construction Team QC survey data (topographic map and profiles).

Attachments:

None

URS Corporation

Approved By: Donald T. Lopez 06/30/09

Donald T. Lopez, P.E. Date:
CQA Engineer

MIXED WASTE LANDFILL APPROVAL FORM

URS

AP #: 010 **DATE: 7/30/09**

Attention: **Don Schofield**
Sandia National Laboratories
P.O. Box 5800 MS 1125
Albuquerque, NM
87185

URS Corporation
6501 Americas Parkway NE, Ste 900
Albuquerque, NM 87110-6367
(505) 855-7500

Subject: **Native Soil Layer Approval** **URS Project No.** 24343640

Item No.	Layer	Description
1.	Native Soil Layer	Native Soil Layer approval

☐ Approved, conforms to CMIP ☒ Conditionally Approved ☐ Declined, does not conform to CMIP

Remarks:

1. The Native Soil Layer was constructed and tested in accordance with the CMIP with the exception of 9 locations which were below the 30-inch thickness requirement. The Native Soil Layer is approved for the placement of the Topsoil Layer with the exception of the 9 low locations. The 9 locations must be corrected, resurveyed, and approved prior to the placement of the Topsoil Layer.
2. The 9 locations requiring additional soil were identified through review of both the QC and QA survey results, and likely represents high spots in the underlying Biointrusion Layer.

Attachments: 1. None

URS Corporation

Approved By: Donald T. Lopez 07/30/09

Donald T. Lopez, P.E. Date:
CQA Engineer

MIXED WASTE LANDFILL APPROVAL FORM

URS

AP #: 011 **DATE: 8/04/09**

Attention: **Don Schofield**
Sandia National Laboratories
P.O. Box 5800 MS 1125
Albuquerque, NM
87185

URS Corporation
6501 Americas Parkway NE, Ste 900
Albuquerque, NM 87110-6367
(505) 855-7500

Subject: **Native Soil Corrections Approval** URS Project No. 24343640

Item No.	Layer	Description
1.	Native Soil Layer	Native Soil Layer Corrections (9 locations), 2.0% east-to-west surface design slope and 6:1 side slopes.

☒ Approved, conforms to CMIP ☐ Conditionally Approved ☐ Declined, does not conform to CMIP

Remarks:

1. The 9 locations previously identified as low areas have been corrected, resurveyed, and are approved. The Native Soil Layer was constructed and tested in accordance with the CMIP and is approved for the placement of the Topsoil Layer.
2. Native Soil Layer thickness, 2.0% east-to-west surface design slope, and 6:1 side slopes are approved based upon the QA verification survey and review of the Construction Team QC survey data (topographic map and profiles).

Attachments:

1. Map showing 9 locations and thickness pre/post adjustment.
2. QC survey results for the thickness of the Native Soil Layer.

URS Corporation

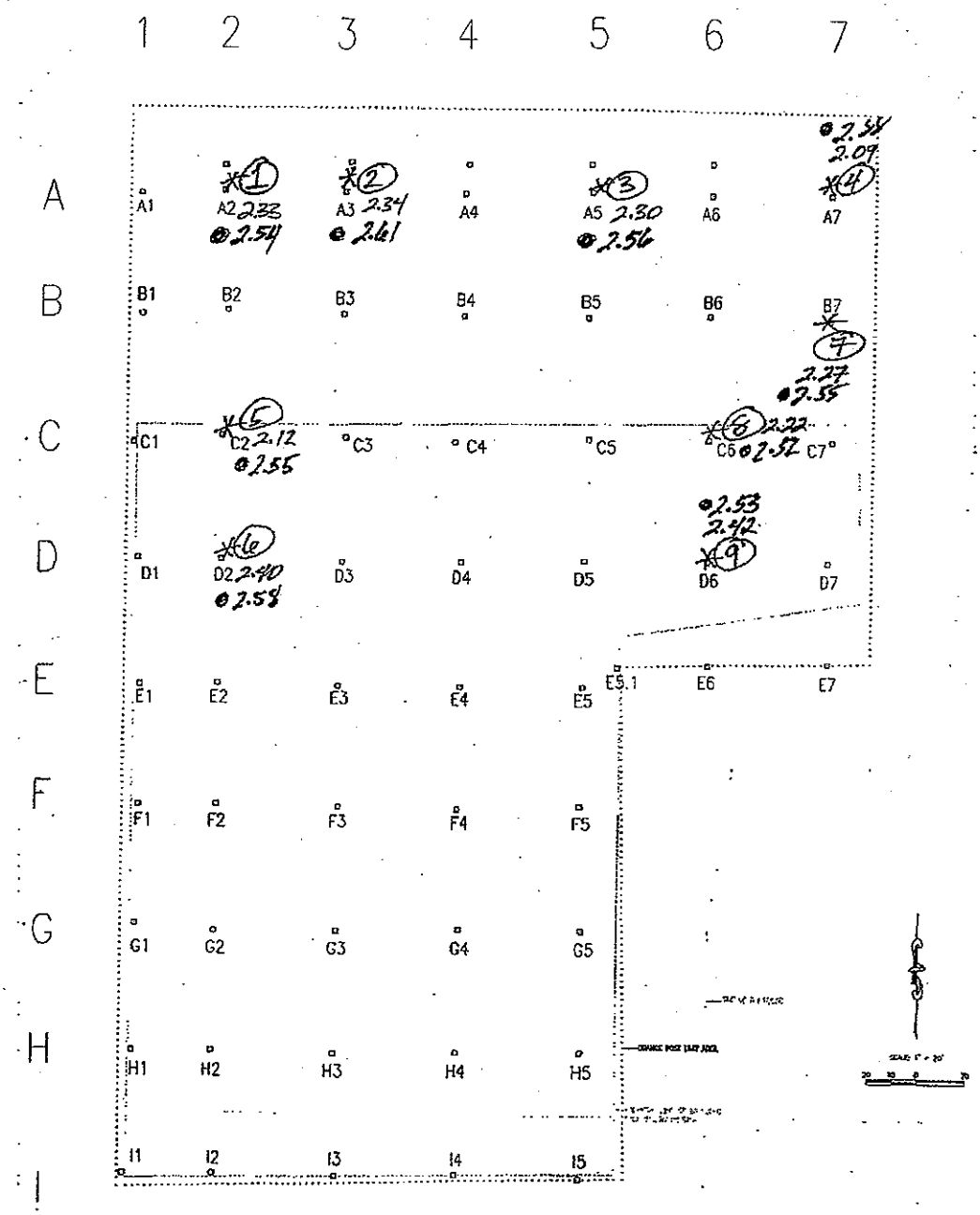
Approved By: Donald T. Lopez 08/12/09

Donald T. Lopez, P.E. Date:
CQA Engineer

SPREAD SHEET DIAGRAM

● = Post Adjustment

= Pre-Adjustment



Plat & Survey By:
ALBUQUERQUE SURVEYING CO., INC. 2110 Mowtal Blvd. N.E. Albuquerque, New Mexico 87107 Ph. (505) 884-4700

NATIVE SOIL LAYER			
Construction QC Survey Results			
Grid #	**Pt. #**	**Elev.**	**Δ Total**
A1	5311	5383.51	2.76
A2	5310	5384.04	2.76
A3	5307	5384.93	2.67
A4	5306	5385.99	2.81
A5	5290	5387.28	2.74
A6	5289	5387.93	2.82
A7	5347	5388.54	2.51
B1	5312	5384.36	2.87
B2	5309	5384.87	2.74
B3	5300	5385.98	2.66
B4	5305	5386.99	2.82
B5	5291	5388.09	2.63
B6	5292	5388.92	2.74
B7	5346	5389.37	2.18
C1	5313	5384.87	2.63
C2	5340	5385.59	2.73
C3	5315	5386.61	2.86
C4	5304	5387.52	2.82
C5	5294	5388.59	2.71
C6	5345	5389.57	2.60
C7	5293	5390.48	2.82
D1	5314	5385.09	2.71
D2	5341	5385.77	2.64
D3	5316	5386.80	2.97
D4	5303	5387.77	2.97
D5	5295	5388.73	2.95
D6	5296	5389.74	2.57
D7	5297	5390.77	3.13
E1	5319	5385.22	2.79
E2	5318	5385.86	2.81
E3	5317	5386.84	2.86
E4	5302	5387.85	3.16
E5	5301	5388.85	3.40
E5.1	5300	5389.12	3.33
E6	5299	5389.83	3.66
E7	5298	5390.89	3.98

Grid #	**Pt. #**	**Elev.**	**Δ Total**
F1	5320	5384.87	2.78
F2	5321	5385.49	2.64
F3	5322	5386.57	2.77
F4	5323	5387.48	2.67
F5	5324	5388.46	3.05
G1	5329	5384.75	2.78
G2	5328	5385.34	2.83
G3	5327	5386.42	2.70
G4	5326	5387.44	3.04
G5	5325	5388.41	3.20
H1	5330	5384.43	2.70
H2	5331	5385.17	2.84
H3	5332	5386.19	2.75
H4	5333	5387.20	2.78
H5	5334	5388.19	3.25
I1	5339	5383.82	2.73
I2	5338	5384.53	2.66
I3	5337	5385.70	2.97
I4	5336	5386.59	2.70
I5	5335	5387.60	3.02
		Average =	**2.85**

MIXED WASTE LANDFILL APPROVAL FORM

URS

AP #: 012 **DATE:** 8/12/09

Attention: **Don Schofield**
Sandia National Laboratories
P.O. Box 5800 MS 1125
Albuquerque, NM
87185

URS Corporation
6501 Americas Parkway NE, Ste 900
Albuquerque, NM 87110-6367
(505) 855-7500

Subject: **Topsoil Layer Approval** URS Project No. 24343640

Item No.	Layer	Description
1.	Topsoil Layer	Approval of Topsoil Layer

☒ Approved, conforms to CMIP ☐ Conditionally Approved ☐ Declined, does not conform to CMIP

Remarks:

1. The Topsoil Layer was constructed in accordance with the CMIP. Thickness, 2.0% east-to-west surface design slope, and 6:1 side slopes verified and meet specifications. The Topsoil layer is approved.
2. Topsoil Layer thickness, 2.0% east-to-west surface design slope, and 6:1 side slopes are approved based upon the QA verification survey and review of the Construction Team QC survey data (topographic map and profiles).

Attachments:

1. QC survey results for the thickness of the Topsoil Layer.

URS Corporation

Approved By: Donald T. Lopez 08/12/09

Donald T. Lopez, P.E. Date:
CQA Engineer

TOPSOIL LAYER			
Construction QC Survey Results			
Grid #	Pt.#	Elev.	Δ Total (Ft)
A1	5256	5384.52	1.01
A2	5262	5385.03	0.99
A3	5264	5385.99	1.06
A4	5267	5387.02	1.03
A5	5274	5388.33	1.05
A6	5279	5388.89	0.96
A7	5281	5389.58	1.04
B1	5276	5385.40	1.04
B2	5261	5385.90	1.03
B3	5265	5387.00	1.02
B4	5266	5388.01	1.02
B5	5273	5389.08	0.99
B6	5278	5389.87	0.95
B7	5282	5390.50	1.13
C1	5277	5385.88	1.01
C2	5255	5386.56	0.97
C3	5247	5387.60	0.99
C4	5248	5388.55	1.03
C5	5249	5389.59	1.00
C6	5284	5390.65	1.08
C7	5283	5391.59	1.11
D1	5254	5386.07	0.98
D2	5246	5386.78	1.01
D3	5245	5387.78	0.98
D4	5244	5388.78	1.01
D5	5243	5389.77	1.04
D6	5288	5390.78	1.04
D7	5285	5391.79	1.02
E1	5253	5386.21	0.99
E2	5238	5386.84	0.98
E3	5239	5387.84	1.00
E4	5240	5388.83	0.98
E5	5241	5389.82	0.97
E5.1	5242	5390.06	0.94

Grid #	Pt.#	Elev.	Δ Total
F1	5252	5385.88	1.01
F2	5237	5386.52	1.03
F3	5236	5387.61	1.04
F4	5235	5388.63	1.15
F5	5234	5389.49	1.03
G1	5251	5385.77	1.02
G2	5232	5386.42	1.08
G3	5258	5387.49	1.07
G4	5257	5388.45	1.01
G5	5233	5389.39	0.98
H1	5250	5385.52	1.09
H2	5231	5386.19	1.02
H3	5272	5387.24	1.05
H4	5270	5388.27	1.07
H5	5230	5389.27	1.08
I1	5259	5384.83	1.01
I2	5260	5385.55	1.02
I3	5228	5386.64	0.94
I4	5271	5387.66	1.07
I5	5229	5388.60	1.00
		Average =	1.02

MIXED WASTE LANDFILL APPROVAL FORM

URS

AP #: 013 **DATE: 8/25/09**

Attention: **Don Schofield**
Sandia National Laboratories
P.O. Box 5800 MS 1125
Albuquerque, NM
87185

URS Corporation
6501 Americas Parkway NE, Ste 900
Albuquerque, NM 87110-6367
(505) 855-7500

Subject: **Seeding, Fertilizer and Mulching Modification** **URS Project No.** 24343640

Item No.	Layer	Description
1.	Seeding	CMIP Reclamation Seeding and Mulching Modification
2.	Fertilizer	Elimination of fertilizer
3.	Mulch	Mulch Approved

☒ Approved, conforms to CMIP ☐ Conditionally Approved ☐ Declined, does not conform to CMIP

Remarks:

1. CMIP modification for reclamation seeding and mulching is approved.
2. Hand broadcasting used in addition to drill seeding to minimize compaction of the Topsoil Layer by minimizing the number of passes required by the tractor pulling the drill seeder. Additional passes would have been necessary to accommodate the increase of seeding rate.
3. Fertilizer not used based upon recommendation from Sandia Staff Biologist. Fertilizer used late in the growing season can make plants more susceptible to frost damage.

Attachments:

1. Email from Don Schofield requesting modification for increased seeding rate and elimination of fertilizer.

URS Corporation

Approved By: Donald T. Lopez 8/25/09

Donald T. Lopez, P.E. Date:
CQA Engineer

Don Lopez/Albuquerque/URSCorp
08/05/2009 04:45 PM

To "Schofield, Donald P" <dpschof@sandia.gov>
cc "Mitchell, Mike M" <mmmitch@sandia.gov>, Marshall Nay/Albuquerque/URSCorp@URSCorp, Paul Molina/Albuquerque/URSCorp@URSCorp, Jack
bcc
Subject Re: CMIP Reveg Modification

Don, Thanks for this mod. We will incorporate this modification in to our CQA effort and the report.

DONALD T. LOPEZ, PE
PRINCIPAL CIVIL/GEOTECHNICAL ENGINEER
INFRASTRUCTURE GROUP LEADER
6501 AMERICAS PARKWAY NE, SUITE 900
ALBUQUERQUE, NEW MEXICO 87110
PH. 505.855.7500 FX. 505.855.7555
CL. 505.301.5965
URS ALBUQUERQUE

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"Schofield, Donald P" <dpschof@sandia.gov>

"Schofield, Donald P"
<dpschof@sandia.gov>
08/05/2009 09:59 AM

To "Don_Lopez@URSCorp.com" <Don_Lopez@URSCorp.com>
cc "Mitchell, Mike M" <mmmitch@sandia.gov>
Subject CMIP Reveg Modification

Mr. Lopez - Sandia National Laboratories (SNL) is approving a modification to the Mixed Waste Landfill (MWL) Corrective Measures Implementation Plan (CMIP) with regards to the revegitation specifications. These modifications come at the request of SNL's staff biologist, and are:

- uniform seeding rate of 80 pounds seed mix per acre (4x CMIP).
- no fertilizer added due to timing (August) of seeding.
- supplemental watering to assist seed germination and root development.

Please incorporate these modifications into URS's CQA effort. Thank you, Donald P Schofield.

MIXED WASTE LANDFILL APPROVAL FORM

URS

AP #: 014 DATE: 9/02/09

Attention: Don Schofield
Sandia National Laboratories
P.O. Box 5800 MS 1125
Albuquerque, NM
87185

URS Corporation
6501 Americas Parkway NE, Ste 900
Albuquerque, NM 87110-6367
(505) 855-7500

Subject: CMIP Re-Vegetation Modification URS Project No. 24343640

Item No.	Layer	Description
1.	Topsoil Layer placement of seed and mulch	Placement of seed and mulch approved

☒ Approved, conforms to CMIP ☐ Conditionally Approved ☐ Declined, does not conform to CMIP

Remarks:

1. The placement of seed and mulch is approved based on visual inspection.

Attachments: 1. None.

URS Corporation

Approved By: Donald T. Lopez 9/02/09
Donald T. Lopez, P.E. Date:
CQA Engineer

ATTACHMENT 3

Daily Quality Control Reports

2006 Daily Quality Control Reports

2006 Daily Quality Control Reports

October 2006

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	10/2/2006	001

WEATHER: Clear, cool

TEMPERATURE: Low 40s High 60s

WEATHER EFFECTS:

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	Weekly Meeting / CQA
Kelly Peil	CQA Engineer	MKM	Weekly Meeting

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Collected initial proctor for subgrade material and proctor for existing surface

SUMMARY OF MEETINGS HELD & ATTENDEES

Weekly Managers' Meeting, attendees included Tim Goering, Joe Fritts, Kelly Peil, Anthony Martinez, Stacy Griffin, Ben Martinez, Corey Woods, Tony Shurter, Brian Fockett, and Don Schofield. See Agenda and Record of Meeting.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: TI-04

QC INSPECTOR — 10/2/06 DATE

QC ENGINEER — 16 Nov 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION	DATE	REPORT NO.
	Sandia MWL CQA Albuquerque, NM	2-Oct-06	001

Crew began removing fence around un-classified area. Removal of small fence complete except for east-west fence in the middle of the un-classified area. Rad personnel performed frisking/swiping of fence material.

Two Proctor samples collected:

MWL-ES-001 Collected from existing surface, approximately 30' Northwest of monitor well MWL-4

MWL-SG-001 Collected from west end of subgrade stockpile

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	10/3/2006	002

WEATHER	Clear, cool	TEMPERATURE	Low 40s	High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No
(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.
DAILY INSPECTION CHECKLISTS: None.

[signature] 10/3/06
QC INSPECTOR DATE

Kelly M Rud 16 Nov 06
QC ENGINEER DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 3-Oct-06	REPORT NO. 002

No QA personnel on site. Crew pulled t-posts from fence around unclassified area. Rad personnel continued frisking/swiping fence material

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	10/4/2006	003

WEATHER Clear, cool | TEMPERATURE Low 40s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No
(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: None.

QC INSPECTOR 10/4/06 DATE

QC ENGINEER 16 Nov 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION	DATE	REPORT NO.
	Sandia MWL CQA Albuquerque, NM	4-Oct-06	003

No QA personnel on site. Crew attended Rad-II training in the morning, in the afternoon began removal of vegetation in the unclassified area.

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	10/5/2006	004

WEATHER Clear, cool | TEMPERATURE Low 40s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No
(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: None.

[signature] 10/5/06
QC INSPECTOR DATE

Kelly M Rud 16 Nov 06
QC ENGINEER DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION	DATE	REPORT NO.
	Sandia MWL CQA Albuquerque, NM	5-Oct-06	004

No QA personnel on site. Crew completed removal of vegetation in unclassified area. Appx. 50 cubic yards of vegetation was placed directly into shredder. Appx. 300 cubic yards of dirt and vegetation mixture was screened, vegetation shredded.

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	10/9/2006	005

WEATHER: Heavy rains | TEMPERATURE: Low 40s High 50s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No
(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: None.

[signature] 10/9/06
QC INSPECTOR DATE

Kelly M Rud 16 Nov 06
QC ENGINEER DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 9-Oct-06	REPORT NO. 005

No field activities on this date due to rain and muddy conditions.

MKM

MKM Engineers, Inc. **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	10/10/2006	006

WEATHER: Rain in a.m., clearing in p.m. TEMPERATURE: Low 40s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	Meeting
Kelly Peil	CQA Engineer	MKM	Meeting

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No
(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

Weekly Managers' Meeting, attendees included Anthony Martinez, Paula Schuh, Don Lopez, Kelly Peil, Joe Fritts, Corey Woods, Harry Buckner, Don Schofield, Tony Shurter, Brian Hunt. See Agenda and Record of Meeting.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: None.

[signature] 10/10/06
QC INSPECTOR DATE

Kelly M Peil 16 Nov 06
QC ENGINEER DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION	DATE	REPORT NO.
	Sandia MWL CQA Albuquerque, NM	10-Oct-06	006

Managers' Meeting held. No field activities on this date due to rain and muddy conditions.

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	10/11/2006	007

WEATHER: Clear, Cool

TEMPERATURE: Low 40s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: None.

QC INSPECTOR — DATE: 10/11/06

QC ENGINEER — DATE: 16 Nov 06

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 11-Oct-06	REPORT NO. 007

No CQA personnel on site. Crew began removal of fence around classified area. Completed removing fence and pulling fenceposts. Began grubbing and shredding classified area material. Completed vegetation removal.

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	10/12/2006	008

WEATHER: Clear, Cool

TEMPERATURE: Low 40s High 60s

WEATHER EFFECTS:

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: None.

QC INSPECTOR 10/12/06 DATE

QC ENGINEER 16Nov06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION	DATE	REPORT NO.
	Sandia MWL CQA Albuquerque, NM	12-Oct-06	008

No CQA personnel on site. Crew cut posts from concrete. Continued shredding and began screening grubbed material from classified area.

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	10/16/2006	009

WEATHER: Clear, Cool

TEMPERATURE: Low 40s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Kelly Peil	CQA Engineer	MKM	Site Audit

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: None.

QC INSPECTOR — 10/16/06 DATE

QC ENGINEER — 16 Nov 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 16-Oct-06	REPORT NO. 009

Kelly Peil on site to conduct 3rd-party audit of field activities, permits, etc. Crew continued screening and shredding operations.

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	10/17/2006	010

WEATHER	Clear, Warm	TEMPERATURE	Low 40s High 70s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: None.

QC INSPECTOR 10/17/06 DATE

QC ENGINEER Kelly M Rud 16 Nov 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 17-Oct-06	REPORT NO. 010

No CQA personnel on site. Crew continued screening and shredding operations.

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	10/18/2006	011

WEATHER	Clear, Warm	TEMPERATURE	Low 40s	High 70s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: None.

[signature] 10/18/06
QC INSPECTOR DATE

Kelly M Reed 16 Nov 06
QC ENGINEER DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 18-Oct-06	REPORT NO. 011

No CQA personnel on site. Crew completed screening and shredding operations (Total of 300 cubic yards screened). Filled in two voids and broke up concrete pad in southeast corner of classified area.

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	10/19/2006	012

WEATHER: Mostly cloudy, cool

TEMPERATURE: Low 40s High 50s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	Meeting
Kelly Peil	CQA Engineer	MKM	Meeting

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

Weekly Managers' Meeting. Attendees included Dick Fate, Joe Fritts, Don Schofield, Tim Goering, Ben Martinez, Kelly Peil, Corey Woods, Don Lopez, Paula Schuh, Anthony Martinez, Brian Fockett. See Agenda and Record of Meeting.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: None.

[signature] 10/19/06
QC INSPECTOR DATE

Kelly M Peil 16 Nov 06
QC ENGINEER DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 19-Oct-06	REPORT NO. 012

Managers' Meeting held. Crew broke up concrete on classified area fenceposts, completed shredding operations.

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	10/23/2006	013

WEATHER Clear, Cool | TEMPERATURE Low 40s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No
(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: None.

[signature] 10/23/06
QC INSPECTOR DATE

[signature] 16 Nov 06
QC ENGINEER DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 23-Oct-06	REPORT NO. 013

No CQA personnel on site. Crew screened grub pile from classified for second time, to 2" minus, completed screening and shredding.

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	10/24/2006	014

WEATHER: Clear, warm | TEMPERATURE: Low 40s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No
(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: None.

Corey Woods 10/24/06
QC INSPECTOR DATE

Kelly M Rud 16 Nov 06
QC ENGINEER DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 24-Oct-06	REPORT NO. 014

Site existing surface and perimeter area clearing and grubbing is complete. Rad clearance has not yet been obtained, CQA personnel do not have access to the site until this is complete. Plan to return tomorrow to perform clear and grub inspection and perform compaction testing.

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	10/25/2006	015

WEATHER: Clear, cool — TEMPERATURE: Low 40s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Wes Newman	Technician	AMEC	Compaction Testing

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No
(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed compaction testing on existing surface. Moisture levels low, tests not recorded.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

Moisture levels on existing surface are low, crew will add water over next two days, will retest on 10/27.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.
DAILY INSPECTION CHECKLISTS: CI-01

[signature] 10/25/06
QC INSPECTOR DATE

Kelly M Ruml 16 NOV 06
QC ENGINEER DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 25-Oct-06	REPORT NO. 015

Arrived on site at 1230, rad clearance has been obtained. Tested several locations along perimeter and existing surface. Density was within specifications but moisture levels were low, around 8-9% compared to optimum of 13.4%. Crew will add water over next two days, will return 10/27 to perform compaction testing. Performed Existing Landfill Surface and Perimeter Clear and Grub inspection.

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	10/26/2006	016

WEATHER Clear, warm | TEMPERATURE Low 40s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No
(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

Moisture levels on existing surface are low, crew adding water, will retest on 10/27.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: None.

QC INSPECTOR 10/26/06 DATE

QC ENGINEER Kelly M Rud 16 Nov 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 26-Oct-06	REPORT NO. 016

No CQA personnel on site. Crew added water to existing landfill surface. URS on site performing survey activities.

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	10/27/2006	017

WEATHER: Clear, cool

TEMPERATURE: Low 40s High 50s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Wes Newman	Technician	AMEC	Compaction Testing/Sample Collection

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed compaction testing on existing surface, test numbers MWL-ES1-001 through -015. Also collected additional samples for proctor analysis, sample numbers MWL-ES-002, -003, and -004.

SUMMARY OF MEETINGS HELD & ATTENDEES

Meeting held between Corey Woods and Joe Fritts regarding existing surface moisture levels. Decision was made to proceed with subgrade installation. Kelly Peil, CQA Engineer, concurred with decision.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

Moisture levels still low on existing surface after adding water for two days. Decision was made that moisture levels cannot be consistently obtained, will proceed with subgrade installation. Density measurements meet specification (90% maximum) at all locations.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: TI-01, TI-04, and TI-07

QC INSPECTOR — 10/27/06 DATE

QC ENGINEER — 16 Nov 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 27-Oct-06	REPORT NO. 017

Returned to perform compaction testing. Moisture levels are still low after adding water for two days. Joe Fritts and Corey Woods determined that moisture levels could not be met in most areas because water had been added for two days already. Decision was made to proceed with subgrade installation. Density was over 90% at all locations. Spoke with Kelly Peil, CQA Engineer, who concurred with decision to proceed with subgrade installation. Three additional proctors were obtained from the existing surface to determine if original proctor was representative:

MWL-ES-002, Center of Classified Area

MWL-ES-003, Center of Northern Portion of Unclassified Area

MWL-ES-004, Center of Southern Portion of Unclassified Area

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	10/30/2006	018

WEATHER: Clear, warm | TEMPERATURE: Low 40s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No
(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.
DAILY INSPECTION CHECKLISTS: CI-02

QC INSPECTOR 10/30/06 DATE

QC ENGINEER 16 Nov 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 30-Oct-06	REPORT NO. 018

Began placing subgrade material in low-lying areas of unclassified area. URS placed stakes for elevation reference in low-lying areas. Surveyors having problems matching design to base points, will lay out 50' grid when problem is resolved.

120 cy placed on this date (completed Lift 1).

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	10/31/2006	019

WEATHER: Clear, warm

TEMPERATURE: Low 40s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Robert Carr	Technician	AMEC	Compaction Testing/Sample Collection

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed compaction tests on Lifts 1 through 4, all tests passed (See TI-07). Also collected samples for proctor analysis from subgrade stockpile, sample numbers MWL-SG-002, -003, and -004.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02, TI-02, TI-04, and TI-07

QC INSPECTOR — 10/31/06 DATE

QC ENGINEER — 16 Nov 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 31-Oct-06	REPORT NO. 019

Continued placing subgrade material in low-lying areas of unclassified area. Lifts placed were relatively small (see Lift Maps). Completed Lifts 2 and 3, began Lift 4. Performed compaction tests on all lifts, all tests passed (See TI-07).

364 cy placed on this date (Lifts 2 through 4).

2006 Daily Quality Control Reports

November 2006

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	11/1/2006	020

WEATHER: Clear, warm

TEMPERATURE: Low 40s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Kelly Peil	CQA Engineer	MKM	Meeting
Robert Carr	Technician	AMEC	Compaction Testing/Sample Collection

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed compaction tests on Lifts 4 and 5, all tests passed (See TI-07).

SUMMARY OF MEETINGS HELD & ATTENDEES

Weekly Managers' Meeting, attendees included Don Schofield, Don Lopez, Corey Woods, Ben Martinez, Joe Fritts, Tim Goering, Kelly Peil, Harry Buckner, Anthony Martinez, Stewart Pike, and Stacy Griffith. See Agenda and Record of Meeting.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02, TI-02, and TI-07

QC INSPECTOR 11/1/06 DATE

QC ENGINEER 16Nov06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 1-Nov-06	REPORT NO. 020

Continued placing subgrade material in low-lying areas of unclassified area. Completed Lifts 4 and 5 (see Lift Maps). Performed compaction tests on all lifts, all tests passed (See TI-07)

Weekly Managers' Meeting held.

498 cy placed on this date (Lifts 4 and 5).

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	11/2/2006	021

WEATHER: Clear, warm

TEMPERATURE: Low 40s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Robert Carr	Technician	AMEC	Compaction Testing/Sample Collection

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed compaction tests on Lifts 4 and 6, all tests passed (See TI-07).

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02, TI-02, TI-04, and TI-07

QC INSPECTOR — 11/2/06 DATE

QC ENGINEER — 16 Nov 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 2-Nov-06	REPORT NO. 021

Continued placing subgrade material in low-lying areas of unclassified area (completed). Completed Lift 6 see Lift Map). Performed compaction tests on Lift 6 and additional area of Lift 4, all tests passed (See TI-07)

412 cy placed on this date (Lift 6)

Collected the following proctors from the 2" minus stockpile (see TI-04):

MWL-SG-005 Northwest corner

MWL-SG-006 Middle west side

MWL-SG-007 Southwest corner

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	11/6/2006	022

WEATHER: Clear, warm

TEMPERATURE: Low 40s High 60s

WEATHER EFFECTS:

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Robert Carr	Technician	AMEC	Compaction Testing/Sample Collection

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed compaction tests on Lift 7, all tests passed (See TI-07).

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02, TI-02, and TI-07

[signature] 11/6/06

QC INSPECTOR DATE

Kelly M Rud 16 Nov 06

QC ENGINEER DATE

MKM Engineers, Inc. **DAILY REPORT CONTINUATION SHEET**

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 6-Nov-06	REPORT NO. 022

Continued placing subgrade material. Completed Lifts 7 and 8 (see Lift Map). Performed compaction tests on Lift 7, all tests passed (See TI-07)

476 cy placed on this date (Lifts 7 and 8)

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	11/7/2006	023

WEATHER: Clear, warm

TEMPERATURE: Low 40s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Robert Carr	Technician	AMEC	Compaction Testing/Sample Collection

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed compaction tests on Lifts 8 and 9, all tests passed (See TI-07).

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02, TI-02, and TI-07

[signature] 11/7/06

QC INSPECTOR DATE

Kelly M Rund 16 Nov 06

QC ENGINEER DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 7-Nov-06	REPORT NO. 023

Continued placing subgrade material. Began Lift 9 (see Lift Map), not yet compete. Performed compaction tests on Lifts 8 and 9, all tests passed (See TI-07)

344 cy placed on this date (Lift 9)

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~OWL~~ CQA	11/8/2006	024

WEATHER: Clear, warm

TEMPERATURE: Low 40s High 70s

WEATHER EFFECTS:

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Robert Carr	Technician	AMEC	Compaction Testing/Sample Collection

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed compaction test on Lift 9, test passed (See TI-07). Collected three samples for proctor analysis from 2" minus stockpile.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02, TI-02, TI-04, and TI-07

QC INSPECTOR 11/8/06 DATE

QC ENGINEER Kelly M Rud 16 Nov 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 8-Nov-06	REPORT NO. 024

Continued placing subgrade material. Completed Lift 9, Began Lift 10 (see Lift Map). Performed compaction test on Lift 9, test passed (See TI-07)

576 cy placed on this date (316 cy on Lift 9, 260 cy on Lift 10)

Collected the following proctors from the 2" minus stockpile:

MWL-SG-008 Northwest corner

MWL-SG-009 Middle west side

MWL-SG-010 Southwest corner

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	11/9/2006	025

WEATHER: Clear, warm

TEMPERATURE: Low 40s High 70s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Robert Carr	Technician	AMEC	Compaction Testing/Sample Collection

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed compaction tests on Lifts 9 and 10, all tests passed (See TI-07).

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02, TI-02, and TI-07

QC INSPECTOR — 11/9/06 DATE

QC ENGINEER — 16 Nov 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 9-Nov-06	REPORT NO. 025

Continued placing subgrade material, Lift 10 (see Lift Map). Performed compaction testing on Lifts 9 and 10, all tests passed (See TI-07)

496 cy placed on this date (Lift 10)

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	11/13/2006	026

WEATHER: Overcast, Cool

TEMPERATURE: Low 40s High 50s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02

[signature] 11/13/06
QC INSPECTOR DATE

Kelly M Pond 16 Nov 06
QC ENGINEER DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION	DATE	REPORT NO.
	Sandia MWL CQA Albuquerque, NM	13-Nov-06	026

Continued placing subgrade material, Lift 10 (see Lift Map).

580 cy placed on this date (Lift 10)

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	11/14/2006	027

WEATHER	Overcast, cool, high winds	TEMPERATURE	Low 40s High 60s
WEATHER EFFECTS	Field activities shut down at 1330 due to high winds		

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Kelly Peil	CQA Engineer	MKM	CQA
Miguel Chavez	Technician	AMEC	Compaction testing/sample collection

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed compaction testing on Lift 10, all tests passed (see TI-07). Collected three samples for proctor analysis.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02, TI-02, TI-04, and TI-07

QC INSPECTOR — 11/14/06 DATE

QC ENGINEER — 7Dec06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 14-Nov-06	REPORT NO. 027

Continued placing subgrade material, completed Lift 10 (see Lift Map). Performed compaction testing on L 10, all tests passed (See TI-07).

280 cy placed on this date, completed Lift 10 (1,616 cy total for Lift 10).

Collected the following samples for proctor analysis:

MWL-SG-011 East end of Southern stockpile

MWL-SG-012 West end of Southern stockpile

MWL-SG-013 South-central area of 2" subgrade stockpile

The Southern stockpile is comprised of material that was on site at the MWL prior to site operations; the material was screened to 2" minus for potential use as subgrade.

Subgrade fill activities were shut down at 1330 due to high winds.

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	11/15/2006	028

WEATHER: Overcast, cool

TEMPERATURE: Low 30s High 50s

WEATHER EFFECTS:

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Miguel Chavez	Technician	AMEC	Compaction testing

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed compaction testing on Lift 11, all tests passed (see TI-07).

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None

DAILY INSPECTION CHECKLISTS: CI-02, TI-02, and TI-07

QC INSPECTOR — 11/15/06 DATE

QC ENGINEER — 7 Dec 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 15-Nov-06	REPORT NO. 028

Continued placing subgrade material, began Lift 11 (see Lift Map). Performed compaction testing on Lift 1 all tests passed (See TI-07).

520 cy placed on this date (Lift 11).

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	11/16/2006	29

WEATHER: Overcast, cool — TEMPERATURE: Low 30s High 50s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Kelly Peil	CQA Engineer	MKM	CQA/Meeting
Miguel Chavez	Technician	AMEC	Compaction testing

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No
(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed compaction testing on Lift 11, all tests passed (see TI-07).

SUMMARY OF MEETINGS HELD & ATTENDEES

Managers' Meeting, attendees included Kelly Peil, Don Schofield, Joe Fritts, Jerry Peace, Tim Goering, Stacy Griffith, Corey Woods, Ben Martinez, Anthony Martinez, Tony Shurter, and Harry Buckner. See Agenda and Meeting Notes.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02, TI-02, TI-04, and TI-07

QC INSPECTOR — 11/16/06 DATE — QC ENGINEER — 7 Dec 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 16-Nov-06	REPORT NO. 029

Continued placing subgrade material, Lift 11 (see Lift Map). Performed compaction testing on Lift 11, all te passed (See TI-07).

464 cy placed on this date (Lift 11).

Collected two additional proctor samples:

MWL-SG-014 - Northwest corner of stockpile

MWL-SG-015 - Southwest corner of stockpile

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	11/20/2006	030

WEATHER: Clear, Warm

TEMPERATURE: Low 30s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Miguel Chavez	Technician	AMEC	Compaction testing

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed compaction testing on Lift 11, all tests passed (see TI-07). Collected three proctor samples, MWL-SG-016, -017, and -018.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02, TI-02, TI-04, and TI-07

QC INSPECTOR — 11/20/06 DATE

QC ENGINEER — 7 Dec 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 20-Nov-06	REPORT NO. 030

Continued placing subgrade material, Lift 11 (see Lift Map). Performed compaction testing on Lift 11, all te passed (See TI-07).

624 cy placed on this date (Lift 11).

Collected three additional proctor samples:

MWL-SG-016 - Southwest corner of stockpile

MWL-SG-017 - Middle west side of stockpile

MWL-SG-018 - Northwest corner of stockpile

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	11/21/2006	031

WEATHER: Clear, Warm

TEMPERATURE: Low 30s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Miguel Chavez	Technician	AMEC	Compaction testing

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed compaction testing on Lift 11, all tests passed (see TI-07).

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02, TI-02, and TI-07

QC INSPECTOR — 11/21/06 DATE

QC ENGINEER — 7 Dec 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 21-Nov-06	REPORT NO. 031

Continued placing subgrade material, Lift 11 (see Lift Map). Performed compaction testing on Lift 11, all te passed (See TI-07).

856 cy placed on this date (Lift 11).

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	11/22/2006	032

WEATHER Clear, Warm | TEMPERATURE Low 30s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Miguel Chavez	Technician	AMEC	Compaction testing

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed final compaction test on Lift 11, test passed (see TI-07).

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02, TI-02, and TI-07

QC INSPECTOR 11/22/06 DATE

QC ENGINEER 7 Dec 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 22-Nov-06	REPORT NO. 032

Continued placing subgrade material, completed Lift 11 (see Lift Map). Performed final compaction test on Lift 11, test passed (See TI-07).

56 cy placed on this date (Lift 11).

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	11/27/2006	033

WEATHER: Overcast, breezy — TEMPERATURE: Low 20s High 50s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Miguel Chavez	Technician	AMEC	Compaction testing

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No
(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Collected three samples for proctor analysis from 2" screened stockpile at CAMU Borrow Area, MWL-SG-019, -020, and -021.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: TI-04

[signature] 11/27/06
QC INSPECTOR DATE

[signature] 7 Dec 06
QC ENGINEER DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 27-Nov-06	REPORT NO. 033

No site activities. Collected three samples for proctor analysis from 2" minus stockpile at CAMU Borrow Area:

MWL-SG-019 - North end of stockpile

MWL-SG-020 - West side of stockpile

MWL-SG-021 - East side of stockpile

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	11/28/2006	034

WEATHER	Overcast, breezy	TEMPERATURE	Low 20s High 50s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No
(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02

QC INSPECTOR 11/28/06 DATE

QC ENGINEER 7Dec06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 28-Nov-06	REPORT NO. 034

Began placing subgrade on final lift (Lift 12).

284 cy placed on this date.

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	11/29/2006	035

WEATHER: Overcast, intermittent snow

TEMPERATURE: Low 10s High 30s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02

G. Woods 11/29/06

QC INSPECTOR DATE

Kelly M Pul 7 Dec 06

QC ENGINEER DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 29-Nov-06	REPORT NO. 035

Continued placing subgrade (Lift 12).

648 cy placed on this date.

Existing 2" minus subgrade pile exhausted. Crew will work the next few days hauling soil from the existing stockpile at the CAMU Borrow Area and excavating/screening additional soil needed to complete the final subgrade lift.

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	11/30/2006	036

WEATHER: Overcast, cold | TEMPERATURE: Low 10s High 30s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Miguel Chavez	Technician	AMEC	Compaction Testing

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No
(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed compaction tests on Lift 12, all tests passed. See TI-07.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: TI-02, TI-07

QC INSPECTOR 11/30/06 DATE

QC ENGINEER 7Dec06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 30-Nov-06	REPORT NO. 036

Crew working on hauling soil from borrow area and excavating/screening additional soils for subgrade.

Performed compaction testing on Lift 12, all tests passed. See Form TI-07.

2006 Daily Quality Control Reports

December 2006

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	12/4/2006	037

WEATHER: Clear, Cool

TEMPERATURE: Low 20s High 50s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02

12/4/06

QC INSPECTOR DATE

27 Dec 06

QC ENGINEER DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 4-Dec-06	REPORT NO. 037

Crew continued excavating/screening additional soils for subgrade and hauling from borrow area to MWL.

Re-started installing subgrade. Installed 160 cy on lift 12.

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~OWL~~ CQA	12/5/2006	038

WEATHER: Clear, Cool

TEMPERATURE: Low 20s High 50s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Miguel Chavez	Technician	AMEC	Compaction Testing

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed compaction testing, Lift 12, all tests passed. Collected one additional proctor from newly screened material (MWL-SG-022).

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02, TI-02, TI-04, TI-07

[signature] 12/5/06
QC INSPECTOR DATE

Kelly M Pond 27 Dec 06
QC ENGINEER DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 5-Dec-06	REPORT NO. 038

Crew continued excavating/screening additional soils for subgrade and hauling from borrow area to MWL.

Continued installing subgrade, 340 cy installed on lift 12.

Collected additional proctor from newly screened material:

MWL-SG-022 - Collected from northeast corner of stockpile at MWL

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	12/6/2006	039

WEATHER	Clear, Cool	TEMPERATURE	Low 20s	High 50s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02

QC INSPECTOR	12/6/06 DATE	QC ENGINEER	27 Dec 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 6-Dec-06	REPORT NO. 039

Crew completed excavating/screening additional soils for subgrade and hauling from borrow area to MWL.

A total of approximately 2,000 cy of additional subgrade material was excavated/screened and hauled.

Continued installing Lift 12, 460 cy.

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	12/7/2006	040

WEATHER: Clear, Cool — TEMPERATURE: Low 20s High 50s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Robert Carr	Technician	AMEC	Compaction Testing

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

Performed compaction testing on Lift 12, all tests passed, see form TI-07.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02, TI-02, TI-07

QC INSPECTOR 12/7/06 DATE

QC ENGINEER 27 Dec 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 7-Dec-06	REPORT NO. 040

Continued installing Lift 12, 492 cy.

Performed compaction tests on Lift 12, all tests passed, see Form TI-07.

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	12/11/2006	041

WEATHER: Clear, Cool

TEMPERATURE: Low 20s High 50s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02

QC INSPECTOR — 12/11/06 DATE

QC ENGINEER — 27Dec06 DATE

MKM Engineers, Inc. **DAILY REPORT CONTINUATION SHEET**

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 11-Dec-06	REPORT NO. 041

Continued installing Lift 12, 220 cy.

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	12/12/2006	042

WEATHER: Clear, Warm

TEMPERATURE: Low 20s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Miguel Chavez	Technician	AMEC	Testing

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

AMEC on site to conduct compaction testing, but proctor results have not been completed, so no tests performed.
Collected two additional samples for proctor analysis (MWL-SG-023 and -024).

SUMMARY OF MEETINGS HELD & ATTENDEES

Managers' Meeting held. Attendees included Joe Fritts, Tim Goering, Corey Woods, Harry Buckner, Ben Martinez, Anthony Martinez. See Agenda and Record of Meeting.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: TI-04

QC INSPECTOR 12/12/06 DATE

QC ENGINEER 27 Dec 06 DATE

MKM Engineers, Inc. **DAILY REPORT CONTINUATION SHEET**

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 12-Dec-06	REPORT NO. 042

Crew began excavating/screening additional subgrade material.

Two samples collected from newly screened material for proctor analysis:

MWL-SG-023 - North side of stockpile at borrow site

MWL-SG-024 - South side of stockpile at borrow site

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	12/13/2006	043

WEATHER	Clear, Warm	TEMPERATURE	Low 20s	High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Miguel Chavez	Technician	AMEC	Testing

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No
(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

AMEC on site to conduct compaction testing, Lift 12, all tests passed. See Form TI-07.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: TI-02, TI-07

QC INSPECTOR 12/13/06 DATE

QC ENGINEER 27 Dec 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION	DATE	REPORT NO.
	Sandia MWL CQA Albuquerque, NM	13-Dec-06	043

Crew continued excavating/screening additional subgrade material.

AMEC on site to conduct compaction testing, Lift 12, all test passed. See Form TI-07.

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	12/14/2006	044

WEATHER: Clear, Warm

TEMPERATURE: Low 20s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Miguel Chavez	Technician	AMEC	Sample Collection

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

AMEC collected two additional samples for proctor analysis from newly screened material, MWL-SG-025 and -026.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02, TI-04

QC INSPECTOR 12/14/06 DATE

QC ENGINEER 27 Dec 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION	DATE	REPORT NO.
	Sandia MWL CQA Albuquerque, NM	14-Dec-06	044

Restarted installation of subgrade. Installed 440 cy Lift 12 (280 cy Proctor 022 and 160 cy Proctor 023).

AMEC on site to collect two additional samples for proctor analysis:

MWL-SG-025 - Collected from south side of MWL stockpile

MWL-SG-026 - North side of site stockpile

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	Sandia ~~CWL~~ MWL CQA	12/15/2006	045

WEATHER: Clear, Warm

TEMPERATURE: Low 20s High 60s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Miguel Chavez	Technician	AMEC	Compaction Testing

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

AMEC on site to conduct compaction testing, all tests passed, see Form TI-07.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02, TI-02, TI-07

QC INSPECTOR 12/15/06 DATE

QC ENGINEER 27 Dec 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 15-Dec-06	REPORT NO. 045

Installed 512 cy Lift 12 (340 cy Proctor 023 and 172 cy Proctor 024).

AMEC on site to conduct compaction testing, all tests passed, see Form TI-07.

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	12/18/2006	046

WEATHER	Overcast, cold, windy	TEMPERATURE	Low 10s	High 40s

WEATHER EFFECTS

PERSONNEL ON-SITE

(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA
Robert Carr	Technician	AMEC	Compaction Testing

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

AMEC on site to conduct compaction testing, all tests passed, see Form TI-07.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: CI-02, TI-02, TI-07

QC INSPECTOR 12/18/06 DATE

QC ENGINEER 27Dec06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 18-Dec-06	REPORT NO. 046

Installed 788 cy, completed Lift 12 (328 cy Proctor 024, 460 cy Proctor 025).

AMEC on site to conduct compaction testing, all tests passed, see Form TI-07.

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~CWL~~ CQA	12/19/2006	047

WEATHER	Cold, windy, intermittent snow	TEMPERATURE	Low 10s High 30s

WEATHER EFFECTS

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY
Corey Woods	CQA Inspector	MKM	CQA

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No
(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.
DAILY INSPECTION CHECKLISTS: CI-02

QC INSPECTOR 12/19/06 DATE

QC ENGINEER 27 Dec 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 19-Dec-06	REPORT NO. 047

Completed final grade work on subgrade.

MKM **MKM Engineers, Inc.** **DAILY QUALITY CONTROL REPORT**

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	12/20/2006	048

WEATHER	Snow	TEMPERATURE	Low	10s	High	30s

WEATHER EFFECTS: No personnel on site due to snow.

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No
(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.
DAILY INSPECTION CHECKLISTS: None

[signature] 12/20/06
QC INSPECTOR DATE

Kelly M Pond 27 Dec 06
QC ENGINEER DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 20-Dec-06	REPORT NO. 048

No personnel on site on this date due to snow.

MKM Engineers, Inc.

DAILY QUALITY CONTROL REPORT

CONTRACT NO.	PROJECT TITLE / LOCATION	DATE	REPORT NO.
	MWL Sandia ~~GWL~~ CQA	12/21/2006	049

WEATHER	Cold, muddy conditions	TEMPERATURE	Low 10s	High 30s

WEATHER EFFECTS: Final grading operations not conducted due to snow and muddy conditions

PERSONNEL ON-SITE
(If space provided below is inadequate, use additional sheets)

NAME	POSITION	EMPLOYER	ACTIVITY

WAS A JOB SAFETY MEETING HELD THIS DATE? ☒ Yes ☐ No

WERE THERE ANY LOST-TIME ACCIDENTS THIS DATE? ☐ Yes ☒ No

(if yes, attach meeting copy of completed OSHA / accident report)

DESCRIPTION OF TESTING PERFORMED

None.

SUMMARY OF MEETINGS HELD & ATTENDEES

None.

LOCATION AND DESCRIPTION OF DEFICIENCIES *(Materials, Equipment, Safety, and/or Workmanship / Action taken or to be taken)*

None.

MATERIAL or EQUIPMENT RECEIVED or RELEASED:

None.

CALIBRATIONS: None.

DAILY INSPECTION CHECKLISTS: None

QC INSPECTOR	12/21/06 DATE	QC ENGINEER	27 Dec 06 DATE

MKM Engineers, Inc.

DAILY REPORT CONTINUATION SHEET

CONTRACT NO.	TITLE AND LOCATION Sandia MWL CQA Albuquerque, NM	DATE 21-Dec-06	REPORT NO. 049

Crew attempted final grading operations on subgrade, but material too wet. Site operations shut down at 1100. No CQA personnel on site on this date.

The Sandia holiday shut-down begins tomorrow, crew will not return to the site until Jan. 3, 2007.

2009 Daily Quality Control Reports

2009 MWL Daily Summary Report Data Location Table:

Throughout construction in 2009 of the MWL ET Cover, Daily Quality Control Reports were prepared by URS CQA personnel as specified in the CMIP CQA Plan (Appendix B, SNL/NM November 2005). The Daily QC Reports included information such as text describing construction activities and daily tasks, meeting summaries, equipment used, personnel on site, inspection checklists/forms, sketches of placed material, field and laboratory testing activities, verification survey activities, etc. All of the information listed above was included in one comprehensive Daily QC Report volume, compiled throughout the duration of the project. At the conclusion of the MWL ET Cover Construction Project, the daily reports were reviewed and finalized in preparation for inclusion as an Attachment within the MWL Alternative Cover CQA Report.

All references to attached information, drawings (i.e. dwg_xx/xx/09_Construction_0x), Appendices, and photos within 2009 Daily QC Reports included in Attachment 3 are no longer valid. Please refer to the cross-reference list provided below for the location of this information in the MWL Alternative Cover CQA Report.

Description:	CQA Report Location:
2009 Daily QC Summary Reports (text describing construction procedures and daily tasks)	Attachment 3
Summary of 2009 ET Cover construction activities and schedule	Table 1
Daily sign-in sheet and visitors log	Not Included[1]
Survey verification grid points and field testing grid blocks	Figure 18
Daily Tailgate Meeting Forms	Not Included[1]
Quality Resolution Meetings and Cover Layer Approval Forms	Table 3
2009 Saturated Hydraulic Conductivity test results	Table 8 and Attachment 7
2009 Standard Proctor, Gradation, and Classification test results	Tables 5-7 and Attachment 7
List of heavy equipment used the MWL ET Cover construction	Table 13
Approximate surface area of material placed	2009 Photographic Log in tabbed section at end of report, Volume 1
Locations of QC and CQA density and moisture tests	Figures 21-29
Location of grubbed material after it was removed from the MWL Subgrade surface.	Not Included[1]
Receiving, construction, and testing inspection forms	Attachments 4-6
QC survey data provided by EDi	Table 12 and 2009 Alternative Cover As-Built Drawings Figure No. 1 - 4 in tabbed section at end of report, Volume 1.
QA verification surveys performed by URS	Quality Assurance Verification Survey Plates 1 – 3 in tabbed section at end of report, Volume 1
Daily photos of construction activities	2009 Photo Log in tabbed section at end of report, Volume 1
Summary report for the extension of monitoring well MWL-MW4	Attachment 8

1. Information maintained in the SNL/NM ES&H and Security Records Center.

2009 Daily Quality Control Reports

May 2009

DAILY SUMMARY REPORT

DATE: 20 May 2009 (Wednesday)
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): Partly cloudy.
WEATHER (PM): Partly cloudy, heavy clouds are rolling in from East Mountains.
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Notice to proceed has been issued and the initial construction has begun early. EDi has updated the schedule accordingly. EDi began removal of the fence surrounding the landfill. Clear and grubbing has started on the slopes of the Existing Subgrade surface.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade.
2. Perimeter surrounding Mixed Waste Landfill Cover.

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00-7:30 AM
Attendees: See attached sign in sheet.
Issues:
-Safety: Snakes, footing, and equipment awareness.
-Tasks: Remove fence and begin clearing and grubbing MWL.

2. Description: Afternoon Safety Briefing
Time: 7:00-7:30 AM
Attendees: See attached sign in sheet.
Issues:
-Safety: Snakes, footing, and equipment awareness.
-Tasks: Clearing and grubbing MWL.

DAILY TASK

I.
A. TASK DESCRIPTION: ***MWL Perimeter Fence Removal***
Remove the perimeter fence surrounding the Mixed Waste Landfill. The removed fence post placed north of the MWL (See dwg_5/20/09_Construction_01).

B. ISSUES/COMMENTS:
1. None

C. EQUIPMENT USED:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Task was completed. The fence was completely removed and placed on north side of MWL.

F. PICTURES OBTAINED:

1. No pictures were collected of this procedure.

II.

A. TASK DESCRIPTION: ***Clear and Grub MWL***

Clear and grubbing of the mixed waste landfill has begun. The items to be removed on the MWL surface, as well as the side slopes of the landfill, appear to be small vegetative material, erosion controlling matting, and small rocks (less than 2"). There is no vegetation that exceeds a height of 6". Most vegetation appears to be dead and does not appear to have any roots exceeding ½-inch.

A loader was used to clear and grub the site. The bucket of the loader was dragged across the surface while the loader moved in reverse. The loader began the removal of vegetative material, erosion controlling matting, and small rocks on the West slope. The loader continued the procedure around the entire perimeter slope of the MWL (See dwg_5/20/09_Construction_01). Due to the dead, dry nature of the vegetation, the method is very effective. The items removed have been stockpiled on the southwest side of the MWL (See dwg_5/20/09_Construction_01).

B. ISSUES/COMMENTS

1. No penetrations to the MWL 6.0-inch or greater occurred.

C. EQUIPMENT USED (See Appendix B for equipment description/details)

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Clear and grubbing of the MWL perimeter slopes has been completed (See dwg_5/20/09_Construction_01). Clear and grubbing of the MWL surface will be continued on 05/21/2009.

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

III.

A. TASK DESCRIPTION: *MWL Survey*

The survey team for EDi was present to collect existing survey data. See Appendix A for existing survey data collected by the EDi survey team.

B. ISSUES/COMMENTS:

1. The EDi survey team was instructed to do a topographic survey of the current, existing conditions of the Existing Subgrade Layer. The EDi survey team will create topographic surveys of each layer (i.e. Existing Subgrade, Biointrusion, Native Soil, etc.). The topographic survey information collected by the EDi survey team will be compared to the QA survey collected by URS. Approval of each finished layer is required before the next layer may begin.
2. EDi's survey team was initially confused because they did not have an electronic copy of the existing conditions survey, which is located in the Mixed Waste Landfill Corrective Measures Implementation Plan (CMIP). EDi's survey team was advised not to use the Existing Subgrade information in the contract drawings. Also, we are not concerned with what the existing conditions were when the drawings were created, but the current existing conditions.
3. URS provided survey control information to the EDi survey team. The control matched information collected by the EDi survey team.

C. EQUIPMENT USED:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. The Existing Subgrade Surface Survey has been collected (See Appendix A). The survey control provided by URS matched EDi's survey team as a QA check.

F. PICTURES OBTAINED:

No pictures were collected of this procedure.

INSPECTION CHECKLISTS REQUIRED

1. Construction Inspection Form CI-01, Existing Landfill Surface and Perimeter Clear and Grub Field Form.

PROPOSED NEXT DAY ACTIVITIES (date: 05/21/2009):

1. Finish clear and grubbing Existing Subgrade.
2. Place fence around metering wells surrounding MWL perimeter.
3. Compact Existing Subgrade.

DAILY SUMMARY REPORT

DATE: 21 May 2009 (Thursday)
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): Cloudy, potential for rain.
WEATHER (PM): Cloudy, light rain during afternoon.
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- EDi continued the process of clearing and grubbing and began compaction of the Existing Subgrade Surface. Fences were placed around the wells on the west perimeter of the MWL.

LOCATION OF CONSTRUCTION

1. Tech Area III (Site 13), Mixed Waste Landfill, Existing Subgrade.

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00-7:25 AM
Attendees: See attached sign in sheet.
Issues:
a. Daily activities: (see below)

b. Safety: Today's safety included a discussion on being aware of the heavy machinery in use and the three items required to operate heavy equipment (backup siren, seatbelt, and fire hydrant).

2. Description: Afternoon Safety Briefing
Time: 12:30-12:40
Attendees: See attached sign in sheet.

Issues:
a. Afternoon activities (see below)

b. Safety: Afternoon safety covered slips trips and falls.

DAILY TASK

I.
A. TASK DESCRIPTION: ***Clear and Grub MWL***

Clear and grubbing of the MWL continued (See task description on the Daily Summary Report dated 05/20/2009 for existing site conditions). Yesterday the side slopes of the MWL were cleared. Today the top surface will be cleared.

A loader was used to clear and grub the site. The bucket of the loader was dragged across the Existing Surface while the loader moved in reverse. The loader began the removal of vegetative material, erosion control matting, and small rocks on the west side of the MWL. The loader continued the procedure across the entire top cover of the Existing Subgrade. Due to the dead, dry nature of the vegetation, the method was very affective. The items removed have been stockpiled on the southeast side of the MWL (see dwg_05/21/09_01).

B. ISSUES/COMMENTS:

1. No penetrations 6.0" or deeper occurred.
2. After clearing and grubbing, a visual inspection was performed by Paul Molina to determine if vegetative material, erosion control matting, and rocks larger then 2" had been removed. It was determined by inspection the materials listed above had indeed been removed
3. Heavy equipment used to clear and grub the MWL did not come within the distance specified in the Corrective Measures Implementation Plan to Monitoring Well M-4.

C. EQUIPMENT USED (See Appendix B for equipment description)

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. The clearing and grubbing of the site has been completed.

F. PICTURES OBTAINED:

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Compaction of Existing Subgrade***

The compaction of the Existing Subgrade began today. A vibrating, smooth drum roller was used for the compaction process. The roller began in the southwest corner and made its first pass across the entire Existing Surface moving from south to north and vice versa. A second pass was made across the Existing Subgrade surface starting in the northeast corner and made the pass form east to west. Compaction was performed across the entire surface as well as the side slopes of the MWL. During the process, the Existing Subgrade surface was sprayed with water to aid in the compaction process. (See dwg_05/21/09_Construction_02).

B. ISSUES/COMMENTS

1. The Subgrade appeared very dense during and after compaction. Density testing will be performed to confirm.
2. The vibrating, smooth drum roller was used to compact the existing Subgrade Layer. Caution was used around monitoring well MW-4 as specified. EDi did not bring heavy equipment within bollard area, which protects the monitoring well.
3. The MWL received rain during the compaction process.
4. It was determined that it was best to turn off the vibration device on the roller for the following reasons:

   -The Existing Subgrade Layer is rock hard and the roller was bouncing uncontrollably.

   - Because the Subgrade Surface was already hard, there was concern the vibration would crack the surface below.

C. EQUPMENT USED (See Appendix B for Equipment Description)
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Two passes of compaction with the vibrating, smooth drum roller were completed (see dwg_05/21_Construction_02). The surface is now ready for the density tests, which is scheduled for tomorrow (05/22/09).

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED
1. CI-01 Construction Inspection Form, Existing Landfill Surface and Perimeter Clear and Grub Field Form.

PROPOSED NEXT DAY ACTIVITIES (date: 05/22/09)
1. Density testing of compacted Existing Subgrade.

DAILY SUMMARY REPORT

DATE: 5/22/2009 (Friday)
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): Cloudy
WEATHER (PM): NA
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Field density test were performed using the Nuclear Method, ASTM D2922, D3017, and D2950. AMEC performed thirteen tests for EDi. An additional six test were performed by AMEC for URS CQA.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade Surface.

LIST OF PERSONNEL:
Please see Appendix C for sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:30 AM
Attendees: See attached sign in sheet.
Issues:
a. Safety: Stay at least six feet back from density test units

DAILY TASK

I.

A. TASK DESCRIPTION: ***Field Density and Moisture Test (Construction)***
Field density test were taken at thirteen different locations. The Existing Subgrade surface was divided into thirteen grids (see attached grid). A density/moisture test was performed at random locations within each of the thirteen grids. Survey data was collected on all testing locations.

B. ISSUES/COMMENTS:

1. All thirteen moisture and density tests met the MWL specification requirements and were approved by Don Lopez, CQA Engineer.

C. EQUIPMENT USED:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. All thirteen moisture and density tests met the MWL specifications requirements and were approved by Don Lopez.

F. PICTURES OBTAINED:

1. Pictures of this procedure were collected and filed.

II. A. TASK DESCRIPTION: ***Field Density Test (CQA)***

Six CQA tests were taken by AMEC for URS. The AMEC representative for the CQA was Robert Carr. A firewall is setup between AMEC representatives Robert Carr and Miguel Chavez to prevent any conflict of interest. Robert Carr was instructed to perform his field moisture/density within an approximate 3-foot radius of every other QC test performed by Miguel Chavez. Density test locations and elevations were collected and plotted by the EDi surveyor.

B. ISSUES/COMMENTS

1. All six CQA moisture and density tests met the MWL specifications requirements and were approved by Don Lopez.
2. QC survey indicates some parts of the 2.0% east-to-west slope and 6:1 side slopes do not meet the design. It was decide to adjust the 6:1 side slopes as well as the 2.0% east-to-west design slope during the construction of overlaying layers.
3. Don Lopez has approved the MWL Existing Surface. Construction of the Biointrusion Layer may now begin.

C. EQUIPMENT USED

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

F. STATUS:

1. Density tests have been completed and approved by Don Lopez.

G. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED (See attached)

1. TI-02; Subgrade Fill Field Test Form

PROPOSED NEXT DAY ACTIVITIES (date: 05/26/2009)

1. Begin Test Biointrusion Barrier.

DAILY SUMMARY REPORT

DATE: 5/26/09 (Tuesday)
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): Slightly Cloudy, good conditions (58 deg)
WEATHER (PM): Slightly Cloudy, good conditions (72 deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- The test section for the Biointrusion Layer was executed today. The initial test procedure discussed in the Construction Site Safety Plan (CSSP, page 37) was determined to be unsuccessful. A second method for the installation of the Biointrusion Barrier was derived and was successful (See below ***Biointrusion Test Area II*** for details).

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade.
2. Former Bulk Waste Staging Area, TA 3, (Biointrusion Rock Location).
3. Borrow Pit, (Pre-screened Soil Stockpile).

LIST OF PERSONNEL:

Please see Appendix C for sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:00 – 7:30 AM
   Attendees: See attached sign in sheet.
   Issues:
   a. The test Biointrusion procedure to be followed.

2. Description: Biointrusion Barrier Procedure Briefing
   Time: 9:45-10:15 PM
   Attendees: See attached sign in sheet.
   Issues:
   a. Discussion of responsibilities and measures that needed to be taken into consideration to have a successful Biointrusion Test.

3. Description: Afternoon Safety Briefing
   Time: 1:00-1:18 PM
   Attendees: See attached sign in sheet.
   Issues:
   a. Rock Delivery: The procedure for continuing with the delivery of rock.
   b. Safety: Proper ear protection and the truck routes needed ensure safety.
   c. Construction: The procedure for continuing the placement of Biointrusion barrier rock.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Biointrusion Test Area I (as discussed in CSSP)***
Please see CSSP (page 37) for procedure description.

The test area consisted of two truckloads of dry, screened loose soil distributed over an approximate 20 x 20-feet area. Using a builder's level, the thickness of the test loose soil layer was determined to be 6-to-8-inch as specified in the CSSP. The soil was initially spread using a motor grader, but EDi later switched to a dozer in an attempt to reduce the soil compaction.

The Biointrusion rock was then placed onto the 6-to-8-inch loose soil layer. The Biointrusion rock was spread to an approximate thickness of 1.0-foot or slightly less. A dozer then compacted the rock in an attempt to push the rock down into the soil layer. After several passes with the dozer, Don Lopez (URS CQA) was not convinced that the Biointrusion rock was being pressed down through the loose soil layer to the existing Subgrade Layer. This raised concerns of the possibility of future settling due to the layer of sand between the Subgrade Layer and the Biointrusion Layer. It was determined this procedure was not adequate to meet Specification Section 02115 located in the CMIP.

B. ISSUES/COMMENTS:

1. There was a discussion about extending the Biointrusion Barrier past the toe of the existing Subgrade Layer. It was determined that it is not necessary to extend the Biointrusion Barrier past the toe.
2. The current slope is approximately 1.8% from East to West in lieu of the 2.0% as specified. The slope will be adjusted to the specified 2.0% during the course of construction. It will be corrected during the Native Soil Layer as apposed to the Biointrusion Barrier due to material availability and ease of construction.
3. The method of constructing the Biointrusion described in the CSSP (Page 37) was determined to be insufficient by Don Lopez PE URS CQA Engineer.

C. EQUIPMENT USED (See Appendix B for Equipment Description)

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. This procedure was ineffective and was canceled. A new method was derived and used as described below.

F. PICTURES OBTAINED:

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Biointrusion Test Area II***

After it was determined that the procedure described above in Test Area I was ineffective, a second test area was created using the tracks of the dozer to scarify the existing Subgrade Surface. It was determined the tracks of the dozer created a texture, which was ideal for the Biointrusion Rock placement. The scarified surface had enough loose soil to fill some of the voids in the rock, as well as create a grooved pattern, which made it easy for the rock to fall into place and interlock. The rock was compacted with the dozer a minimum of four times. Loose, screened soil was then placed over the rock layer and worked into the voids by spreading with the dozer. This method proved to be very effective. (See below for updated Biointrusion installation procedure).

The Following is the Updated Biointrusion Layer Installation Procedure:

The Biointrusion layer will be constructed in compliance with the CMIP, Specification Section 02115. The following is the procedure recommended by Don Lopez PE (URS CQA Engineer) for the Biointrusion Layer:

The rock used for the Biointrusion Layer will continue to be the rock acquired by SNL. The rock is located at the former Bulk Waste Staging Area in TA 3.

The EDI Team will scarify the Existing Subgrade Surface using the tracks of a dozer. A minimum of four passes with the dozer tracks is required across the existing Subgrade Surface. Once the Subgrade Surface has been prepared, the Biointrusion Rock may be spread across the scarified surface. The rock layer will then be compacted with a minimum of four passes by the dozer to ensure compaction and interlocking of the rock. Compaction shall be performed until rocks are firmly locked into place. The entire Biointrusion Rock Layer Surface must be completed, surveyed, and approved before any further construction may take place.

Once the rock layer is compacted in place and approved, additional dry loose soil will be placed over the surface. A dozer will then spread the loose soil across the rock surface and work the loose soil into the voids. The soil will then be compacted with a minimum of four passes with the vibratory roller. After this is completed and approved, water will be applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content.

END

B. ISSUES/COMMENTS

1. After the Test Method II was determined to be affective, it was applied for the remainder of the day to the South side of the MWL. Approximately 300-CY of the Biointrusion layer was installed.
2. Water was not applied to the Biointrusion Layer to fill voids today.

3. No survey was performed today. The survey team should be out tomorrow for as-built conditions and elevation confirmations for the Biointrusion Layer.
4. Crushed rock used for the Biointrusion Layer did meet specifications by method of visual inspection.
5. No heavy equipment was operated around the monitoring wells.

C. EQUPMENT USED (See Appendix B for Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

F. STATUS:
1. Approximately 300 CY of the Biointrusion Layer was installed today (20 Truck Loads @ approx 15 CY/truck). See dwg_05/26/09_Construction_01.
2. Approximately 90 CY of the loose, dry soil for the voids was installed in test pad (6 truck loads @ approx 15 CY/truck). This was only for the test pad and will not be continued until the Biointrusion Rock Layer is completed and approved.
3. Water was not applied to the Biointrusion Layer today.

G. PICTURES
1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED
1. Biointrusion Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 05/27/09)
1. Continue installation of the Biointrusion Barrier.
2. Raise Well

I DAILY SUMMARY REPORT

DATE: 5/27/09 (Wednesday)
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): Clear Sky (54 deg.)
WEATHER (PM): Partly Cloudy (71 deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Construction of the Biointrusion Layer continued today.
- The Monitoring Well MW-4 Extension procedure occurred today.

LOCATION OF CONSTRUCTION

1. Tech Area 3, Sandia Mixed Waste Landfill, Existing Subgrade Layer
2. Former Bulk Waste Staging Area, TA 3, (Biointrusion Rock Location)

LIST OF PERSONNEL:
Please see Appendix C for sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:25 AM
Attendees: See attached sign in sheet.
Issues:
CONSTRUCTION:
a. The haul road from the borrow pit is going to need some regular maintenance. The road is starting to fall apart.
b. EDi needs to keep a count on the number of rock and sand loads hauled from the Borrow Site to the MWL.
c. Procedure: Continue Biointrusion Rock Barrier construction.

SAFETY:
a. Be sure to stay upwind of the rock pours due to the dust.
b. Be sure to have the proper ear and eye protection.
c. Weekly safety inspections are going to be conducted for the duration of the project.

2. Description: Afternoon Safety Briefing
Time: 12:37 – 12:47 PM
Attendees: See attached sign in sheet.
Issues: Same as morning session

DAILY TASK

I.

A. TASK DESCRIPTION: ***Installation of Biointrusion Layer***

The installation of the Biointrusion Layer continued today. See the Daily Report dated 05/26/09 for the revised method of installation for the Biointrusion Layer. See drwg_05/26/09_Construction_01 for illustration of installed Biointrusion Layer.

EDi provided spot survey today to verify the 1.0-foot minimum thickness. The survey followed the dozer and verified thickness of the layer placed. Some areas were 1.0-foot as specified; however, some were below the 1.0-foot or above the 1.25-foot requirement. A final survey will need to be conducted once the Biointrusion Layer is installed to confirm the 1.0-foot thickness as specified.

B. ISSUES/COMMENTS:

1. A defined method to test the thickness of the Biointrusion layer has not been established. A surveyor was checking the thickness as the rock was installed; however, the method did not ensure the entire surface met specification thicknesses before the soil was to be placed to fill the voids. Paul Molina spoke with Don Schofield, Mike Mitchell, and Chris Edgman regarding the situation. It was agreed there needs to be survey data verifying the specification thickness requirements before the soil to fill the voids was placed. The method decided upon is to place the entire Biointrusion Layer before proceeding with the placement of the soil to fill the voids. A survey of the entire surface will then be conducted, checked, and approved. This will ensure the 1.0-foot depth as specified (see Biointrsuion Installation Procedure in Revised Daily Report 05/22/09).

C. EQUIPMENT USED:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 900 CY of the Biointrusion Layer was installed today (60 Truck Loads @ approx 15 CY/truck). See dwg_05/27/09_Construction_01.

F. PICTURES OBTAINED:

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Monitoring Well MW-4 Extension***

The extension of the MW-4 Extension Well began about 10:30 AM. A team used on a regular basis for maintenance of the Sandia Monitoring Wells was brought in to conduct the procedure. Submittal and procedure outline have been provided by Mike Saunders (see attached).

B. ISSUES/COMMENTS

1. No concrete pad was located around Monitoring Well MW-4. The pad was previously buried during the Subgrade Installation. A new pad will be poured around the well once the final layer is completed.
2. The bollards were cut in place. This was to prevent pulling up the concrete anchors, which are buried under the Subgrade Layer.

C. EQUPMENT USED
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

F. STATUS:
1. The Monitoring Well extension was completed.

G. PICTURES
1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED
1. Biointrusion Inspection Form (see attached)

PROPOSED NEXT DAY ACTIVITIES (date: 05/28/09)
1. Continue with Biointrusion Layer

DAILY SUMMARY REPORT

DATE: 05/28/09 (Thursday)
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:50 AM, Clear sky (58 deg.)
WEATHER (PM): 1:50 PM, Cloudy, received rain and 10-mile lightning warning. Crew was brought back to trailer or asked to stay in equipment if it had an enclosed cab.
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- The ribbon cutting occurred today directly after the morning Tailgate Meeting
- Construction of the Biointrusion Layer continued.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Subgrade Layer.
2. Former Bulk Waste Staging Area, TA 3, (Biointrusion Rock Location)

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:00-8:30 AM
   Attendees: See attached sign in sheet.
   Issues:
   a. Construction Procedure: The same procedure as yesterday regarding the installation of the Biointrusion Layer is to be followed. It is important for EDi to keep count of the number of loads of rock and sand brought from the borrow site to the Mixed Waste Landfill.
   b. QA Issues: Soil samples of the borrow area material plan to be taken today.
   c. Safety: Hearing protection needs to be worn around heavy equipment on site.
   d. Heavy Equipment Refueling: The Sandia Mixed Waste Landfill does not have a designated area for refueling onsite. Instead, a fuel truck will go to the heavy equipment to refuel when needed. This is acceptable onsite as long as the refueling does not take place on the Mixed Waste Landfill Cover. Spill prevention measures need to be taken while refueling onsite equipment.

INCIDENT REPORT:

Chris Timm lost consciousness this morning during the Tailgate Meeting (approximately 7:15 AM). Chris fell from a standing position onto his front side without warning. Chris was unconscious and did not move for approximately 10 seconds. 911 was dialed and Emergency Responders were contacted as specified in the CSSP. Members of EDI drove to the front gate to direct the Emergency Responders to the Mixed Waste Landfill. Chris regained consciousness and was talking. He did appear to understand what had happened and where he was.

RIBBON CUTTING

After the AM Tailgate Meeting a ribbon cutting was performed. The procedure ended at 8:30. Pictures were taken of the event.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Biointrusion Layer Construction***

The installation of the Biointrusion Layer continued today. See the Daily Report dated 05/26/09 for the revised method of installation for the Biointrusion Layer. See dwg_05/27/09_Construction_01 for illustration of installed Biointrusion Layer.

B. ISSUES/COMMENTS:

1. Temporary bollards were set around MW-4, which had been extended yesterday.

C. EQUIPMENT USED:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 630 CY of the Biointrusion Layer was installed today (42 Truck Loads @ approx 15 CY/truck). See dwg_05/27/09_Construction_01.

F. PICTURES OBTAINED:

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Biointrusion Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 05/28/09)

1. Continue with Biointrusion Construction

DAILY SUMMARY REPORT

DATE: 5/29/09 (Friday)
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 11:30 (73 deg)
WEATHER (PM): 3:34 (80 deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Construction of the Biointrusion Layer continued today.
- Marshall Nay (URS CQA) arrived at the MWL and collected data to classify the Biointrusion rock.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade Surface.
2. Former Bulk Waste Staging Area, TA 3, (Biointrusion Rock Location).

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:00 – 7:25 AM
   Attendees: See attached sign in sheet.
   Issues:
   a. Procedure: Continuation of the Biointrusion Layer.
   b. Safety: Do not refuel on landfill.
   c. Safety: The minimum distance away from equipment without hearing protection is 30-feet.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Installation of Biointrusion Layer***

The installation of the Biointrusion Layer continued today. See the Daily Report dated 05/26/09 for the revised method of installation for the Biointrusion Layer. See dwg_05/29/09_Construction_01 for illustration of installed Biointrusion Layer.

B. ISSUES/COMMENTS:

1. Equipment did not come within specified distance to Monitoring Well MW-4.
2. Joe Estrada from the DOE made a site visit to observe construction. Joe appeared to be pleased with the procedure as well as the progress.

C. EQUIPMENT USED:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 810 CY of the Biointrusion Layer was installed today (54 Truck Loads @ approx 15 CY/truck). See dwg_05/29/09_Construction_01.

F. PICTURES OBTAINED:

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***QA Biointrusion Rock Classification***

Marshall Nay (URS CQA) arrived on site and collected 25 random samples of the Biointrusion rock. Measurements and weights of the 25 samples were recorded. two rock samples were collected and taken offsite with Marshall for additional density testing.

B. ISSUES/COMMENTS

1. Marshall Nay and Paul Molina collected data. Marshall Nay will perform the analysis and create the report.

C. EQUPMENT USED

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

F. STATUS:

1. The samples have been collected. Marshall Nay will conduct the test and formulate the report at later date.

G. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Biointrusion Inspection Form

2. A checklist is not required for the rock classification test conducted by Marshall Nay.

PROPOSED NEXT DAY ACTIVITIES (date: 06/01/09)

1. Continuation of Biointrusion Layer.

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DAILY SUMMARY REPORT

DATE: 06/01/09 (Monday)
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:00 AM (60 deg) Clear sky
WEATHER (PM): 4:04 PM (79 deg) Clear sky, wind
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Construction of the Biointrusion Layer continued today.
- Don Lopez, Marshall Nay and Harry Buckner arrived onsite to discuss the QA Survey and the topsoil gravel admixture.
- The roads need to be re-graded as specified in the Storm Water Pollution Prevention Plan.

LOCATION OF CONSTRUCTION

1. Tech Area III; Sandia Mixed Waste Landfill; Existing Subgrade Layer
2. Former Bulk Waste Staging Area, TA 3, (Biointrusion Rock Location)

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:00-7:25 AM
   Attendees: See attached sign in sheet.
   Issues:
   a. Construction: The roads may need to be worked on. The criteria are ½-inch of rain or 14-days.
   b. Continuation of Biointrusion Layer on West end of Existing Subgrade.
   c. Safety: Heavy equipment operators and drivers should not talk on phones while operating heavy equipment.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Installation of Biointrusion Layer***

The installation of the Biointrusion Layer continued today. See the Daily Report dated 05/26/09 for the revised method of installation for the Biointrusion Layer. See attached dwg_06/01/09_Construction_01 for illustration of installed Biointrusion Layer.

B. ISSUES/COMMENTS:

1. Equipment did not come within specified distance of Monitoring Well MW-4.

C. EQUIPMENT USED (See Appendix B for Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 840 CY of the Biointrusion Layer was installed today (56 Truck Loads @ approx 15 CY/truck). See dwg_06/01/09_Construction_01.

F. PICTURES OBTAINED:

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Construction/QA Survey Coordination***

Harry Buckner (URS) and Jerome Sanchez (EDi) discussed procedures to coordinate the construction and QA survey.

B. ISSUES/COMMENTS

1. Jerome (EDi survey rep.) was not sure how URS was going to perform the QA check. Jerome was instructed to use the 50-foot grid created for the Existing Subgrade. Jerome is to take elevations of the Biointrusion Barrier Layer at the exact locations he took elevations on the Existing Subgrade. Harry Buckner will do his QA on the exact same locations using the 50-foot grid.

C. EQUIPMENT USED

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Harry Buckner will do the CQA survey check on Friday (06/05/09) or Monday (06/08/09) depending on the status of the Biointrusion Layer. Harry will use the method described above to check the thickness of the Biointrusion Rock Barrier.

F. PICTURES OBTAINED

1. Pictures of this procedure will be collected and filed.

III.

A. TASK DESCRIPTION: ***3/8-inch Crushed Gravel***

EDi has submitted the 3/8-inch crushed gravel to be combined with the topsoil.

B. ISSUES/COMMENTS

1. The following are the main functions of the ¾ -inch gravel. These will be taken into consideration and will be the criteria used for determination of the ¾-inch rock substitution:

a. Erosion control.
b. Permeability in the soil matrix, which will allow the water to penetrate for plant growth.
c. Aerate the soil for the plant root structure.

C. EQUPMENT USED
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

F. STATUS:
1. Chris Edgmon will prepare a submittal of the three rock samples he was able to obtain. URS will make a determination of the rock to be used based off of this submittal. (See attached for rock substitution submittal)

G. PICTURES OBTAINED
1. Pictures of the ¾-inch rock substitution samples are included in the Rock Substitution Submittal. These pictures are also filed.

IV.

A. TASK DESCRIPTION: ***Re-Grade Dirt Roads***

The dirt road surrounding the Mixed Waste Landfill was re-graded as specified in the MWL Storm Water Pollution Prevention Plan (SWPPP). The SWPPP requires the road to be re-graded every 17-days or if the site receives ½-inch of rain.

B. ISSUES/COMMENTS
1. Road graded as specified in the SWPPP.

C. EQUPMENT USED (See Appendix B For Equipment Description)
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

F. STATUS:
1. Road has been re-graded as required.

G. PICTURES OBTAINED
1. No pictures taken.

INSPECTION CHECKLISTS REQUIRED
1. Biointrusion Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 05/02/2009)
1. Continue with installation of Biointrusion Layer.

DAILY SUMMARY REPORT

DATE: 06/02/2009 (Tuesday)
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 10:52 (70 deg.); Partly cloudy
WEATHER (PM): 4:00 (79 deg); Partly cloudy; lightning warning stopped construction at 4:00 PM today.
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Construction of the Biointrusion Layer continued today.

LOCATION OF CONSTRUCTION

1. Tech Area III; Sandia Mixed Waste Landfill; Existing Subgrade
2. Former Bulk Waste Staging Area, TA 3, (Biointrusion Rock Location)

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:00 AM
   Attendees: See attached sign-in sheet.
   Issues:
   a. Safety: Truck route established for the day
   b. Procedure: Continuation of the rock layer

2. Description: Afternoon Safety Briefing
   Time: 12:40-12:50 PM
   Attendees: See attached sign in sheet.
   Issues:
   a. Safety: Truck route will stay the same as this morning.
   b. Continuation of the rock layer

DAILY TASK

I.

A. TASK DESCRIPTION: ***Installation of Biointrusion Layer***

The installation of the Biointrusion Layer continued today on the west slope. See the Daily Report dated 05/26/09 for the revised method of installation for the Biointrusion Layer. See attached dwg_06/02/09_Construction_01 for illustration of installed Biointrusion Layer.

B. ISSUES/COMMENTS:

1. None

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 780 CY of the Biointrusion Layer was installed today (52 Truck Loads @ approx 15 CY/truck). See dwg_06/02/09_Construction_01.

F. PICTURES OBTAINED:
1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED
1. Biointrusion Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 06/02/09)
1. Continue with construction of Biointrusion Layer

DAILY SUMMARY REPORT

DATE: 06/03/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:06 AM; Clear sky (57 deg.)
WEATHER (PM): 1:38 PM; Clear sky, clouds in the distance, (75 deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Construction of Biointrusion layer continued on west and northwest side.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Former Bulk Waste Staging Area, TA-III, (Biointrusion Rock Location)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:06 AM – 7:18 AM
Attendees: See attached sign in sheet.
Issues:
a. Procedure: Continuation of Biointrusion Laydown. Be sure to use caution around Monitoring Well MW-4.
b. Safety: Be aware of heat stress. Drink water throughout the day.

2. Description: Afternoon Safety Briefing
Time: 12:30 PM- 12:45 PM
Attendees: See attached sign in sheet.
Issues:
a. Same as morning tailgate meeting.

DAILY TASK

I.
A. TASK DESCRIPTION: ***Installation of Biointrusion Layer***
The installation of the Biointrusion Layer continued today on the west slope. See the Daily Report dated 05/26/09 for the revised method of installation for the Biointrusion Layer. See attached dwg_06/03/09_Construction_01 for illustration of installed Biointrusion Layer.

B. ISSUES/COMMENTS:
1. None
C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 1035 CY of the Biointrusion Layer was installed today (69 Truck Loads @ approx 15 CY/truck). See dwg_06/02/09_Construction_01.

F. PICTURES OBTAINED:

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Biointrusion Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 06/04/09)

1. Continue the construction of the Biointrusion Barrier.

DAILY SUMMARY REPORT

DATE: 06/04/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:02 AM; Clear sky (60 deg.)
WEATHER (PM): 2:10 PM; Partly cloudy, (79 deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Construction of Biointrusion layer continued on north side.
- A meeting was held regarding the QA survey procedure and the Biointrusion Rock.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Former Bulk Waste Staging Area, TA III, (Biointrusion Rock Location)

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:00 AM – 7:26 AM
   Attendees: See attached sign in sheet.
   Issues:
   a. Procedure: Continuation of Biointrusion Laydown. Be sure to use caution around Monitoring Well MW-4.
   b. Safety: Emergency Contact 911, Non-Emergency 311.

2. Description: Afternoon Safety Briefing
   Time: 12:30 PM- 12:45
   Attendees: See attached sign in sheet.
   Issues:
   a. Same as morning tailgate meeting.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Installation of Biointrusion Layer***

The installation of the Biointrusion Layer continued today. See the Daily Report dated 05/26/09 for the revised method of installation for the Biointrusion Layer. See attached dwg_06/04/09_Construction_01 for illustration of installed Biointrusion Layer.

B. ISSUES/COMMENTS:

1. Rock was placed around the Monitoring well MW-4. Heavy equipment was not used for compaction within the specified radius of the Monitoring Well MW-4.

2. It was determined that there is not enough rock in the Former Bulk Waste Staging Area, TA III, to complete the Biointrusion Barrier Layer.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. The last of the rock located in the Former Bulk Waste Staging Area, TA 3, will be used by tomorrow. Additional rock is being tested for compliance and will be purchased if acceptable. Approximately 1020 CY of the Biointrusion Layer was installed today (68 Truck Loads @ approx 15 CY/truck). See dwg_06/04/09_Construction_01.

F. PICTURES OBTAINED:
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***QA Survey/Biointrusion Rock Meeting (1:00 –1:45 pm)***

A meeting was held between Sandia, EDi, and this afternoon to discuss the following:

1. There is not going to be enough rock in the Former Bulk Waste Staging Area, TA III, to complete the Biointrusion layer. The original rock was purchased at the San Lazarus Gulch in the San Pedro Mountains (San Pedro rock). Ben Martinez (Sandia) contacted San Pedro Rock and was informed that there is more of the same rock available; however, it has more fines in it then the original rock. Don Lopez has requested a sample of the proposed rock for his inspection. Don Lopez will make his decision to approve/disapprove the additional Biointrusion rock based on visual inspection/Engineering Judgment.

2. Harry Buckner (URS) will begin the QA survey on Friday (06/05/09). Harry will begin his survey on the south end of the MWL and proceed north. Harry will convert the survey data collected into a usable format on Saturday (06/06/09) to determine the Biointrusion Layer thickness. URS intends to provide EDi with approval/disapproval of at least the south portion of the Biointrusion Layer Monday morning. Any survey not completed on Friday will be collected on Monday.

3. There was a discussion over the "actual thickness" of the Biointrusion Layer compared to the "computed thickness". The computed Biointrusion Layer thickness is determined by comparing the elevation of the Existing Subgrade to the elevation of the Biointrusion Layer. However, the rock is being placed onto a scarified surface, not the surveyed Existing Subgrade, which allows the rock to

push down into the Existing Subgrade approximately 1-to-2 inches. This causes the actual thickness to be greater then what the computed thickness derived from survey data is showing. Don Lopez has decided to accept a computed Biointrusion Layer thickness of 11-inches to compensate for the above.

INSPECTION CHECKLISTS REQUIRED

1. Biointrusion Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 06/05/09)

1. Continue the construction of the Biointrusion Barrier.
2. QA Survey

DAILY SUMMARY REPORT

DATE: 06/05/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:20 am (64 deg); partly cloudy
WEATHER (PM): 1:00 pm (76 deg); partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continued construction of Biointrusion Layer
- Field CQA Survey of South side of MWL (URS)

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Former Bulk Waste Staging Area, TA III, (Biointrusion Rock Location)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Installation of Biointrusion Layer***
The installation of the Biointrusion Layer continued today. See the Daily Report dated 05/26/09 for the revised method of installation for the Biointrusion Layer. See attached dwg_06/05/09_Construction_01 for illustration of installed Biointrusion Layer.

B. ISSUES/COMMENTS:

1. The last of the rock in the Former Bulk Staging Area was used today. Additional rock is going to need to be purchased to finish the Biointrusion Layer. The original rock was purchased at San Pedro Rock. There is more of the same rock available, however, Don Lopez will need to approve the rock before it is used. EDi hopes to start shipment of the rock the following Monday (06/08/09).

2. Don Schofield has decided to allow EDi to order more rock from San Pedro Rock at risk. The rock available at San Pedro Rock is the exact same rock and is from the same stockpile.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. All available rock in Bulk Staging Area was used today. Approximately 435 CY of the Biointrusion Layer was installed today (29 Truck Loads @ approx 15 CY/truck). See dwg_06/05/09_Construction_01.

F. PICTURES OBTAINED:
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***CQA Survey of Biointrusion Thickness***

Harry Buckner (URS) and Paul Molina (URS) conducted the QA survey on the south end of the MWL. The survey data collected will be converted into a usable format to determine the Biointrusion Layer thickness (See results attached). URS intends to provide EDi with approval/disapproval of at least the south end of the Biointrusion Layer. Additional QA Survey will be conducted on Monday (6/8/09).

B. ISSUES/COMMENTS
1. Four Points on the southwest slope did not pass the 1-foot minimum thickness requirement (See results attached). EDi will need to place more rock on this section. URS will then recheck the survey at these four spots. All other areas on the south portion of the Biointrusion layer are approved.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

F. STATUS:
1. See attached for QA Survey Results

G. PICTURES OBTAINED
1. Pictures of this procedure were not collected

INSPECTION CHECKLISTS REQUIRED
1. Biointrusion Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 06/08/09)
1. Continue with Biointrusion Layer if rock is delivered.
2. Begin placing the loose sand and working into voids of Biointrusion Layer in approved sections.
3. Continue QA Survey on north end of MWL

DAILY SUMMARY REPORT

DATE: 06/08/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:10(67 deg); partly cloudy
WEATHER (PM): 2:00 (78 deg); partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continued construction of Biointrusion Layer on northeast side.
- Field CQA Survey of northwest side of MWL (URS).
- Begin placement of loose soil into Biointrusion Layer voids in approved areas.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade.
2. Former Bulk Waste Staging Area, TA III, (Biointrusion Rock Location).

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Installation of Biointrusion Layer***
The installation of the Biointrusion Layer continued today. See the Daily Report dated 05/26/09 for the revised method of installation for the Biointrusion Layer. See attached dwg_06/08/09_Construction_01 for illustration of installed Biointrusion Layer.

B. ISSUES/COMMENTS:

1. Additional rock was purchased from San Pedro Rock to finish the Biointrusion Layer. Don Lopez approved the rock after a visual inspection. Don Lopez also checked with San Pedro Rock to confirm the rock purchased was from the same stockpile as the original.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Rock was shipped from San Pedro Rock and placed directly on the Existing Subgrade. Approximately 479 CY of the Biointrusion Layer was installed today. 313.94 tons of rock was delivered on site.

F. PICTURES OBTAINED:

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***CQA Survey of Biointrusion Thickness***

Harry Buckner (URS) and Paul Molina (URS) conducted the QA survey on the Northwest end of the MWL. The survey data collected will be converted into a usable format on Tuesday morning (06/09/09) to determine the Biointrusion Layer thickness (see results attached). URS intends to provide EDi with approval/disapproval of the Northwest portion of the Biointrusion Layer Tuesday morning (06/09/09). The final QA Survey will be performed when the Biointrusion Layer is completed on the Northeast end.

B. ISSUES/COMMENTS

1. Two Points on the Northwest end did not pass the 1-foot minimum thickness requirement. EDi will need to place more rock on this section. URS will then recheck the survey at these two points.

2. EDi corrected the four points that did not pass the 1-foot minimum thickness requirement (see results attached). URS has rechecked these points and will give approval tomorrow (6/09/09).

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. See attached for QA Survey Results

F. PICTURES OBTAINED

1. Pictures of this procedure were not collected

III

A. TASK DESCRIPTION: ***Placement Of Loose Soil In Biointrusion Voids***

The south portion of the MWL has been approved for the placement of loose soil into the Biointrusion Voids (with the exception of 4 low areas). See the Daily Report dated 05/26/09 for the method of installation and compaction of the loose soil into the voids.

B. ISSUES/COMMENTS

1. None

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

F. STATUS:

1. Approximately 612 CY of loose soil was placed and worked into the Biointrusion voids today (with the exception of 4 low areas) (34 Truck Loads @ approx 18 CY/truck). See dwg_06/08/09_Construction_02.

G. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Biointrusion Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 06/09/09)

1. Continue with Biointrusion Layer with delivered rock.
2. Continue placing the loose sand and working into voids of Biointrusion Layer in approved sections.

DAILY SUMMARY REPORT

DATE: 06/09/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:08; Partly cloudy (56 deg)
WEATHER (PM): 4:06; Partly cloudy (71 deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continued construction of Biointrusion Layer on northeast nide
- Place loose soil into Biointrusion Voids of approved area

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Former Bulk Waste Staging Area, TA III, (Biointrusion Rock Location)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Installation of Biointrusion Layer***
The installation of the Biointrusion Layer continued today. See the Daily Report dated 05/26/09 for the revised method of installation for the Biointrusion Layer. See attached dwg_06/09/09_Construction_01 for illustration of installed Biointrusion Layer.

B. ISSUES/COMMENTS:

1. Additional rock was purchased from San Pedro Rock to finish the Biointrusion Layer. Don Lopez approved the rock after a visual inspection.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Rock was shipped from San Pedro Rock and placed directly on the Existing Subgrade. Approximately 307 CY of the Biointrusion Layer was installed today 429.57 tons of rock was delivered on site.

F. PICTURES OBTAINED:

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Placement Of Loose Soil Into Biointrusion Voids***
The Northwest portion of the MWL has been approved for the placement of loose soil into the Biointrusion Voids (with the exception of 2 locations) . See the Daily Report dated 05/26/09 for the method of installation and compaction of the loose soil into the voids.

B. ISSUES/COMMENTS
1. None

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

F. STATUS:
1. Approximately 864 CY of loose soil was placed and worked into the Biointrusion voids today (48 Truck Loads @ approx 18 CY/truck). See dwg_06/08/09_Construction_02.

G. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

III.

A. TASK DESCRIPTION: ***CQA Survey of Biointrusion Thickness***
Approval of Northwest and resurveyed areas.

B. ISSUES/COMMENTS

1. EDi corrected the four points that did not pass the 1-foot minimum thickness requirement (see results attached). URS has rechecked these points and they are now approved.
2. Northwest Biointrusion Layer approved with the exception of 2 locations on North Slope.

C. EQUPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

F. STATUS:
1. See attached for QA Survey Results

G. PICTURES OBTAINED
1. Pictures of this procedure were not collected

INSPECTION CHECKLISTS REQUIRED

1. Biointrusion Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 06/10/09)

1. Continue with Biointrusion Layer with delivered rock.
2. Continue placing the loose sand and working into voids of Biointrusion Layer in approved sections.

DAILY SUMMARY REPORT

DATE: 06/10/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): Heavy Rain
WEATHER (PM): NA
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- No construction was performed today due to weather conditions.
- A meeting was held with URS, Sandia, and EDi for coordination of the Biointrusion survey and the Final Report.

LOCATION OF CONSTRUCTION

1. NA

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 AM
Attendees: See attached sign in sheet.
Issues: No construction today

DAILY TASK

I.
A. TASK DESCRIPTION: ***Meeting***
A meeting was held to discuss the continuation of construction for the Biointrusion Layer and to coordinate the Final Report.

B. ISSUES/COMMENTS:

- The Biointrusion Layer (without the soil in the voids) may be a difficult layer to use as a new datum due to irregularities in the rock. Also, the rock is being pushed flat when the soil is placed and spread with a dozer into the voids and then compacted with a vibrating, smooth drum roller. Because of rock being pushed flat under the soil, we would not know the exact elevation of the rock after the sand has been placed and compacted. A better datum may be to use the Biointrusion Layer after the voids have been filled with loose soil and compacted with the vibrating, smooth drum roller. The loose soil makes a thin soil layer above the rock, which may be a better surface to create a starting datum for the Native Soil Layer.

1. It was decided that to make the corrections for the 2.0% surface slope and 6:1 side slopes during the Native Soil Layer because of construction constraints due to the

Biointrusion rock. It will be very difficult to adjust the Biointrusion rock surface to meet the specifications. As of now, the surface slopes are approximately at an average of 1.8%. Correcting the slope with the first couple of Native Soil Lifts will give us a better idea of how much material we are going to be short on the native soil layer. It will also be a much easier material to adjust to the specification requirements.

2. Most of the Biointrusion Layer thickness was within the specified thickness. There were a couple of points on the orange corner post that were high. These points are going to be corrected for the final QA survey on Friday.

3. We are expecting information from Jerry Peace regarding the Biointrusion Rock. This information is to be incorporated into the final report. (Jerry Peace information attached)

4. Mike Mitchell reviewed the Final Report Outline provided by Marshall Nay. Mike approved the outline and requested that the outline be updated throughout the duration of the project.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Meeting complete

F. PICTURES OBTAINED:
1. NA

INSPECTION CHECKLISTS REQUIRED
None required

PROPOSED NEXT DAY ACTIVITIES (date: 06/11/09)
1. Continue with Biointrusion Layer rock construction
2. Continue placing loose sand and compacting into Biointrusion rock voids in approved areas.

DAILY SUMMARY REPORT

DATE: 06/11/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:00; Partly cloudy (56 deg)
WEATHER (PM): 4:06 PM; Partly cloudy (71 deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continued construction of Biointrusion Layer on northeast side
- Place Loose soil into Biointrusion Voids of approved area.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade.
2. Former Bulk Waste Staging Area, TA III, (Biointrusion Rock Location).

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Installation of Biointrusion Layer***
The installation of the Biointrusion Layer continued today on the northeast surface and slope. See the Daily Report dated 05/26/09 for the revised method of installation for the Biointrusion Layer. See attached dwg_06/11/09_Construction_01 for illustration of installed Biointrusion Layer.

B. ISSUES/COMMENTS:

1. Additional rock was purchased from San Pedro Rock to finish the Biointrusion Layer.
2. The final Biointrusion rock should be installed by 12:00 PM tomorrow (06/12/09). Harry Buckner (URS) will be out at that time to finish his QA survey.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Rock was shipped from San Pedro Rock and placed directly on the Existing Subgrade. Approximately 558 CY of the Biointrusion Layer was installed today 781.88 tons of rock was delivered on site.

F. PICTURES OBTAINED:

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Placement Of Loose Soil In Biointrusion Voids***

The northwest portion of the MWL has been approved for the placement of loose soil into the Biointrusion Voids. See the Daily Report dated 05/26/09 for the method of installation and compaction of the loose soil into the voids.

B. ISSUES/COMMENTS

1. None

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

F. STATUS:

1. Approximately 1044 CY of loose soil was placed and worked into the Biointrusion voids today (58 Truck Loads @ approx 18 CY/truck). See dwg_06/08/09_Construction_02.

G. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Biointrusion Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 06/12/09)

1. Continue with Biointrusion Layer with delivered rock.
2. Continue placing the loose sand and working into voids of Biointrusion Layer in approved sections.
3. Survey QA on Final section.

DAILY SUMMARY REPORT

DATE: 06/12/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:10; Partly Cloudy (57 deg)
WEATHER (PM): 3:50 PM; Partly Cloudy (76 deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Biointrusion Layer
- Field CQA Survey of Northeast side of MWL (URS)
- Place Loose soil into Biointrusion Voids of approved area

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Former Bulk Waste Staging Area, TA III, (Biointrusion Rock Location)

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:03 am
   Attendees: See attached sign in sheet.

Procedure:
- Please see general description above

Safety:
-Be sure to use proper eye protection
-New people need to be informed to drive patterns and other safety precautions.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Installation of Biointrusion Layer***

The installation of the Biointrusion Layer continued today on the northeast surface and slopes. See the Daily Report dated 05/26/09 for the revised method of installation for the Biointrusion Layer. See attached dwg_06/12/09_Construction_01 for illustration of installed Biointrusion Layer.

B. ISSUES/COMMENTS:

1. The final area to have the Biointrusion Rock Installed was completed today at 12:00 PM.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. The construction of the Biointrusion Rock Layer (not including loose sand to fill voids) was completed today. Rock was shipped from San Pedro Rock and placed directly on the Existing Subgrade. Approximately 197 CY of the Biointrusion Layer was installed today. 275.88 tons of rock was delivered on site.

F. PICTURES OBTAINED:

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***CQA Survey of Biointrusion Thickness***

Harry Buckner (URS) and Paul Molina (URS) conducted the QA survey on the Northeast portion of the MWL. The survey data collected will be converted into a usable format on Monday (06/15/09) and reviewed to determine the Biointrusion Layer thickness (see results attached). URS intends to provide EDi with approval/disapproval of the Biointrusion Layer Monday morning (06/15/09).

B. ISSUES/COMMENTS

1. The two locations that did not meet the minimum thickness requirement on the previous QA survey (See survey Data 06/08/09) were corrected.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

F. STATUS:

1. See attached for QA Survey Results

III.

A. TASK DESCRIPTION: ***Placement Of Loose Soil In Biointrusion Voids***

The northwest end of the MWL has been approved for the placement of loose soil into the Biointrusion Voids. See the Daily Report dated 05/26/09 for the method of installation and compaction of the loose soil into the voids.

B. ISSUES/COMMENTS

1. None

C. EQUPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

F. STATUS:

1. Approximately 165 CY of loose soil was placed and worked into the Biointrusion voids today (11 Truck Loads @ approx 18 CY/truck). See dwg_06/08/09_Construction_02.

G. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Biointrusion Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 06/15/09)

1. Continue placing the loose sand and working into the voids of the Biointrusion Rock layer in approved sections.

DAILY SUMMARY REPORT

DATE: 06/15/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:10; Partly cloudy (57 deg)
WEATHER (PM): 3:50; Partly cloudy (76 deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Place loose soil into Biointrusion Voids of approved area

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pits, TA-3

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

DAILY TASK

I

A. TASK DESCRIPTION: ***CQA of Biointrusion Rock Thickness***
The Biointrusion northeast and northwest corrections (2 locations) are approved. The entire Biointrusion Layer (rock) is now approved.

II

A. TASK DESCRIPTION: ***Placement Of Loose Soil In Biointrusion Voids***
The northeast surface and slopes of the MWL has been approved for the placement of loose soil into the Biointrusion Voids. See the Daily Report dated 05/26/09 for the method of installation and compaction of the loose soil into the voids. The two grid point locations on the north slope have been corrected, resurveyed, and are approved.

B. ISSUES/COMMENTS
1. None

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 522 CY of loose soil was placed and worked into the Biointrusion voids today (29 Truck Loads @ approx 18 CY/truck). See dwg_06/15/09_Construction_01.

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Biointrusion Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 06/16/09)

1. Continue placing the loose soil and working into voids of Biointrusion Layer in approved sections.
2. Meeting regarding the procedure for the Native Soil Lifts 10:00 AM.

DAILY SUMMARY REPORT

DATE: 06/16/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:00; Clear sky (58 deg)
WEATHER (PM): 3:00; Clear sky (86 deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continued placing loose soil into Biointrusion Voids and compacting with roller.
- A meeting was held with URS, Sandia, and EDi for coordination of the Biointrusion survey and construction of the Native Soil Layer.
- Began placement of 6:1 slope around MWL where required for lifts #1 and #2.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Borrow Pits

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 AM
Attendees: See attached sign in sheet.
Issues: None

DAILY TASK

I.

A. TASK DESCRIPTION: ***Placement Of Loose Soil In Biointrusion Voids***
The Northeast surface and slopes of the MWL has been approved for the placement of loose soil into the Biointrusion Voids. See the Daily Report dated 05/26/09 for the method of installation and compaction of the loose soil into the voids.

B. ISSUES/COMMENTS
1. None

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

F. STATUS:

1. Approximately 108 CY of loose soil was placed and worked into the Biointrusion voids today (34 Truck Loads @ approx 18 CY/truck). See dwg_06/16/09_Construction_01.

2. Biointrusion Layer Completed and surveyed by EDi.

G. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Meeting***

A meeting was held to discuss the new datum on the Biointrusion Layer and the construction of the Native Soil Layer.

B. ISSUES/COMMENTS:

1. Vladimir Jirik (Subcontractor Survey for EDi) attended today's meeting to discuss potential solutions for construction of the Native Soil Layer. There is currently an approximate 3-inch or less (nominal) compacted soil layer from the loose soil that was worked into the Biointrusion Rock voids. The thin soil layer creates a better surface to build the Native Soil Layer on due to the irregularities of the Biointrusion Rock. Vladimir Jirik is going to verify the nominal 3-inch thickness via survey CADD software. This thin soil layer will be the new construction datum. Vladimir has also been asked to create a topographic survey of the current existing surface (thin soil layer). This topographic survey will be based on the same 50-foot grid previously used on the Existing Subgrade and Biointrusion Rock Layer. The topographic survey will show the current elevations as well as the slope across the MWL surface. There will also be section cuts to show the difference in the current existing slope and a projected 2.0% slope to meet the contract specifications. Based off of this data, an approach will be determined to continue the construction of the Native Soil Layer.

2. Vladimir Jirik made a suggestion to bring the Native Soil up as a flat surface rather than correct the 2.0% slope on the final lift. This has already been discussed and is not the preferred method due to foreseeing soil shortages. It is also believed it is better to start correcting for the 2.0% slope as soon as possible due to some deviations in elevation existing in the Subgrade, which have continued through the Biointrusion Layer. Vladimir also suggested reverting back to the contract design for the remainder of the project. This is not ideal to use because the contract design does not fit exactly with what the existing conditions are. A final decision will be made based off of the survey data expected tomorrow.

3. The actual size of the MWL is greater then the 2.6-acre originally anticipated. The larger cover footprint due to the thicker Biointrusion Layer and resulting side slopes is anticipated to result in a shortage of screened soil fill. The actual size of the MWL as of now is about 3.05 acres Additional soil can be extracted from the

Borrow Area, however, the exact amount is not known. Additional testing may need to be conducted in the Borrow Area to determine the depth of the Calichie layer.

4. Marshall Nay did an average on the thickness of the Biointrusion Rock Layer. The nominal thickness is approximately 1.29-feet, which is very close to the 1.25-foot maximum specified in the CMIP.

5. As of now, URS is not going to do a QA survey on the MWL until the 2-1/2-foot Native Soil Layer is complete. URS will do QA density/moisture test every 6-inch lift as specified in the CMIP.

6. It appears that we are not going to be able to correct the slope to 2.0% on the first lift of Native Soil due to the thickness requirements in the CMIP (8-inch loose, 6-inch compacted). The 2.0% slope will probably need to be made up incrementally with multiple lifts. To be discussed more when additional survey information is received tomorrow (06/17/09).

7. Specification section 02200 requires a hydraulic conductivity testing on each Native Soil Layer lift (8-inch loose, 6-inch compacted). No ASTM Standard was specifically called out in the Specifications and there are a couple of test to choose from:
    a. The first test, ASTM D-5084, is a flexible wall hydraulic conductivity test. This test requires an "undisturbed" compacted sample to be taken in the field. The sample is then taken back to the lab to determine the hydraulic properties.
    b. The second test, ASTM-5856, is a rigid wall hydraulic conductivity test. This test requires a sample to be taken from the field and returned to the lab. The sample is then compacted and tested at the lab. This test will take 3-5 days and is the most appropriate method based upon the CMIP and a team evaluation of the K-Sat testing logistics and alternatives.

8. During the pre-bid there was discussion concerning the potential for delay in schedule due to the hydraulic conductivity testing. The bidding contractors concern was they could control the moisture content and the density in the soil, however, because they are required to use the soil pre-determined by Sandia, they would not have control over the outcome of the hydraulic conductivity test. As a solution, Sandia agreed to not delay the project due to hydraulic conductivity testing.

9. EDi will begin adjusting the slopes of the MWL to 6:1 as specified on the north, east, and west slopes during the Native Soil Layer. The lifts will be placed in 8-inch loose, 6-inch compacted lifts as specified. Density/Moisture testing will be conducted after the completion of two 6-inch lifts. The Density/Moisture tests will be performed by driving the stake down and testing at 6-inches. The stake will then be driven an additional 6-inches (12-inch total) to test the first 6-inch

Native Soil Lift. A random location will be chosen on each side to be tested (3 locations; 6 test) per 12-inch lift. URS will perform random QA Density/Moisture tests to verify the results obtained by EDi. This procedure of adding the 6:1 slope is significantly adding to the size of the MWL.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Meeting to be continued tomorrow when additional survey information is obtained.

F. PICTURES OBTAINED:
1. NA

III.

A. TASK DESCRIPTION: ***Begin Construction of 6:1 Slope around MWL Perimeter***
Construction of the 6:1 Slope on the North, East, and West slopes began today (Lifts #1 and #2).

B. ISSUES/COMMENTS
1. The slope will be constructed in 12-inch compacted increments because it is not part of the actual cover. Testing will be performed every 12-inches both at a depth of 12-inches and 6-inches.

2. The east and west slope will require about 6 lifts to reach the 6:1 slope requirement. The north slope will require 8 lifts to reach the 6:1 slope.

3. The actual size of the footprint will be between 3.0-to-4.0-acres in size in lieu of 2.6-acres as specified in the CMIP. A final survey will be conducted around the perimeter toe of the MWL to determine the actual size once complete.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 504 CY of loose soil was placed and compacted for the 6:1 side slope lifts #1 and #2. See dwg_06/16/09_Construction_02.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Biointrusion Layer Inspection Form
2. Native Soil Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 06/17/09)

1. A meeting will be conducted on how to proceed with the construction of the Native Soil Layer based on the survey data.
2. Continue placing the 6:1 slope around MWL where required.
3. Density Testing on 6:1 slope as required.

DAILY SUMMARY REPORT

DATE: 06/17/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:00; Clear Sky (58 deg)
WEATHER (PM): 3:00; Clear Sky (86 deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- The slope continued to be adjusted to a 6:1 slope around MWL where required
- Density/Moisture testing on 6:1 Slope Lift #1, #2, #3 and #4 (EDi).
- Meeting Regarding Native Soil construction

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Borrow Pits

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Meeting***
A meeting was held to discuss the beginning the Native Soil Layer construction.

B. ISSUES/COMMENTS:

- A meeting was held with Sandia, EDi, and URS to discuss the construction of the Native Soil Layer. The topographic survey depicting the current existing conditions was provided by Vladimir Jirik (EDi surveyor). The Topographic map shows existing elevations, the thickness of the thin soil layer covering the Biointrusion Layer, section cuts of existing slopes, and the projected 2.0% slope.

1. After reviewing the topographic survey, it was determined the thin soil layer filling the Biointrusion voids was a nominal 3.0" thickness. It was determined that this was an acceptable thickness. The thin soil layer is now approved.

2. After reviewing the survey, it was determined imperfections in the Biointrusion Layer that had been inherited by the low areas in the Existing Subgrade Layer were still present. Grid Blocks #7, #8, and #11 have low areas that require additional Native Soil material in order to achieve the 2.0% slope required across the MWL from east to west. Because of the maximum 8-inch loose, 6-inch compacted soil constraint in the CMIP, the difference in thickness will need to be constructed in two individual "wedge lifts". Each of the wedge lifts thickness will be within the specified requirements and will receive Moisture/Density testing as required. Once the slope is corrected using the wedge lifts, the additional lifts

(Lifts 3 through 8) will be placed in uniform 6-inch compacted lifts across the entire surface to achieve the 30.0-inch minimum requirement.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Meeting completed

F. PICTURES OBTAINED:
1. NA

II.

A. TASK DESCRIPTION: ***Continue Construction and Testing of 6:1***

Construction of the 6:1 Slope on the North, East, and West slopes continued today. Lifts #1 and #2 were continued and completed today. Lifts #3 and #4 began and were completed today. Density/Moisture tests were conducted for Slope Lifts #1, #2, #3 and #4.

B. ISSUES/COMMENTS
1. None

C. EQUPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 792 CY of loose soil was placed and compacted for the 6:1 side slope lifts #1, #2, #3, and #4. See dwg_06/17/09_Construction_01.

2. Density/Moisture testing was conducted by EDi for Slope Lifts # 1, #2, #3 and #4. All test results were in accordance with the Specifications.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

Native Soil Inspection Sheet
Density/Moisture Tests Sheet

PROPOSED NEXT DAY ACTIVITIES (date: 06/18/09)
1. Continue construction and testing of 6:1 slope surrounding the MWL.

DAILY SUMMARY REPORT

DATE: 06/18/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 10:09; Clear Sky (76 deg)
WEATHER (PM): 2:00; Clear Sky (deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- The slope continued to be adjusted to a 6:1 slope around MWL where required.
- Density/Moisture testing on 6:1 slopes; slope lifts #5, and #6 Side (EDi).
- Begin Construction of Lift #7 and #8 on North Slope only.
- Grade stakes were placed for the construction of the Native Soil "wedge lifts".

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pits, TA-III

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 AM
Attendees: See attached sign in sheet.
Issues: None

DAILY TASK

I.

A. TASK DESCRIPTION: ***Continue Construction and Testing of 6:1***
Construction of the 6:1 Slope on the North, East, and West slopes continued today. Lifts #5 and #6 were continued and completed today. Lifts #7 and #8 began today. Density/Moisture tests were conducted for Slope Lifts #5 and #6.

B. ISSUES/COMMENTS
1. Slope lifts #7 and #8 will only occur on the North face of the MWL. The East and west slopes were brought to a 6:1 slope in six lifts.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 1170 CY of loose soil was placed and compacted for the 6:1 side slope lifts #5 and #6. See dwg_06/17/09_Construction_01.

2. Density/Moisture testing was conducted by EDi for Slope Lifts # 5 and #6. All test results were in accordance with the Specifications.

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Native Soil Inspection Sheet

1. Moisture/Density Test Sheet

PROPOSED NEXT DAY ACTIVITIES (date: 06/19/09)

1. Continue the construction and testing of the 6:1 slope on the north face of the MWL.

2. Construct Native Soil Wedge Lifts #1 and #2.

DAILY SUMMARY REPORT

DATE: 06/19/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 10:00; Clear sky (77deg)
WEATHER (PM): 2:10; Clear sky (deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Complete and test 6:1 slope on north side of MWL
- Finish construction of 1st Native Soil lift, Wedge Lift #1
- Construct 2nd Native Soil lift, Wedge Lift #1
- Density/Moisture tests on 1st and 2nd Wedge Lifts
- QA Density/Moisture tests on north, east, and west 6:1 slopes (URS)
- QA Density/Moisture tests on north 6:1 slope (EDi)

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Borrow Pits

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Construction and Testing of 1st Native Soil Lift, Wedge Lift #1***
EDi completed the construction on Wedge Lift #1 (Native Soil Lift 1). Density/Moisture testing by EDi occurred in grid blocks #7, #8, and #11. Density/Moisture testing by URS occurred in grid blocks #8 and #11.

B. ISSUES/COMMENTS:
1. None

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Density/Moisture tests conducted for EDi and URS were in compliance with specifications (See Appendix C-06/19/09)

F. PICTURES OBTAINED:
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Construction and Testing of 2nd Native Soil Lift, Wedge Lift #2***

EDi began and completed the construction of Wedge Lift #2 (Native Soil Lift #2). Density/Moisture testing by EDi occurred on grid blocks, #8, and #11. Density/Moisture testing by URS occurred in grid block #11.

B. ISSUES/COMMENTS

1. None

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Density/Moisture test conducted for EDi and URS were in compliance with specifications (See Appendix C-06/19/09)

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

III.

A. TASK DESCRIPTION: ***QA Density/Moisture Tests on 6:1 Side Slopes***

The construction of the final lifts on the north slope of the MWL (lift #7 and #8) were completed and tested today. QA testing was also conducted on the final lifts (lift #5 and #6) on the east and west slopes of the MWL.

B. ISSUES/COMMENTS

1. The results of the QA (URS) Moisture/Density test conducted on the 6-inch 6:1 North slope (lift 8) appears erroneous. The results were not consistent with tests performed prior or with results obtained by EDi in the same location (See Appendix C-URS-6/19/09).

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Density/Moisture Tests on east and west slopes are in accordance with the Specifications for both EDi and URS.

2. Density/Moisture Tests on the north slope appear to have a gross error for URS. The results obtained do not appear reasonable based on the results obtained by EDi and prior tests conducted by URS on similar soil material. URS will retest the north slope on 06/22/09.

INSPECTION CHECKLISTS REQUIRED

1. Native Soil Inspection Sheet
2. Density/Moisture Test Sheet

PROPOSED NEXT DAY ACTIVITIES (date: 06/22/09)

1. Retest density and moisture content on north Slope of MWL

DAILY SUMMARY REPORT

DATE: 06/22/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:38; (72 deg); Partly Cloudy
WEATHER (PM): NA
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Soil from the berm surrounding the MWL was taken to the borrow area to be screened and mixed with the Native Soil.
- A meeting was conducted to review the MWL now that the Wedge Lifts (#1 and #2) have been completed.
- 6-inch Density/Moisture CQA (URS) retesting of the 6:1 north slope, Lift 8.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pits, TA-3

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:00 am
   Attendees: See attached sign in sheet.

Procedure:

- Remove soil berm surrounding the MWL and take to borrow area to be screened and mixed with Native Soil.

DAILY TASK

I.

A. TASK DESCRIPTION: ***CQA (URS) Retesting of 6:1 North Slope***

The results from the density test conducted on the 6-inch 6:1 north slope (Lift #8) on 6/19/09 appear erroneous. The results were not consistent with tests performed prior on the moisture and density results (See Appendix C-URS-6/19/09). Paul Molina (URS) decided to redo the QA 6-inch Density/Moisture test on the 6:1 north Slope.

B. ISSUES/COMMENTS:

1. Robert Carr arrived onsite at 10:00 am. Robert was instructed by Paul Molina (URS) to perform three 6-inch tests across the 6:1 north slope (See attached for tests locations). One test was taken per grid block (#5, #10, and #13) across the north slope to confirm the moisture and density. One of the tests conducted was in the same area of the erroneous test performed on 6/19/09. The three tests met

the Specifications, which confirmed our suspicion that the test performed on 6/19/09 was a faulty reading.

2. Chris Williams (Sandia) allowed Robert Carr to come onsite without checking Roberts Troxler machine. Chris was in a meeting, which did not allow him to come to the MWL. Chris checked Robert's testing equipment last on 06/19/09.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. The North 6:1 slope is in compliance with the Specification requirements.

F. PICTURES OBTAINED:
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Meeting (URS, EDi, Sandia)***

Chris Edgman (EDi) received an updated topographic map with section cuts of the MWL, which includes the installation of the two wedge lifts (See Appendix A). The maps and section cuts were reviewed to discuss how construction of the Native Soil Layer should continue.

B. ISSUES/COMMENTS
1. Chris Edgman wanted to know if URS wanted EDi to perform their Density/Moisture tests in the exact same location for each lift. Marshall Nay and Paul Molina (URS) decided it was best not to have the Density/Moisture tests performed in the same location, but to have them randomly selected within the 13 grids previously established (one test per grid).

2. Discussion on identifying which proctor is to be used for different locations on the MWL occurred. There is currently a range of proctor maximum densities and optimum moisture content from 112.2-to-119.1 pcf and 10.3-to-14.4% respectively. Marshall Nay (URS) calculated the average of all of the current proctors. Marshall received an average maximum density and optimum moisture content of 116.0 pcf and 12.3% respectively. Jon Schermerhorn (AMEC) conducted field proctors as the two wedge lifts were being placed and received a maximum density and optimum moisture content of 115.7 pcf and 12.6 respectively. Both Marshall and Jon acquired similar results, which supported the Density/Moisture tests results.

3. After reviewing the new topographic map it was determined there are still slopes that do not meet the 2.0% requirement. The Native Soil Layer was brought up into

the specified tolerance range, however, after reviewing the section cuts there are still some areas that are below the 2.0% grade line that will need correction. EDi proposed correcting these low areas during the third lift of Native Soil. The third lift will fill the low areas with approx 3-to-6-inches of soil while placing only a thin layer of soil, if any, on the areas with higher elevations. This will create a flat surface at approximately 2.0% across the entire MWL. Because soil will only be placed in the low areas, it is not sufficient to perform Density/Moisture tests on all 13 grids. Only the areas that receive enough soil (approximately 4-inch minimum) will be tested. The areas that do not receive enough soil to test during the third lift will be tested during the fourth lift.

4. After the third lift is tested and approved, the fourth lift will begin. The fourth lift will also be a thin lift (less then 6-inches) to prevent the areas that received a small amount of soil in the third lift, but not enough soil to test, from exceeding the 6-inch maximum thickness specification constraint. The fourth lift will also be used to "fine-tune" the 2.0% slope. After the fourth lift, the Native Soil remaining lifts (5 through 8) will be constructed and tested in consistent 6-inch lifts at the 2.0% slope. EDi will provide Marshall Nay with a copy of the Topographic Survey Data after the fourth lift (See Appendix A).

C. EQUIPMENT USED (See Appendix B For Equipment Description):
   1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
   1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
   1. Meeting concluded

F. PICTURES OBTAINED
   1. NA

INSPECTION CHECKLISTS REQUIRED
   1. Density/Moisture Test Sheet

PROPOSED NEXT DAY ACTIVITIES (date: 06/23/09)
   1. Begin third lift of Native Soil Layer
   2. Test third lift of Native Soil Layer

DAILY SUMMARY REPORT

DATE: 06/23/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:38, (72 deg); Partly Cloudy
WEATHER (PM): 1:21; (72 deg); Cloudy, 10 mi. lightning warning @ 1:15 pm
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Placement of the Native Soil Lift #3. Density/Moisture testing were conducted for the Native Soil, lift 3.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Borrow Pits

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 AM
Attendees: See attached sign in sheet.
Procedure:
- Place Native Soil Lift #3 onto the MWL.
-Test Native Soil Lift #3
Safety:
-Keep interior of trucks clean to prevent slip/falls

DAILY TASK

I.
A. TASK DESCRIPTION: ***Native Soil, 3rd Lift***
The 3rd lift of the Native Soil Layer began today.

B. ISSUES/COMMENTS:
1. After reviewing the new topographic map it was determined there are still slopes that do not meet the 2.0% requirement. EDi proposed correcting these low areas during the third lift of Native Soil. The third lift will fill the low areas with approx 3-to-6-inches of soil while placing only a thin layer of soil, if any, on the areas with higher elevations. This will create a flat surface at approximately 2.0% across the entire MWL.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary
D. EQUIPMENT CALIBRATION CERTIFICATES

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 1206 CY of Native Soil was placed and compacted on the west side of the MWL in grid blocks #1, #2, #3, and #4. See dwg_06/23/09_Construction_01.

F. PICTURES OBTAINED:

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Density/Moisture Testing, 3rd Lift***

Moisture/Density test on the Native Soil 3rd lift.

B. ISSUES/COMMENTS

1. Because soil will only be placed in the low areas, it is not sufficient to perform density/moisture tests on all 13 grids on the 3rd lift. Only the areas that receive enough soil (approximately 4-inch) will be tested (See Appendix C-6/23/09). The areas that do not receive enough soil to test during the third lift will be tested during the fourth lift. Caution will be taken not to exceed the 6-inch thickness specification constraint during the 4th lift on areas not tested during the 3rd lift.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. One QA Density/Moisture test was performed in grid block #2. EDi performed Density/Moisture test in grid blocks #1 and #2 (See Appendix C).

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Native Soil Inspection Sheet
2. Moisture/Density Test Sheet

PROPOSED NEXT DAY ACTIVITIES (date: 6/24/09)

1. Finish constructing and testing Native Soil Lift #3.
2. Begin construction of Native Soil Lift #4.

DAILY SUMMARY REPORT

DATE: 06/24/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 9:21; (72 deg); Partly Cloudy
WEATHER (PM): 3:30; (87 deg); Partly Cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Completion of Native Soil lift #3. Density/Moisture testing were conducted for the Native Soil, Lift #3.
- Begin Native Soil Lift #4
- Meeting

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Borrow Pits

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 AM
Attendees: See attached sign in sheet.
Procedure:
- Place and test Native Soil Lift #3 onto the MWL.
-Begin Native Soil Lift #4.
Safety:
-Speed limits around Tech Area III have been reduced to 30 MPH.
- Review of water truck safety.

DAILY TASK

I.
A. TASK DESCRIPTION: ***Native Soil, 3rd Lift***
Continue construction and testing of the Native Soil Layer 3rd lift.

ISSUES/COMMENTS:

1. After reviewing the new topographic map it was determined there are still slopes that do not meet the 2.0% requirement. EDi proposed correcting these low areas during the third lift of Native Soil. The third lift will fill the low areas with approx 3-to-6-inches of soil while placing only a thin layer of soil, if any, on the areas with higher elevations. This will create a flat surface at approximately 2.0% across the entire MWL.

2. URS tested grid block #8. EDi tested grid blocks # 6, and #8.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 500 CY of Native Soil was placed and compacted on the East side of the MWL. See dwg_06/24/09_Construction_01.

F. PICTURES OBTAINED:
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Native Soil, 4th Lift***

Begin construction of the Native Soil Layer 4th lift. Construction from west to east.

ISSUES/COMMENTS:
1. The areas that did not receive enough soil to test during the 3rd lift. These areas will be tested during the 4th lift. Caution will be taken not to exceed the 6-inch thickness specification constraint during the 4th lift on areas not tested during the 3rd lift. The locations of the tested areas will be surveyed. The 4th lift was not tested for density and moisture today.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 616 CY of Native Soil was placed and compacted on the west side of the MW. See dwg_06/24/09_Construction_01. The soil was only placed; it will need to be compacted tomorrow.

F. PICTURES OBTAINED:
1. Pictures of this procedure were collected and filed.

III.

A. TASK DESCRIPTION: ***Meeting (9:00 am) Sandia, EDi, URS***

See Issues/Comments for meeting description.

B. ISSUES/COMMENTS:

1. Edgewood Aggregate may not be able to provide enough crushed gravel to meet the current schedule. Edgewood Aggregate is providing the 3/8" crushed gravel previously approved for the Topsoil Layer. EDi is resubmitting the Crushed Gravel from Fisher as an alternative to the crushed gravel previously approved by Edgewood Aggregate (See Appendix G, Submittals #1 and #8). EDi may use crushed gravel from both Edgewood aggregate and Fisher. A new sample of the Fisher aggregate was provided today and appears very similar to the previously approved Edgewood aggregate.

2. Approximately 2000 tons of 3/8" crushed gravel was estimated. Due to the MWL being greater than 2.6-acres specified in the CMIP, additional 3/8" crushed gravel will be needed.

3. Due to the MWL being greater than 2.6-acres specified in the CMIP, additional soil will need to be excavated out of the borrow area. The decision was made not to do any borings in the borrow area to determine the depth of the caliche layer because the caliche layer can be mixed to meet the specification requirements. We will only want to use the caliche soil mix in the Native Soil Layer because of the high level of alkalines found in caliche. Alkalines are not ideal for the Topsoil Layer because they will hinder the growth of surface vegetation.

4. It was determined the 6:1 slope on the west face of the MWL is going to cover the bottom portion of the west Monitoring Wells. Additional discussion will occur on how to prevent the Monitoring Wells from being covered after we determine what the Monitoring Well Inspection requirements are.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
Meeting concluded

F. PICTURES OBTAINED:
1. Native Soil Inspection Sheet
2. Moisture/Density Tests Sheet

INSPECTION CHECKLISTS REQUIRED

PROPOSED NEXT DAY ACTIVITIES (date: 6/25/09)
1. Continue constructing and testing Native Soil Lift 4.

DAILY SUMMARY REPORT

DATE: 06/25/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:33; (71 deg); Partly cloudy
WEATHER (PM): 12:45; (82 deg); Cloudy, lightning warnings.
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue the construction of Native Soil Layer lift 4

LOCATION OF CONSTRUCTION:

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:03
Attendees: See attached sign in sheet.
Procedure:
- Will do SWPPP requirements due to ½-inch of rain received yesterday
- EDi and URS will conduct testing on the 4th Native Soil Lift

Safety:
- Equipment operators need to use stairs to exit equipment to prevent injury.
- Be sure to have proper MSDS for hazardous materials.

2. Description: Afternoon Safety Briefing
Time:
Attendees: See attached sign in sheet.
Issues:

DAILY TASK

I.
A. TASK DESCRIPTION: ***Native Soil Layer, 4th Lift***
Continue the construction of the Native Soil Layer, Lift #4. Construction will occur from west to east.

B. ISSUES/COMMENTS:
1. Native Soil Layer, Lift #4 was not completed today because of weather delays.

2. Native Soil Lift #4 cannot be placed in grid block 11 until Native Soil Lift #3 is tested in grid block 11.

3. No Density/Moisture testing occurred today.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 1170 CY of Native Soil was placed and compacted for Lift #4. See dwg_06/25/09_Construction_01.

F. PICTURES OBTAINED:
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***3/8-Inch Topsoil Crushed Gravel***

Edgewood Aggregate may not be able to provide enough crushed gravel to meet the current schedule. Edgewood Aggregate is providing the 3/8-inch crushed gravel previously approved for the Topsoil Layer. EDi is resubmitting the Crushed Gravel from Fisher as an alternative to the crushed gravel previously approved by Edgewood Aggregate (See Appendix G, Submittals #1 and #8). EDi is proposing to use crushed gravel from both Edgewood aggregate and Fisher. A new sample of the Fisher aggregate was provided yesterday and contains similar physical properties as the previously approved Edgewood aggregate.

B. ISSUES/COMMENTS:
1. EDi plans to mix the 3/8-inch crushed gravel available by Edgewood Aggregate with the 3/8-inch crushed gravel from Fisher.
2. Approximately 2,300-tons of crushed gravel will be needed.
3. No available aggregate met specifications for % passing through the #4 sieve. An aggregate was selected and approved using engineering judgment. Marshall Nay (URS) has approved the Fisher 3/8-inch crushed gravel today in lieu of Don Lopez.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Marshall Nay (URS) has approved the Fisher 3/8-inch crushed gravel today.

F. PICTURES OBTAINED

1. NA

INSPECTION CHECKLISTS REQUIRED

1. Native Soil Inspection Sheet

PROPOSED NEXT DAY ACTIVITIES (date: 06/26/09)

1. Test Grid Block 11, Native Soil Lift #3.
2. Test Grid Blocks 1-10, Native Soil Lift #4
3. Complete Native Soil Lift #4

DAILY SUMMARY REPORT

DATE: 06/26/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:41; (67 deg); Clear Sky
WEATHER (PM): 3:00; (78 deg); Cloudy, 10 Mile Lightning Warning
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue the construction of Native Soil Lift #4
- Density/Moisture tests, Native Soil Lift #3, Grid Block 11
- Density/Moisture tests, Native Soil Lift #4, Grid Blocks 1-10
- NMED tour of MWL at 2:00 pm
- Begin EDi survey of Native Soil Lift #3 and #4.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00-7:20 AM
Attendees: See attached sign in sheet.
Procedure:
-NMED tour will be conducted at 2:00pm today
-Density/Moisture tests will be conducted today
-EDi plans to start shipping the 3/8-inch crushed gravel to borrow pit next week
Safety:
-Be sure to wear proper eye protection.

DAILY TASK

I.
A. TASK DESCRIPTION: ***Native Soil Lift #4 and Testing of Native Soil Lift #3***
Native Soil Layer, Lift #4 was continued today. Native Soil Layer, Lift #4 was not completed due to a lightning. Construction continued from east to west.

B. ISSUES/COMMENTS:

1. Density/Moisture testing was conducted for Native Soil Layer, Lift #3 in Grid Block 11 prior to installing Native Soil Lift #4 in Grid Block 11.

2. URS conducted Density/Moisture testing for Lift #3 in Grid Block 11.

3. Density/Moisture testing was conducted for Native Soil Layer, Lift #4 in Grid Blocks 1-10 by EDi. The final testing of the 4th Native Soil Lift will be performed on 06/29/09. URS conducted testing in Grid Blocks 1, 3, 5, 9, and 7.

4. EDi began survey of Native Soil Lifts #3 and #4 today. Survey will continue 6/29/09.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 432 CY of Native Soil was placed and compacted for Lift #4. See dwg_06/26/09_Construction_01. Moisture/Density Tests will be conducted on 06/29/09. Survey data collected today will also be reviewed on 06/30/09.

F. PICTURES OBTAINED:
1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED
1. Native Soil Inspection Sheet
2. Density/Moisture Sheet

ADDITIONAL NOTES:
1. Mike Mitchell provided URS with a copy of the Topsoil Layer compaction data for the Chem. Waste Landfill. The information discusses the difference in compaction of the Topsoil Layer using a dozer and loader (See attached). This information may be used to resolve compaction issues on the Mixed Waste Landfill Topsoil Layer.

PROPOSED NEXT DAY ACTIVITIES (date: 06/29/04)
1. Perform survey of Native Soil Lifts #3 and #4.
2. Final Construction of Native Soil, Lift #4.
3. Final Moisture/Density Tests on Native Soil, Lift #4.

DAILY SUMMARY REPORT

DATE: 06/29/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:34; (61 deg), Clear Sky
WEATHER (PM): NA
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Complete the construction, testing and survey of Native Soil, Lift #4
- Begin shipment of 3/8-inch crushed gravel
- Hand compaction of Native Soil, Lift #4 around Monitoring Well, M-4
- EDi survey of Native Soil Lifts #3 and #4 continued today.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:03 AM
   Attendees: See attached sign in sheet.

Procedure:

-Complete construction, survey, and testing of NS Lift #4.
-Begin shipment of 3/8-inch crushed gravel for topsoil.

Safety:

-Be sure to use proper eye protection.
-New people need to be informed to drive patterns and other safety precautions.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Native Soil, Lift #4***

The construction, testing and survey of Native Soil Lift #4 continued today.

B. ISSUES/COMMENTS:

1. EDi conducted a survey of the MWL after Native Soil Lift #4 was completed. The survey data will be converted into a topographic map to be reviewed prior to starting Native Soil Lift #5.

2. Density/Moisture testing was conducted on the remaining grid blocks for the Native Soil Lift, #4. URS provided QA testing on Grid Blocks #11 and #13. EDi conducted testing on Grid Blocks # 11, #12, and #13.

3. Native Soil, Lift #4 was compacted around the Monitoring Well (M-4) using hand compaction methods as specified.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. The construction, testing, and survey of Native Soil Lift #4 were completed today. A topographic map of the survey will be Constructed and verified before Native Soil Lift #5 may begin.

2. Hand compaction around the Monitoring Well (M-4) was completed today.

F. PICTURES OBTAINED:
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***3/8-Inch Crushed Gravel Shipment***

The 3/8-inch crushed gravel for topsoil shipment began today.

B. ISSUES/COMMENTS
1. 3/8-inch crushed gravel is being stored at the Borrow Pit.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. 18 loads (Approximately 450-tons) of 3/8-inch crushed gravel was shipped and stored at the Sandia Borrow Pit.

F. PICTURES OBTAINED
1. No pictures of this procedure were collected today.

INSPECTION CHECKLISTS REQUIRED
1. Density/Moisture Tests Sheet

PROPOSED NEXT DAY ACTIVITIES (date: 06/30/09)
1. Review topographic map of Native Soil Lift #4.
2. Begin Construction of Native Soil Lift #5 if topographic survey is approved.

3. Continue shipment of 3/8-inch crushed gravel for Topsoil Layer.

DAILY SUMMARY REPORT

DATE: 06/30/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 10:24 (75 deg); Partly cloudy
WEATHER (PM): 3:00 (86 deg); 10 Mile lightning warning
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Review topographic map of Native Soil Lift #4 for approval
- Minor corrections to Native Soil Lift #4
- Begin construction of Native Soil Lift #5
- Continue shipment of 3/8-inch crushed gravel for the Topsoil Layer.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:02 – 7:20 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)
Safety:
-The Site Safety Plan is being edited to allow the site safety officer to allow the continuation of work even if clearance has not been given by Sandia Officials.

DAILY TASK

I.
A. TASK DESCRIPTION: ***Topographic Map For Native Soil Lift #4***
The topographic map of Native Soil Lift #4 was reviewed to ensure the lift was in compliance with the CMIP.

B. ISSUES/COMMENTS:

1. The topographic survey is very close to the anticipated slopes and thickness required in the CMIP.

2. Section Cut #6 of the topographic survey has approximately 1.0-inch of soil over the ideal 2.0% slope line. This section has been tested and has met all Moisture/Density requirements. This section will be placed in a 5.0-inch lift for

Native Soil Lift #5 to comply with the 6.0-inch maximum of compacted soil constraint.

3. Section Cut #7 of the topographic survey has a small area that is approximately 1.0-to-2.0-inch below the ideal 2.0% slope line. This area will be reworked, recompacted, and resurveyed before Native Soil Lift #5 will begin. The topographic survey will be updated accordingly.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Section Cut #7 has been reworked, recompacted, and resurveyed. Native Soil Lift #4 has been approved. Native Soil Lift #5 may now begin.

F. PICTURES OBTAINED:
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Native Soil, Lift #5***

Begin construction of Native Soil Lift #5. Construction will proceed from east to west.

B. ISSUES/COMMENTS
1. No Density/Moisture testing was conducted today

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 756 CY of Native Soil was placed and compacted for Lift #5. See dwg_06/30/09_Construction_01. Moisture/Density Tests will be conducted on 07/01/09.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

III.

A. TASK DESCRIPTION: ***3/8-Inch Crushed Gravel Shipment***

The 3/8-inch crushed gravel for topsoil shipment continued today.

B. ISSUES/COMMENTS

1. 3/8-inch crushed gravel is being stored at the Borrow Pit.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
   2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
   1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
   1. 25 loads (Approximately 625-tons) of 3/8-inch crushed gravel was shipped and stored at the Sandia Borrow Pit.

F. PICTURES OBTAINED
   1. No pictures of this procedure were collected today.

INSPECTION CHECKLISTS REQUIRED

PROPOSED NEXT DAY ACTIVITIES (date: 07/01/09)
1. Continue the construction of Native Soil Lift #5
2. Density/Moisture tests on completed portions of Native Soil Lift #5
3. Continue shipping the 3/8-inch crushed gravel to the Sandia Borrow Pit.

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DAILY SUMMARY REPORT

DATE: 07/01/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:15; (67 deg); Partly cloudy
WEATHER (PM): 2:33; (88 deg); Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Native Soil Lift #5.
- Density/Moisture tests of Native Soil Lift # 5 in completed areas.
- Continue shipment of 3/8-inch crushed gravel for the Topsoil Layer.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:02 – 7:20 AM
   Attendees: See attached sign in sheet.

Procedure:
-(See general description above)

Safety:
- Be aware of traffic on turns that are not 90 deg.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Native Soil, Lift #5***

Continue construction of Native Soil Lift #5. Construction will continue from east to west. Density/Moisture testing on Native Soil Lift #5 will begin today.

B. ISSUES/COMMENTS

1. Density/Moisture testing was conducted today. URS tested grid block 12. EDi tested grid blocks 11, 12, and 13.

2. A location on the corner of Grid Bock 7 (See Attached) was found which requires a fill of 0.90-feet to achieve the proper elevation. 0.45-feet of Native Soil was placed yesterday (06/30/09) at this location. This location will receive Density/Moisture testing today. An additional 0.45-feet of Native Soil will then be placed to achieve the 0.90-feet required. The second lift of 0.45-feet will be tested with the remainder of Native Soil Lift #5 as required in the CMIP.

3. The first 0.45-feet layer placed yesterday was tested for moisture/density, but failed. The area was reworked, recompacted, and retested. The moisture/density test was then successful. The second 0.45-feet layer was then placed (to account for the 0.9-feet thickness). EDi performed a moisture/density test in this location which also passed.

4. The grader had a small leak which caused a small delay in the construction of Native Soil Lift #5.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 792 CY of Native Soil was placed and compacted for Lift #5. See dwg_07/01/09_Construction_01. Moisture/Density tests were conducted today for Native Soil Lift #5.

2. The 0.9-feet low area was corrected and tested in two 0.45-feet lifts in compliance with the CMIP.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***3/8-Inch Crushed Gravel Shipment***

The 3/8-inch crushed gravel for topsoil shipment continued today.

B. ISSUES/COMMENTS
1. 3/8-inch crushed gravel is being stored at the Borrow Pit.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. 25 loads (628-tons) of 3/8-inch crushed gravel was shipped and stored at the Sandia Borrow Pit.

F. PICTURES OBTAINED
1. No pictures of this procedure were collected today.

INSPECTION CHECKLISTS REQUIRED

1. Native Soil Inspection Forms

PROPOSED NEXT DAY ACTIVITIES (date: 07/02/09)

1. Continue the construction of Native Soil Lift #5
2. Density/Moisture tests on completed portions of Native Soil Lift #5

DAILY SUMMARY REPORT

DATE: 07/02/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 9:38; (74 deg); Partly cloudy
WEATHER (PM): NA
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Native Soil Lift #5.
- Density/Moisture tests of Native Soil Lift # 5 in completed areas.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:02 – 7:20 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)
Safety:
- Be aware of traffic on turns that are not 90 deg.

DAILY TASK

I.
A. TASK DESCRIPTION: ***Native Soil, Lift #5***
Continue construction of Native Soil Lift #5. Construction will continue from east to west. Density/Moisture testing on Native Soil Lift #5 will continue today.

B. ISSUES/COMMENTS
1. Density/Moisture testing was conducted today. URS tested grid blocks # 6, 8, and 10. EDi tested grid blocks 6, 7, 8, 9, and 10.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 630 CY (35 Belly Dumps @ Approx 18 CY per truck) of Native Soil was placed and compacted for Lift #5. See dwg_07/02/09_Construction_01. Moisture/Density tests were conducted today.

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Native Soil Inspection Forms

PROPOSED NEXT DAY ACTIVITIES (date: 07/06/09)

1. Continue the construction of Native Soil Lift #5
2. Density/Moisture tests on completed portions of Native Soil Lift #5

DAILY SUMMARY REPORT

DATE: 07/06/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:20; (66 deg); Clear sky
WEATHER (PM): 2:34; (86 deg); Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Native Soil Lift #5
- Calibration of Pug Mill

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:02 – 7:20 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)
Safety:
- Be aware of traffic on turns that are not 90 deg.

DAILY TASK

I.
A. TASK DESCRIPTION: ***Native Soil, Lift #5***
Continue construction of Native Soil Lift #5. Construction will continue from east to west.

B. ISSUES/COMMENTS
1. No density/moisture testing today.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 756 CY (42 Belly Dumps @ Approx 18 CY per truck) of Native Soil was placed and compacted for Lift #5. See dwg_07/06/09_Construction_01. Moisture/Density Tests will be conducted on 07/07/09.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Calibration of Pug Mill***

Pioneer Industries has completed the setup of the Pug Mill and has begun calibration.

B. ISSUES/COMMENTS
1. Gravel and soil are being weighed using the Pug Mill. The gravel and soil are then taken to a Sandia scale located off site. The Pug Mill is then adjusted to match the Sandia scale as to get accurate soil-to-rock ratios required in CMIP.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Calibration will continue tomorrow (07/07/09).

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED
1. Native Soil Inspection Forms.

PROPOSED NEXT DAY ACTIVITIES (date: 07/07/09)
1. Continue the construction of Native Soil Lift #5
2. Density/Moisture tests on completed portions of Native Soil Lift #5

DAILY SUMMARY REPORT

DATE: 07/07/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:11; (65 deg); Clear sky
WEATHER (PM): 4:30; (91 deg) Clear sky
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction and testing of Native Soil Lift #5
- Calibration of Pug Mill/ Production of Topsoil with 3/8-inch gravel
- Begin excavation of additional Top/Native Soil out of TA-3 Borrow Area

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:04 – 7:20 AM
   Attendees: See attached sign in sheet.

Procedure:

-(See general description above)

Safety:

- Weekly inspection today
- Wear proper PPE
- Use ladder's properly
- Be aware of traffic at Borrow area due to higher activity

DAILY TASK

I.

A. TASK DESCRIPTION: ***Native Soil, Lift #5***

Continue construction and testing of Native Soil Lift #5. Construction will continue from east to west. See Drawing 07/07/09.

B. ISSUES/COMMENTS

1. Density/Moisture tests were conducted at 3:00 PM today within grids 1, 2, 3, 4, and 5 by EDi. Numerous moisture tests were below the requirement (Required Density: 117 pcf, Required Moisture: 12.0 +/- 2.0%). It was determined grids 1 through 5 are to be scarified and reworked. URS postponed QA testing due to EDi test failures. URS will conduct QA test on 7/09/09.

2. Grids 1, 2, 3, 4, and 5 were scarified using the rippers on the grader. Some additional water was added.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 756 CY (42 Belly Dumps @ Approx 18 CY per truck) of Native Soil was placed and compacted for Lift #5. See dwg_07/07/09_Construction_01. Moisture/Density Tests were conducted today. Retest to be conducted on 07/09/09.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Calibration of Pug Mill/3-8-Inch Gravel and Topsoil Mix***

Pioneer Industries has completed the setup of the pug mill and has begun the calibration. The calibration will be completed today and the production of 3/8-inch crushed gravel/Topsoil Mix will begin.

B. ISSUES/COMMENTS
1. Gravel and topsoil are being weighed using the Pug Mill. The gravel and topsoil are then taken to a calibrated Sandia scale located off of the jobsite. Once the topsoil and gravel are weighed using the Sandia scale, the Pug Mill is adjusted to match the Sandia scale +/- 1.0%. Once the Pug Mill is calibrated, topsoil and 3/8-inch crushed gravel will be added. The Pug Mill will combine the gravel and topsoil to produce the topsoil/gravel mixture as specified in the CMIP. The Topsoil Specifications require a 25%, by volume admixture of 3/8-inch crushed gravel to the topsoil. By knowing the weight of the crushed gravel and topsoil and adding to the Pug Mill accordingly, this has been accomplished.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. The Calibration was completed today

2. Approximately 100 CY of the 3/8-inch crushed gravel/Topsoil mixture was produced today.

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

III.

A. TASK DESCRIPTION: ***Excavation of Additional Topsoil***

Additional topsoil is being excavated and screened at the Sandia Borrow Pit (TA-3).

B. ISSUES/COMMENTS

1. The west portion of the Sandia Borrow Pit (TA-3) is being excavated for additional Top/Native Soil for the MWL .

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 125 CY of topsoil was excavated and screened today. Additional Top/Native Soil will continue to be excavated out of the Borrow Pit (TA-3) tomorrow.

F. PICTURES OBTAINED

Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Native Soil Inspection Form
2. Moisture/Density Test Sheet

PROPOSED NEXT DAY ACTIVITIES (date: 07/08/09)

1. Continue the construction of Native Soil Lift #5
2. Continue reworking grids 1, 2, 3, 4, and 5.
3. Continue the excavation for additional Top/Native Soil out of the West portion of Borrow Pit (TA-3)
4. Continue 3/8-inch crushed gravel/Topsoil mixture in Pug Mill

DAILY SUMMARY REPORT

DATE: 07/08/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 9:26; (79 deg); Clear sky
WEATHER (PM): 4:00; (92 deg); Clear sky
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Native Soil Lift #5
- Production of Topsoil with 3/8-inch gravel
- Continue excavation of additional Top/Native Soil out of TA-3 Borrow Area
- NMED arrived onsite at 9:30 AM

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:04 – 7:20 AM
   Attendees: See attached sign in sheet.

Procedure:
- (See general description above)

Safety:
-Use caution at borrow site due to numerous vehicles being operated.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Native Soil, Lift #5***

Continue construction of Native Soil Lift #5. Construction will continue from east to west.

B. ISSUES/COMMENTS

1. Grids 1, 2, 3, 4, and 5 were reworked today. The reworked grids will be tested tomorrow (07/09/09).

2. EDi had equipment problems today. The excavator has a broken track, the grader has a flat tire, and one of the screens has a filter that is not working. EDi is working to fix the equipment quickly.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 720 CY (40 Belly Dumps @ Approx 18 CY per truck) of Native Soil was placed and compacted for Lift #5. See dwg_07/08/09_Construction_01

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Pug Mill/3-8-Inch Gravel and Topsoil Mix***
The production of 3/8-inch crushed gravel/Topsoil mix continued today.

B. ISSUES/COMMENTS
1. The Topsoil Specifications require a 25%, by volume admixture of 3/8-inch crushed gravel to the topsoil. By knowing the weight of the crushed gravel and topsoil and adding to the Pug Mill accordingly, this has been accomplished this.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 780 CY of the 3/8-inch crushed gravel/Topsoil mixture was produced today.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

III.

A. TASK DESCRIPTION: ***Excavation of Additional Topsoil***
Additional soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

B. ISSUES/COMMENTS
1. The west portion of the Sandia Borrow Pit (TA-3) is being excavated for additional Top/Native Soil for the MWL. The additional volume of material excavated will be recorded once determined at a later date.

2. Large rocks were noticed in the Native Soil stockpile. When the screen was inspected, a hole was found which was allowing a couple of larger rocks to slip

through. The screen was shut down and will be replaced or fixed tomorrow. The large rocks that were found were removed from the Native Soil.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
   2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
   1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
   1. Additional Top/Native Soil will continue to be excavated out of the Borrow Pit (TA-3) tomorrow. Total volume will be determined at a later date.

F. PICTURES OBTAINED
   Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED
Native Soil Inspection Form

IV.
A. TASK DESCRIPTION: **NMED SITE TOUR**
NMED arrived onsite at 9:30 am. Don Schofield escorted them around the MWL and took them up into the scissor lift.

PROPOSED NEXT DAY ACTIVITIES (date: 07/09/09)
1. Continue the construction and testing of Native Soil Lift #5
2. Continue the excavation for additional Top/Native Soil out of the west portion of Borrow Pit (TA-3)
3. Continue 3/8-inch crushed gravel/Topsoil mixture in Pug Mill

DAILY SUMMARY REPORT

DATE: 07/09/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:09; (70 deg); Clear sky
WEATHER (PM): 3:00; (91 deg); Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction and testing of Native Soil Lift #5
- Production of Topsoil with 3/8-inch gravel
- Continue excavation of additional Top/Native Soil out of TA-3 Borrow Area

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:04 – 7:20 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)
Safety:
- Keep hydrated due to hot temperatures
- Pull over vehicle when using cell phone
- Be sure to use seat belt

DAILY TASK

I.
A. TASK DESCRIPTION: ***Native Soil, Lift #5***
Continue construction and testing of Native Soil Lift #5. Construction will continue from east to west.

B. ISSUES/COMMENTS
1. Grids #1, #2, #3, #4, and #5 were reworked yesterday. Construction of the remaining areas in these grids was completed today.

2. Density/Moisture tests were retaken today within grids #1, #2, #3, #4, and #5 by EDi. URS performed QA Density/Moisture tests in grids #2 and #4.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 522 CY (29 Belly Dumps @ Approx 18 CY per truck) of Native Soil was placed and compacted for Lift #5. See dwg_07/09/09_Construction_01

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Pug Mill/3-8-Inch Gravel and Topsoil Mix***
The production of 3/8-inch crushed gravel/topsoil mix continued today.

B. ISSUES/COMMENTS
1. Continued production of the 3/8-inch crushed gravel/topsoil mixture.

C. EQUPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 625 CY of the 3/8-inch crushed gravel/topsoil mixture was produced today.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

III.

A. TASK DESCRIPTION: ***Excavation of Additional Topsoil***
Additional soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

B. ISSUES/COMMENTS
1. The stationary screen was shutdown this morning to replace the broken screen which allowed a couple of larger rocks to slip through. The broken screen was replaced and excavation and screening continued.

2. The northwest portion of the Sandia Borrow Pit (TA-3) is being excavated for additional Top/Native Soil for the MWL. The additional volume of material excavated will be recorded once determined at a later date.

C. EQUPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Additional Top/Native Soil will continue to be excavated out of the Borrow Pit (TA-3) tomorrow. Total volume will be determined at a later date.

F. PICTURES OBTAINED
Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED
1. Native Soil Inspection Form
2. Moisture/Density Test Sheet

PROPOSED NEXT DAY ACTIVITIES (date: 07/10/09)
1. Complete the construction of Native Soil Lift #5
2. Continue the excavation for additional Top/Native Soil out of the West portion of Borrow Pit (TA-3)
3. Continue 3/8-inch crushed gravel/Topsoil mixture in Pug Mill
4. Begin construction of Native Soil Lift #6
5. Survey of Native Soil Lift #5

DAILY SUMMARY REPORT

DATE: 07/10/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:09; (70 deg); Clear sky
WEATHER (PM): 3:00; (91 deg); Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Complete the construction of Native Soil Lift #5
- Production of topsoil with 3/8-inch gravel
- Continue excavation of additional Top/Native Soil out of TA-3 Borrow Area
- Begin construction of Native Soil Lift #6

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:04 – 7:20 AM
   Attendees: See attached sign in sheet.

Procedure:

- (See general description above)

Safety:

- Keep hydrated due to hot temperatures
- Pull over vehicle when using cell phone
- Be sure to use seat belt

DAILY TASK

I.

A. TASK DESCRIPTION: ***Native Soil, Lift #5***
Continue construction and survey of Native Soil Lift #5.

B. ISSUES/COMMENTS

1. The west slope was completed for Native Soil Lift #5.

2. QC survey of Lift # 5 was performed and completed today by EDi.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 108 CY (6 Belly Dumps @ Approx 18 CY per truck) of Native Soil was placed and compacted for Lift #5. See dwg_07/10/09_Construction_01

2. Construction of Native Soil Lift #5 was completed today.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Native Soil, Lift #6***

Construction of Native Soil Lift # 6 began today. Construction will continue from east to west across MWL surface.

B. ISSUES/COMMENTS
1. Construction has begun for Lift #6. Native Soil was only placed today. The Native Soil placed will receive water and compaction on Monday (07/13/09).
2. No moisture/density testing occurred today.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 648 CY (36 Belly Dumps @ Approx 18 CY per truck) of Native Soil was placed for Lift #6. See dwg_07/10/09_Construction_01. Native soil for this lift will be compacted on Monday (7/13/09)

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

III.

A. TASK DESCRIPTION: ***Pug Mill/3-8-Inch Gravel and Topsoil Mix***

The production of 3/8-inch crushed gravel/topsoil mix continued today.

B. ISSUES/COMMENTS
1. The production of 3/8-inch crushed gravel/Topsoil mix continued today.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 600 CY of the 3/8-inch crushed gravel/Topsoil mixture was produced today.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

VI.

A. TASK DESCRIPTION: ***Excavation of Additional Topsoil***

Additional soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

B. ISSUES/COMMENTS
1. The west portion of the Sandia Borrow Pit (TA-3) is being excavated for additional Top/Native Soil for the MWL. The additional volume of material excavated will be recorded once determined at a later date.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 650 CY of soil was excavated and screened for topsoil.
2. Approximately 558 CY of soil was excavated and screened for native soil.

F. PICTURES OBTAINED

Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED
1. Native Soil Inspection Form
2. Moisture/Density Test Sheet

PROPOSED NEXT DAY ACTIVITIES (date: 07/13/09)
1. Continue the construction of Native Soil Lift #6
2. Continue the excavation for additional Top/Native Soil out of the West portion of Borrow Pit (TA-3)
3. Continue 3/8-inch crushed gravel/Topsoil mixture in Pug Mill

DAILY SUMMARY REPORT

DATE: 07/13/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 9:26; (79 deg); Clear sky
WEATHER (PM): 3:58; (96 deg); Clear sky
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Native Soil Lift #6
- Production of Topsoil with 3/8-inch gravel
- Continue excavation of additional Top/Native Soil out of TA-3 Borrow Area

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:04 – 7:20 AM
   Attendees: See attached sign in sheet.

Procedure:

-(See general description above)

Safety:

- Temp may get to 98 deg. Be sure to drink fluids.
- The evacuation location is the Golf Course
- There is a new muster point located at the borrow area by rain gauge

DAILY TASK

I.

A. TASK DESCRIPTION: ***Native Soil, Lift #6***

Continue construction of Native Soil Lift #6. Construction will continue from east to west.

B. ISSUES/COMMENTS

1. Construction continued from east to west today for Native Soil Lift #6. Grids #11 and #12 were completed today. EDi began construction on Grids #6, #7, #8, and #9.

2. Soil placed on Friday (07/10/09) was moisture conditioned and compacted today in grid blocks #11, #12, and #13.

3. No moisture/density testing today.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 738 CY (41 Belly Dumps @ Approx 18 CY per truck) of Native Soil was placed and compacted for Lift #6. See dwg_07/13/09_Construction_01

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Pug Mill/3-8-Inch Gravel and Topsoil Mix***
The production of 3/8-inch crushed gravel/Topsoil mix continued today.

B. ISSUES/COMMENTS
1. The production of 3/8-inch crushed gravel/Topsoil mix continued today.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 600 CY of the 3/8-inch crushed gravel/Topsoil mixture was produced today.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

III.

A. TASK DESCRIPTION: ***Excavation of Additional Topsoil***
Additional soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

B. ISSUES/COMMENTS
1. The west portion of the Sandia Borrow Pit (TA-3) is being excavated for additional Top/Native Soil for the MWL. The additional volume of material excavated will be recorded once determined at a later date.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
   2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
   1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
   1. Approximately 600 CY of soil was excavated for Topsoil.
   2. Approximately 687 CY of soil was excavated for Native soil.

F. PICTURES OBTAINED
   Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED
   1. Native Soil Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 07/14/09)
   1. Continue the construction and testing of Native Soil Lift #6
   2. Continue the excavation for additional Top/Native Soil out of the west portion of Borrow Pit (TA-3)
   3. Continue 3/8-inch crushed gravel/topsoil mixture in Pug Mill
   4. Meeting with URS, EDi, and Sandia to discuss Native Soil and Topsoil volume shortages.

DAILY SUMMARY REPORT

DATE: 07/14/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:13: (74 deg); Clear sky
WEATHER (PM): 3:17: (88 deg); Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction and testing of Native Soil Lift #6
- Production of Topsoil with 3/8-inch gravel
- Delivery of additional 3/8-inch crushed gravel to Borrow Area
- Continue excavation of additional Top/Native Soil out of TA-3 Borrow Area
- Volume calculation meeting
- Audit by Sandia and SSO was conducted today

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:04 – 7:20 AM
   Attendees: See attached sign in sheet.

Procedure:
-(See general description above)

Safety:

- Use caution around Pug Mill due to dust.
- Weekly Safety Inspection today.
- Consume plenty of fluids due to hot weather.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Native Soil, Lift #6***

Continue construction and density/moisture testing of Native Soil Lift #6. Construction will continue from east to west.

B. ISSUES/COMMENTS

1. Construction continued from east to west today for Native Soil Lift #6.

2. EDi conducted Density/Moisture testing in grids #11, #12, and #13. URS conducted testing in grids #11 and #13.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 1170CY (65 Belly Dumps @ Approx 18 CY per truck) of Native Soil was placed and compacted for Lift #6. See dwg_07/14/09_Construction_01

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Pug Mill/3-8-Inch Gravel and Topsoil Mix***
The production of 3/8-inch crushed gravel/Topsoil mix continued today.

B. ISSUES/COMMENTS
1. The production of 3/8-inch crushed gravel/Topsoil mix continued today.

2. More 3/8-inch crushed gravel was delivered to the borrow area by Fisher.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 800 CY of the 3/8-inch crushed gravel/Topsoil mixture was produced today.
2. Approximately 420-tons of 3/8-inch crushed gravel was delivered by fisher.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

III.

A. TASK DESCRIPTION: ***Excavation of Additional Topsoil***
Additional soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

B. ISSUES/COMMENTS
1. Additional soil is being excavated and screened at the Sandia Borrow Pit.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 100 CY of soil was excavated and screened for Topsoil.
2. Approximately 582 CY of soil was excavated and screened for Native Soil.

F. PICTURES OBTAINED
Pictures of this procedure were collected and filed.

IV.

A. TASK DESCRIPTION: ***Volume Calculation Meeting***

A meeting was held with Sandia, EDi, and URS to discuss additional volume calculations for the Native and Topsoil Layers.

B. ISSUES/COMMENTS
1. Due to the MWL surface area being larger than initially anticipated, additional Native Soil and Topsoil is required. Sandia has requested EDi provide a proposal for the additional volumes/cost to complete the MWL. Sandia has also requested URS provide a third party analysis of the volumes/cost to complete the MWL. The volumes/cost provided by URS shall be used to verify the proposal provided by EDi to Sandia.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. EDi provided Sandia with a proposal of 9,615-CY of additional Native Soil and 1,590-CY of additional Topsoil for the completion of the MWL. URS provided an independent review of the additional soil volumes required using two methods (free-body diagram and construction history data). Both methods were close to the results obtained by EDi. URS informed Sandia that EDi's estimate for additional volume calculations are accurate (See attached for calculations/results).

F. PICTURES OBTAINED
1. NA

INSPECTION CHECKLISTS REQUIRED
1. Native Soil Inspection Form

2. Moisture/Density Testing Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 07/15/09)

1. Continue the construction of Native Soil Lift #6
2. Continue the excavation for additional Top/Native Soil out of the west portion of Borrow Pit (TA-3)
3. Fix screen for 3/8-inch/Topsoil mixture

DAILY SUMMARY REPORT

DATE: 07/15/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 10:15; (79 deg); Clear Sky
WEATHER (PM): 1:45; (93 deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Native Soil Lift #6
- Continue production of 3/8-inch/Topsoil Mixture
- Continue excavation of additional Top/Native Soil out of TA-3 Borrow Area

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:04 – 7:20 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)
Safety:
- Temp may get to 98 deg. Be sure to drink fluids.
- The evacuation location is the Golf Course.
- There is a new muster point located at the borrow area by rain gauge.

DAILY TASK

I.
A. TASK DESCRIPTION: ***Native Soil, Lift #6***
Continue construction of Native Soil Lift #6. Construction will continue from east to west.

B. ISSUES/COMMENTS
1. Construction continued from east to west today for Native Soil Lift #6.

2. Much of the compaction was not done today due to the grader and loader requiring repairs. The belly dumps of Native Soil continued without the compaction process. The soil will receive moisture and compaction tomorrow.

3. No moisture/density testing was conducted today.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 954 CY of Native Soil was placed and compacted for Lift #6. See dwg_07/15/09_Construction_01

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Pug Mill/3-8-Inch Gravel and Topsoil Mix***
The production of 3/8-inch crushed gravel/Topsoil Mix continued today.

B. ISSUES/COMMENTS
1. The production of 3/8-inch crushed gravel/Topsoil Mix continued today.
2. The Pug Mill was shut down for about two hours today for routine maintenance.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 650 CY of the 3/8-inch crushed gravel/Topsoil mixture was produced today.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

III.

A. TASK DESCRIPTION: ***Excavation of Additional Topsoil/Native Soil***
Additional Native Soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

B. ISSUES/COMMENTS
1. Additional Native Soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 558 CY of soil was excavated and screened today for Native Soil.

F. PICTURES OBTAINED
Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED
1. Native Soil Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 07/16\/09)
1. Continue the construction of Native Soil Lift #6
2. Continue the excavation for additional Top/Native Soil out of the west portion of Borrow Pit (TA-3)
3. Continue 3/8-inch crushed gravel/Topsoil mixture in Pug Mill
4. Meeting with URS, EDi, and Sandia to discuss Native Soil and Topsoil volume shortages.

DAILY SUMMARY REPORT

DATE: 07/16/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 10:00; (79 deg); Clear sky
WEATHER (PM): 2:29; (93 deg); cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Native Soil Lift #6
- Begin construction of Native Soil Lift #7
- Continue production of 3/8-inch/Topsoil Mixture
- Continue excavation of additional Top/Native Soil out of TA-3 Borrow Area

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:21 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)

Safety:
- Be sure to check if eye protection is UV certified.

DAILY TASK

I.

A. TASK DESCRIPTION: ***Native Soil, Lift #6***
Continue construction of Native Soil Lift #6. Construction will continue from east to west.

B. ISSUES/COMMENTS
1. Construction continued on west portion of MWL.
2. EDi conducted survey on Native Soil Lift #6 today.
3. No density/moisture testing today.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 700 CY of Native Soil was placed and compacted for Lift #6. See dwg_07/16/09_Construction_01

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Native Soil, Lift #7***

Native Soil Lift #7 began construction today on the east slope.

B. ISSUES/COMMENTS

1. Native Soil Lift #7 began construction today. Construction will continue from east to west.
2. No density/moisture test were conducted today.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 164 CY of Native Soil was placed and compacted for Lift #7. See dwg_07/16/09_Construction_02

III.

A. TASK DESCRIPTION: ***Pug Mill/3-8-Inch Gravel and Topsoil Mix***

The production of 3/8-inch crushed gravel/Topsoil Mix continued today.

B. ISSUES/COMMENTS

1. None

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 900 CY of the 3/8-inch crushed gravel/Topsoil mixture was produced today.

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

IV.

A. TASK DESCRIPTION: ***Excavation of Additional Topsoil/Native Soil***

Additional Native Soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

B. ISSUES/COMMENTS

1. Additional Native Soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 1000 CY of soil was excavated and screened for Native Soil
2. Approximately 500 CY of soil was excavated and screened for Topsoil.

F. PICTURES OBTAINED

Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Native Soil Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 07/17/09)

1. Moisture/Density Tests on remaining portions of Native Soil Lift #6
2. Continue construction of Native Soil Lift #7
3. Continue the excavation for additional Top/Native Soil out of the west portion of Borrow Pit (TA-3)
4. Continue 3/8-inch crushed gravel/Topsoil mixture in Pug Mill

DAILY SUMMARY REPORT

DATE: 07/17/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 10:00; (79 deg); Clear sky
WEATHER (PM): 2:29; (93 deg); Cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Native Soil Lift #7
- Density/Moisture Testing of Native Soil Lift #6
- Continue production of 3/8-inch/Topsoil Mixture
- Continue excavation of additional Top/Native Soil out of TA-3 Borrow Area
- Meeting with URS, Sandia, and EDi

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:21 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)
Safety:

DAILY TASK

I.
A. TASK DESCRIPTION: ***Native Soil, Lift #6 Density and Moisture Testing Only***
Density/Moisture Testing of Native Soil Lift #6.

B. ISSUES/COMMENTS

1. The density/moisture test conducted by EDi around MW-4 did not pass. The area is to be reworked and retested on Monday (7/20/09).

2. URS tested grid blocks #2, #4, #6, #8, and #9. EDi tested grid blocks 1-10.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. MW-4 to be retested reworked and retested on Monday (7/20/09)

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Native Soil, Lift #7***

The construction of Native Soil Lift #7 continued today.

B. ISSUES/COMMENTS
1. Construction will continue from east to west.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 828 CY (46 Belly Dumps @ Approx 18 CY per truck) of Native Soil was placed and compacted for Lift #7. See dwg_07/17/09_Construction_01

III.

A. TASK DESCRIPTION: ***Pug Mill/3-8-Inch Gravel and Topsoil Mix***

The production of 3/8-inch crushed gravel/Topsoil Mix continued today.

B. ISSUES/COMMENTS
1. None

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

F. STATUS:
1. Approximately 800 CY of the 3/8-inch crushed gravel/Topsoil mixture was produced today.

G. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

IV.

A. TASK DESCRIPTION: ***Excavation of Additional Topsoil/Native Soil***

Additional Native Soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

B. ISSUES/COMMENTS

1. Additional Native Soil is being excavated and screened at the Sandia Borrow Pit (TA-3)

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Additional Top/Native soil were excavated out of the Borrow Pit (TA-3).

F. PICTURES OBTAINED

Pictures of this procedure were collected and filed.

V.

A. TASK DESCRIPTION: ***Meeting (Material Volume Calculations)***

A meeting was held with Sandia, EDi, and URS to discuss the material volume shortages of the MWL.

B. ISSUES/COMMENTS

1. Mike Mitchell and Paul Molina realized the contract drawings in the CMIP are not correct. The drawings in the MWL show an area of 2.6 acres however, due to the footprint growing the estimated volumes in the CMIP may be incorrect.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Meeting concluded

F. PICTURES OBTAINED

No pictures of this task were obtained.

INSPECTION CHECKLISTS REQUIRED

1. Native Soil Inspection Form
2. Density/Moisture Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 07/20/09)

1. Continue construction of Native Soil Lift #7
2. Retest Moisture/Density around Monitoring Well MW-4
3. Continue the excavation for additional Top/Native Soil out of the west portion of Borrow Pit (TA-3)
4. Continue 3/8-inch crushed gravel/Topsoil mixture in Pug Mill

DAILY SUMMARY REPORT

DATE: 07/20/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 10:00; (79 deg); Clear sky
WEATHER (PM): 2:29; (93 deg); Cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Native Soil Lift #7
- Density/Moisture Testing of Native Soil Lift #6 around MW-4 (EDi)
- Continue production of 3/8-inch/Topsoil Mixture
- Continue excavation of additional Top/Native Soil out of TA-3 Borrow Area

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:21 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)
Safety:

DAILY TASK

I.
A. TASK DESCRIPTION: ***Native Soil, Lift #6***
Density/Moisture Testing of Native Soil Lift #6.

B. ISSUES/COMMENTS
1. The Density/Moisture test around MW-4 did not pass on 7/17/09 due to low density and high moisture. The area around MW-4 was reworked using hand compaction methods and retested by EDi which met specifications.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. The Density/Moisture retest around MW-4 passed.

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Native Soil, Lift #7***

The construction of Native Soil Lift #7 continued today.

B. ISSUES/COMMENTS

1. Construction will continue from east to west.

2. Additional Belly Dump Trucks were brought in to increase the rate of construction for Native Soil Lifts #7 and #8.

C. EQUIPMENT USED:

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

F. STATUS:

1. Approximately 1630 CY of Native Soil was placed and compacted for Lift #7. See dwg_07/20/09_Construction_01

III.

A. TASK DESCRIPTION: ***Pug Mill/3-8-Inch Gravel and Topsoil Mix***

The production of 3/8-inch crushed gravel/Topsoil Mix continued today.

B. ISSUES/COMMENTS

1. None

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 1000 CY of the 3/8-inch crushed gravel/Topsoil mixture was produced today.

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

IV.

A. TASK DESCRIPTION: ***Excavation of Additional Topsoil/Native Soil***

Additional top/native soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

B. ISSUES/COMMENTS

1. Additional top/native soil is being excavated and screened at the Sandia Borrow Pit (TA-3)

C. EQUIPMENT USED (See Appendix B For Equipment Description):

3. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Additional Top/Native soil is being excavated and screened at the Sandia Borrow Pit (TA-3)

F. PICTURES OBTAINED

Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Native Soil Inspection Form
2. Density/Moisture Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 07/21/09)

1. Continue construction and Density/Moisture testing of Native Soil Lift #7
2. Continue the excavation for additional Top/Native Soil out of the west portion of Borrow Pit (TA-3)
3. Continue 3/8-inch crushed gravel/Topsoil mixture in Pug Mill

DAILY SUMMARY REPORT

DATE: 07/21/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 10:10; (79 deg); Clear sky
WEATHER (PM): 4:28; (87 deg); Cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Native Soil Lift #7
- Density/Moisture Testing of Native Soil Lift #7
- Begin construction of Native Soil Lift #8
- Continue production of 3/8-inch/Topsoil Mixture/Delivery of additional 3/8-inch crushed gravel
- Continue excavation of additional Top/Native Soil out of TA-3 Borrow Area

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:18 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Native Soil, Lift #7 (Construction and Testing)***
The construction and testing of Native Soil Lift #7 continued today.

B. ISSUES/COMMENTS
1. Construction will continue from east to west.

2. Density/moisture testing occurred today. URS conducted testing in grid blocks #11, #13, #9, and #7. Edi conducted testing in grid blocks #6-13.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 1306 CY of Native Soil was placed and compacted for Lift #7. See dwg_07/21/09_Construction_01

2. Native Soil Lift #7 construction was completed today. Remaining density/moisture tests will be conducted tomorrow (07/22/09) in grid blocks 1-5.

II.

A. TASK DESCRIPTION: ***Native Soil, Lift #8 (Construction)***

The construction of Native Soil Lift #8 began today.

B. ISSUES/COMMENTS

1. Construction of Native Soil Lift #8 will be from east to west.

2. Native Soil for Lift #8 was only placed today. Compaction will occur tomorrow.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 300 CY of Native Soil was placed and compacted for Lift #8. See dwg_07/21/09_Construction_01.

III.

A. TASK DESCRIPTION: ***Pug Mill/3-8-Inch Gravel and Topsoil Mix***

The production of 3/8-inch crushed gravel/topsoil Mix continued today.

B. ISSUES/COMMENTS

1. Additional 3/8-inch crushed gravel was delivered to Borrow Area today around 9:00 AM.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately400 CY of the 3/8-inch crushed gravel/Topsoil mixture was produced today.

2. Approximately 201-tons of 3/8-inch crushed gravel were delivered to the Borrow Area today.

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

IV.

A. TASK DESCRIPTION: ***Excavation of Additional Topsoil/Native Soil***

Additional Native Soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

B. ISSUES/COMMENTS

1. Additional Native Soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Additional Top/Native Soil will continue to be excavated out of the Borrow Pit (TA-3) tomorrow.

F. PICTURES OBTAINED

Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Native Soil Inspection Form
2. Density/Moisture Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 07/22/09)

1. Density/Moisture Test on Native Soil Lift #7
2. Continue construction of Native Soil Lift #8
3. Continue the excavation for additional Top/Native Soil out of the west portion of Borrow Pit (TA-3)
4. Continue 3/8-inch crushed gravel/Topsoil mixture in Pug Mill

DAILY SUMMARY REPORT

DATE: 07/22/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:10; (71 deg); Clear sky, muddy conditions due to rain previous night (07/21/09).
WEATHER (PM): 4:02; (87 deg); Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Density/Moisture Testing of Native Soil Lift #7
- Continue construction of Native Soil Lift #8 (Compaction Only, No Trucks)
- Continue excavation of additional Top/Native Soil out of TA-3 Borrow Area
- 3/8-inch crushed gravel shipment was delivered

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:18 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)
Safety:
-Be aware of slips, trips, and falls

DAILY TASK

I.
A. TASK DESCRIPTION: ***Native Soil, Lift #7 (Testing)***
The Density/Moisture testing of Native Soil Lift #7 continued today.

B. ISSUES/COMMENTS
1. URS conducted tests in grid blocks 1, 3, and 5. EDi conducted tests in grid blocks 1-5. All test were passing.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Final Density/Moisture test for Native Soil Lift #7 were completed today. All test were passing.

II.

A. TASK DESCRIPTION: ***Native Soil, Lift #8 (Construction)***

The construction of Native Soil Lift #8 continued today.

B. ISSUES/COMMENTS

1. Construction of Native Soil Lift #8 will occur from east to west.

2. The Native Soil for Lift #8 was only compacted today. The belly dump trucks were not able to place additional Native Soil on MWL due to muddy conditions from precipitation received the previous night (07/21/09).

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. The Native Soil for Lift #8 was only compacted today. The belly dump trucks were not able to place additional Native Soil on MWL due to muddy conditions from precipitation received the previous night (07/21/09). Construction will continue tomorrow (7/23/09)

III.

A. TASK DESCRIPTION: ***Pug Mill/3-8-Inch Gravel and Topsoil Mix***

The production of 3/8-inch crushed gravel and Topsoil Mix did not occur today due to muddy conditions. Additional 3/8-inch gravel was delivered to Borrow Area.

B. ISSUES/COMMENTS

1. None

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Additional 3/8-inch crushed gravel was delivered to Borrow Area today. Approximately 142 tons (6-loads) was delivered.

F. PICTURES OBTAINED
1. NA

IV.

A. TASK DESCRIPTION: ***Excavation of Additional Topsoil/Native Soil***

Additional Top/Native soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

B. ISSUES/COMMENTS
1. The Additional Top/Native soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. The Additional Top/Native soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

F. PICTURES OBTAINED

Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED
1. Density/Moisture Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 07/23/09)
1. Continue construction of Native Soil Lift #8
2. Continue the excavation for additional Top/Native Soil out of the west portion of Borrow Pit (TA-3)
3. Continue 3/8-inch crushed gravel/Topsoil mixture in Pug Mill

DAILY SUMMARY REPORT

DATE: 07/23/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:39 am (69 deg); Clear sky
WEATHER (PM):
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Native Soil Lift #8
- Continue production of 3/8-inch/Topsoil Mixture
- Continue excavation of additional Top/Native Soil out of TA-3 Borrow Area

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:21 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Native Soil, Lift #8***
Continue construction of Native Soil Lift #8.

B. ISSUES/COMMENTS
1. Construction continued from east to west on MWL for Native Soil Lift #8.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 1458 CY of Native Soil was placed and compacted for Lift #8. See dwg_07/23/09_Construction_01

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Pug Mill/3-8-Inch Gravel and Topsoil Mix***

The production of 3/8-inch crushed gravel/Topsoil Mix continued today.

B. ISSUES/COMMENTS

1. None

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

F. STATUS:

1. Approximately 300 CY of the 3/8-inch crushed gravel/Topsoil mixture was produced today.

G. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

III.

A. TASK DESCRIPTION: ***Excavation of Additional Topsoil/Native Soil***

Additional Native Soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

B. ISSUES/COMMENTS

1. Additional Native Soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Additional Native Soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

F. PICTURES OBTAINED

Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Native Soil Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 07/24/09)

1. Moisture/Density Tests on completed portions of Native Soil Lift #8
2. Continue construction of Native Soil Lift #8
3. Continue the excavation for additional Top/Native Soil out of the west portion of Borrow Pit (TA-3)
4. Complete 3/8-inch crushed gravel/Topsoil mixture in Pug Mill

DAILY SUMMARY REPORT

DATE: 07/24/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:28; (68 deg); Clear sky
WEATHER (PM): 4:07; (95 deg); Clear sky
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Moisture/Density Tests on completed portions of Native Soil Lift #8 (EDi)
- Continue construction of Native Soil Lift #8
- Continue the excavation for additional Top/Native Soil out of the West portion of Borrow Pit (TA-3)
- Complete 3/8-inch crushed gravel/Topsoil mixture in Pug Mill

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:21 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Native Soil, Lift #8***
Continue construction of Native Soil Lift #8.

B. ISSUES/COMMENTS
1. Construction continued from east to west on MWL for Native Soil Lift #8.
2. EDi conducted moisture/density tests on grid blocks 11, 12, and 13. All test were passing.
3. URS did not conduct any moisture/density tests today.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 1410 CY of Native Soil was placed and compacted for Lift #8. See dwg_07/23/09_Construction_01

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Pug Mill/3-8-Inch Gravel and Topsoil Mix***

The production of 3/8-inch crushed gravel/Topsoil Mix was completed today.

B. ISSUES/COMMENTS

1. Pioneer completed the production of 3/8-inch crushed gravel/topsoil mixture.
2. Pioneer has begun demobilization of the Pug Mill.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Pioneer completed the production of 3/8-inch crushed gravel/topsoil mixture.
2. Pioneer has begun demobilization of the Pug Mill.

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

III.

A. TASK DESCRIPTION: ***Excavation of Additional Topsoil/Native Soil***

Additional Native Soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

B. ISSUES/COMMENTS

1. Additional Native Soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Additional Native Soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

2. Topsoil will no longer be excavated due to the Pug Mill operation being complete.
3. The south portion of the Borrow Area has begun excavation and screening for additional Native Soil material.

F. PICTURES OBTAINED

Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Native Soil Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 07/27/09)

1. Continue construction of Native Soil Lift #8.
2. URS QA survey

DAILY SUMMARY REPORT

DATE: 07/27/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:15; (67 deg); Clear sky
WEATHER (PM): 1:00; (89deg); Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Construction of Native Soil Lift #8
- URS QA survey
- Excavation and screening of Native Soil
- Pug Mill demobilization

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:21 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)

DAILY TASK

I.

A. TASK DESCRIPTION: ***Native Soil, Lift #8***
Continue construction of Native Soil Lift # 8

B. ISSUES/COMMENTS
1. Construction continued from East to West on MWL for Native Soil Lift #8.
2. Harry Buckner (URS) began QA survey of Native Soil Layer.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 962 CY of Native Soil was placed and compacted for Lift #8. See dwg_07/27/09_Construction_01
2. URS will continue QA survey tomorrow (7/28/09).

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Pug Mill/3-8-Inch Gravel and Topsoil Mix***
Demobilization of Pug Mill.

B. ISSUES/COMMENTS
1. None

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. The Pug Mill continued demobilization.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

III.

A. TASK DESCRIPTION: ***Excavation of Additional Native Soil***
Additional Native Soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

B. ISSUES/COMMENTS
1. Additional Native Soil is being excavated and screened at the Sandia Borrow Pit (TA-3).

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. The excavation for both Top and Native Soil was completed today.
2. EDi has begun cleaning and leveling the Borrow Area

F. PICTURES OBTAINED
Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Native Soil Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 07/28/09)

1. Moisture/Density Tests on completed portions of Native Soil Lift #8
2. QA/QC survey verification
3. Demobilization of Pug Mill

DAILY SUMMARY REPORT

DATE: 07/28/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:15 am (67 deg); Clear Sky
WEATHER (PM): 1:10 pm (93 deg); Partly Cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- URS QA Survey
- Construction and testing of Native Soil Lift #8
- Meeting to discuss additional volume requirements
- Borrow Area cleanup

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:00 – 7:21 AM
   Attendees: See attached sign in sheet.

Procedure:
-(See general description above)

DAILY TASK

I.

A. TASK DESCRIPTION: ***Native Soil, Lift #8***
Continue construction and testing of Native Soil Lift #8.

B. ISSUES/COMMENTS

1. EDi continued to water and compact soil into place from east to west.

2. URS conducted moisture/density tests on grid blocks #2, #4, #6, #8, #10, and #12. All QA tests were passing.

3. EDi conducted moisture/density tests on grid blocks #1-10 (#11, #12, and #13 had already been tested). Grid blocks #1-7 and #9 passed. Grid blocks #8, #10, and around MW-4 failed due to low moisture. All grid blocks were reworked, re-compacted, and retested. All three passed the second round of tests conducted by EDi.

4. QA survey was continued by URS

5. QC survey was conducted by EDi.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Construction and testing of Native Soil Lift #8 is now complete. QA/QC survey will determine if any corrections are needed. If not, the Topsoil Layer may begin.

2. URS and EDi will continue the QA and QC survey tomorrow.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Pug Mill/3-8-Inch Gravel and Topsoil Mix***
Demobilization of the Pug Mill continued today.

B. ISSUES/COMMENTS
1. None

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Demobilization of the Pug Mill continued today.

F. PICTURES OBTAINED
1. No picture were taken.

III.

A. TASK DESCRIPTION: ***Borrow Area Cleanup***
EDi continued the cleanup and leveling of the borrow area.

INSPECTION CHECKLISTS REQUIRED
1. Native Soil Inspection Forms

2. Moisture/Density Form

PROPOSED NEXT DAY ACTIVITIES (date: 07/29/09)

1. QA survey meeting.

DAILY SUMMARY REPORT

DATE: 07/29/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:15; (67 deg); Clear sky
WEATHER (PM): 1:00; (92 deg); Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- QA/QC survey
- Meeting with Sandia and EDi to discuss final report and topsoil changes.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:21 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Native Soil, Lift #8***
Construction has been completed, QA and QC survey continued today.

B. ISSUES/COMMENTS
1. QA survey was continued by URS

2. QC survey was conducted by EDi.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. QA survey was completed by URS

2. QC survey was completed by EDi.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Pug Mill/3-8-Inch Gravel and Topsoil Mix***
Demobilization of Pug Mill.

B. ISSUES/COMMENTS
1. None

C. EQUIPMENT USED (See Appendix B For Equipment Description):
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. The Pug Mill continued demobilization.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

III.

A. TASK DESCRIPTION: ***Borrow Area Cleanup***
EDi continued the cleanup and leveling of the borrow area.

INSPECTION CHECKLISTS REQUIRED
1. NA

PROPOSED NEXT DAY ACTIVITIES (date: 07/27/09)
1. Review of Native Soil QA/QC results.

DAILY SUMMARY REPORT

DATE: 07/30/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:15; (67 deg); Clear sky
WEATHER (PM): 1:00; (92 deg); Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- URS presented QA survey of the Native Soil to Sandia and EDi.
- No Construction Today

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:21 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Native Soil, Lift #8 Meeting***
Review of Native Soil QA/QC survey. .

B. ISSUES/COMMENTS

1. The QA/QC was reviewed today to determine if thickness and slopes were in accordance with the CMIP.

2. EDi had survey crew (ASCI) with equipment to address any concerns we may have with the review.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. After reviewing both the QA (URS) and the QC (EDi) topographic surveys, it was determined the results obtained were very similar. Between the two surveys, nine locations were located that needed to be raised in order to be in compliance with the CMIP. These nine areas were only 1-to4-inches below the required thickness. EDi rechecked these nine areas with survey equipment and confirmed they required 1-to-4-inches of additional soil. These areas are to be filled with soil and resurveyed before construction of the Topsoil Layer may begin at these points. The Native Soil Layer is approved with the exception of the nine locations that require correction.

F. PICTURES OBTAINED

1. NA.

INSPECTION CHECKLISTS REQUIRED

1. NA

PROPOSED NEXT DAY ACTIVITIES (date: 07/31/09)

1. Adjust areas of concern.
2. EDi resurvey areas of concern.

DAILY SUMMARY REPORT

DATE: 07/31/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:15; (67 deg); Clear sky
WEATHER (PM): 1:00; (87 deg); Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Final Corrections to Native Soil Lift #8
- EDi Survey

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:21 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Native Soil, Lift #8***
Corrections to Native Soil Lift #8 were made to be in compliance with CMIP requirements.

B. ISSUES/COMMENTS
1. EDi performed corrections to the nine areas and 6:1 side slopes identified in the EDi and URS topographic surveys.

2. EDi performed their final survey on the corrected areas.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Soil was removed from areas with extra material on 6:1 side slopes and placed on the nine areas with thickness below 2.5-feet. The material was then compacted, and resurveyed. URS will confirm new thickness of the Native Soil at these locations on Monday (06/03/09).

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. NA

PROPOSED NEXT DAY ACTIVITIES (date: 08/03/09)

1. URS survey of nine low areas.

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DAILY SUMMARY REPORT

DATE: 08/03/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:20; (69 deg); Clear sky
WEATHER (PM): 1:06; (88 deg); Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Begin Construction of Topsoil
- URS QA Survey (Final 9 Locations)

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:21 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Topsoil Construction***
Construction began on the Topsoil Layer

B. ISSUES/COMMENTS

1. URS conducted the quality assurance final survey on the remaining nine locations as well as the 6:1 side slopes. EDi will need these areas approved before they continue construction in these areas.

2. EDi began construction of the Topsoil Layer on the areas previously approved by URS. EDi placed the topsoil using belly dumps and then spread the material using the grader. Care is taken not to over compact the topsoil layer.

3. EDi is not allowed to place topsoil around the nine locations awaiting approval from Don Lopez. Approval is expected tomorrow (8/4/09).

C. EQUIPMENT USED (See Appendix B For Equipment Description):

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 2132 CY of Topsoil was placed. See dwg_08/03/09_Construction_01

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Topsoil Inspection Forms

PROPOSED NEXT DAY ACTIVITIES (date: 08/04/09)

1. Continue construction of Topsoil
2. Approval of remaining nine locations.

DAILY SUMMARY REPORT

DATE: 08/04/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:49; (69 deg); Clear sky
WEATHER (PM): 1:45; (91 deg); Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Topsoil Layer
- URS Approval of final Native Soil Areas and Slopes

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:21 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Topsoil Construction***
The construction of the Topsoil layer continued today.

B. ISSUES/COMMENTTS
1. Construction of Topsoil Continued today from east to west

2. Don Lopez (URS) approved the remaining nine areas as well as the 6:1 slopes for topsoil construction. EDi may now place topsoil at these locations.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Approximately 1950 CY of Topsoil was placed. See dwg_08/04/09_Construction_01

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Topsoil Inspection Form

PROPOSED NEXT DAY ACTIVITIES (date: 08/05/09)

1. Continue construction of the Topsoil Layer
2. Begin placement of the Soil Vapor Monitoring Wells.

DAILY SUMMARY REPORT

DATE: 08/05/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:30; (69 deg); Clear sky
WEATHER (PM): 2:18; (94 deg); Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Topsoil Layer
- Begin Placement of Soil Vapor Monitoring Wells

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:21 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Topsoil Construction***
The construction of the Topsoil layer continued today.

B. ISSUES/COMMENTTS
1. Construction of Topsoil Continued today from east to west

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 2028 CY of Topsoil was placed. See dwg_08/06/09_Construction_01

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Install Soil Vapor Monitoring Wells***

Construction of the Soil Vapor Monitoring wells began today.

B. ISSUES/COMMENTS

1. The first geo-probe was bored to a depth of approximately 42.0-44.0-feet. The Geo-probe reached the caliche layer at a depth of approximately 37.0-40.0-feet. The caliche layer appeared to be a more difficult layer to penetrate then the Biointrusion Layer. The Biointrusion Layer was passed through with ease.

C. EQUIPMENT USED:

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. The first of the two probes was pushed down to approximately 43.0-feet. The additional well materials required for completion will arrive onsite tomorrow (08/06/09).

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Topsoil Forms

PROPOSED NEXT DAY ACTIVITIES (date: 08/06/09)

1. Continue the placement of the Soil Vapor Monitoring Wells.

2. Continue the construction of the Topsoil Layer. EDi is going to begin their CQ Survey.

DAILY SUMMARY REPORT

DATE: 08/06/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:31; (69 deg); Clear sky
WEATHER (PM): 1:54; (94 deg); Heavy rain @ 2:30 pm
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Topsoil Layer
- Continue installation of Soil Vapor Monitoring Wells

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:21 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Topsoil Construction***
The construction of the Topsoil layer continued today.

B. ISSUES/COMMENTTS
1. Construction of Topsoil Continued today from east to west

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 2106 CY of Topsoil was placed. See dwg_08/06/09_Construction_01.

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Instal Soil Vapor Monitoring Wells***

Construction of the Soil Vapor Monitoring Wells continued today.

B. ISSUES/COMMENTS

1. The installation of the first Soil Vapor Monitoring Well was completed today.

2. The installation of the second Soil Vapor Monitoring Well began today.

3. The first attempt at placing the second Soil Vapor Monitoring Well was unsuccessful due to "soil lock" in the casing. The casing was driven about 42.0-feet in depth and the polyethylene tubing and screen were placed to the desired depth. When the soil began to be placed down the casing it locked up causing a failure in the installation.

4. The second attempt of installing the second Soil Vapor Monitoring Well has begun. The casing has been driven down into the MWL about 42.0-feet. The installation will be completed tomorrow (08/07/09). The initial hole for the second attempt will be filled with Bentonite tomorrow.

C. EQUPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. The installation of the second Soil Vapor Monitoring Wells will be completed tomorrow (8/7/09).

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Topsoil Inspection Sheet

PROPOSED NEXT DAY ACTIVITIES (date: 08/07/09)

1. Continue the construction of the Topsoil Layer.
2. Complete soil vapor monitoring wells.

DAILY SUMMARY REPORT

DATE: 08/07/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:31; (69 deg); Clear sky
WEATHER (PM): 4:27; (92 deg); Heavy rain @ 2:30 pm
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Topsoil Layer
- Complete installation of Soil Vapor Monitoring Wells

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade
2. Sandia Borrow Pit (TA-3)

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:21 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Topsoil Construction***
The construction of the Topsoil layer continued today.

B. ISSUES/COMMENTTS

1. Construction of Topsoil Continued today from east to west. The topsoil placement was completed. The QA survey will be conducted on Monday (8/10/09).

2. The remaining soil in the Borrow Area was used before the Topsoil Layer on the west slope was completed. However, the Topsoil Layer has been placed at approximately a 1.4-foot thickness (1.0-foot thickness requirement) which allows for some of the already placed surface to be used to complete the West Slope.

3. EDi conducted survey of the completed areas on Topsoil Layer. Corrections are being made to high and low areas.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. Approximately 962 CY of Topsoil was placed. See dwg_08/07/09_Construction_01.

2. The Topsoil Layer placement is complete. The final QA survey (URS) will be conducted on Monday (08/10/09).

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Instal Soil Vapor Monitoring Wells***
Construction of the Soil Vapor Monitoring Wells was completed today.

B. ISSUES/COMMENTS
1. The installation of the second Soil Vapor Monitoring Well was completed today.

2. The hole created by the geo-probe for the initial failed attempt of the second Soil Vapor Monitoring Well was filled with Bentonite.

C. EQUIPMENT USED:
2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. The installation of the second Soil Vapor Monitoring Well was completed today.
2. Mike Saunders and WDC demobilized today.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED
1. Topsoil Inspection Sheet

PROPOSED NEXT DAY ACTIVITIES (date: 08/10/09)
1. Continue the construction of the Topsoil Layer.
2. Continue adjustment of the Topsoil Layer

3. EDi to conduct blue topping for surevey on Topsoil Layer.

DAILY SUMMARY REPORT

DATE: 08/10/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:20; (72 deg); Clear sky
WEATHER (PM): 11:47; (81 deg); Clear sky
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Topsoil Layer
- Blue top of Topsoil layer (EDi)

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:21 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Topsoil Construction***
The adjustment of the Topsoil layer continued today.

B. ISSUES/COMMENTTS

1. The Topsoil layer continued to be adjusted. Soil is being moved from thick areas to west slope.

2. The topsoil layer was blue topped by the EDi survey team to ensure accurate thickness and slopes. The Topsoil Layer was adjusted in preparation for the QA survey tomorrow (08/11/09) by URS.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. Final corrections and the QA survey (URS) will be conducted on Tuesday (08/11/09).

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. NA

PROPOSED NEXT DAY ACTIVITIES (date: 08/11/09)

1. Continue the adjustment of the Topsoil Layer.
2. QA survey (URS) to Topsoil Layer

DAILY SUMMARY REPORT

DATE: 08/11/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:40; (72 deg); Clear sky
WEATHER (PM): 4:05; (94 deg); Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue adjustment of Topsoil Layer
- Complete Topsoil blue topping (EDi)
- URS QA Survey

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:19 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Topsoil Construction***
The adjustment of the Topsoil layer continued today.

B. ISSUES/COMMENTTS

1. EDi completed adjustment to the Topsoil Layer and the blue topping of the Topsoil Layer.

2. URS was onsite to begin QA survey.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. EDi has completed the construction and blue topping of the Topsoil Layer. EDi will complete their survey tomorrow (8/12/09).

2. URS completed the QA survey of the Topsoil Layer.

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

MEETING

Marshall Nay and Paul Molina met with Mike Mitchell to discuss/coordinate the quarterly report. Mike presented Paul and Marshall with tasks to complete the quarterly report.

INSPECTION CHECKLISTS REQUIRED

1. Topsoil Inspection Sheet

PROPOSED NEXT DAY ACTIVITIES (date: 08/12/09)

1. Begin construction of sprinkler system.
2. EDi to complete survey.

DAILY SUMMARY REPORT

DATE: 08/12/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:42; (72 deg); Clear sky
WEATHER (PM): 2:05; (86 deg); Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- QA approval of Topsoil Layer (URS)
- Begin construction of Sprinkler System (Rain For Rent)
- Install casing, bollards, and concrete pads for soil vapor monitoring wells.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:19 AM
Attendees: See attached sign in sheet.
Procedure:
-(See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Topsoil Construction***
The construction of the Topsoil layer continued today.

B. ISSUES/COMMENTTS

1. Don Lopez approved the QA survey for the Topsoil Layer.

2. ASCI conducted final QC survey of the Topsoil Layer.

3. EDi scarified the Topsoil Layer to stimulate plant growth. The rippers on the back of the grater were used to scarify the surface per the CMIP.

C. EQUIPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. The Topsoil Layer was scarified to break up large dirt clouds and loosen the soil to stimulate seeding germination and plant growth.

2. QC (EDi) survey was completed today.

3. QA approval of Topsoil Layer today.

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Soil Vapor and MW-4 Monitoring Wells***

The installation of the concrete pads, casing, and bollards began today for the Soil Vapor Monitoring Wells.

B. ISSUES/COMMENTTS

1. The installation of the concrete pads, casing, and bollards began today for the Soil Vapor Monitoring Wells.

2. Hand tools were used to dig down to the Native Soil Surface for the installation of the casing. The casing was dug and placed down 3.0-feet below topsoil surface.

3. 5.0-foot bollards are being placed around the wells. The bollards will be placed at a depth of 2.0-feet below the Topsoil surface. This will leave 3.0-feet of bollard above the Topsoil surface.

4. 3x3-foot pads will be installed around the Soil Vapor Monitoring Well. 4x4-foot pads will be installed around Monitoring Well M-4.

C. EQUIPMENT USED (See Appendix B For Equipment Description):

2. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:

1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:

1. The installation will be continued tomorrow (08/13/09).

F. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

III.

A. TASK DESCRIPTION: ***Sprinkler System***

The construction of the Sprinkler System/Irrigation System began today.

B. ISSUES/COMMENTTS

1. Sandia has approved the modification for temporary water and seeding to the CMIP. The following is the modification:
    a. Uniform seeding rate of 80-pounds of seed mix per acre (4x CMIP)
    b. No fertilizer is to be added due to the timing (August) of seeding.
    c. Supplemental watering to assist seed germination and root development.

C. STATUS:

1. Irrigation pipe, sprinkler system, and materials were delivered to the site today. The installation of the sprinkler system will begin tomorrow (8/13/09).

D. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Topsoil Inspection Sheet

PROPOSED NEXT DAY ACTIVITIES (date: 08/13/09)

1. Complete the construction of the concrete pads, bollards, and casing for the Soil Vapor Monitoring Wells.
2. Installation of sprinkler system.

DAILY SUMMARY REPORT

DATE: 08/13/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 8:30; (75 deg); Cloudy
WEATHER (PM): 3:31; (88 deg); Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction of Sprinkler System
- Install casing, bollards, and concrete pads for soil vapor monitoring wells.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:00 – 7:19 AM
   Attendees: See attached sign in sheet.

Procedure:
-(See general description above)

DAILY TASK

I.

A. TASK DESCRIPTION: ***Soil Vapor and MW-4 Monitoring Wells***

The installation of the concrete pads, casing, and bollards continued today for the Soil Vapor Monitoring Wells.

B. ISSUES/COMMENTTS

1. The installation of the concrete pads, casing, and bollards continued today for the Soil Vapor Monitoring Wells and MW-4.

2. Hand tools were used to dig down to the Native Soil Surface for the installation of the casing. The casing was dug and placed down 3.0-feet below topsoil surface.

3. 5.0-foot bollards are being placed around the wells. The bollards will be placed at a depth of 2.0-feet below the Topsoil Layer surface. This will leave 3.0-feet of bollard above the Topsoil Layer surface.

4. 3x3-foot pads will be installed around the soil vapor monitoring well. 4x4-foot pads will be installed around monitoring well M-4.

C. EQUPMENT USED (See Appendix B For Equipment Description):
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

D. EQUIPMENT CALIBRATION CERTIFICATES:
1. Refer to Table 2-1 MWL Alternative Cover Construction Equipment Summary

E. STATUS:
1. The installation was completed today.

F. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Sprinkler System***

The construction of the sprinkle/irrigation system continued today. (Rain For Rent)

B. ISSUES/COMMENTTS
1. The sprinkler/irrigation system was inspected and installed across the surface today.

C. STATUS:
1. The sprinkler/irrigation system was inspected and installed across the surface today.

D. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED
1. NA

PROPOSED NEXT DAY ACTIVITIES (date: 08/14/09)
1. Continue installation and testing of the sprinkler/irrigation system.

DAILY SUMMARY REPORT

DATE: 08/14/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:30 am (63 deg); Partly Cloudy
WEATHER (PM): 3:00 pm (83 deg) partly Cloudy, Light rain
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Continue construction and testing of Sprinkler System

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:12 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Sprinkler System***
The construction of the Sprinkler System/Irrigation System continued today.

B. ISSUES/COMMENTTS

1. The sprinkler system installation was completed today. A total of 18 sprinkler lines were installed going from east to west across the MWL.

2. EDi adjusted the sprinkler system and tested a couple of areas. It was determined that all 18 sprinkler lines could be run at the same time if two ports of the fire hydrant were used.

3. There is concern that the sprinklers will not apply a large enough volume of water to the surface to provide 2-to-3-inches of penetration. A meeting is to be held with Jon Schermerhorn (AMEC) and Jennifer Payne (Sandia Biologist) to discuss.

C. STATUS:

1. The sprinkler system installation was completed today and Rain For Rent was able to demobilize.

D. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Topsoil Inspection Sheet

PROPOSED NEXT DAY ACTIVITIES (date: 08/17/09)

1. Continue testing of sprinkler system.

DAILY SUMMARY REPORT

DATE: 08/17/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:05; (64 deg); Partly cloudy
WEATHER (PM): 3:47; (90 deg) Partly cloudy, light rain
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- No work performed on cover today
- Sprinkler Meeting (Sandia and EDi)

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:00 – 7:11 AM
   Attendees: See attached sign in sheet.

Procedure:

- (See general description above)

DAILY TASK

I.

A. TASK DESCRIPTION: ***Sprinkler System***

Meeting with Sandia and EDi (URS not present).

B. ISSUES/COMMENTS:

1. Jon Schermerhorn (AMEC) had a meeting with Jennifer Payne (Sandia Biologist) to discuss watering issues. The main concern is that the sprinkler heads will not provide enough water to penetrate the Topsoil Layer a depth of approximately 3-inches. It was decided to remove the nozzles on every third sprinkler and test the lines to determine how many lines can be run with the change of volume.

C. STATUS:

1. Watering Schedule is yet to be determined.

D. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. NA

PROPOSED NEXT DAY ACTIVITIES (date: 08/18/09)

1. Continue testing of sprinkler system.

DAILY SUMMARY REPORT

DATE: 08/18/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:05; (62 deg); Partly cloudy
WEATHER (PM): 4:15; (93 deg) Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- No work performed on cover today
- Sprinkler Meeting (Sandia and EDi)

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:11 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Sprinkler System***
Meeting with Sandia and EDi (URS not present).

B. ISSUES/COMMENTS:

1. Jon Schermerhorn (AMEC) had a meeting with Jennifer Payne (Sandia Biologist) to discuss watering issues. The two of them tried different watering setups to determine the best watering schedule. Jon and Jennifer decided to leave on the (5/64) nozzle.

C. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. NA

PROPOSED NEXT DAY ACTIVITIES (date: 08/19/09)

1. Seeding Contractor to deliver grass seeds and begin mobilization.

DAILY SUMMARY REPORT

DATE: 08/19/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:05; (62 deg); Partly cloudy
WEATHER (PM): 4:15; (93 deg); Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Seeding was delivered and Contractor Mobilized (Lee Landscaping)

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:11 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Seeding***
Seeding of MWL

B. ISSUES/COMMENTS:

1. Lee Landscaping arrived onsite and mobilized.
2. Native Grass Seed was delivered and stored in the conex to keep dry.
3. Lee Landscaping removed rocks from around the Mixed Waste Landfill cover to prevent damage to equipment
4. Lee Landscaping has some equipment that did not pass inspection. They are required to bring out new equipment tomorrow (8/20/09)
5. The ends of the sprinkler system were removed so Lee Landscaping would be able to maneuver their equipment without damage to the sprinkler system. The sprinkler system ends will be placed back once the seeding is completed.

C. STATUS:
1. See issues/comments

D. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Seeding Inspection Forms

PROPOSED NEXT DAY ACTIVITIES (date: 08/20/09)

1. Scarify and break up clumps for seeding.

DAILY SUMMARY REPORT

DATE: 08/20/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:06; (61 deg); Partly cloudy
WEATHER (PM): 4:02; (93 deg) Partly cloudy, light rain
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Scarify/Till Topsoil surface for seeding.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:12 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Seeding***
Seeding of MWL

B. ISSUES/COMMENTS:

1. Lee Landscape tilled the Topsoil Surface with a tractor pulled till. The tractor scarified/tilled the cover, side slopes, and surrounding area in preparation for the seeding. The tractor excavated approximately 3-inches of soil and broke up clods larger then 4-inches in dimension.

C. STATUS:
1. Lee Landscapes began scarifying/tilling the topsoil surface. This procedure will be completed tomorrow (8/21/09).

D. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED
1. Seeding Inspection Forms

PROPOSED NEXT DAY ACTIVITIES (date: 08/21/09)

1. Scarify and brake up clumps for seeding.

DAILY SUMMARY REPORT

DATE: 08/21/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:15; (66 deg); Partly cloudy
WEATHER (PM): 4:03 pm (91 deg) Partly cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Scarify/Till Topsoil surface for seeding.

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 – 7:12 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Seeding***
Seeding of MWL

B. ISSUES/COMMENTS:

1. Lee landscape continued scarifying the Topsoil Surface with a tractor pulled till. The tractor scarified/tilled the cover, side slopes, and surrounding area in preparation for the seeding. The tractor pulled till excavated approximately 3-inches and broke up clods larger then 4-inches in dimension.
2. On the edges of the cover, the tilling was done perpendicular to the slope direction so water will not cause rills to develop.
3. Tilling of the Topsoil Layer surface was completed today.
4. The sprinkler ends were covered with plastic bags to prevent straw from clogging the sprinkler system.
5. Lee Landscapes also had personnel walk along the sprinkler pipe and break up clods that were too close to the system for the tiller to get.

C. STATUS:

1. Lee Landscapes finished scarifying/tilling the topsoil surface.

D. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Seeding Inspection Forms

PROPOSED NEXT DAY ACTIVITIES (date: 08/24/09)

1. Begin Seeding

DAILY SUMMARY REPORT

DATE: 08/24/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:15; (61 deg); Partly cloudy
WEATHER (PM): 4:03; (79 deg); Partly cloudy,
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- No construction occurred today due to heavy rain on Saturday night (8/23/09).

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:

Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:

1. Description: Morning Tailgate Meeting
   Time: 7:00 – 7:12 AM
   Attendees: See attached sign in sheet.

Procedure:

- (See general description above)

DAILY TASK

INSPECTION CHECKLISTS REQUIRED

PROPOSED NEXT DAY ACTIVITIES (date: 08/25/09)

1. Begin Seeding

DAILY SUMMARY REPORT

DATE: 08/25/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:01; (57 deg); Cloudy
WEATHER (PM): NA
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Seeding

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Mixed Waste Landfill Seeding***
The seeding for the Mixed Waste Landfill officially started today.

B. ISSUES/COMMENTTS

1. The volume of drill (80 lb/acre, see attached) seed can not be placed because of equipment constraints. It takes approximately 5 passes with the drill seed to spread the required volume of seed, which is causing more compaction to the scarified/tilled topsoil than desired. It was decided to spread half of the volume of seed (40-lb/acre) by hand and place the other half by making 2 passes with the drill seed.

2. No fertilizer is required due to time of year seeding is occurring (August).

3. Supplemental watering sprinkler system has already been installed.

F. STATUS:

1. Seed is being placed from north to south. Lee Landscapes will continue seeding tomorrow.

G. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Seeding Inspection Forms

PROPOSED NEXT DAY ACTIVITIES (date: 08/26/09)

1. Continue Seeding

DAILY SUMMARY REPORT

DATE: 08/26/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:01 am (57 deg); Cloudy
WEATHER (PM): 2:31 pm (78 deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Seeding

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Mixed Waste Landfill Seeding***
The seeding for the Mixed Waste Landfill continued today.

B. ISSUES/COMMENTTS

1. The volume of drill (80 lb/acre) seed cannot be placed because of equipment constraints. It takes approximately 5 passes with the drill seed to spread the required volume of seed, which is causing more compaction to the scarified/tilled topsoil than desired. It was decided to spread half of the volume of seed (40-lb/acre) by hand and place the other half by making 2 passes with the drill seed.

2. No fertilizer is required due to time of year seeding is occurring (August).

3. Supplemental watering sprinkler system has already been installed.

C. STATUS:

1. Seed continued being placed from north to south. Approximately 0.75-acres were covered with seed today. Lee Landscapes will continue seeding tomorrow.

D. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Seeding Inspection Forms

PROPOSED NEXT DAY ACTIVITIES (date: 08/27/09)

1. Continue Seeding

DAILY SUMMARY REPORT

DATE: 08/27/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:10; (58 deg); Cloudy
WEATHER (PM): 2:59; (75 deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Seeding

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Mixed Waste Landfill Seeding***
The seeding for the Mixed Waste Landfill continued today.

B. ISSUES/COMMENTTS

1. The volume of drill (80 lb/acre) seed cannot be placed because of equipment constraints. It takes approximately 5 passes with the drill seed to spread the required volume of seed, which is causing more compaction to the scarified/tilled topsoil then desired. It was decided to spread half of the volume of seed (40-lb/acre) by hand and place the other half by making 2 passes with the drill seed.

2. No fertilizer is required due to time of year seeding is occurring (August).

3. Supplemental watering sprinkler system has already been installed.

C. STATUS:

1. Seed continued being placed from north to south. Approximately 1.0-acres were covered with seed today. Lee Landscapes will continue seeding tomorrow.

D. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Seeding Inspection Forms

PROPOSED NEXT DAY ACTIVITIES (date: 08/28/09)

1. Continue Seeding
2. Lee Landscapes will begin placing and crimping straw

DAILY SUMMARY REPORT

DATE: 08/28/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:10; (58 deg); Cloudy
WEATHER (PM): 3:59; (89 deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Placing and crimping straw

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Mixed Waste Landfill Seeding***`
Straw began being placed and crimped into place.

B. ISSUES/COMMENTTS

1. Lee Landscapes began covering previously placed and drilled seed with straw. A blower was used to place straw over desired areas. The straw was then crimped into place.

2. The blower used to place the straw broke down at approximately 11:00 am and had to be taken offsite to be repaired.

C. STATUS:

1. Lee Landscapes will continue placing straw over placed seed on Monday.

D. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Seeding Inspection Forms

PROPOSED NEXT DAY ACTIVITIES (date: 08/31/09)

1. Lee Landscapes will begin placing and crimping straw

DAILY SUMMARY REPORT

DATE: 08/31/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:10; (56deg); Cloudy
WEATHER (PM): 4:02; (90 deg)
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Placing and crimping straw
- Installation of perimeter fence

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Mixed Waste Landfill Seeding***
Straw continued being placed and crimped into place.

B. ISSUES/COMMENTTS

1. Lee Landscapes continued covering previously placed and drilled seed with straw. A blower was used to place straw over desired areas. The straw was then crimped into place.

2. Rocks were applied to the crimper to add additional weight to the crimping process.

C. STATUS:

1. Straw was placed and crimped over preplaced seed.

D. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Installation of Fence Surrounding MWL***
ACME Began installing the MWL perimeter fence

B. ISSUES/COMMENTS
1. ACME began installing the MWL perimeter fence.

C. STATUS:
1. ACME began driving the post surrounding the MWL for fence. The corner post and gate posts for the barbed wire fence have been installed.

D. PICTURES OBTAINED
1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED
1. Seeding Inspection Forms

PROPOSED NEXT DAY ACTIVITIES (date: 09/01/09)
1. Lee Landscapes will continue placing and crimping straw

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DAILY SUMMARY REPORT

DATE: 09/01/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:10; (56deg); Cloudy
WEATHER (PM): 3:22; (85 deg); Rain, lightning warning, did not interfere with construction.
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Placing and crimping straw
- Seeding
- Installation of perimeter fence

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Mixed Waste Landfill Seeding***
Seed and straw continued being placed and crimped into place.

B. ISSUES/COMMENTTS

1. The volume of drill (80 lb/acre) seed cannot be placed because of equipment constraints. It takes approximately 5 passes with the drill seed to spread the required volume of seed, which is causing more compaction to the scarified/tilled topsoil than desired. It was decided to spread half of the volume of seed (40-lb/acre) by hand and place the other half by making 2 passes with the drill seed.

2. No fertilizer is required due to time of year seeding is occurring (August).

3. Supplemental watering sprinkler system has already been installed.

4. Lee landscapes continued covering previously placed and drilled seed with straw. A blower was used to place straw over desired areas. The straw was then crimped into place.

C. STATUS:

1. Straw was placed and crimped over preplaced seed.
2. Seed as placed and drilled on south cover and slope of MWL

D. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Installation of Fence Surrounding MWL***

ACME continued installing the MWL perimeter fence

B. ISSUES/COMMENTS

1. ACME continued installing the MWL perimeter fence and barbed wire.

C. STATUS:

1. ACME installed fence post around the north, east, and south sides of the MWL. Barbed wire was placed on the post across the south and east sides.

D. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Seeding Inspection Forms

PROPOSED NEXT DAY ACTIVITIES (date: 09/02/09)

1. Lee Landscapes will continue placing and crimping straw
2. Continue placing seed
3. Continue installation of fence.

DAILY SUMMARY REPORT

DATE: 09/02/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:10; (56deg); Cloudy
WEATHER (PM): 3:22; (85 deg); Cloudy
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Placing and crimping straw
- Seeding
- Installation of perimeter fence
- Survey of perimeter fence

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)

DAILY TASK

I.
A. TASK DESCRIPTION: ***Mixed Waste Landfill Seeding***
Seed and straw continued being placed and crimped into place.

B. ISSUES/COMMENTTS

1. The volume of drill (80 lb/acre) seed can not be placed because of equipment constraints. It takes approximately 5 passes with the drill seed to spread the required volume of seed, which is causing more compaction to the scarified/tilled topsoil than desired. It was decided to spread half of the volume of seed (40-lb/acre) by hand and place the other half by making 2 passes with the drill seed.

2. No fertilizer is required due to time of year seeding is occurring (August).

3. Supplemental watering sprinkler system has already been installed.

4. Lee Landscapes continued covering previously placed and drilled seed with straw. A blower was used to place straw over desired areas. The straw was then crimped into place.

C. STATUS:

1. The placement of seed and straw was completed today.
2. Lee Landscapes was able to demobilize today

D. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

II.

A. TASK DESCRIPTION: ***Installation of Fence Surrounding MWL/Fence Survey***

ACME continued installing the MWL perimeter fence

B. ISSUES/COMMENTS

1. ACME continued installing the MWL perimeter fence and barbed wire.
2. The gates were installed today.
3. EDi surveyed the fence post locations.

C. STATUS:

1. ACME completed the installation of the fence and was able to demobilize.
2. The survey of the fence was completed today.
3. The installation of the gates was completed today.

D. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

INSPECTION CHECKLISTS REQUIRED

1. Seeding Inspection Forms

PROPOSED NEXT DAY ACTIVITIES (date: 09/03/09)

1. Sprinkler system adjustment

DAILY SUMMARY REPORT

DATE: 09/03/09
PROJECT NAME: Sandia Mixed Waste Landfill
WEATHER (AM): 7:10; (56deg); Cloudy
WEATHER (PM): 3:22; (88 deg);
INSPECTED BY: Paul Molina (URS)

GENERAL DESCRIPTION:

- Sprinkler System
- Gate Locking ceremony

LOCATION OF CONSTRUCTION

1. Tech Area III, Sandia Mixed Waste Landfill, Existing Subgrade

LIST OF PERSONNEL:
Please see attached sign-in sheet/visitors log.

SUMMARY OF MEETINGS:
1. Description: Morning Tailgate Meeting
Time: 7:00 AM
Attendees: See attached sign in sheet.
Procedure:
- (See general description above)

DAILY TASK

I.

A. TASK DESCRIPTION: ***Sprinkler System***
The sprinkler system was restarted today.

B. ISSUES/COMMENTS
1. The sprinkler system was reconstructed and restarted today.

C. STATUS:
1. The irrigation pipes were re-connected and aligned. The bags were taken off of the sprinklers and the end pipes.

2. The irrigation pipes were flushed to remove straw and debris that may have gotten inside during the seeding and mulching process.

3. The sprinkler system was started and minor adjustments were made. The system ran for approximately two hours.

G. PICTURES OBTAINED

1. Pictures of this procedure were collected and filed.

GATE LOCKING CEREMONY

The gate locking ceremony started at approximately 3:00 pm. The site was officially locked and the project was completed at 3:30 pm.

PROPOSED NEXT DAY ACTIVITIES

1. NA

END

ATTACHMENT 4

Receiving Inspection Forms and Documentation

2005 Biointrusion Rock

PAUL PARKER CONSTRUCTION
P O BOX 459
LOS ALAMOS, NEW MEXICO 87544
PHONE: 505-662-7456 FAX 505-661-6168

November 21, 2005 — INVOICE# 05-1121

TO: Sandia National Laboratories
ATT: Armani Vadiee
MS 0214
P. O. Box 5800
Albuquerque, NM 87185-0214

****

PROJECT: Document NO.: 494326 — PAGE 1

DATE	DESCRIPTION	TOTAL TONS	PRICE PER TON	TOTAL
10/4/THRU 11/14/05	1" to 6" Cobble Stone Rock	8114.84	$26.00	$210,985.84
			TOTAL	**$210,985.84**
		NM	STATE TAX	$13,186.61
OCT 24,2005		TOTAL AMOOUNT DUE		**$224,172.45**

YOU MAY DEDUCT THE STATE TAX IF YOU FURNISH US WITH A NEW MEXICO NON TAXABLE CERTIFICATE.
OUR CRS NO.:01-736398-005

Non Tax Certificate # A-1504384-003

11/26/05 ROA CK# 1226013 210,985.84

PAUL PARKER CONSTRUCTION
P O BOX 459
LOS ALAMOS, NEW MEXICO 87544
PHONE: 505-662-7456 FAX 505-661-6168

October 24, 2005 INVOICE# 05-1021

TO: Sandia National Laboratories
ATT: Armani Vadiee
MS 0214
P. O. Box 5800
Albuquerque, NM 87185-0214

****

PROJECT: Document NO.: 494326

DATE	DESCRIPTION	TICKET NO	DRIVER	TOTAL TONS	PRICE PER TON	TOTAL
10/4/05	1" to 6" Cobble Stone Rock	13115	Joe	13.52	$26.00	$351.52
	1" to 6" Cobble Stone Rock	13116	Robin	21.30	$26.00	$553.80
	1" to 6" Cobble Stone Rock	13117	Paul	22.34	$26.00	$580.84
10/5/05	1" to 6" Cobble Stone Rock	13118	Justin	22.92	$26.00	$595.92
	1" to 6" Cobble Stone Rock	13119	Robin	23.52	$26.00	$611.52
	1" to 6" Cobble Stone Rock	13120	Robin	22.97	$26.00	$597.22
	1" to 6" Cobble Stone Rock	13121	Joe	13.32	$26.00	$346.32
	1" to 6" Cobble Stone Rock	13122	Joe	13.79	$26.00	$358.54
	1" to 6" Cobble Stone Rock	13123	Robin	23.14	$26.00	$601.64
	1" to 6" Cobble Stone Rock	13124	Justin	21.46	$26.00	$557.96
	1" to 6" Cobble Stone Rock	13125	Joe	13.21	$26.00	$343.46
10/6/05	1" to 6" Cobble Stone Rock	13126	Justin	21.32	$26.00	$554.32
	1" to 6" Cobble Stone Rock	13127	Robin	23.45	$26.00	$609.70
	1" to 6" Cobble Stone Rock	13128	void		$26.00	$0.00
	1" to 6" Cobble Stone Rock	13129	Joe	13.56	$26.00	$352.56
	1" to 6" Cobble Stone Rock	13130	Robin	22.34	$26.00	$580.84
	1" to 6" Cobble Stone Rock	13131	Justin	23.69	$26.00	$615.94
	1" to 6" Cobble Stone Rock	13132	Robin	23.49	$26.00	$610.74
	1" to 6" Cobble Stone Rock	13133	Justin	22.75	$26.00	$591.50
	1" to 6" Cobble Stone Rock	13134	Joe	13.91	$26.00	$361.66
	1" to 6" Cobble Stone Rock	13135	Justin	23.55	$26.00	$612.30
10/7/05	1" to 6" Cobble Stone Rock	13136	Robin	23.88	$26.00	$620.88
	1" to 6" Cobble Stone Rock	13137	Joe	14.03	$26.00	$364.78
	1" to 6" Cobble Stone Rock	13138	Justin	25.89	$26.00	$673.14
	1" to 6" Cobble Stone Rock	13139	Robin	21.65	$26.00	$562.90
	1" to 6" Cobble Stone Rock	13140	Joe	13.52	$26.00	$351.52
	1" to 6" Cobble Stone Rock	13141	Justin	22.79	$26.00	$592.54
	1" to 6" Cobble Stone Rock	13142	Robin	23.81	$26.00	$619.06
	1" to 6" Cobble Stone Rock	13143	Justin	25.06	$26.00	$651.56
	1" to 6" Cobble Stone Rock	13144	Justin	23.54	$26.00	$612.04
10/10/05	1" to 6" Cobble Stone Rock	13145	Joe	13.56	$26.00	$652.60
	1" to 6" Cobble Stone Rock	13146	Robin	25.10	$26.00	$349.70
	1" to 6" Cobble Stone Rock	13147	Joe	13.45	$26.00	$349.70
	1" to 6" Cobble Stone Rock	13148	Robin	24.23	$26.00	$629.98

	DOCUMENT #: 494326				PAGE #2	
10/11/05	1" to 6" Cobble Stone Rock	13149	Robin	24.88	$26.00	$646.88
	1" to 6" Cobble Stone Rock	13150	Joe	14.41	$26.00	$374.66
	1" to 6" Cobble Stone Rock	13151	Albert	23.68	$26.00	$615.68
	1" to 6" Cobble Stone Rock	13152	Tony	22.72	$26.00	$590.72
	1" to 6" Cobble Stone Rock	13153	Meek	14.15	$26.00	$367.90
	1" to 6" Cobble Stone Rock	13154	Robin	23.82	$26.00	$619.32
	1" to 6" Cobble Stone Rock	13155	Joe	13.21	$26.00	$343.46
	1" to 6" Cobble Stone Rock	13156	Albert	22.31	$26.00	$580.06
	1" to 6" Cobble Stone Rock	13157	Tony	24.55	$26.00	$638.30
	1" to 6" Cobble Stone Rock	13158	Robin	24.44	$26.00	$635.44
	1" to 6" Cobble Stone Rock	13159	Meek	13.25	$26.00	$344.50
	1" to 6" Cobble Stone Rock	13160	Tony	25.13	$26.00	$653.38
	1" to 6" Cobble Stone Rock	13161	Albert	23.72	$26.00	$616.72
	1" to 6" Cobble Stone Rock	13162	Joe	13.56	$26.00	$352.56
10/12/05	1" to 6" Cobble Stone Rock	13163	Robin	26.60	$26.00	$691.60
	1" to 6" Cobble Stone Rock	13164	Albert	23.58	$26.00	$613.08
	1" to 6" Cobble Stone Rock	13165	Joe	13.45	$26.00	$349.70
	1" to 6" Cobble Stone Rock	13166	Robin	23.58	$26.00	$613.08
	1" to 6" Cobble Stone Rock	13167	Joe	13.32	$26.00	$346.32
	1" to 6" Cobble Stone Rock	13168	Albert	22.49	$26.00	$584.74
	1" to 6" Cobble Stone Rock	13169	Robin	25.38	$26.00	$659.88
	1" to 6" Cobble Stone Rock	13170	Joe	13.46	$26.00	$349.96
	1" to 6" Cobble Stone Rock	13171	Albert	24.92	$26.00	$647.92
10/13/05	1" to 6" Cobble Stone Rock	13172	Tony	22.36	$26.00	$581.36
	1" to 6" Cobble Stone Rock	13173	Albert	23.17	$26.00	$602.42
	1" to 6" Cobble Stone Rock	13174	Joe	13.40	$26.00	$348.40
	1" to 6" Cobble Stone Rock	13175		24.53	$26.00	$637.78
	1" to 6" Cobble Stone Rock	13176	Albert	23.11	$26.00	$600.86
	1" to 6" Cobble Stone Rock	13177	Tony	24.12	$26.00	$627.12
	1" to 6" Cobble Stone Rock	13178	Robin	24.04	$26.00	$625.04
	1" to 6" Cobble Stone Rock	13179	Paul	22.67	$26.00	$589.42
	1" to 6" Cobble Stone Rock	13180	Albert	22.96	$26.00	$596.96
	1" to 6" Cobble Stone Rock	13181	Tony	22.46	$26.00	$583.96
10/14/05	1" to 6" Cobble Stone Rock	13182	Robin	23.25	$26.00	$604.50
	1" to 6" Cobble Stone Rock	13183	Tony	22.26	$26.00	$578.76
	1" to 6" Cobble Stone Rock	13184	Albert	22.22	$26.00	$577.72
	1" to 6" Cobble Stone Rock	13185	Robin	25.17	$26.00	$654.42
	1" to 6" Cobble Stone Rock	13186	Tony	22.93	$26.00	$596.18
	1" to 6" Cobble Stone Rock	13187	Albert	23.29	$26.00	$605.54
	1" to 6" Cobble Stone Rock	13188	Robin	24.22	$26.00	$629.72
	1" to 6" Cobble Stone Rock	13189	Tony	22.51	$26.00	$585.26
	1" to 6" Cobble Stone Rock	13190	Albert	23.56	$26.00	$612.56
10/17/05	1" to 6" Cobble Stone Rock	13191	Tony	22.15	$26.00	$575.90
	1" to 6" Cobble Stone Rock	13192	Joe	13.59	$26.00	$353.34
	1" to 6" Cobble Stone Rock	13193	Robin	25.06	$26.00	$651.56
	1" to 6" Cobble Stone Rock	13194	Matt	24.13	$26.00	$627.38
	1" to 6" Cobble Stone Rock	13195	Tony	22.31	$26.00	$580.06
	1" to 6" Cobble Stone Rock	13196	Robin	24.14	$26.00	$627.64
	1" to 6" Cobble Stone Rock	13197	Matt	21.83	$26.00	$567.58
	1" to 6" Cobble Stone Rock	13198	Joe	14.02	$26.00	$364.52
	1" to 6" Cobble Stone Rock	13199	Tony	25.20	$26.00	$655.20

	DOCUMENT #: 494326				PAGE #3	
10/18/05	1" to 6" Cobble Stone Rock	13200	Matt	22.99	$26.00	$597.74
	1" to 6" Cobble Stone Rock	13232	Robin	24.26	$26.00	$630.76
	1" to 6" Cobble Stone Rock	13233	Tony	24.10	$26.00	$626.60
	1" to 6" Cobble Stone Rock	13234	Tony	23.93	$26.00	$622.18
	1" to 6" Cobble Stone Rock	13235	Matt	22.57	$26.00	$586.82
	1" to 6" Cobble Stone Rock	13236	Robin	25.03	$26.00	$650.78
	1" to 6" Cobble Stone Rock	13237	Tony	23.56	$26.00	$612.56
	1" to 6" Cobble Stone Rock	13238	Matt	22.41	$26.00	$582.66
	1" to 6" Cobble Stone Rock	13239	Robin	23.92	$26.00	$621.92
	1" to 6" Cobble Stone Rock	13240	Tony	24.12	$26.00	$627.12
10/19/05	1" to 6" Cobble Stone Rock	13241	James	12.86	$26.00	$334.36
	1" to 6" Cobble Stone Rock	13242	Matt	22.51	$26.00	$585.26
	1" to 6" Cobble Stone Rock	13243	Robin	22.79	$26.00	$592.54
	1" to 6" Cobble Stone Rock	13244	Joe	13.99	$26.00	$363.74
	1" to 6" Cobble Stone Rock	13245	Tony	23.89	$26.00	$621.14
	1" to 6" Cobble Stone Rock	13246	J. Meek	15.30	$26.00	$397.80
	1" to 6" Cobble Stone Rock	13247	Robin	22.63	$26.00	$588.38
	1" to 6" Cobble Stone Rock	13248	Tony	22.88	$26.00	$594.88
	1" to 6" Cobble Stone Rock	13249	J. Meek	12.96	$26.00	$336.96
	1" to 6" Cobble Stone Rock	13250	Robin	25.04	$26.00	$651.04
	1" to 6" Cobble Stone Rock	13251	Joe	13.25	$26.00	$344.50
	1" to 6" Cobble Stone Rock	13252	Tony	26.02	$26.00	$676.52
	1" to 6" Cobble Stone Rock	13253	J. Meek	13.71	$26.00	$356.46
10/20/05	1" to 6" Cobble Stone Rock	13254	J. Meek	23.94	$26.00	$622.44
	1" to 6" Cobble Stone Rock	13255	Tony	25.46	$26.00	$661.96
	1" to 6" Cobble Stone Rock	13256	IDA	24.79	$26.00	$644.54
	1" to 6" Cobble Stone Rock	13257	Justin	23.91	$26.00	$621.66
	1" to 6" Cobble Stone Rock	13258	Albert	22.60	$26.00	$587.60
	1" to 6" Cobble Stone Rock	13259	Eloy	24.96	$26.00	$648.96
	1" to 6" Cobble Stone Rock	13260	Tony	23.48	$26.00	$610.48
	1" to 6" Cobble Stone Rock	13261	Justin	22.45	$26.00	$583.70
	1" to 6" Cobble Stone Rock	13262	Albert	23.56	$26.00	$612.56
	1" to 6" Cobble Stone Rock	13263	Matt	23.46	$26.00	$609.96
	1" to 6" Cobble Stone Rock	13264	Justin	21.92	$26.00	$569.92
	1" to 6" Cobble Stone Rock	13265	Tony	23.70	$26.00	$616.20
	1" to 6" Cobble Stone Rock	13266	Eloy	27.62	$26.00	$718.12
10/21/05	1" to 6" Cobble Stone Rock	13267	Matt	24.49	$26.00	$636.74
	1" to 6" Cobble Stone Rock	13268	Justin	23.50	$26.00	$611.00
	1" to 6" Cobble Stone Rock	13269	Tony	24.29	$26.00	$631.54
	1" to 6" Cobble Stone Rock	13270	Albert	24.96	$26.00	$648.96
	1" to 6" Cobble Stone Rock	13271	Eloy	27.71	$26.00	$720.46
	1" to 6" Cobble Stone Rock	13272	Justin	22.40	$26.00	$582.40
	1" to 6" Cobble Stone Rock	13273	Matt	24.98	$26.00	$649.48
	1" to 6" Cobble Stone Rock	13274	Justin	22.50	$26.00	$585.00
	1" to 6" Cobble Stone Rock	13275	Eloy	27.56	$26.00	$716.56
	1" to 6" Cobble Stone Rock	13276	Tony	23.87	$26.00	$620.62
	1" to 6" Cobble Stone Rock	13277	Matt	24.33	$26.00	$632.58
			TOTAL TONS	2832.49	TOTAL DUE:	$73,644.74

PAUL PARKER CONSTRUCTION
P O BOX 459
LOS ALAMOS, NEW MEXICO 87544
PHONE: 505-662-7456 FAX 505-661-6168

November 10, 2005 INVOICE# 05-1110

TO: Sandia National Laboratories
ATT: Armani Vadiee
MS 0214
P. O. Box 5800
Albuquerque, NM 87185-0214

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PROJECT: Document NO.: 494326 PAGE 1

DATE	DESCRIPTION	TICKET NO	DRIVER	TOTAL TONS	PRICE PER TON	TOTAL
10/24/05	1" to 6" Cobble Stone Rock	13278	Matt	22.01	$26.00	$572.26
	1" to 6" Cobble Stone Rock	13279	Eloy	26.11	$26.00	$678.86
	1" to 6" Cobble Stone Rock	13280	Albert	24.03	$26.00	$624.78
	1" to 6" Cobble Stone Rock	13281	Tony	26.82	$26.00	$697.32
	1" to 6" Cobble Stone Rock	13282	Robin	23.66	$26.00	$615.16
	1" to 6" Cobble Stone Rock	13283	P Jones	25.71	$26.00	$668.46
	1" to 6" Cobble Stone Rock	13284	Justin	23.45	$26.00	$609.70
	1" to 6" Cobble Stone Rock	13285	Albert	23.26	$26.00	$604.76
	1" to 6" Cobble Stone Rock	13286	Tony	23.98	$26.00	$623.48
	1" to 6" Cobble Stone Rock	13287	Eloy	28.96	$26.00	$752.96
	1" to 6" Cobble Stone Rock	13288	Robin	23.27	$26.00	$605.02
	1" to 6" Cobble Stone Rock	13289	Armenta	24.28	$26.00	$631.28
	1" to 6" Cobble Stone Rock	13290	P Jones	25.89	$26.00	$673.14
	1" to 6" Cobble Stone Rock	13291	Tony	25.44	$26.00	$661.44
	1" to 6" Cobble Stone Rock	13292	Armenta	23.37	$26.00	$607.62
	1" to 6" Cobble Stone Rock	13293	Justin	24.07	$26.00	$625.82
	1" to 6" Cobble Stone Rock	13294	P Jones	25.65	$26.00	$666.90
10/25/05	1" to 6" Cobble Stone Rock	13295	Justin	23.41	$26.00	$608.66
	1" to 6" Cobble Stone Rock	13296	Tony	23.20	$26.00	$603.20
	1" to 6" Cobble Stone Rock	13297	Albert	24.45	$26.00	$635.70
	1" to 6" Cobble Stone Rock	13298	Robin	22.42	$26.00	$582.92
	1" to 6" Cobble Stone Rock	13299	P Jones	26.31	$26.00	$684.06
	1" to 6" Cobble Stone Rock	13300	Tony	24.08	$26.00	$626.08
	1" to 6" Cobble Stone Rock	13301	Albert	25.11	$26.00	$652.86
	1" to 6" Cobble Stone Rock	13302	Justin	21.90	$26.00	$569.40
	1" to 6" Cobble Stone Rock	13303	Robin	25.95	$26.00	$674.70
	1" to 6" Cobble Stone Rock	13304	Eloy	27.98	$26.00	$727.48
	1" to 6" Cobble Stone Rock	13305	Tony	22.80	$26.00	$592.80
	1" to 6" Cobble Stone Rock	13306	P Jones	26.62	$26.00	$692.12
	1" to 6" Cobble Stone Rock	13307	Albert	23.97	$26.00	$623.22
	1" to 6" Cobble Stone Rock	13308	Justin	22.02	$26.00	$572.52
	1" to 6" Cobble Stone Rock	13309	Robin	23.32	$26.00	$606.32
	1" to 6" Cobble Stone Rock	13310	Tony	25.09	$26.00	$652.34
	1" to 6" Cobble Stone Rock	13311	P Jones	25.74	$26.00	$669.24
	1" to 6" Cobble Stone Rock	13312	Eloy	27.12	$26.00	$705.12

	DOCUMENT #: 494326				PAGE #2	
10/25/05	1" to 6" Cobble Stone Rock	13313	Albert	21.89	$26.00	$569.14
10/26/05	1" to 6" Cobble Stone Rock	13314	Tony	23.91	$26.00	$621.66
	1" to 6" Cobble Stone Rock	13315	Albert	24.51	$26.00	$637.26
	1" to 6" Cobble Stone Rock	13316	Eloy	28.84	$26.00	$749.84
	1" to 6" Cobble Stone Rock	13317	Albert	25.45	$26.00	$661.70
	1" to 6" Cobble Stone Rock	13318	Tony	27.99	$26.00	$727.74
	1" to 6" Cobble Stone Rock	13319	Robin	24.83	$26.00	$645.58
	1" to 6" Cobble Stone Rock	13320	James	13.43	$26.00	$349.18
	1" to 6" Cobble Stone Rock	13321	Justin	24.43	$26.00	$635.18
	1" to 6" Cobble Stone Rock	13322	Eloy	28.00	$26.00	$728.00
	1" to 6" Cobble Stone Rock	13323	P Jones	27.17	$26.00	$706.42
	1" to 6" Cobble Stone Rock	13324	Albert	23.57	$26.00	$612.82
	1" to 6" Cobble Stone Rock	13325	Tony	24.08	$26.00	$626.08
	1" to 6" Cobble Stone Rock	13326	James	13.51	$26.00	$351.26
	1" to 6" Cobble Stone Rock	13327	Robin	23.49	$26.00	$610.74
	1" to 6" Cobble Stone Rock	13328	Justin	23.24	$26.00	$604.24
	1" to 6" Cobble Stone Rock	13329	Eloy	26.55	$26.00	$690.30
	1" to 6" Cobble Stone Rock	13330	P Jones	26.51	$26.00	$689.26
	1" to 6" Cobble Stone Rock	13331	Albert	25.38	$26.00	$659.88
10/27/05	1" to 6" Cobble Stone Rock	13332	Robin	25.50	$26.00	$663.00
	1" to 6" Cobble Stone Rock	13333	P Jones	27.26	$26.00	$708.76
	1" to 6" Cobble Stone Rock	13334	Albert	23.26	$26.00	$604.76
	1" to 6" Cobble Stone Rock	13335	Eloy	27.37	$26.00	$711.62
	1" to 6" Cobble Stone Rock	13336	Matt	24.50	$26.00	$637.00
	1" to 6" Cobble Stone Rock	13337	Albert	23.13	$26.00	$601.38
	1" to 6" Cobble Stone Rock	13338	Eloy	28.64	$26.00	$744.64
	1" to 6" Cobble Stone Rock	13339	Tony	23.83	$26.00	$619.58
	1" to 6" Cobble Stone Rock	13340	P Jones	32.54	$26.00	$846.04
	1" to 6" Cobble Stone Rock	13341	Albert	23.47	$26.00	$610.22
	1" to 6" Cobble Stone Rock	13342	Robin	25.71	$26.00	$668.46
	1" to 6" Cobble Stone Rock	13343	Eloy	29.26	$26.00	$760.76
	1" to 6" Cobble Stone Rock	13344	Tony	24.72	$26.00	$642.72
	1" to 6" Cobble Stone Rock	13345	Matt	24.77	$26.00	$644.02
	1" to 6" Cobble Stone Rock	13346	P Jones	28.48	$26.00	$740.48
10/28/05	1" to 6" Cobble Stone Rock	13347	Robin	24.23	$26.00	$629.98
	1" to 6" Cobble Stone Rock	13348	Justin	23.60	$26.00	$613.60
	1" to 6" Cobble Stone Rock	13349	Eloy	27.20	$26.00	$707.20
	1" to 6" Cobble Stone Rock	13350	P Jones	26.03	$26.00	$676.78
	1" to 6" Cobble Stone Rock	13351	Robin	24.96	$26.00	$648.96
	1" to 6" Cobble Stone Rock	13352	Albert	25.03	$26.00	$650.78
	1" to 6" Cobble Stone Rock	13353	Justin	23.46	$26.00	$609.96
	1" to 6" Cobble Stone Rock	13354	Eloy	26.66	$26.00	$693.16
	1" to 6" Cobble Stone Rock	13355	P Jones	28.70	$26.00	$746.20
	1" to 6" Cobble Stone Rock	13356	Robin	25.20	$26.00	$655.20
	1" to 6" Cobble Stone Rock	13357	Justin	23.71	$26.00	$616.46
	1" to 6" Cobble Stone Rock	13358	Albert	23.31	$26.00	$606.06
	1" to 6" Cobble Stone Rock	13359	P Jones	28.45	$26.00	$739.70
	1" to 6" Cobble Stone Rock	13360	Eloy	27.28	$26.00	$709.28
10/31/05	1" to 6" Cobble Stone Rock	13361	Justin	23.54	$26.00	$612.04
	1" to 6" Cobble Stone Rock	13362	Paul Jones	28.43	$26.00	$739.18
	1" to 6" Cobble Stone Rock	13363	Eloy	27.25	$26.00	$708.50
	1" to 6" Cobble Stone Rock	13364	Albert	24.35	$26.00	$633.10
	1" to 6" Cobble Stone Rock	13365	Robin	22.14	$26.00	$575.64

	DOCUMENT NO: 494326				PAGE 3	
10/31/05	1" to 6" Cobble Stone Rock	13366	Paul Jones	26.19	$26.00	$680.94
	1" to 6" Cobble Stone Rock	13367	Albert	23.67	$26.00	$615.42
	1" to 6" Cobble Stone Rock	13368	Eloy	25.72	$26.00	$668.72
	1" to 6" Cobble Stone Rock	13369	Justin	23.73	$26.00	$616.98
	1" to 6" Cobble Stone Rock	13370	Paul Jones	26.78	$26.00	$696.28
	1" to 6" Cobble Stone Rock	13371	Robin	26.54	$26.00	$690.04
	1" to 6" Cobble Stone Rock	13372	Justin	23.43	$26.00	$609.18
	1" to 6" Cobble Stone Rock	13373	Albert	23.43	$26.00	$609.18
	1" to 6" Cobble Stone Rock	13374	Eloy	27.10	$26.00	$704.60
11/1/05	1" to 6" Cobble Stone Rock	13375	Paul Jones	29.08	$26.00	$756.08
	1" to 6" Cobble Stone Rock	13376	Albert	23.50	$26.00	$611.00
	1" to 6" Cobble Stone Rock	13377	Eloy	27.01	$26.00	$702.26
	1" to 6" Cobble Stone Rock	13378	Paul Jones	25.34	$26.00	$658.84
	1" to 6" Cobble Stone Rock	13379	Albert	25.20	$26.00	$655.20
	1" to 6" Cobble Stone Rock	13380	Paul Jones	26.30	$26.00	$683.80
	1" to 6" Cobble Stone Rock	13381	Eloy	28.00	$26.00	$728.00
	1" to 6" Cobble Stone Rock	13382	Albert	23.66	$26.00	$615.16
	1" to 6" Cobble Stone Rock	13383	Paul Jones	27.53	$26.00	$715.78
	1" to 6" Cobble Stone Rock	13384	Eloy	27.84	$26.00	$723.84
11/2/05	1" to 6" Cobble Stone Rock	13385	Albert	22.56	$26.00	$586.56
	1" to 6" Cobble Stone Rock	13386	Paul Jones	27.69	$26.00	$719.94
	1" to 6" Cobble Stone Rock	13387	Eloy	25.26	$26.00	$656.76
	1" to 6" Cobble Stone Rock	13388	Matt	12.54	$26.00	$326.04
	1" to 6" Cobble Stone Rock	13389	Tony	23.85	$26.00	$620.10
	1" to 6" Cobble Stone Rock	13390	Albert	24.61	$26.00	$639.86
	1" to 6" Cobble Stone Rock	13391	Paul Jones	24.18	$26.00	$628.68
	1" to 6" Cobble Stone Rock	13392	Tony	24.26	$26.00	$630.76
	1" to 6" Cobble Stone Rock	13393	Justin	24.28	$26.00	$631.28
	1" to 6" Cobble Stone Rock	13394	Eloy	26.32	$26.00	$684.32
	1" to 6" Cobble Stone Rock	13395	Albert	22.74	$26.00	$591.24
	1" to 6" Cobble Stone Rock	13396	Paul Jones	25.53	$26.00	$663.78
	1" to 6" Cobble Stone Rock	13397	Tony	22.87	$26.00	$594.62
	1" to 6" Cobble Stone Rock	13398	Justin	22.63	$26.00	$588.38
	1" to 6" Cobble Stone Rock	13399	Eloy	26.45	$26.00	$687.70
	1" to 6" Cobble Stone Rock	13400	Robin	23.12	$26.00	$601.12
11/3/05	1" to 6" Cobble Stone Rock	3448	Justin	22.54	$26.00	$586.04
	1" to 6" Cobble Stone Rock	3449	Albert	24.39	$26.00	$634.14
	1" to 6" Cobble Stone Rock	3450	Paul Jones	26.79	$26.00	$696.54
	1" to 6" Cobble Stone Rock	3451	Missing Ticket		$26.00	$0.00
	1" to 6" Cobble Stone Rock	3452	Eloy	27.48	$26.00	$714.48
	1" to 6" Cobble Stone Rock	3453	Justin	23.74	$26.00	$617.24
	1" to 6" Cobble Stone Rock	3454	Robin	23.29	$26.00	$605.54
	1" to 6" Cobble Stone Rock	3455	Paul Jones	25.91	$26.00	$673.66
	1" to 6" Cobble Stone Rock	3456	Albert	23.63	$26.00	$614.38
	1" to 6" Cobble Stone Rock	3457	Eloy	27.75	$26.00	$721.50
	1" to 6" Cobble Stone Rock	3458	Justin	22.63	$26.00	$588.38
	1" to 6" Cobble Stone Rock	3459	Paul Jones	24.50	$26.00	$637.00
	1" to 6" Cobble Stone Rock	3460	Albert	22.85	$26.00	$594.10
	1" to 6" Cobble Stone Rock	3461	Eloy	26.53	$26.00	$689.78
	1" to 6" Cobble Stone Rock	3462	Justin	22.53	$26.00	$585.78
11/4/05	1" to 6" Cobble Stone Rock	3463	Robin	23.31	$26.00	$606.06
	1" to 6" Cobble Stone Rock	3464	Tony	22.90	$26.00	$595.40
	1" to 6" Cobble Stone Rock	3465	Albert	22.31	$26.00	$580.06

	DOCUMENT NO: 494326				PAGE 4	
11/4/05	1" to 6" Cobble Stone Rock	3466	Tony	27.13	$26.00	$705.38
	1" to 6" Cobble Stone Rock	3467	Paul Jones	26.52	$26.00	$689.52
	1" to 6" Cobble Stone Rock	3468	Albert	23.80	$26.00	$618.80
	1" to 6" Cobble Stone Rock	3469	Justin	22.69	$26.00	$589.94
	1" to 6" Cobble Stone Rock	3470	Tony	23.88	$26.00	$620.88
	1" to 6" Cobble Stone Rock	3471	Paul Jones	25.14	$26.00	$653.64
	1" to 6" Cobble Stone Rock	3472	Justin	24.04	$26.00	$625.04
	1" to 6" Cobble Stone Rock	3473	Jaf	23.20	$26.00	$603.20
				TOTAL TONS		
				3672.62		
					TOTAL	**$95,488.12**
				NM	STATE TAX	$5,968.00
OCT 24,2005		PLUS STATE TAX DUE FROM INVOUCE 05-1021				$4,602.80
	YOU MAY DEDUCT THE STATE			TOTAL AMOOUNT DUE		**$106,058.92**
	TAX IF YOU FURNISH US WITH					
	A NEW MEXICO NON TAXABLE					
	CERTIFICATE.					
	OUR CRS NO.:01-736398-005					

PAUL PARKER CONSTRUCTION
P O BOX 459
LOS ALAMOS, NEW MEXICO 87544
PHONE: 505-662-7456 FAX 505-661-6168

November 17, 2005 INVOICE# 05-1117

TO: Sandia National Laboratories
ATT: Armani Vadiee
MS 0214
P. O. Box 5800
Albuquerque, NM 87185-0214

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PROJECT: Document NO.: 494326 PAGE 1

DATE	DESCRIPTION	TICKET NO	DRIVER	TOTAL TONS	PRICE PER TON	TOTAL
11/7/05	1" to 6" Cobble Stone Rock	13401	Paul Jones	25.76	$26.00	$669.76
	1" to 6" Cobble Stone Rock	13402	Eloy	27.22	$26.00	$707.72
	1" to 6" Cobble Stone Rock	13403	Tony	22.90	$26.00	$595.40
	1" to 6" Cobble Stone Rock	13404	Justin	22.96	$26.00	$596.96
	1" to 6" Cobble Stone Rock	13405	Albert	22.74	$26.00	$591.24
	1" to 6" Cobble Stone Rock	13406	Tony	23.87	$26.00	$620.62
	1" to 6" Cobble Stone Rock	13407	Paul Jones	25.47	$26.00	$662.22
	1" to 6" Cobble Stone Rock	13408	Eloy	26.71	$26.00	$694.46
	1" to 6" Cobble Stone Rock	13409	Tony	22.89	$26.00	$595.14
	1" to 6" Cobble Stone Rock	13410	Paul Jones	24.80	$26.00	$644.80
	1" to 6" Cobble Stone Rock	13411	Eloy	25.97	$26.00	$675.22
11/8/05	1" to 6" Cobble Stone Rock	13412	Paul Jones	25.31	$26.00	$658.06
	1" to 6" Cobble Stone Rock	13413	Tony	22.93	$26.00	$596.18
	1" to 6" Cobble Stone Rock	13414	J. Meek	13.90	$26.00	$361.40
	1" to 6" Cobble Stone Rock	13415	Justin	23.41	$26.00	$608.66
	1" to 6" Cobble Stone Rock	13416	Paul Jones	25.70	$26.00	$668.20
	1" to 6" Cobble Stone Rock	13417	P Jones	25.71	$26.00	$668.46
	1" to 6" Cobble Stone Rock	13418	Justin	23.69	$26.00	$615.94
11/9/05	1" to 6" Cobble Stone Rock	13419	Tony	23.76	$26.00	$617.76
	1" to 6" Cobble Stone Rock	13420	Albert	23.31	$26.00	$606.06
	1" to 6" Cobble Stone Rock	13421	P. Jones	25.67	$26.00	$667.42
	1" to 6" Cobble Stone Rock	13422	Eloy	25.53	$26.00	$663.78
	1" to 6" Cobble Stone Rock	13423	Justin	23.46	$26.00	$609.96
	1" to 6" Cobble Stone Rock	13424	Tony	23.24	$26.00	$604.24
	1" to 6" Cobble Stone Rock	13425	Albert	23.01	$26.00	$598.26
	1" to 6" Cobble Stone Rock	13426	Eloy	28.64	$26.00	$744.64
	1" to 6" Cobble Stone Rock	13427	Justin	27.98	$26.00	$727.48
	1" to 6" Cobble Stone Rock	13428	P. Jones	26.51	$26.00	$689.26
	1" to 6" Cobble Stone Rock	13429	Joe	13.69	$26.00	$355.94
	1" to 6" Cobble Stone Rock	13430	Albert	24.34	$26.00	$632.84
	1" to 6" Cobble Stone Rock	13431	Eloy	24.66	$26.00	$641.16
	1" to 6" Cobble Stone Rock	13432	Albert	23.69	$26.00	$615.94
11/10/05	1" to 6" Cobble Stone Rock	13433	Albert	25.09	$26.00	$652.34
	1" to 6" Cobble Stone Rock	13434	P Jones	27.67	$26.00	$719.42
	1" to 6" Cobble Stone Rock	13435	Eloy	26.94	$26.00	$700.44

	DOCUMENT #: 494326				PAGE #2	
11/10/05	1" to 6" Cobble Stone Rock	13436	Justin	24.25	$26.00	$630.50
	1" to 6" Cobble Stone Rock	13437	Albert	24.97	$26.00	$649.22
	1" to 6" Cobble Stone Rock	13438	Eloy	26.67	$26.00	$693.42
	1" to 6" Cobble Stone Rock	13439	Paul Jones	23.39	$26.00	$608.14
	1" to 6" Cobble Stone Rock	13440	Justin	23.39	$26.00	$608.14
	1" to 6" Cobble Stone Rock	13441	Eloy	26.37	$26.00	$685.62
	1" to 6" Cobble Stone Rock	13442	Paul Jones	24.07	$26.00	$625.82
	1" to 6" Cobble Stone Rock	13443	Justin	23.77	$26.00	$618.02
	1" to 6" Cobble Stone Rock	13444	Eloy	25.51	$26.00	$663.26
11/11/05	1" to 6" Cobble Stone Rock	13445	Paul Jones	25.68	$26.00	$667.68
	1" to 6" Cobble Stone Rock	13446	Albert	23.35	$26.00	$607.10
	1" to 6" Cobble Stone Rock	13447	Eloy	26.39	$26.00	$686.14
	1" to 6" Cobble Stone Rock	13448	Tony	22.86	$26.00	$594.36
	1" to 6" Cobble Stone Rock	13449	Justin	22.71	$26.00	$590.46
	1" to 6" Cobble Stone Rock	13450	Tony	21.27	$26.00	$553.02
	1" to 6" Cobble Stone Rock	13451	Eloy	26.72	$26.00	$694.72
	1" to 6" Cobble Stone Rock	13452	Albert	23.96	$26.00	$622.96
	1" to 6" Cobble Stone Rock	13453	P Jones	27.55	$26.00	$716.30
	1" to 6" Cobble Stone Rock	13454	Justin	23.51	$26.00	$611.26
	1" to 6" Cobble Stone Rock	13455	Tony	23.30	$26.00	$605.80
	1" to 6" Cobble Stone Rock	13456	Eloy	26.41	$26.00	$686.66
	1" to 6" Cobble Stone Rock	13457	Albert	23.84	$26.00	$619.84
	1" to 6" Cobble Stone Rock	13458	Paul Jones	25.94	$26.00	$674.44
	1" to 6" Cobble Stone Rock	13459	Justin	25.88	$26.00	$672.88
11/14/05	1" to 6" Cobble Stone Rock	13460	Paul Jones	24.24	$26.00	$630.24
	1" to 6" Cobble Stone Rock	13462	Robin	24.21	$26.00	$629.46
	1" to 6" Cobble Stone Rock	13463	Paul Jones	25.08	$26.00	$652.08
	1" to 6" Cobble Stone Rock	13464	Justin	21.03	$26.00	$546.78
	1" to 6" Cobble Stone Rock	13465	Elloy	24.90	$26.00	$647.40
	1" to 6" Cobble Stone Rock	13466	Paul Jones	24.88	$26.00	$646.88
	1" to 6" Cobble Stone Rock	13467	Robin	24.50	$26.00	$637.00
						$41,852.98
			TOTAL TONS:	1609.73		
					NM ST. TAX	$2,615.81
					TOTAL DUE	$44,468.79

2009 Biointrusion Rock

PAUL PARKER CONSTRUCTION
P O BOX 459
LOS ALAMOS, NEW MEXICO 8754
PHONE: 505-662-7456

DATE: JUNE 12,2009

INVOICE # 09-0612

TO: ENVIRONMENTAL DIMENSIONS INC.
P O BOX 6250
ALBUQUERQUE, NEW MEXICO 87197-6250

****

REFERENCE JOB # 288

DATE	MATERIAL	TICKET NO.	TONS	PRICE PER TON	JOB NAME	TOTAL
6/8/2009	3"-6" COBBLE	19063	22.19	$18.00	EDI SNL TECH 3	$399.42
6/8/2009	3"-6" COBBLE	19064	23.12	$18.00	EDI SNL TECH 3	$416.16
6/8/2009	3"-6" COBBLE	19065	23.45	$18.00	EDI SNL TECH 3	$422.10
6/8/2009	3"-6" COBBLE	19066	23.34	$18.00	EDI SNL TECH 3	$420.12
6/8/2009	3"-6" COBBLE	19067	21.98	$18.00	EDI SNL TECH 3	$395.64
6/8/2009	3"-6" COBBLE	19068	22.22	$18.00	EDI SNL TECH 3	$399.96
6/8/2009	3"-6" COBBLE	19069	22.32	$18.00	EDI SNL TECH 3	$401.76
6/8/2009	3"-6" COBBLE	19070	24.56	$18.00	EDI SNL TECH 3	$442.08
6/8/2009	3"-6" COBBLE	19071	22.91	$18.00	EDI SNL TECH 3	$412.38
6/9/2009	3"-6" COBBLE	19072	27.83	$18.00	EDI SNL TECH 3	$500.94
6/9/2009	3"-6" COBBLE	19073	22.65	$18.00	EDI SNL TECH 3	$407.70
6/9/2009	3"-6" COBBLE	19074	23.23	$18.00	EDI SNL TECH 3	$418.14
6/9/2009	3"-6" COBBLE	19076	26.16	$18.00	EDI SNL TECH 3	$470.88
6/9/2009	3"-6" COBBLE	19077	21.92	$18.00	EDI SNL TECH 3	$394.56
6/9/2009	3"-6" COBBLE	19078	24.53	$18.00	EDI SNL TECH 3	$441.54
6/9/2009	3"-6" COBBLE	19079	22.94	$18.00	EDI SNL TECH 3	$412.92
6/9/2009	3"-6" COBBLE	19080	23.87	$18.00	EDI SNL TECH 3	$429.66
6/9/2009	3"-6" COBBLE	19087	22.13	$18.00	EDI SNL TECH 3	$398.34
6/9/2009	3"-6" COBBLE	19089	24.96	$18.00	EDI SNL TECH 3	$449.28
6/9/2009	3"-6" COBBLE	19092	22.8	$18.00	EDI SNL TECH 3	$410.40
6/9/2009	3"-6" COBBLE	19093	25.34	$18.00	EDI SNL TECH 3	$456.12
6/9/2009	3"-6" COBBLE	19094	25.81	$18.00	EDI SNL TECH 3	$464.58
6/9/2009	3"-6" COBBLE	19095	24.54	$18.00	EDI SNL TECH 3	$441.72
6/9/2009	3"-6" COBBLE	19096	23.46	$18.00	EDI SNL TECH 3	$422.28
6/9/2009	3"-6" COBBLE	19097	21.92	$18.00	EDI SNL TECH 3	$394.56
6/9/2009	3"-6" COBBLE	19098	22.80	$18.00	EDI SNL TECH 3	$410.40
6/9/2009	3"-6" COBBLE	19101	24.84	$18.00	EDI SNL TECH 3	$447.12
6/9/2009	3"-6" COBBLE	19124	24.07	$18.00	EDI SNL TECH 3	$433.26
6/9/2009	3"-6" COBBLE	19186	23.09	$18.00	EDI SNL TECH 3	$415.62
6/9/2009	3"-6" COBBLE	19187	22.05	$18.00	EDI SNL TECH 3	$396.90
6/9/2009	3"-6" COBBLE	19197	23.61	$18.00	EDI SNL TECH 3	$424.98
6/9/2009	3"-6" COBBLE	19198	15.91	$18.00	EDI SNL TECH 3	$286.38

PAUL PARKER CONSTRUCTION						
P O BOX 459						
LOS ALAMOS, NEW MEXICO 8754						
PHONE: 505-662-7456						
DATE:	JUNE 12,2009					
				INVOICE #	09-0612	
						PAGE #2
6/12/2009	3"-6" COBBLE	19200	21.87	$18.00	EDI SNL TECH 3	$393.66
6/12/2009	3"-6" COBBLE	19131	26.10	$18.00	EDI SNL TECH 3	$469.80
6/12/2009	3"-6" COBBLE	19138	25.3	$18.00	EDI SNL TECH 3	$455.40
6/12/2009	3"-6" COBBLE	19139	25.07	$18.00	EDI SNL TECH 3	$451.26
6/12/2009	3"-6" COBBLE	19140	23.92	$18.00	EDI SNL TECH 3	$430.56
6/12/2009	3"-6" COBBLE	19141	23.98	$18.00	EDI SNL TECH 3	$431.64
6/12/2009	3"-6" COBBLE	19142	25.6	$18.00	EDI SNL TECH 3	$460.80
6/12/2009	3"-6" COBBLE	19143	24.97	$18.00	EDI SNL TECH 3	$449.46
6/12/2009	3"-6" COBBLE	19144	25.01	$18.00	EDI SNL TECH 3	$450.18
6/12/2009	3"-6" COBBLE	19145	24.78	$18.00	EDI SNL TECH 3	$446.04
6/12/2009	3"-6" COBBLE	19146	26.76	$18.00	EDI SNL TECH 3	$481.68
6/12/2009	3"-6" COBBLE	19147	24.66	$18.00	EDI SNL TECH 3	$443.88
6/12/2009	3"-6" COBBLE	19154	24.78	$18.00	EDI SNL TECH 3	$446.04
					MATERIALS	$19,248.30
	FREIGHT CHARGE	1069.35 TONS @$12.00 PER TON			FREIGHT CHARGE	$12,832.20
					NM STATE TAX	EXEMPT
					TOTAL DUE	$32,080.50
	TEMRS: FREIGHT CHARGE DUE 15 DAYS FROM DATE OF INVOICE					
	MATERIALS DUE 30 DAYS FROM DATE OF INVOICE					

PAUL PARKER CONSTRUCTION
P O BOX 459
LOS ALAMOS, NEW MEXICO 8754
PHONE: 505-662-7456

DATE: JUNE 15,2009

INVOICE # 09-0615

TO: ENVIRONMENTAL DIMENSIONS INC.
P O BOX 6250
ALBUQUERQUE, NEW MEXICO 87197-6250

REFERENCE JOB # 288

DATE	MATERIAL	TICKET NO.	TONS	PRICE PER TON	JOB NAME	TOTAL
6/11/09	3"-6" COBBLE	19099	26.43	$18.00	EDI SNL TECH 3	$475.74
6/11/09	3"-6" COBBLE	19102	25.98	$18.00	EDI SNL TECH 3	$467.64
6/11/09	3"-6" COBBLE	19103	24.87	$18.00	EDI SNL TECH 3	$447.66
6/11/09	3"-6" COBBLE	19104	22.59	$18.00	EDI SNL TECH 3	$406.62
6/11/09	3"-6" COBBLE	19105	26.23	$18.00	EDI SNL TECH 3	$472.14
6/11/09	3"-6" COBBLE	19106	24.02	$18.00	EDI SNL TECH 3	$432.36
6/11/09	3"-6" COBBLE	19107	24.35	$18.00	EDI SNL TECH 3	$438.30
6/11/09	3"-6" COBBLE	19108	24.58	$18.00	EDI SNL TECH 3	$442.44
6/11/09	3"-6" COBBLE	19109	24.64	$18.00	EDI SNL TECH 3	$443.52
6/11/09	3"-6" COBBLE	19110	26.5	$18.00	EDI SNL TECH 3	$477.00
6/11/09	3"-6" COBBLE	19111	24.7	$18.00	EDI SNL TECH 3	$444.60
6/11/09	3"-6" COBBLE	19112	25.25	$18.00	EDI SNL TECH 3	$454.50
6/11/09	3"-6" COBBLE	19113	27.46	$18.00	EDI SNL TECH 3	$494.28
6/11/09	3"-6" COBBLE	19114	27.13	$18.00	EDI SNL TECH 3	$488.34
6/11/09	3"-6" COBBLE	19115	27.72	$18.00	EDI SNL TECH 3	$498.96
6/11/09	3"-6" COBBLE	19116	25.78	$18.00	EDI SNL TECH 3	$464.04
6/11/09	3"-6" COBBLE	19118	25.52	$18.00	EDI SNL TECH 3	$459.36
6/11/09	3"-6" COBBLE	19119	24.59	$18.00	EDI SNL TECH 3	$442.62
6/11/09	3"-6" COBBLE	19120	24.35	$18.00	EDI SNL TECH 3	$438.30
6/11/09	3"-6" COBBLE	19122	24.45	$18.00	EDI SNL TECH 3	$440.10
6/11/09	3"-6" COBBLE	19123	25.62	$18.00	EDI SNL TECH 3	$461.16
6/11/09	3"-6" COBBLE	19121	23.10	$18.00	EDI SNL TECH 3	$415.80
6/11/09	3"-6" COBBLE	19133	23.63	$18.00	EDI SNL TECH 3	$425.34
6/11/09	3"-6" COBBLE	19135	24.22	$18.00	EDI SNL TECH 3	$435.96
6/11/09	3"-6" COBBLE	19137	26.04	$18.00	EDI SNL TECH 3	$468.72
	FREIGHT CHARGE	629.75 TONS @	$12.00 PER TON		MATERIALS	$11,335.50
					FREIGHT CHARGE	$7,557.00
					NM STATE TAX	EXEMPT
				PREVIOUS	BALANCE	$32,080.50
					TOTAL DUE	$50,973.00

TERMS: FREIGHT CHARGE DUE 15 DAYS FROM DATE OF INVOICE
MATERIALS DUE 30 DAYS FROM DATE OF INVOICE

P O BOX 459
LOS ALAMOS, NEW MEXICO 8754
PHONE: 505-662-7456

DATE: JUNE 15,2009

INVOICE # 09-0615-A

TO: ENVIRONMENTAL DIMENSIONS INC.
P O BOX 6250
ALBUQUERQUE, NEW MEXICO 87197-6250

****

REFERENCE JOB # 288 — PAGE # 1

DATE	MATERIAL	TICKET NO.	TONS	PRICE PER TON	JOB NAME	TOTAL
6/11/2009	3"-6" COBBLE	19100	25.88	$18.00	EDI SNL TECH 3	$465.84
6/11/2009	3"-6" COBBLE	19132	22.72	$18.00	EDI SNL TECH 3	$408.96
6/11/2009	3"-6" COBBLE	19136	26.48	$18.00	EDI SNL TECH 3	$476.64
6/11/2009	3"-6" COBBLE	19150	26.02	$18.00	EDI SNL TECH 3	$468.36
6/11/2009	3"-6" COBBLE	19151	24.67	$18.00	EDI SNL TECH 3	$444.06
6/11/2009	3"-6" COBBLE	19152	24.47	$18.00	EDI SNL TECH 3	$440.46
6/11/2009	3"-6" COBBLE	19153	26.11	$18.00	EDI SNL TECH 3	$469.98
		TONS	176.35		MATERIALS	**$3,174.30**
	FREIGHT CHARGE	176.35	$12.00 PER TON		FREIGHT CHARGE	**$2,116.20**

	PREVIOUS	**BALANCE** **$50,973.00**
TERMS: FREIGHT CHARGE DUE 15 DAYS FROM DATE OF INVOICE	Credit on Tickets	19038 & 19072 **-$60.86**
ERIALS DUE 30 DAYS FROM DATE OF INVOICE	Credit on Freight	**-$39.24**
	Credit on Ticket	19135 F&M **-$726.60**
		Sub Total $55,436.80
		NM STATE TAX **$3,534.10**
		TOTAL DUE **$58,970.90**

2009 Aggregate

Table 2

Material Receiving for 3/8" Crushed Gravel

Supplier	Material	Ticket #	Date Received	Quantity (tons)
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62474	6/29/2009	25.27
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62476	6/29/2009	26.08
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62477	6/29/2009	22.29
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62479	6/29/2009	25.42
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62485	6/29/2009	22.63
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62487	6/29/2009	25.75
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62616	6/29/2009	27.74
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62618	6/29/2009	27.86
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62624	6/29/2009	22.60
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62627	6/29/2009	26.39
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62645	6/29/2009	25.94
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62705	6/29/2009	27.04
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62709	6/29/2009	27.20
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62711	6/29/2009	22.17
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62730	6/29/2009	28.01
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62770	6/29/2009	27.55
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62774	6/29/2009	27.65
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62775	6/29/2009	22.29
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62880	6/30/2009	26.24
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62883	6/30/2009	23.05
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62892	6/30/2009	22.71
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62893	6/30/2009	22.76
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62895	6/30/2009	26.63
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	62898	6/30/2009	28.26
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63011	6/30/2009	27.74
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63014	6/30/2009	23.05
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63015	6/30/2009	22.78
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63018	6/30/2009	27.72
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63024	6/30/2009	22.29
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63037	6/30/2009	28.27
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63109	6/30/2009	27.74
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63111	6/30/2009	23.50
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63118	6/30/2009	21.52
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63124	6/30/2009	27.73
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63132	6/30/2009	25.46
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63136	6/30/2009	28.27
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63148	6/30/2009	27.79
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63150	6/30/2009	23.35
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63151	6/30/2009	22.02
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63152	6/30/2009	27.62
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63153	6/30/2009	26.82
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63194	7/1/2009	28.15
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63197	7/1/2009	22.70
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63200	7/1/2009	26.75
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63204	7/1/2009	26.64
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63220	7/1/2009	26.95
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63223	7/1/2009	23.31
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63230	7/1/2009	22.80
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63327	7/1/2009	21.74
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63330	7/1/2009	26.56

Supplier	Material	Ticket #	Date Received	Quantity (tons)
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63331	7/1/2009	25.92
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63341	7/1/2009	26.35
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63357	7/1/2009	27.45
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63361	7/1/2009	23.09
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63363	7/1/2009	22.69
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63428	7/1/2009	22.50
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63430	7/1/2009	27.02
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63434	7/1/2009	26.41
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63458	7/1/2009	27.03
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63460	7/1/2009	27.49
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63462	7/1/2009	22.28
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63481	7/1/2009	21.13
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63482	7/1/2009	27.63
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63483	7/1/2009	26.36
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63491	7/1/2009	22.00
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	63492	7/1/2009	27.64
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	65590	7/14/2009	27.90
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	65591	7/14/2009	24.54
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	65592	7/14/2009	26.93
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	65595	7/14/2009	24.41
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	65597	7/14/2009	26.57
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	65670	7/14/2009	27.80
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	65673	7/14/2009	24.79
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	65675	7/14/2009	24.19
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	65681	7/14/2009	27.78
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	65691	7/14/2009	27.68
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	65741	7/14/2009	23.40
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	65743	7/14/2009	26.07
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	65756	7/14/2009	26.09
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	65758	7/14/2009	27.59
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	65761	7/14/2009	28.41
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	65782	7/14/2009	26.10
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	67010	7/21/2009	27.33
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	67012	7/21/2009	23.59
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	67013	7/21/2009	23.39
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	67075	7/21/2009	26.88
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	67079	7/21/2009	23.69
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	67141	7/21/2009	26.74
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	67152	7/21/2009	22.07
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	67173	7/21/2009	27.52
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	67228	7/22/2009	23.75
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	67227	7/22/2009	23.81
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	67299	7/22/2009	23.15
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	67301	7/22/2009	23.78
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	67428	7/22/2009	23.81
Fisher Sand & Gravel Co.	3/8" Minus Crushed Gravel	67432	7/22/2009	24.12
			TOTAL	**2435.67**

2009 Seed and Mulch

RI-01
RECEIVING INSPECTION FORM
SEED/FERTILIZER/MULCH

Project Name: Sandia Mixed Waste Landfill
Weather: 62 low – 93 high
Material Name: Seed and Mulch
Transporter/Supplier: Lee Landscaping
Number of Bags/Bales: 26 Bags of seed (80 lb/Acre)

Date: 08/19/2009 Time: N A
Inspected By: Paul Molina (URS)
Delivery Shipment No. #1
Storage Location MWL Conex

	SPECIFICATION	MATERIAL RECEIVED	NOTE NO.
Supplier: Lee Landscape			
Supplier Designation: NA			
Material: Seed and Mulch			

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Checks before unloading:		
Have delivery tickets and QC certificates been provided for seed/fertilizer/mulch received?	YES	
Does the material description match the construction specifications?	YES	
Is the material free of damage?	YES	
Is the material acceptable for use?	YES	
Checks before unloading:		
Is the material free of damage?	YES	
Is the material properly stored?	YES	
Is the storage area free of water and/or moisture?	YES	

NOTES: No fertilizer required per design change due to time of year of seed placement.

2009 Seed Bag Labels

NOTE: The seed bag labels provided in this Attachment include copies of 23 seed bag labels. As stated on each label, the full order included 26 bags, with 25 containing 36.39 pounds of seed and 1 bag containing 10.48 pounds, for total of 926.23 pounds of seed.

Although the full order including 26 bags was received and inspected, 3 labels could not be located after receipt and inspection, and are not included in this attachment. Two of the missing labels were for 36.39 pound bags, and one was for the 10.48 pound bag.

MWL Seed Bag Label 1

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
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This Bag Weighs 36.39 Bulk Pounds
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Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
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Lee Landscaping
6.3225 Acre Custom Mix
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JOB: Sandia National Lab

Lot# M-9118

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Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
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6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
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JOB: Sandia National Lab

Lot# M-9118

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Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

MWL Seed Bag Label 2

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
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Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

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This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
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4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
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There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

MWL Seed Bag Label 3

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

MWL Seed Bag Label 4

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

MWL Seed Bag Label 5

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	23.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

MWL Seed Bag Label 6

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	25.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	25.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Curtis & Curtis Seed
4500 N. Prince
Clovis, NM 88101
Phone: 575-762-4759

Lee Landscaping
6.3225 Acre Custom Mix
4 Times the rate (80 PLS/Acre)
25 - .25 Acre Bags @ 36.39 Bulk Pounds Each
1 - .0725 Acre @ 10.48 Bulk Pounds
JOB: Sandia National Lab

Lot# M-9118

Item	Origin	Purity	Germ	Dormant	Germ & Dormant	Test Date	Total PLS Pounds
Galleta Viva	Texas	25.14%	95.00%	00.00%	95.00% (TZ)	07/09	202.3
Black Grama Nogal, Certified	Texas	21.95%	93.00%	00.00%	93.00% (TZ)	12/08	151.7
Sand Dropseed Not Stated	New Mexico	08.87%	17.00%	76.00%	93.00%	03/09	075.9
Spike Muhly El Vado	Wyoming	11.69%	56.50%	14.00%	70.50%	02/09	075.9

Other Crop: 00.15%
Weed Seed: 00.05%
Inert Matter: 34.15%

There Are 26 Bags For This Mix
This Bag Weighs 36.39 Bulk Pounds
Use This Bag For .25 Acres

Total Bulk Pounds: 920.225

ATTACHMENT 5

Construction Inspection Forms

2006 Construction Inspection Forms

CI-01
CONSTRUCTION INSPECTION FORM
EXISTING LANDFILL SURFACE AND PERIMETER CLEAR AND GRUB FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover CQA Date 10-25-06 Time 1330

Weather Mostly Cloudy Inspected by Corey Woods

Compaction Equipment Smooth Drum Roller

Surface area and location covered during shift Existing landfill surface and perimeter

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have all shrubs, grass, roots, and other vegetation been completely cleared and grubbed from the landfill surface and perimeter?	YES	
Has the landfill surface and perimeter been inspected to ensure that all loose or soft zones have been properly compacted?	YES	1
Has the landfill surface and perimeter been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	1

NOTES:

① Compaction testing at 5 tests/Acre will be conducted to ensure adequate coverage of compaction equipment.

CQA Inspector Signature [signature] CQA Engineer Signature [signature]

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MVL Cover CQA
Inspected by Corey Woods
Borrow Area West of CAMU
Weather Clear, Cool

Date 10/30/06 Time 1430
Max Dry Density (pcf) 113.2
Optimum Moisture (%) 10.9

Compaction Equipment Smooth Drum Roller

Fill Description 2" Minus screened subgrade stockpile

Volume and location of soil placed during shift 120 cy, Low-lying areas of Northern half of unclassified Area, Lift 1

Surface area and location covered during shift Low-lying areas, northern half of unclassified area, See Lift Maps

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	NO	1
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	2

NOTES:

① Survey crew having problems matching data points to Sandia data. Elevations were surveyed, but grid will be completed at a later date.

② Compaction tests will be conducted to ensure adequate coverage.

CQA Inspector Signature [signature]

CQA Engineer Signature Kelly M Pickel

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWA Cover CQA
Inspected by Cory Woods
Borrow Area West of CAMU
Weather Clear, cool

Date 10/31/06 Time 1400
Max Dry Density (pcf) 113.2
Optimum Moisture (%) 10.9

Compaction Equipment Smooth Drum Roller

Fill Description 2" minus screened subgrade stockpile

Volume and location of soil placed during shift 240 cy, low-lying areas of northern half of unclassified area, lifts 2, 3, 4

Surface area and location covered during shift low-lying areas, northern half of unclassified area, see lift maps.

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	NO	1
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	2

NOTES:

① Survey crew having problems matching data points to saved data. Elevations were surveyed, but grid will be completed at a later date.

② Compaction tests will be conducted to ensure adequate coverage

CQA Inspector Signature [signature]

CQA Engineer Signature [signature]

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWC Cover CQA
Inspected by Corey Woods
Borrow Area West of CAMU
Weather Clear, Warm

Date 11/1/06 Time 1130

Max Dry Density (pcf) 113.2
Optimum Moisture (%) 10.9

Compaction Equipment Smooth Drum Roller

Fill Description 2" Minus screened subgrade stockpile

Volume and location of soil placed during shift 364 cy, low-lying areas of northern half of unclassified area, Lifts 4 and 5

Surface area and location covered during shift Low-lying areas, northern half of unclassified area, see lift maps

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	1

NOTES:

1 Coverage will be verified with compaction testing

CQA Inspector Signature [signature]

CQA Engineer Signature Kelly M Rich

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover CQA
Inspected by Corey Woods
Borrow Area West of CAMU
Weather Clear, Warm

Date 11/2/06 Time 1400

Max Dry Density (pcf) 113.2
Optimum Moisture (%) 10.9

Compaction Equipment Smooth Drum Roller

Fill Description 2" Minus screened subgrade stockpile

Volume and location of soil placed during shift 412 cy, low-lying areas of unclassified area, Lift 6

Surface area and location covered during shift Low-lying areas of unclassified area, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	1

NOTES:

1) Coverage verified with compaction testing.

CQA Inspector Signature [signature]

CQA Engineer Signature Kelly M Rich

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover CQA
Inspected by Corey Woods
Borrow Area West of CAMU
Weather Clear, Warm

Date 11/6/06 Time 1100

Max Dry Density (pcf) 113.3
Optimum Moisture (%) 13.2

Compaction Equipment Smooth Drum Roller

Fill Description 2" Minus subgrade stockpile

Volume and location of soil placed during shift 476 cy total, 100 cy Lift 7, 376 cy Lift 8, see Lift Maps

Surface area and location covered during shift Lifts 7 and 8, see Lift Maps

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	1

NOTES:

1) coverage verified by compaction testing

CQA Inspector Signature [signature]

CQA Engineer Signature [signature]

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover CQA
Inspected by Corey Woods
Borrow Area West of CAMU
Weather Clear, Warm

Date 11/7/06 Time 0930

Max Dry Density (pcf) 113.3 / 117.4
Optimum Moisture (%) 13.2 / 12.9

Compaction Equipment Smooth Drum Roller

Fill Description 2" Minus subgrade stockpile

Volume and location of soil placed during shift 344 cy Lift 9, see Lift Map

Surface area and location covered during shift Lift 9, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	1

NOTES:

① Coverage verified by compaction testing

CQA Inspector Signature [signature]

CQA Engineer Signature [signature]

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover CQA
Inspected by Corey Woods
Borrow Area West of CAMU
Weather Clear, Warm

Date 11/8/06 Time 1030

Max Dry Density (pcf) 117.4
Optimum Moisture (%) 12.9

Compaction Equipment Smooth Drum Roller

Fill Description 2" Minus Subgrade stockpile

Volume and location of soil placed during shift 576 cy, Lifts 9 and 10, See lift Maps
316 cy placed on Lift 9 (Completed), 260 cy on Lift 10

Surface area and location covered during shift Lifts 9 & 10, see Lift Maps

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	1

NOTES:

1) Coverage verified with compaction testing

CQA Inspector Signature [signature]

CQA Engineer Signature Kelly M Rice

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover CQA
Inspected by Corey Woods
Borrow Area West of CAMU
Weather Clear, warm

Date 11/9/06 Time 1500

Max Dry Density (pcf) 118.3 / 118.7
Optimum Moisture (%) 12.7 / 12.4

Compaction Equipment Smooth Drum Roller

Fill Description 2" Minus subgrade stockpile

Volume and location of soil placed during shift 496 cy, Lift 10, see Lift Map

Surface area and location covered during shift Lift 10, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	No	1

NOTES:

① coverage verified with compaction testing

CQA Inspector Signature [signature]

CQA Engineer Signature Kelly M Rice

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWC Cover CQA
Inspected by Corey Woods
Borrow Area west of CAMU
Weather Overcast, Cool

Date 11/13/06 Time 1430

Max Dry Density (pcf) 119.0
Optimum Moisture (%) 11-2

Compaction Equipment Smooth Drum Roller

Fill Description 2" Minus subgrade Stockpile

Volume and location of soil placed during shift 580 cy, Lift 10, see Lift Map

Surface area and location covered during shift Lift 10, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	1

NOTES:

① Coverage verified with compaction testing.

CQA Inspector Signature [signature]

CQA Engineer Signature Kelly M Rich

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name GWC Cover CQA
Inspected by Cory Woods
Borrow Area West of CCAMU
Weather Overcast, cold, windy

Date 11/14/06 Time 0830

Max Dry Density (pcf) 115.4
Optimum Moisture (%) 12.9

Compaction Equipment Smooth Drum Roller

Fill Description 2" Minus subgrade stockpile

Volume and location of soil placed during shift 280 c.y. completed Lift 10, see lift Map

Surface area and location covered during shift Lift 10, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	1

NOTES:

1) Coverage verified with compaction testing

CQA Inspector Signature [signature]

CQA Engineer Signature Kelly M Pirl

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover CQA
Inspected by Corey Woods
Borrow Area West of CTMU
Weather Clear, cool

Date 11/15/06 Time 1430

Max Dry Density (pcf) 115.4 / 116.5
Optimum Moisture (%) 12.5 / 13.0

Compaction Equipment Smooth Drum Roller

Fill Description 2" Minus subgrade stockpile

Volume and location of soil placed during shift 5720 cy, Lift 11, see Lift Map

Surface area and location covered during shift Lift 11, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	1

NOTES:

① Coverage verified with compaction tests

CQA Inspector Signature [signature]

CQA Engineer Signature [signature]

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL cover CQA
Inspected by Corey Woods
Borrow Area West of CAMU
Weather Overcast, cool

Date 11/16/06 Time 1000

Max Dry Density (pcf) 116.5 / 113.5
Optimum Moisture (%) 13.0 / 13.0

Compaction Equipment Smooth Drum Roller

Fill Description 2" Minus subgrade stockpile

Volume and location of soil placed during shift 464 cubic yards, Lift 11, see Lift Map.
200 cy proctor MWL-SG-008, 264 cy proctor MWL-SG-009

Surface area and location covered during shift Lift 11, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	1

NOTES:

(1) Coverage verified with compaction testing

CQA Inspector Signature [signature]

CQA Engineer Signature [signature]

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover CQA
Inspected by Corey Woods
Borrow Area West of CAMU
Weather Clear, Warm

Date 11/20/06 Time 1400

Max Dry Density (pcf) 113.5 / 113.6
Optimum Moisture (%) 13.0 / 12.6

Compaction Equipment Smooth Drum Roller

Fill Description 2" Minus Subgrade stockpile

Volume and location of soil placed during shift 624 cy total, (236 proctor MWL-SG-009, 388 proctor MWL-SG-010), Lift 11, see Lift Map

Surface area and location covered during shift Lift 11, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	

NOTES:

CQA Inspector Signature [signature]

CQA Engineer Signature [signature]

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name NWC Cover CQA
Inspected by Cory Woods
Borrow Area West of CAMU
Weather Clear, warm

Date 11/20/06 Time 1400

Max Dry Density (pcf) 113.6 / 116.0
Optimum Moisture (%) 12.6 / 12.3

Compaction Equipment Smooth Drum Roller

Fill Description 2" Minus subgrade stockpile

Volume and location of soil placed during shift 856 cy total (112 cy proctor 010, 500 cy proctor 013, 244 cy proctor 014). Lift 11, see Lift Map

Surface area and location covered during shift Lift 11, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	

NOTES:

CQA Inspector Signature

CQA Engineer Signature Kelly M Pond

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover CQA
Inspected by Cory Woods
Borrow Area West of CAMU
Weather Clear, warm

Date 11/22/06 Time 1000
Max Dry Density (pcf) 117.9
Optimum Moisture (%) 13.0

Compaction Equipment Smooth Drum Roller

Fill Description 2" Minus subgrade stockpile

Volume and location of soil placed during shift 56 cy (Proctor MWL-SG-014) completed Lift 11

Surface area and location covered during shift Lift 11, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	

NOTES:

CQA Inspector Signature [signature]

CQA Engineer Signature [signature]

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover CQA
Inspected by Corey Woods
Borrow Area West of CAMU
Weather overcast

Date 11/28/06 Time 1300

Max Dry Density (pcf) 117.9
Optimum Moisture (%) 13.0

Compaction Equipment Smooth Drum Roller

Fill Description 2" Minus subgrade stockpile

Volume and location of soil placed during shift 284 cy (Proctor 014), began Lift 12

Surface area and location covered during shift Began Lift 12, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	

NOTES:

CQA Inspector Signature [signature]

CQA Engineer Signature Kelly M Pond

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover CQA
Inspected by Corey Woods
Borrow Area West of CAMU
Weather Cold / Snow

Date 11/29/06 Time 1400
Max Dry Density (pcf) 118.1
Optimum Moisture (%) 13.3

Compaction Equipment Smooth Drum Roller

Fill Description 2" Minus subgrade stockpile

Volume and location of soil placed during shift 648 cy (Proctor 015), Lift 12

Surface area and location covered during shift Lift 12, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	

NOTES:

CQA Inspector Signature

CQA Engineer Signature Kelly M Rust

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover CQA
Inspected by Corey Woods
Borrow Area West of CAMU
Weather Clear, Cool

Date 12/4/2006 Time 1030
Max Dry Density (pcf) 118.4
Optimum Moisture (%) 12.7

Compaction Equipment Smooth Drum Roller

Fill Description 2" Minus screened subgrade

Volume and location of soil placed during shift 160 cy, Lift 12, see Lift Map, Proctor 020

Surface area and location covered during shift Lift 12, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	

NOTES:

CQA Inspector Signature _____

CQA Engineer Signature Kelly M Pinel

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover - CQA
Inspected by Cory Woods
Borrow Area West of CAMU
Weather Clear, Cool

Date 12/5/06 Time 1430
Max Dry Density (pcf) 118.4
Optimum Moisture (%) 12.7

Compaction Equipment Smooth Drum Vibratory Roller

Fill Description 2" Minus screened subgrade

Volume and location of soil placed during shift 340 cy, Lift 12, see Lift Map, Proctor 020

Surface area and location covered during shift Lift 12, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	

NOTES:

CQA Inspector Signature [signature]

CQA Engineer Signature [signature]

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover CQA
Inspected by Cory Woods
Borrow Area West of CAMU
Weather Clear, Cool

Date 12/6/06 Time 1100

Max Dry Density (pcf) 112.4
Optimum Moisture (%) 13.6

Compaction Equipment Smooth Drum Vibratory Roller

Fill Description 2" Minus screened subgrade

Volume and location of soil placed during shift 460 cy, Lift 12, see Lift Map, Proctor 019

Surface area and location covered during shift Lift 12, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	

NOTES:

CQA Inspector Signature

CQA Engineer Signature Kelly M Pond

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover-CQA
Inspected by Cory Woods
Borrow Area West of CAMU
Weather Clear, Cool

Date 12/7/06 Time 1400
Max Dry Density (pcf) 119.0
Optimum Moisture (%) 12.0

Compaction Equipment Smooth Drum Vibratory Roller

Fill Description 2" Minus Screened subgrade

Volume and location of soil placed during shift 492 cy, Lift 12, See Lift Map, Proctor 021

Surface area and location covered during shift Lift 12, See Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	

NOTES:

CQA Inspector Signature [signature]

CQA Engineer Signature [signature]

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MNL Cover CQA
Inspected by Corey Woods
Borrow Area West of CAMU
Weather Clear, Cool

Date 12/11/06 Time 1500

Max Dry Density (pcf) 115.9
Optimum Moisture (%) 12.2

Compaction Equipment Smooth Drum Vibratory Roller

Fill Description 2" Minus Screened subgrade

Volume and location of soil placed during shift 220 cy, Lift 12, see Lift Map, Proctor 022

Surface area and location covered during shift Lift 12, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	

NOTES:

CQA Inspector Signature [signature]

CQA Engineer Signature Kelly M Reid

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover CQA
Inspected by Corey Woods
Borrow Area West of CAMU
Weather Clear, warm

Date 12/14/06 Time 1000

Max Dry Density (pcf) 115.9 / 117.9
Optimum Moisture (%) 12.2 / 12.1

Compaction Equipment Smooth Drum Vibratory Roller

Fill Description 2" Mono screened subgrade

Volume and location of soil placed during shift 440 CY, Lift 12, see Lift Map (280 cy Proctor 022, 160 cy Proctor 023)

Surface area and location covered during shift Lift 12, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	

NOTES:

CQA Inspector Signature [signature]

CQA Engineer Signature Kelly M Pierce

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover CQA
Inspected by Corey Woods
Borrow Area West of CAMU
Weather Clear, warm

Date 12/15/06 Time 1000

Max Dry Density (pcf) 117.9 / 116.5
Optimum Moisture (%) 12.1 / 12.0

Compaction Equipment Smooth Drum Vibratory Roller

Fill Description 2" Minus screened subgrade

Volume and location of soil placed during shift 512 cy, cell 12, see cell Map. (340 cy Proctor 023, 172 cy Proctor 024)

Surface area and location covered during shift Cell 12, see Cell Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	

NOTES:

CQA Inspector Signature [signature]

CQA Engineer Signature Kelly M Reid

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover CQA
Inspected by Corey Woods
Borrow Area West of CAMU
Weather Overcast, cold, windy

Date 12/18/06 Time 1000
Max Dry Density (pcf) 116.5
Optimum Moisture (%) 12.0

Compaction Equipment Smooth Drum Vibratory Roller

Fill Description 2" Minus screened subgrade

Volume and location of soil placed during shift 788 cy, Lift 12, See Lift Map

Surface area and location covered during shift Lift 12, See Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	

NOTES:

CQA Inspector Signature

CQA Engineer Signature Kelly M Pail

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL Cover CQA
Inspected by Cory Woods
Borrow Area West of CAMU
Weather Cold, Windy, Intermittent snow

Date 12/19/06 Time 1030
Max Dry Density (pcf) _____
Optimum Moisture (%) _____

Compaction Equipment Smooth Drum Vibratory Roller

Fill Description 2" Minus subgrade stockpile

Volume and location of soil placed during shift ~~ea, Lift 12, see Lift Map~~ (a)
Completed final grade on Lift 12 (Final subgrade Lift)

Surface area and location covered during shift Lift 12, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?	YES	
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?	YES	
Have TA-3 borrow soils been determined to be suitable for subgrade fill?	YES	
Has approved fill been used during subgrade construction?	YES	
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	YES	
Has the number of passes and the coverage of the compaction equipment been documented?	NO	

NOTES: Completed subgrade installation.

CQA Inspector Signature _____ CQA Engineer Signature _____

CI-02
CONSTRUCTION INSPECTION FORM
SUBGRADE FILL FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name MWL
Inspected by KMP
Borrow Area
Weather clear / sunny - breezy

Date 11 Apr 07 Time 10 AM
Max Dry Density (pcf)
Optimum Moisture (%)

Compaction Equipment N A

Fill Description N A

Volume and location of soil placed during shift N A

Surface area and location covered during shift south 1/3 of subgrade layer covered with ~~ero~~ straw blanket

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has all organic matter, rubble, trash, and deleterious material been removed from subgrade fill prior to use?		N A
Has the prepared subgrade been surveyed for final grades to verify that it conforms to the construction drawings?		
Have TA-3 borrow soils been determined to be suitable for subgrade fill?		
Has approved fill been used during subgrade construction?		
Has the subgrade been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?		
Has the number of passes and the coverage of the compaction equipment been documented?		

NOTES: (1) Erosion control blanket installation; shallow trench excavated along toe of subgrade layer to anchor the edge of the straw blanket. Blankets are laid in an east-west direction across the site to minimize the prevailing wind effect. Blankets are installed in accordance with manufacturer's instructions, i.e. six inch overlap, staples 18 inches apart along overlap and intermittently down the middle of the blankets,

CQA Inspector Signature

CQA Engineer Signature

(over)

(2) Drainage swale: The partial ~~drai~~ swale was excavated on the eastern side of the MWL in the footprint of the design drawing location for the final swale. The swale is next to the subgrade layer toe of slope. The final swale could not be excavated because of the interference with the side-slopes of the final cover layers. The swales ~~E~~ NE and SE corners divert any water around the MWL and to the west. No rock armorment is installed at this time.

CQA Engineer Signature Kelly M. Pirl

2009 Construction Inspection Forms

CI-01

CONSTRUCTION INSPECTION FORM
EXISTING LANDFILL SURFACE AND PERIMETER CLEAR AND GRUB FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name Sandia Mixed Waste LF Date 5/21/09 Time Tibbom

Weather Cloudy Inspected by Paul McInnis

Compaction Equipment Loader (See attached)

Surface area and location covered during shift Top surface of existing Subgrade was Cleared and grubbed of material. See daily report

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have all shrubs, grass, roots, and other vegetation been completely cleared and grubbed from the landfill surface and perimeter?	Yes	Existing Surface
Has the landfill surface and perimeter been inspected to ensure that all loose or soft zones have been properly compacted?	Yes	
Has the landfill surface and perimeter been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	Yes	
Has the number of passes and the coverage of the compaction equipment been documented?	Yes	

NOTES:

Meets Specification Requirements. Scott T. [illegible] PE
CQA Engineer.
May 22, 2009.

CI-01
CONSTRUCTION INSPECTION FORM
EXISTING LANDFILL SURFACE AND PERIMETER CLEAR AND GRUB FIELD FORM

ONE FORM PER SHIFT WHEN THIS WORK IS BEING DONE

Project Name Sandia Mixed Waste LF Date 5/20/09 Time 9:00 am

Weather Cloudy Inspected by David Molnar

Compaction Equipment Loader (See attached)

Surface area and location covered during shift Perimeter slope was Clear and grubbed. (See daily report)

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have all shrubs, grass, roots, and other vegetation been completely cleared and grubbed from the landfill surface and perimeter?	yes	ground slope.
Has the landfill surface and perimeter been inspected to ensure that all loose or soft zones have been properly compacted?	yes	
Has the landfill surface and perimeter been inspected to ensure that it is free of all rocks greater than 2 inches in dimension?	yes	
Has the number of passes and the coverage of the compaction equipment been documented?	yes	

NOTES:

COA

Meets Specification Requirements

Daniel T. Lyon PE
CQA Engineer

CONSTRUCTION INSPECTION FORM
BIOINTRUSION BARRIER CONSTRUCTION

Project Name: Sandia Mixed Waste Landfill

Date: 05/27/2009

Inspected By: Paul Molina (URS)

Approximate surface area of Biointrusion Rock installed: **Approx. 900 CY (60 loads @ 15 CY/Load)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
The Was the Existing Subgrade Layer scarified using a minimum of four passes with the tracks of the dozer?	**YES**
After the rock was spread, was a minimum of four passes with the dozer performed to compact/interlock the Biointrusion Barrier Rock?	**YES**
Was the Biointrusion rock thickness verified with survey equipment to ensure a minimum thickness of 1.0 – feet?	**YES**
Was dry, loose soil placed over the Biointrusion Barrier and worked into the voids with a minimum of four passes with the vibratory, smooth drum roller.	**NO**
Was water applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content (-2 to +2 percent)?	**NO**

NOTES:

1. The placement of dry, loose soil and water is not permitted until the Biointrusion Layer is completed and approved.

Carl T. [illegible] PE 5/27/09

CONSTRUCTION INSPECTION FORM
BIOINTRUSION BARRIER CONSTRUCTION

Project Name: Sandia Mixed Waste Landfill Date: 05/28/2009

Inspected By: Paul Molina (URS)

Approximate surface area of Biointrusion Rock installed: **Approx. 630 CY (42 loads @ 15 CY/Load)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
The Was the Existing Subgrade Layer scarified using a minimum of four passes with the tracks of the dozer?	**YES**
After the rock was spread, was a minimum of four passes with the dozer performed to compact/interlock the Biointrusion Barrier Rock?	**YES**
Was the Biointrusion rock thickness verified with survey equipment to ensure a minimum thickness of 1.0 – feet?	**YES**
Was dry, loose soil placed over the Biointrusion Barrier and worked into the voids with a minimum of four passes with the vibratory, smooth drum roller.	**NO**
Was water applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content (-2 to +2 percent)?	**NO**

NOTES:

1. The placement of dry, loose soil and water is not permitted until the Biointrusion Layer is completed and approved.

Gardell T. Lyon PE, 5/28/09

CONSTRUCTION INSPECTION FORM
BIOINTRUSION BARRIER CONSTRUCTION

Project Name: Sandia Mixed Waste Landfill

Date: 05/29/2009

Inspected By: Paul Molina (URS)

Approximate surface area of Biointrusion Rock installed: **Approx. 810 CY (54 loads @ 15 CY/Load)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
The Was the Existing Subgrade Layer scarified using a minimum of four passes with the tracks of the dozer?	**YES**
After the rock was spread, was a minimum of four passes with the dozer performed to compact/interlock the Biointrusion Barrier Rock?	**YES**
Was the Biointrusion rock thickness verified with survey equipment to ensure a minimum thickness of 1.0 – feet?	**YES**
Was dry, loose soil placed over the Biointrusion Barrier and worked into the voids with a minimum of four passes with the vibratory, smooth drum roller.	**NO**
Was water applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content (-2 to +2 percent)?	**NO**

NOTES:

1. The placement of dry, loose soil and water is not permitted until the Biointrusion Layer is completed and approved.

Gerald T. [illegible] PE 5/29/2009

CONSTRUCTION INSPECTION FORM
BIOINTRUSION BARRIER CONSTRUCTION

Project Name: Sandia Mixed Waste Landfill Date: 06/01/2009

Inspected By: Paul Molina (URS)

Approximate surface area of Biointrusion Rock installed: **Approx. 840 CY (56 loads @ 15 CY/Load)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
The Was the Existing Subgrade Layer scarified using a minimum of four passes with the tracks of the dozer?	**YES**
After the rock was spread, was a minimum of four passes with the dozer performed to compact/interlock the Biointrusion Barrier Rock?	**YES**
Was the Biointrusion rock thickness verified with survey equipment to ensure a minimum thickness of 1.0 – feet?	**YES**
Was dry, loose soil placed over the Biointrusion Barrier and worked into the voids with a minimum of four passes with the vibratory, smooth drum roller.	**NO**
Was water applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content (-2 to +2 percent)?	**NO**

NOTES:

1. The placement of dry, loose soil and water is not permitted until the Biointrusion Layer is completed and approved.

Paul T. Lyons PE, 6/01/2009

CONSTRUCTION INSPECTION FORM
BIOINTRUSION BARRIER CONSTRUCTION

Project Name: Sandia Mixed Waste Landfill Date: 06/02/2009

Inspected By: Paul Molina (URS)

Approximate surface area of Biointrusion Rock installed: **Approx. 780 CY (52 loads @ 15 CY/Load)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
The Was the Existing Subgrade Layer scarified using a minimum of four passes with the tracks of the dozer?	**YES**
After the rock was spread, was a minimum of four passes with the dozer performed to compact/interlock the Biointrusion Barrier Rock?	**YES**
Was the Biointrusion rock thickness verified with survey equipment to ensure a minimum thickness of 1.0 – feet?	**YES**
Was dry, loose soil placed over the Biointrusion Barrier and worked into the voids with a minimum of four passes with the vibratory, smooth drum roller.	**NO**
Was water applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content (-2 to +2 percent)?	**NO**

NOTES:

1. The placement of dry, loose soil and water is not permitted until the Biointrusion Layer is completed and approved.

Gerald T. Lyon PE 6/02/2009

CONSTRUCTION INSPECTION FORM
BIOINTRUSION BARRIER CONSTRUCTION

Project Name: Sandia Mixed Waste Landfill Date: 06/03/2009

Inspected By: Paul Molina (URS)

Approximate surface area of Biointrusion Rock installed: **Approx. 1035 CY (69 loads @ 15 CY/load)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Was the Existing Subgrade Layer scarified using a minimum of four passes with the tracks of the dozer?	**YES**
After the rock was spread, was a minimum of four passes with the dozer performed to compact/interlock the Biointrusion Barrier Rock?	**YES**
Was the Biointrusion rock thickness verified with survey equipment to ensure a minimum thickness of 1.0 – feet?	**YES**
Was dry, loose soil placed over the Biointrusion Barrier and worked into the voids with a minimum of four passes with the vibratory, smooth drum roller.	**NO**
Was water applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content (-2 to +2 percent)?	**NO**

NOTES:

1. The placement of dry, loose soil and water is not permitted until the Biointrusion Layer is completed and approved.

Donald T. [illegible] PE, 6/03/2009

CONSTRUCTION INSPECTION FORM
BIOINTRUSION BARRIER CONSTRUCTION

Project Name: Sandia Mixed Waste Landfill Date: 06/04/2009

Inspected By: Paul Molina (URS)

Approximate surface area of Biointrusion Rock installed: **Approx. 1020 CY (68 loads @ 15 CY/load)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Was the Existing Subgrade Layer scarified using a minimum of four passes with the tracks of the dozer?	YES
After the rock was spread, was a minimum of four passes with the dozer performed to compact/interlock the Biointrusion Barrier Rock?	YES
Was the Biointrusion rock thickness verified with survey equipment to ensure a minimum thickness of 1.0 – feet?	YES
Was dry, loose soil placed over the Biointrusion Barrier and worked into the voids with a minimum of four passes with the vibratory, smooth drum roller.	NO
Was water applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content (-2 to +2 percent)?	NO

NOTES:

1. The placement of dry, loose soil and water is not permitted until the Biointrusion Layer is completed and approved.

Bradd T. [illegible] PE, 6/04/2009

CONSTRUCTION INSPECTION FORM
BIOINTRUSION BARRIER CONSTRUCTION

Project Name: Sandia Mixed Waste Landfill Date: 06/05/2009

Inspected By: Paul Molina (URS)

Approximate surface area of Biointrusion Rock installed: **Approx. 435 CY (29 loads @ 15 CY/load)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Was the Existing Subgrade Layer scarified using a minimum of four passes with the tracks of the dozer?	**YES**
After the rock was spread, was a minimum of four passes with the dozer performed to compact/interlock the Biointrusion Barrier Rock?	**YES**
Was the Biointrusion rock thickness verified with survey equipment to ensure a minimum thickness of 1.0 – feet?	**YES**
Was dry, loose soil placed over the Biointrusion Barrier and worked into the voids with a minimum of four passes with the vibratory, smooth drum roller.	**NO**
Was water applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content (-2 to +2 percent)?	**NO**

NOTES:

1. The placement of dry, loose soil and water is not permitted until the Biointrusion Layer is completed and approved.

Donald T. [signature] PE, 6/05/2009

CONSTRUCTION INSPECTION FORM
BIOINTRUSION BARRIER CONSTRUCTION

Project Name: Sandia Mixed Waste Landfill Date: 06/08/2009

Inspected By: Paul Molina (URS)

Approximate surface area of Biointrusion Rock installed: **Approx. 479CY (312.94 tons delivered)**

Approximate surface area of Loose Soil in voids installed: **Approx. 612 CY (34 loads @ 18 CY/load)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Was the Existing Subgrade Layer scarified using a minimum of four passes with the tracks of the dozer?	**YES**
After the rock was spread, was a minimum of four passes with the dozer performed to compact/interlock the Biointrusion Barrier Rock?	**YES**
Was the Biointrusion rock thickness verified with survey equipment to ensure a minimum thickness of 1.0 – feet?	**YES**
Was dry, loose soil placed over the Biointrusion Barrier and worked into the voids with a minimum of four passes with the vibratory, smooth drum roller.	**YES**
Was water applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content (-2 to +2 percent)?	**NO**

NOTES:

1. The placement of dry, loose soil to fill Biointrusion Voids has been approved for South Portion of MWL. Water has not been approved.

Daniel T. Gallegos PE, 6/08/2009

CONSTRUCTION INSPECTION FORM
BIOINTRUSION BARRIER CONSTRUCTION

Project Name: Sandia Mixed Waste Landfill Date: 06/09/2009

Inspected By: Paul Molina (URS)

Approximate surface area of Biointrusion Rock installed: **Approx. 307 CY (429.57 tons delivered)**

Approximate surface area of Loose Soil in voids installed: **Approx. 864 CY (48 loads @ 18 CY/load)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Was the Existing Subgrade Layer scarified using a minimum of four passes with the tracks of the dozer?	**YES**
After the rock was spread, was a minimum of four passes with the dozer performed to compact/interlock the Biointrusion Barrier Rock?	**YES**
Was the Biointrusion rock thickness verified with survey equipment to ensure a minimum thickness of 1.0 – feet?	**YES**
Was dry, loose soil placed over the Biointrusion Barrier and worked into the voids with a minimum of four passes with the vibratory, smooth drum roller.	**YES**
Was water applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content (-2 to +2 percent)?	**NO**

NOTES:

1. Water has not been approved to fill rock voids at this time.

Carlos T. Lyp PE. 6/09/2009

CONSTRUCTION INSPECTION FORM
BIOINTRUSION BARRIER CONSTRUCTION

Project Name: Sandia Mixed Waste Landfill Date: 06/10/2009

Inspected By: Paul Molina (URS)

Approximate surface area of Biointrusion Rock installed: **Approx. 0 CY (XX loads @ 15 CY/load)**

Approximate surface area of Loose Soil in voids installed: **Approx. 0 CY (XX loads @ 18 CY/load)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Was the Existing Subgrade Layer scarified using a minimum of four passes with the tracks of the dozer?	**NO**
After the rock was spread, was a minimum of four passes with the dozer performed to compact/interlock the Biointrusion Barrier Rock?	**NO**
Was the Biointrusion rock thickness verified with survey equipment to ensure a minimum thickness of 1.0 – feet?	**NO**
Was dry, loose soil placed over the Biointrusion Barrier and worked into the voids with a minimum of four passes with the vibratory, smooth drum roller.	**NO**
Was water applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content (-2 to +2 percent)?	**NO**

NOTES:

1. No construction today.

Daniel T. Lyon PE, 6/10/2009

CONSTRUCTION INSPECTION FORM
BIOINTRUSION BARRIER CONSTRUCTION

Project Name: Sandia Mixed Waste Landfill Date: 06/11/2009

Inspected By: Paul Molina (URS)

Approximate surface area of Biointrusion Rock installed: **Approx. 558 CY (781.88 tons delivered)**

Approximate surface area of Loose Soil in voids installed: **Approx. 1044 CY (58 loads @ 18 CY/load)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Was the Existing Subgrade Layer scarified using a minimum of four passes with the tracks of the dozer?	**YES**
After the rock was spread, was a minimum of four passes with the dozer performed to compact/interlock the Biointrusion Barrier Rock?	**YES**
Was the Biointrusion rock thickness verified with survey equipment to ensure a minimum thickness of 1.0 – feet?	**YES**
Was dry, loose soil placed over the Biointrusion Barrier and worked into the voids with a minimum of four passes with the vibratory, smooth drum roller.	**YES**
Was water applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content (-2 to +2 percent)?	**NO**

NOTES:

1. Water has not been approved to fill rock voids at this time.

Daniel T. [illegible] PE, 6/11/2009

CONSTRUCTION INSPECTION FORM
BIOINTRUSION BARRIER CONSTRUCTION

Project Name: Sandia Mixed Waste Landfill

Date: 06/12/2009

Inspected By: Paul Molina (URS)

Approximate surface area of Biointrusion Rock installed: **Approx. 197 CY (275.88 tons delivered)**

Approximate surface area of Loose Soil in voids installed: **Approx. 936 CY (52 loads @ 18 CY/load)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Was the Existing Subgrade Layer scarified using a minimum of four passes with the tracks of the dozer?	**YES**
After the rock was spread, was a minimum of four passes with the dozer performed to compact/interlock the Biointrusion Barrier Rock?	**YES**
Was the Biointrusion rock thickness verified with survey equipment to ensure a minimum thickness of 1.0 – feet?	**YES**
Was dry, loose soil placed over the Biointrusion Barrier and worked into the voids with a minimum of four passes with the vibratory, smooth drum roller.	**YES**
Was water applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content (-2 to +2 percent)?	**NO**

NOTES:

1. Water has not been approved to fill rock voids at this time.

Bendel T. [illegible] PE. 6/12/2009

CONSTRUCTION INSPECTION FORM
BIOINTRUSION BARRIER CONSTRUCTION

Project Name: Sandia Mixed Waste Landfill Date: 06/15/2009

Inspected By: Paul Molina (URS)

Approximate surface area of Biointrusion Rock installed: **Approx. 0 CY**

Approximate surface area of Loose Soil in voids installed: **Approx. 522 CY (29 loads @ 18 CY/load)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Was the Existing Subgrade Layer scarified using a minimum of four passes with the tracks of the dozer?	**YES**
After the rock was spread, was a minimum of four passes with the dozer performed to compact/interlock the Biointrusion Barrier Rock?	**YES**
Was the Biointrusion rock thickness verified with survey equipment to ensure a minimum thickness of 1.0 – feet?	**YES**
Was dry, loose soil placed over the Biointrusion Barrier and worked into the voids with a minimum of four passes with the vibratory, smooth drum roller.	**YES**
Was water applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content (-2 to +2 percent)?	**NO**

NOTES:

1. Water has not been approved to fill rock voids at this time.

Ronald T. [signature] PE, 6/15/2009

CONSTRUCTION INSPECTION FORM
BIOINTRUSION BARRIER CONSTRUCTION

Project Name: Sandia Mixed Waste Landfill

Date: 06/16/2009

Inspected By: Paul Molina (URS)

Approximate surface area of Biointrusion Rock installed: **Approx. 0 CY**

Approximate surface area of Loose Soil in voids installed: **Approx. 108CY (6 loads @ 18 CY/load)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Was the Existing Subgrade Layer scarified using a minimum of four passes with the tracks of the dozer?	**YES**
After the rock was spread, was a minimum of four passes with the dozer performed to compact/interlock the Biointrusion Barrier Rock?	**YES**
Was the Biointrusion rock thickness verified with survey equipment to ensure a minimum thickness of 1.0 – feet?	**YES**
Was dry, loose soil placed over the Biointrusion Barrier and worked into the voids with a minimum of four passes with the vibratory, smooth drum roller.	**YES**
Was water applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content (-2 to +2 percent)?	**NO**

NOTES:

1. Water has not been approved to fill rock voids at this time.

Gerald T. [illegible] PE, 6/16/2009

CONSTRUCTION INSPECTION FORM
BIOINTRUSION BARRIER CONSTRUCTION

Project Name: Sandia Mixed Waste Landfill Date: 05/26/2009

Inspected By: Paul Molina (URS)

Approximate surface area of Biointrusion Rock installed: **Approx. 300 CY (20 loads @ 15 CY/Load)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
The Was the Existing Subgrade Layer scarified using a minimum of four passes with the tracks of the dozer?	YES
After the rock was spread, was a minimum of four passes with the dozer performed to compact/interlock the Biointrusion Barrier Rock?	YES
Was the Biointrusion rock thickness verified with survey equipment to ensure a minimum thickness of 1.0 – feet?	YES
Was dry, loose soil placed over the Biointrusion Barrier and worked into the voids with a minimum of four passes with the vibratory, smooth drum roller.	NO
Was water applied to bring the soil in the filled voids of the rock to approximately the optimum moisture content (-2 to +2 percent)?	NO

NOTES:

1. The placement of dry, loose soil and water is not permitted until the Biointrusion Layer is completed and approved.

Daniel T. [illegible] PE, 5/26/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill — **Date: 06/16/2009**

Lift Number: 6:1 Slopes Lift 1& 2 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 120.1

Weather: 3:00 PM (86 deg); Clear Sky — Optimum Moisture (%) 11.6

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface area and location covered during shift: (Approx. 504 CY) North, East and West 6:1 Slopes

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(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Daniel T. [illegible] PE, 6/16/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill — **Date: 06/17/2009**

Lift Number: 6:1 Slopes Lift 1, 2, 3, &4 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 120.1

Weather: 3:20 PM (86 deg); Clear Sky — Optimum Moisture (%) 11.6

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface area and location covered during shift: (Approx. 792 CY) North, East and West 6:1 Slopes

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(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Bandel T. [illegible] PE, 6/17/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill — **Date: 06/18/2009**

Lift Number: 6:1 Slopes Lifts # 5, 6, 7, & 8 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 120.1

Weather: 10:09 am PM (76 deg); Clear Sky — Optimum Moisture (%) 11.6

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface area and location covered during shift: (Approx. 1170 CY) North, East and West 6:1 Slopes

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(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Bonnie Ti [illegible] PE, 6/18/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill — **Date: 06/19/2009**

Lift Number: Wedge Lifts #1 & #2 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 115.8

Weather: 2:10 PM (85 deg); Clear Sky — Optimum Moisture (%) 12.3

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface area and location covered during shift: (Approx. 1080 CY) Northeast Wedge Lifts 1 & 2

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Daniel T. [illegible] PE, 6/19/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill
Date: 06/22/2009
Lift Number: NA
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 115.8
Weather: 7:38 AM (72 deg); Partly Cloudy
Optimum Moisture (%) 12.3

Compaction Equipment: NA
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface area and location covered during shift: (Approx. 810 CY) MWL Berm To Borrow Area

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(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Daniel T. [signature] PE, 6/22/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill — **Date: 06/23/2009**

Lift Number: Native Soil Lift #3 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 115.8

Weather: 1:21 PM (72 deg); Cloudy — Optimum Moisture (%) 12.3

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface area and location covered during shift: (Approx. 1206 CY) MWL Cover Native Soil Lift #3

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Randal T. [illegible] PE, 6/27/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill — **Date: 06/24/2009**

Lift Number: Native Soil Lift #3 & 4 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 3:30 PM (87 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface area and location covered during shift: (Approx. 1116 CY) MWL Cover Native Soil Lift #3 & 4

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Gerald T. [illegible] PE, 6/24/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill — **Date: 06/25/2009**

Lift Number: Native Soil Lift #4 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 12:45 PM (82 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface area and location covered during shift: (Approx. 1170 CY) MWL Cover Native Soil Lift #4

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Bradley T. [illegible] PE, 6/25/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill
Lift Number: Native Soil Lift #4
Borrow Area: Native Soil Borrow Area
Weather: 3:00 PM (78 deg); Partly Cloudy

Date: 06/26/2009
Inspected By: Paul Molina
Max Dry Density (pcf) 117.0
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface area and location covered during shift: (Approx. 432 CY) MWL Cover Native Soil Lift #4

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	YES
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	YES
Has approved fill been used during lift construction?	YES
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	YES
Has the number of passes and the coverage of compaction equipment been documented?	YES

NOTES:

Donald T. [signature] PE, 6/26/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill | **Date: 06/29/2009**

Lift Number: Native Soil Lift #4 | Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area | Max Dry Density (pcf) 117.0

Weather: 7:34 (61 deg); Partly Cloudy | Optimum Moisture (%) 12.0

Compaction Equipment: NA

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface area and location covered during shift: (Approx. 0 CY) MWL Cover Native Soil Lift #4

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**NO**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**NO**
Has approved fill been used during lift construction?	**NO**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**NO**
Has the number of passes and the coverage of compaction equipment been documented?	**NO**

NOTES:

No soil has been placed today

Bonded T. [illegible] PE, 6/29/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill
Date: 06/30/2009
Lift Number: Native Soil Lift #5
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 3:00 PM (86 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller.
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface area and location covered during shift: (Approx. 756 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Randal T. [illegible] PE, 6/30/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill
Lift Number: Native Soil Lift #5
Borrow Area: Native Soil Borrow Area
Weather: 2:33 PM (88 deg); Partly Cloudy

Date: 07/01/2009
Inspected By: Paul Molina
Max Dry Density (pcf) 117.0
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface area and location covered during shift: (Approx. 792 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	YES
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	YES
Has approved fill been used during lift construction?	YES
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	YES
Has the number of passes and the coverage of compaction equipment been documented?	YES

NOTES:

Randal T. [signature] PE, 7/01/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill
Lift Number: Native Soil Lift #5
Borrow Area: Native Soil Borrow Area
Weather: 9:38 AM (74 deg); Partly Cloudy

Date: 07/02/2009
Inspected By: Paul Molina
Max Dry Density (pcf) 117.0
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface area and location covered during shift: (Approx. 630 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Donald T. [signature] PE, 7/02/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill
Date: 07/03/2009
Lift Number: Native Soil Lift #5
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: NA
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface area and location covered during shift: (Approx. 0 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Gerald T. [illegible] PE, 7/03/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill — **Date: 07/06/2009**

Lift Number: Native Soil Lift #5 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 2:34 PM (86 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface area and location covered during shift: (Approx. 756 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Daniel T. [illegible] PE, 7/06/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill — **Date: 07/07/2009**

Lift Number: Native Soil Lift #5 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 4:30 PM (91 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface area and location covered during shift: (Approx. 756 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Bonded T. [illegible] PE, 7/07/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill
Date: 07/08/2009
Lift Number: Native Soil Lift #5
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 4:00 PM (92 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface area and location covered during shift: (Approx. 720 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Gerald T. [illegible] PE, 7/08/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill — **Date: 07/09/2009**

Lift Number: Native Soil Lift #5 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 3:00 PM (91 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface area and location covered during shift: (Approx. 522 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Bonded Ti PE, 7/09/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill — **Date: 07/10/2009**

Lift Number: Native Soil Lift #5 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 3:00 PM (90 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface area and location covered during shift: (Approx. 756 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Donald T. [illegible] PE, 7/10/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill — **Date: 07/13/2009**

Lift Number: Native Soil Lift #5 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 3:58 PM (96 deg); Clear Sky — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface area and location covered during shift: (Approx. 738 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Daniel T. [illegible] PE, 7/13/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill
Date: 07/14/2009
Lift Number: Native Soil Lift #6
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 7:13 AM (74 deg); Clear Sky
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller.
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface area and location covered during shift: (Approx. 1170 CY) MWL Cover Native Soil Lift #6

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Donald T. [signature] PE, 7/14/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill
Date: 07/15/2009
Lift Number: Native Soil Lift #6
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 1:45 PM (93 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller.
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface area and location covered during shift: (Approx. 954 CY) MWL Cover Native Soil Lift #6

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Daniel T. [illegible] PE, 7/15/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill
Date: 07/16/2009
Lift Number: Native Soil Lift #6
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 2:29 PM (93 deg); Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface area and location covered during shift: (Approx. 864 CY) MWL Cover Native Soil Lift #6

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Randal T. Lyp PE, 7/16/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill
Date: 07/17/2009

Lift Number: Native Soil Lift #7
Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0

Weather: 2:29 PM (93 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface area and location covered during shift: (Approx. 828 CY) MWL Cover Native Soil Lift #7

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Randal T. [illegible] PE 7/17/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill — **Date: 07/20/2009**

Lift Number: Native Soil Lift #7 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 3:05 PM (78 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface area and location covered during shift: (Approx. 1630 CY) MWL Cover Native Soil Lift #7

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Donald T. [illegible] PE, 7/20/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill — **Date: 07/21/2009**

Lift Number: Native Soil Lift #7 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 4:28 PM (87 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface area and location covered during shift: (Approx. 1606 CY) MWL Cover Native Soil Lift #7

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Bendel T. [illegible] PE, 7/21/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill
Date: 07/22/2009
Lift Number: Native Soil Lift #8
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 4:02 PM (87 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface area and location covered during shift: (Approx. 0 CY) MWL Cover Native Soil Lift #8

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Daniel T. [illegible] PE, 7/22/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill — **Date: 07/23/2009**

Lift Number: Native Soil Lift #8 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 3:00 PM (78 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface area and location covered during shift: (Approx. 1458 CY) MWL Cover Native Soil Lift #8

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Donald T. [illegible] PE, 7/23/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill
Lift Number: Native Soil Lift #8
Borrow Area: Native Soil Borrow Area
Weather: 8:39 AM (69 deg); Clear Sky

Date: 07/24/2009
Inspected By: Paul Molina
Max Dry Density (pcf) 117.0
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface area and location covered during shift: (Approx. 1410 CY) MWL Cover Native Soil Lift #8

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Bonded Ti PE, 7/24/2009

CI-03
CONSTRUCTION INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill
Date: 07/27/2009
Lift Number: Native Soil Lift #8
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 1:00 PM (87 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface area and location covered during shift: (Approx. 962 CY) MWL Cover Native Soil Lift #8

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Have TA-3 Borrow soils been determined to be suitable for Native Soil Lifts?	**YES**
Has approved fill been used during lift construction?	**YES**
Has the lift been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**
Has the number of passes and the coverage of compaction equipment been documented?	**YES**

NOTES:

Donald T. Ley PE, 7/27/2009

CI-04
CONSTRUCTION INSPECTION FORM
TOPSOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill

Date: 08/03/2009
Inspected By: Paul Molina

Borrow Area: Topsoil Borrow Area
Weather: 1:06 PM (88 deg); Partly Cloudy

Topsoil Description: Topsoil Located in TA-3 Borrow Area

Volume and location of soil placed during shift: (Approx. 2132 CY) MWL Cover Topsoil

---

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Has the topsoil been admixed with 25% by volume 3/8-inch crushed gravel?	**YES**
Has approved topsoil been used for the topsoil layer?	**YES**
Has the topsoil been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**

NOTES:

Daniel T. [illegible] PE, 08/03/2009

CI-04
CONSTRUCTION INSPECTION FORM
TOPSOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill

Date: 08/04/2009
Inspected By: Paul Molina

Borrow Area: Topsoil Borrow Area
Weather: 1:45 PM (91 deg); Partly Cloudy

Topsoil Description: Topsoil Located in TA-3 Borrow Area

Volume and location of soil placed during shift: (Approx. 1950 CY) MWL Cover Topsoil

---

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Has the topsoil been admixed with 25% by volume 3/8-inch crushed gravel?	**YES**
Has approved topsoil been used for the topsoil layer?	**YES**
Has the topsoil been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**

NOTES:

Randall T. [illegible] PE, 08/04/2009

CI-04
CONSTRUCTION INSPECTION FORM
TOPSOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill

Date: 08/05/2009
Inspected By: Paul Molina

Borrow Area: Topsoil Borrow Area
Weather: 2:18 PM (94 deg); Partly Cloudy

Topsoil Description: Topsoil Located in TA-3 Borrow Area

Volume and location of soil placed during shift: (Approx. 2028 CY) MWL Cover Topsoil

---

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	**YES**
Has the topsoil been admixed with 25% by volume 3/8-inch crushed gravel?	**YES**
Has approved topsoil been used for the topsoil layer?	**YES**
Has the topsoil been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	**YES**

NOTES:

Randel T. [illegible] PE, 08/05/2009

CI-04
CONSTRUCTION INSPECTION FORM
TOPSOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill

Date: 08/06/2009
Inspected By: Paul Molina

Borrow Area: Topsoil Borrow Area
Weather: 1:54 PM (94 deg); Heavy Rain @ 2:30 PM

Topsoil Description: Topsoil Located in TA-3 Borrow Area

Volume and location of soil placed during shift: (Approx. 2106 CY) MWL Cover Topsoil

---

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	YES
Has the topsoil been admixed with 25% by volume 3/8-inch crushed gravel?	YES
Has approved topsoil been used for the topsoil layer?	YES
Has the topsoil been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	YES

NOTES:

David T. [illegible] PE, 08/06/2009

CI-04
CONSTRUCTION INSPECTION FORM
TOPSOIL LAYER FIELD FORM

ONE PER SHIFT WHEN WORK IS BEING DONE

Project Name: Sandia Mixed Waste Landfill

Date: 08/07/2009
Inspected By: Paul Molina

Borrow Area: Topsoil Borrow Area
Weather: 11:47 AM (79 deg)

Topsoil Description: Topsoil Located in TA-3 Borrow Area

Volume and location of soil placed during shift: (Approx. 962 CY) MWL Cover Topsoil

---

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO (If no, see notes below)
Has the previous lift been surveyed for final grades to verify that in conforms to the construction specifications?	YES
Has the topsoil been admixed with 25% by volume 3/8-inch crushed gravel?	YES
Has approved topsoil been used for the topsoil layer?	YES
Has the topsoil been inspected to ensure that it is free of all rocks greater than 2-inches in dimension?	YES

NOTES:

Randal T. [signature] PE, 08/07/2009

CI-05
CONSTRUCTION INSPECTION FORM
RECLAMATION SEEDING AND MULCHING FIELD FORM
(Complete One Form Per Shift When This Work Is Being Done)

Project Name: Sandia Mixed Waste Landfill Date: 08/25/2009 Time: 8:00 am

Weather: 7:01 am (57 deg); cloudy Inspected By: Paul Molina (URS)

Surface area and location covered during shift **Approx. ¾ acre (60lb. of seed)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the cover surface been surveyed for final grade prior to placement of seed?	YES	
Has approved seed been used for seeding?	YES	
Has the cover surface been mulched and crimped after seeding?	NO	1
Did application rate of seed mix meet the construction specifications?	YES	2

** (If no, see notes below)

NOTES:

1. No mulch was placed on seed today.
2. Application rate of seed mix is 80 lb/acre per revised CMIP.

Bradley T. [illegible] PE, 08/25/2009

CI-05
CONSTRUCTION INSPECTION FORM
RECLAMATION SEEDING AND MULCHING FIELD FORM
(Complete One Form Per Shift When This Work Is Being Done)

Project Name: Sandia Mixed Waste Landfill Date: 08/26/2009 Time: 8:00 am

Weather: 7:01 am (57 deg); cloudy Inspected By: Paul Molina (URS)

Surface area and location covered during shift **Approx. ¾ acre (60lb. of seed)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the cover surface been surveyed for final grade prior to placement of seed?	YES	____
Has approved seed been used for seeding?	YES	____
Has the cover surface been mulched and crimped after seeding?	NO	1
Did application rate of seed mix meet the construction specifications?	YES	2

** (If no, see notes below)

NOTES:

1. No mulch was placed on seed today.
2. Application rate of seed mix is 80 lb/acre per revised CMIP.

[signature] PE, 08/26/2009

CI-05
CONSTRUCTION INSPECTION FORM
RECLAMATION SEEDING AND MULCHING FIELD FORM
(Complete One Form Per Shift When This Work Is Being Done)

Project Name: Sandia Mixed Waste Landfill Date: 08/27/2009 Time: 8:00 am

Weather: 7:10 am (58 deg); cloudy Inspected By: Paul Molina (URS)

Surface area and location covered during shift **Approx. 1.0 acre (80 lb. of seed)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the cover surface been surveyed for final grade prior to placement of seed?	YES	
Has approved seed been used for seeding?	YES	
Has the cover surface been mulched and crimped after seeding?	NO	1
Did application rate of seed mix meet the construction specifications?	YES	2

** (If no, see notes below)

NOTES:

1. No mulch was placed on seed today.
2. Application rate of seed mix is 80 lb/acre per revised CMIP.

Randel T. [illegible] PE, 08/27/2009

CI-05
CONSTRUCTION INSPECTION FORM
RECLAMATION SEEDING AND MULCHING FIELD FORM
(Complete One Form Per Shift When This Work Is Being Done)

Project Name: Sandia Mixed Waste Landfill Date: 08/28/2009 Time: 8:00 am

Weather: 7:10 am (58 deg); cloudy Inspected By: Paul Molina (URS)

Surface area and location covered during shift **Approx. 0 acre (0 lb. of seed); Straw only.**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the cover surface been surveyed for final grade prior to placement of seed?	YES	
Has approved seed been used for seeding?	YES	
Has the cover surface been mulched and crimped after seeding?	YES	
Did application rate of seed mix meet the construction specifications?	NO	1

** (If no, see notes below)

NOTES:

1. No seed was placed on seed today. Mulch only

Daniel T. [illegible] PE, 08/28/2009

CI-05
CONSTRUCTION INSPECTION FORM
RECLAMATION SEEDING AND MULCHING FIELD FORM
(Complete One Form Per Shift When This Work Is Being Done)

Project Name: Sandia Mixed Waste Landfill Date: 08/31/2009 Time: 8:00 am

Weather: 7:10 am (56 deg); cloudy Inspected By: Paul Molina (URS)

Surface area and location covered during shift **Approx. 0 acre (0 lb. of seed); Straw only.**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the cover surface been surveyed for final grade prior to placement of seed?	YES	____
Has approved seed been used for seeding?	YES	____
Has the cover surface been mulched and crimped after seeding?	YES	____
Did application rate of seed mix meet the construction specifications?	NO	1

** (If no, see notes below)

NOTES:

1. No seed was placed on seed today. Mulch only

Ronald T. [signature] PE, 08/31/2009

CI-05
CONSTRUCTION INSPECTION FORM
RECLAMATION SEEDING AND MULCHING FIELD FORM
(Complete One Form Per Shift When This Work Is Being Done)

Project Name: Sandia Mixed Waste Landfill Date: 09/01/2009 Time: 8:00 am

Weather: 7:00 am (57 deg); cloudy Inspected By: Paul Molina (URS)

Surface area and location covered during shift **Approx. 1.0 acre (80 lb. of seed)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the cover surface been surveyed for final grade prior to placement of seed?	YES	____
Has approved seed been used for seeding?	YES	____
Has the cover surface been mulched and crimped after seeding?	YES	____
Did application rate of seed mix meet the construction specifications?	YES	1

** (If no, see notes below)

NOTES:

1. Application rate of seed mix is 80 lb/acre per revised CMIP.

Daniel T. [illegible] PE, 09/01/2009

CI-05
CONSTRUCTION INSPECTION FORM
RECLAMATION SEEDING AND MULCHING FIELD FORM
(Complete One Form Per Shift When This Work Is Being Done)

Project Name: Sandia Mixed Waste Landfill Date: 09/02/2009 Time: 8:00 am

Weather: 7:00 am (57 deg); cloudy Inspected By: Paul Molina (URS)

Surface area and location covered during shift **Approx. 1.0 acre (80 lb. of seed)**

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the cover surface been surveyed for final grade prior to placement of seed?	YES	____
Has approved seed been used for seeding?	YES	____
Has the cover surface been mulched and crimped after seeding?	YES	____
Did application rate of seed mix meet the construction specifications?	YES	1

** (If no, see notes below)

NOTES:

1. Application rate of seed mix is 80 lb/acre per revised CMIP.

David T. [illegible] PE, 09/02/2009

ATTACHMENT 6

Testing Inspection Forms

2006 Testing Inspection Forms

TI-01
TESTING INSPECTION FORM
EXISTING LANDFILL SURFACE AND PERIMETER FIELD TEST FORM

Project Name MWL Cover CQA Date 12/27/06 Time 1015

Inspected by Corey Woods Weather Clear Cool

Compaction Equipment Smooth Drum Roller

Surface area and location covered during shift Existing surface and perimeter

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has soil been moistened to approximate optimum moisture content?	No	1
Has surface been compacted/proof-rolled utilizing 10 passes of a roller?	NO	2
Have depressions been filled with moistened, clean fill, and recompacted with ten passes of a roller?	NO	2
Did roller have a minimum ballasted weight of 25 tons?	No	2
Did roller have a minimum pneumatic tire pressure of 90 psi?	NO	2
Was any proof rolling conducted within a 2-ft radius of any groundwater monitoring well?	NO	

NOTES:

① Out of 15 tests performed, only 3 met ± 2% of optimum. Optimum moisture of proctor was unusually high, however (13.4%). Three additional proctors were collected to be analyzed by AMEC. Decision was made to proceed with subgrade installation, density measurements met spec. for all locations.

② Compaction testing was conducted in lieu of requirements regarding 10 passes and type of compaction equipment.

CQA Inspector Signature [signature] CQA Engineer Signature Kelly M Ford

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name MWC Cover CQA Date 10/31/06 Time 0800-1500

Lift Number 1 through 4 Inspected by Corey Woods

Borrow Area West of CAMU Weather Clear, C80's

Compaction Equipment Smooth drum roller

Soil Description 2" Mmax screened subgrade

Volume and location of soil placed during shift Northern half of unclassified Area, 240 cy

Surface area and location covered during shift Low-lying areas of Northern half of unclassified areas, Trenches B and C

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	NO	1
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	2

NOTES:

(1) Survey grid not yet in place, locations approximated, see Lift Maps

(2) Backscatter Method used to avoid coming in contact with potentially contaminated Material

CQA Inspector Signature [signature] CQA Engineer Signature Kelly M Rice

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name MWL Cover CQA Date 11/1/06 Time 1130

Lift Number 4 and 5 Inspected by Corey Woods

Borrow Area West of CAMU Weather Clear, Warm

Compaction Equipment Smooth Drum Roller

Soil Description 2" minus screened subgrade stockpile

Volume and location of soil placed during shift 364 cy, low-lying areas of northern half of unclassified are, Lifts 4 and 5

Surface area and location covered during shift Low-lying areas, northern half of unclassified area, see lift maps

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	

NOTES:

CQA Inspector Signature [signature] CQA Engineer Signature [signature]

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name MWL Cover CQA Date 11/2/06 Time 1400

Lift Number 6 Inspected by Corey Woods

Borrow Area West of CAMU Weather Clear, Warm

Compaction Equipment Smooth Drum Roller

Soil Description 2" Minus screened subgrade stockpile

Volume and location of soil placed during shift 412 cy, low-lying areas of unclassified area, Lift 6

Surface area and location covered during shift low-lying areas of unclassified area, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	

NOTES:

CQA Inspector Signature [signature] CQA Engineer Signature Kelly M Pierce

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name MWL Cover CQA Date 11/6/06 Time 1100

Lift Number 7 and 8 Inspected by Corey Woods

Borrow Area West of CAMU Weather Clear, warm

Compaction Equipment Smooth Drum Roller

Soil Description 2" minus subgrade stockpile

Volume and location of soil placed during shift 476 cy total, 100 cy Lift 7, 376 cy Lift 8, see Lift Maps

Surface area and location covered during shift Lifts 7 and 8, see Lift Maps

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	

NOTES:

CQA Inspector Signature [signature] CQA Engineer Signature [signature]

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name Mill Cover CQA Date 11/7/06 Time 0930

Lift Number 9 Inspected by Corey Woods

Borrow Area West of CAMU Weather Clear, Warm

Compaction Equipment Smooth Drum Roller

Soil Description 2" Minus subgrade stockpile

Volume and location of soil placed during shift 344 cy, Lift 9, see 1:ft Map

Surface area and location covered during shift Lift 9, see 1:ft Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	

NOTES:

CQA Inspector Signature Corey Woods CQA Engineer Signature Kelly M Rich

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name MWC Cover CQA Date 11/8/06 Time 1030

Lift Number 9 Inspected by Corey Woods

Borrow Area West of CAMU Weather Clear, Warm

Compaction Equipment Smooth Drum Roller

Soil Description 2" minus subgrade stockpile

Volume and location of soil placed during shift 576 cy total, 316 Lift 9, 260 Lift 10, See Lift map for location

Surface area and location covered during shift Completed Lift 9, started Lift 10, see Lift Maps

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	

NOTES:

CQA Inspector Signature [signature] CQA Engineer Signature [signature]

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name MWL Cover CQA Date 11/9/06 Time 1500

Lift Number 9 and 10 Inspected by Corey Woods

Borrow Area West of CAMU Weather Clear, Warm

Compaction Equipment Smooth Drum Roller

Soil Description 2" Minus subgrade stockpile

Volume and location of soil placed during shift 496 cy, Lift 10, See Lift Map

Surface area and location covered during shift Lift 10, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	

NOTES:

CQA Inspector Signature [signature] CQA Engineer Signature Kelly M Rich

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name MWC Cover CQA Date 11/14/06 Time 0830

Lift Number 10 Inspected by Corey Woods

Borrow Area West of CAMU Weather Overcast, high winds

Compaction Equipment Smooth Drum Roller

Soil Description 2" Minus subgrade stockpile

Volume and location of soil placed during shift 280 cy, completed Lift 10, see Lift Map

Surface area and location covered during shift Lift 10, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	

NOTES:

CQA Inspector Signature Corey Woods CQA Engineer Signature Kelly M Pino

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name MWC Cover CQA Date 11/15/06 Time 1430

Lift Number 11 Inspected by Corey Woods

Borrow Area West of CAMU Weather Clear, cool

Compaction Equipment smooth Drum Roller

Soil Description 2" minus subgrade stockpile

Volume and location of soil placed during shift 520 cy. Lift 11, see Lift Map

Surface area and location covered during shift Lift 11, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	n/a	

NOTES:

CQA Inspector Signature [signature] CQA Engineer Signature [signature]

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name MWL Cover CQA Date 11/16/06 Time 1500

Lift Number 11 Inspected by Tracy Woods

Borrow Area West of CAMU Weather Overcast, Cool

Compaction Equipment Smooth Drum Roller

Soil Description 2" Minus Subgrade

Volume and location of soil placed during shift 464 cy total - 200 cy proctor MWL-SG-008, 264 cy proctor MWL-SG-009, Lift 11, see Lift Map

Surface area and location covered during shift Lift 11, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	

NOTES:

CQA Inspector Signature [signature] CQA Engineer Signature [signature]

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name MWL Cover CQA Date 11/20/06 Time 1400

Lift Number 11 Inspected by Corey Woods

Borrow Area West of CAMU Weather Clear, Warm

Compaction Equipment Smooth Drum Roller

Soil Description 2" Minus Subgrade stockpile

Volume and location of soil placed during shift 624 cy total 236 cy Proctor MWL-SG-009, 388 proctor MWL-SG-010, Lift 11, see Lift Map

Surface area and location covered during shift Lift 11, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	

NOTES:

CQA Inspector Signature [signature] CQA Engineer Signature [signature]

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name MWL Cover CQA Date 11/21/06 Time 1400

Lift Number 11 Inspected by Corey Woods

Borrow Area West of CAMU Weather Clear, Warm

Compaction Equipment Smooth Drum Roller

Soil Description 2" Minus subgrade stockpile

Volume and location of soil placed during shift 856 cy total (112 proctor 010, 500 cy Proctor 013, and 244 cy Proctor 014), Lift 11, see Map

Surface area and location covered during shift Lift 11, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	

NOTES:

CQA Inspector Signature [signature] CQA Engineer Signature [signature]

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name NWC Cover CQA Date 11/22/06 Time 1000

Lift Number 11 Inspected by Tony Woods

Borrow Area West of CAMU Weather Clear, Warm

Compaction Equipment Smooth Drum Roller

Soil Description 2" Minus Subgrade Stockpile

Volume and location of soil placed during shift 56 cy (Proctor 014), completed Lift 11

Surface area and location covered during shift Completed Lift 11, see Lift Map.

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	

NOTES:

CQA Inspector Signature [signature] CQA Engineer Signature [signature]

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name MWL Cover CQA Date 11/30/06 Time 0930

Lift Number 12 Inspected by Corey Woods

Borrow Area West of CAMU Weather Clear, Cold

Compaction Equipment Smooth Drum Roller

Soil Description 2" Minus subgrade stockpile

Volume and location of soil placed during shift None on this date

Surface area and location covered during shift None on this date, tests taken on soils placed 11/28 and 11/29

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	

NOTES:

CQA Inspector Signature [signature] CQA Engineer Signature [signature]

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name MWL Cover CQA Date 12/5/06 Time 1430

Lift Number 12 Inspected by Corey Woods

Borrow Area West of CAMU Weather Clear, Cool

Compaction Equipment Smooth Drum Vibratory Roller

Soil Description 2" Minus Screened Subgrade

Volume and location of soil placed during shift 340 Cy, Lift 12, See Lift Map

Surface area and location covered during shift Lift 12, See Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	

NOTES:

CQA Inspector Signature [signature] CQA Engineer Signature [signature]

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name MWL Cover CQA Date 12/7/06 Time 1400

Lift Number 12 Inspected by Corey Woods

Borrow Area West of CAMU Weather Clear, Cool

Compaction Equipment Smooth Drum Vibratory Roller

Soil Description 2" Minus screened subgrade

Volume and location of soil placed during shift 492 cy, Lift 12, see Lift Map

Surface area and location covered during shift Lift 12, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	

NOTES:

CQA Inspector Signature [signature] CQA Engineer Signature [signature]

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name MWL Cover CQA Date 12/13/06 Time 1000

Lift Number 12 Inspected by Corey Woods

Borrow Area West of CAMU Weather Clear, Warm

Compaction Equipment Smooth Drum Vibratory Roller

Soil Description 2" Minus screened Subgrade

Volume and location of soil placed during shift N/A (No soil placed during this shift, testing conducted on material placed 12/11)

Surface area and location covered during shift N/A

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	

NOTES:

CQA Inspector Signature [signature] CQA Engineer Signature [signature]

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name MWL Cover CQA Date 12/15/06 Time 1000

Lift Number 12 Inspected by Corey Woods

Borrow Area West of CAMU Weather Clear, Warm

Compaction Equipment Smooth Drum Vibratory Roller

Soil Description 2" Minus screened subgrade

Volume and location of soil placed during shift 512 cy, Lift 12, see Lift Map

Surface area and location covered during shift Lift 12, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	

NOTES:

CQA Inspector Signature [signature] CQA Engineer Signature [signature]

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name MWL Cover CQA Date 12/18/06 Time 1000

Lift Number 12 Inspected by Corey Woods

Borrow Area west of CAMU Weather Overcast, cold, windy

Compaction Equipment Smooth Drum Vibratory Roller

Soil Description 2" Minus screened subgrade

Volume and location of soil placed during shift cy, Lift 12, see Lift Map

Surface area and location covered during shift Lift 12, see Lift Map

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D 2922 and ASTM D 3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	N/A	

NOTES:

CQA Inspector Signature [signature] CQA Engineer Signature Kelly M Reid

TI-04
TESTING INSPECTION FORM
SUBGRADE FILL LABORATORY TEST VERIFICATION FORM

Project Name MWL CQA Date 10/2/06 Time 1330

Inspected by Corey Woods

Weather Clear, Cool

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor test in accordance with ASTM D 698?	YES	
Has gradation been performed in accordance with ASTM C 136?	YES	
Has classification been performed in accordance with ASTM D 2487 and D 4318?	YES	
Do laboratory tests meet the construction specification?	YES	1

NOTES:

Collected the following proctors on this date:
MWL-ES-001 - Existing surface, appx. 30' NW of monitor well MW-4
MWL-SG-001 - Subgrade stockpile, west end

Results received Oct. 19

1 No specification for existing surface

CQA Inspector Signature [signature] CQA Engineer Signature [signature]

TI-04
TESTING INSPECTION FORM
~~SUBGRADE FILL~~ LABORATORY TEST VERIFICATION FORM
Existing Surface

Project Name MWL Cover CQA Date 10/27/06 Time 1100

Inspected by Tony Woods

Weather Clear, Cool

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor test in accordance with ASTM D 698?	YES	
Has gradation been performed in accordance with ASTM C 136?	YES	
Has classification been performed in accordance with ASTM D 2487 and D 4318?	YES	
Do laboratory tests meet the construction specification?	N/A	1

NOTES:
samples collected 10/27, MWL-ES-002, -003, and -004
1 No specification for existing surface
Results received 11/2/06

CQA Inspector Signature [signature]

CQA Engineer Signature Kelly M Rich

TI-04
TESTING INSPECTION FORM
SUBGRADE FILL LABORATORY TEST VERIFICATION FORM

Project Name MWL Cover CQA Date 10/31/06 Time 1430

Inspected by Corey Woods

Weather Clear, Cool

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor test in accordance with ASTM D 698?	YES	
Has gradation been performed in accordance with ASTM C 136?	YES	
Has classification been performed in accordance with ASTM D 2487 and D 4318?	YES	
Do laboratory tests meet the construction specification?	YES	

NOTES:

Samples collected 10/31/06 -

MWL-SG-002 - Southwest corner of stockpile

MWL-SG-003 - Middle west end of stockpile

MWL-SG-001 - Northwest corner of stockpile

Results received 11/6/06

CQA Inspector Signature _____ CQA Engineer Signature Kelly M Reil

TI-04
TESTING INSPECTION FORM
SUBGRADE FILL LABORATORY TEST VERIFICATION FORM

Project Name MWL Cover CQA Date 11/2/06 Time 1430

Inspected by Corey Woods

Weather Clear, Warm

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor test in accordance with ASTM D 698?	YES	
Has gradation been performed in accordance with ASTM C 136?	YES	
Has classification been performed in accordance with ASTM D 2487 and D 4318?	YES	
Do laboratory tests meet the construction specification?	YES	

NOTES:

Collected proctors MWL-SG-005, -006, and -007 on 11/2

Results received 11/6 for MWL-SG-005 and -006

Results received 11/13 for MWL-SG-007

CQA Inspector Signature [signature]

CQA Engineer Signature Kelly M Pinil

TI-04
TESTING INSPECTION FORM
SUBGRADE FILL LABORATORY TEST VERIFICATION FORM

Project Name MWL Cover CQA Date 11/8/06 Time 1030

Inspected by Corey Woods

Weather Clear, Warm

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor test in accordance with ASTM D 698?	YES	
Has gradation been performed in accordance with ASTM C 136?	YES	
Has classification been performed in accordance with ASTM D 2487 and D 4318?	YES	
Do laboratory tests meet the construction specification?	YES	

NOTES:

Collected the following proctor samples on 11/8/06:

MWL-SG-008 - Northwest corner of subgrade stockpile
MWL-SG-009 - Middle west of stockpile
MWL-SG-010 - Southwest corner of stockpile

Results for MWL-SG-008 received 11/14/06
Results for MWL-SG-009 and -010 received 11/15/06

CQA Inspector Signature C. Woods

CQA Engineer Signature Kelly M Rich

TI-04
TESTING INSPECTION FORM
SUBGRADE FILL LABORATORY TEST VERIFICATION FORM

Project Name MWL Cover CQA Date 11/14/06 Time 0900

Inspected by Terry Woods

Weather Overcast, High winds

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor test in accordance with ASTM D 698?	YES	
Has gradation been performed in accordance with ASTM C 136?	YES	
Has classification been performed in accordance with ASTM D 2487 and D 4318?	YES	
Do laboratory tests meet the construction specification?	NO	1

NOTES:

The following samples were collected for proctor analysis on 11/14:

MWL-SG-011 - East end of Southern Stockpile
MWL-SG-012 - West end of Southern Stockpile
MWL-SG-013 - South-central area of subgrade stockpile.

> Material from a pile that was existing on-site prior to present field operations, screened to 2" minus

(1) Results received 11/20/06. Sample MWL-SG-011 #200 sieve at 15% vs. 20-40% in spec. This sample was from the soil pile that was existing at the MWL prior to field operations, this soil will be used for perimeter grading only, not for subgrade placement.

CQA Inspector Signature Terry Woods

CQA Engineer Signature Kelly M Reid

TI-04
TESTING INSPECTION FORM
SUBGRADE FILL LABORATORY TEST VERIFICATION FORM

Project Name MWL Cover CQA Date 11/16/06 Time 1530

Inspected by Cory Woods

Weather Overcast, Cool

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor test in accordance with ASTM D 698?	YES	
Has gradation been performed in accordance with ASTM C 136?	YES	
Has classification been performed in accordance with ASTM D 2487 and D 4318?	YES	
Do laboratory tests meet the construction specification?	YES	

NOTES:

Collected the following samples for proctor analysis on 11/16:

MWL-SG-014 Northwest corner of subgrade stockpile

MWL-SG-015 Southwest corner of subgrade stockpile

Received Results 11/28

CQA Inspector Signature _____ CQA Engineer Signature Kelly M Rich

TI-04
TESTING INSPECTION FORM
SUBGRADE FILL LABORATORY TEST VERIFICATION FORM

Project Name MWL Cover CQA Date 11/20/06 Time 1430

Inspected by Corey Woods

Weather Clear, Warm

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor test in accordance with ASTM D 698?	NO	1
Has gradation been performed in accordance with ASTM C 136?	YES	
Has classification been performed in accordance with ASTM D 2487 and D 4318?	YES	
Do laboratory tests meet the construction specification?	YES	

NOTES:

Collected the following samples for proctor analysis on 11/20:

MWL-SG-016 Southwest corner of subgrade stockpile
MWL-SG-017 Middle west side " "
MWL-SG-018 Northwest corner of " "

Results for MWL-SG-016 and -017 received 11/28

Results for MWL-SG-018 received 12/4

① Proctor MWL-SG-018 analyzed by ASTM 1557 (Modified proctor). This proctor was not used for compaction testing.

CQA Inspector Signature _____ CQA Engineer Signature _____

TI-04
TESTING INSPECTION FORM
SUBGRADE FILL LABORATORY TEST VERIFICATION FORM

Project Name MWL Cover CQA Date 11/27/06 Time 1100

Inspected by Corey Woods

Weather Overcast, Breezy, Cold

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor test in accordance with ASTM D 698?	YES	
Has gradation been performed in accordance with ASTM C 136?	YES	
Has classification been performed in accordance with ASTM D 2487 and D 4318?	YES	
Do laboratory tests meet the construction specification?	YES	

NOTES:

Collected the following samples for proctor analysis on 11/27:

MWL-SG-019 North End of stockpile
MWL-SG-020 West side of stockpile
MWL-SG-021 East side of stockpile

Samples collected from stockpile at CAMU Borrow Area

Received Results for MWL-SG-020 on 12/5
Received Results for MWL-SG-019 and -021 on 12/7

CQA Inspector Signature _____ CQA Engineer Signature _____

TI-04
TESTING INSPECTION FORM
SUBGRADE FILL LABORATORY TEST VERIFICATION FORM

Project Name MWL Core CQA Date 12/5/06 Time 1500

Inspected by Corey Woods

Weather Clear, Cool

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor test in accordance with ASTM D 698?	YES	
Has gradation been performed in accordance with ASTM C 136?	YES	
Has classification been performed in accordance with ASTM D 2487 and D 4318?	YES	
Do laboratory tests meet the construction specification?	YES	

NOTES:

Collected sample MWL-SA-022 for proctor analysis, newly screened material.

Results received 12/13

CQA Inspector Signature

CQA Engineer Signature Kellyn Pirl

TI-04
TESTING INSPECTION FORM
SUBGRADE FILL LABORATORY TEST VERIFICATION FORM

Project Name MWL Cover CQA Date 12/12/06 Time 1100

Inspected by Corey Woods

Weather Clear, Warm

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor test in accordance with ASTM D 698?	YES	
Has gradation been performed in accordance with ASTM C 136?	YES	
Has classification been performed in accordance with ASTM D 2487 and D 4318?	YES	
Do laboratory tests meet the construction specification?	YES	

NOTES:

Collected two samples for proctor analysis from stockpile at borrow area:

MWL-SG-023 - North side of stockpile

MWL-SG-024 - South side of stockpile

Received Results for MWL-SG-023 on 12/15

Received Results for MWL-SG-024 on 12/18

CQA Inspector Signature [signature]

CQA Engineer Signature Kelly M Pril

TI-04
TESTING INSPECTION FORM
SUBGRADE FILL LABORATORY TEST VERIFICATION FORM

Project Name MWL Cover CQA Date 12/14/06 Time 1000

Inspected by Cory Woods

Weather Clear, warm

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor test in accordance with ASTM D 698?	YES	
Has gradation been performed in accordance with ASTM C 136?	YES	
Has classification been performed in accordance with ASTM D 2487 and D 4318?	YES	
Do laboratory tests meet the construction specification?		

NOTES:

Collected the following samples for Proctor analysis from the newly screened material stockpile at the MWL:

MWL-SG-025 - South side of stockpile
MWL-SG-026 - North side of stockpile

Results for MWL-SG-025 recevd 12/20

CQA Inspector Signature [signature] CQA Engineer Signature [signature]

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

See Attached

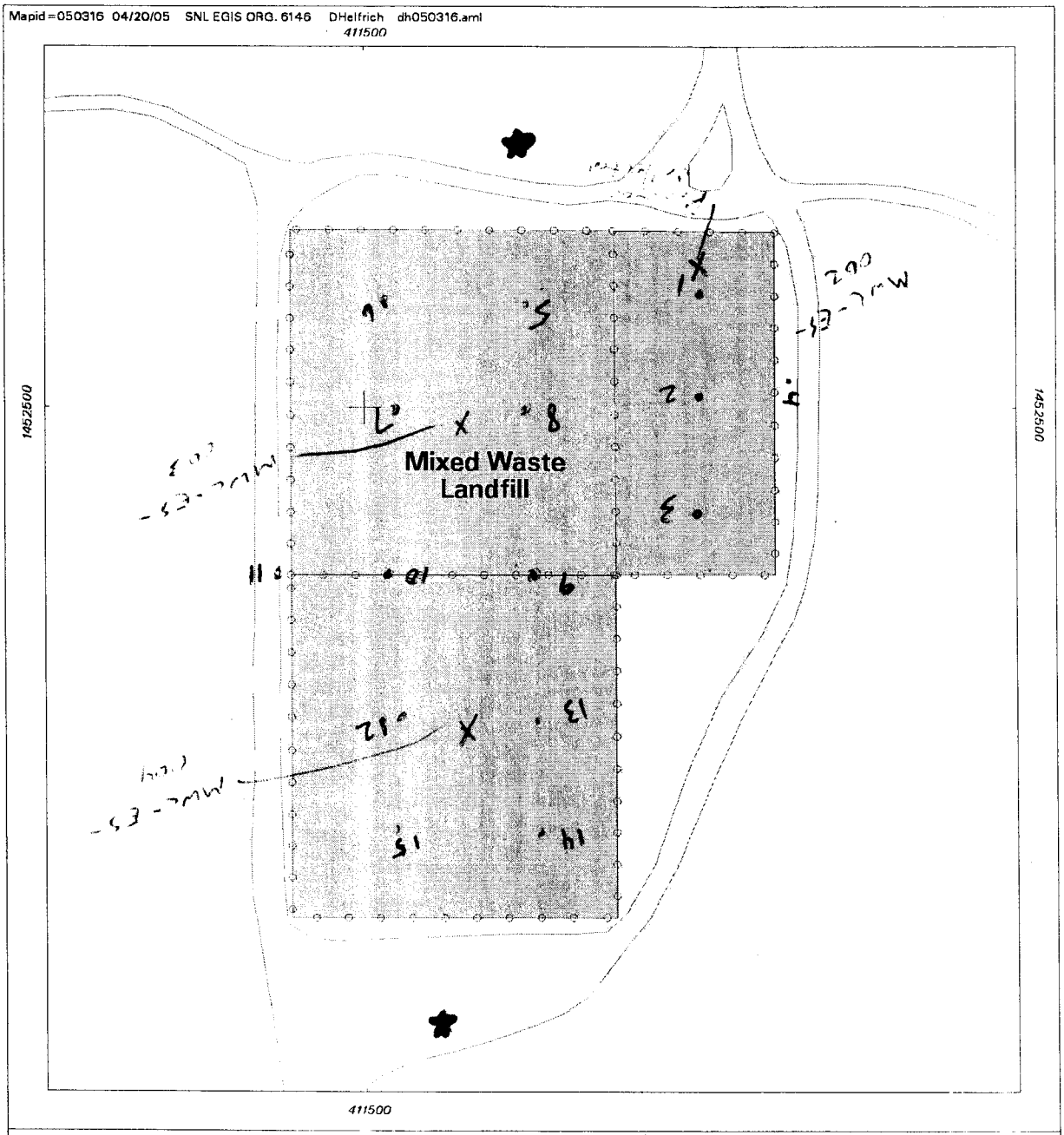
Project Name:
Date: 10/27/06 Time: 1000 Weather: Clear, Cool
Stockpile Area: Existing Surface
Borrow Area: N/A
Type of Construction: Existing Surface
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 115.5 ; Proctor ~~MWL-ES-001~~ MWL-ES-001
Optimum Moisture: 13.4%

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
MWL-ESI-001	See Attached			104.1	90.1	13.8	+0.4	Existing Surface
MWL-ESI-002				111.8	96.8	7.5	-3.9	
MWL-ESI-003				110.2	95.4	7.8	-3.6	
MWL-ESI-004				106.0	91.8	10.2	-3.2	
MWL-ESI-005				106.8	92.5	7.1	-6.3	
MWL-ESI-006				107.8	93.3	7.4	-6.0	
MWL-ESI-007				111.0	96.1	9.5	-3.9	
MWL-ESI-008				108.2	93.7	10.6	-2.8	
MWL-ESI-009				108.7	94.1	8.0	-5.4	
MWL-ESI-010				103.5	89.6	11.9	-1.5	
MWL-ESI-011				107.7	93.2	8.4	-5.0	
MWL-ESI-012				117.3	>100	8.1	-5.3	
MWL-ESI-013				114.2	98.9	8.8	-4.6	
MWL-ESI-014				110.2	95.4	8.8	-4.6	
MWL-ESI-015				109.8	95.1	11.9	-1.5	

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kellyn Pink

Extra Surface compaction test locations



Legend

- Muster Point
- Unpaved Road
- Fence
- Mixed Waste Landfill

Figure 3
Mixed Waste Landfill
Muster Points

0 50 100
Scale in Feet

0 12 24
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

See Lift Maps

Project Name:
Date: 10/31/06 Time: 0800 Weather: Clear, Cool
Stockpile Area: 2" Minus subgrade stockpile
Borrow Area: West of CAMU
Type of Construction: Subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 113.2
Optimum Moisture: 10.9 Proctor MWL-SG-001

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
Time								
0800 MWL-SG1-001	Middle of Trench C, appx. 100' south of Northern Boundary			113.2	100	9.1	-1.8	2" Minus subgrade
MWL-SG1-002	Middle of Trench B, appx. 110 south of Northern Boundary			112.8	99.6	9.8	-1.1	
1030 MWL-SG2-001	Middle of Trench C, appx. 75' south of Northern Boundary			110.6	97.7	11.1	+0.2	
MWL-SG2-002	Middle of Trench B, Appx. 80' south of Northern Boundary			113.0	99.8	10.6	-0.3	
1400 MWL-SG3-001	Middle of Trench B, 100' South			106.7	94.3	10.0	-0.9	
MWL-SG3-002	Middle of Trench B, 150' South			105.3	93.0	10.6	-0.3	
MWL-SG3-003	Middle of Trench A, 100' South			113.0	99.8	10.0	-0.9	
MWL-SG3-004	Middle of Trench C, 160' South			109.6	96.8	10.7	-0.2	
MWL-SG3-005	Middle of Trench C, 100' South			113.2	100	9.0	-1.9	
MWL-SG4-001	Middle of Trench B, 75' South			106.2	93.8	10.7	-0.2	
MWL-SG4-002	Middle of Trench B, 150' South			106.8	94.3	10.5	-0.4	

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kelly M Rule

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

Project Name:
Date: 11/1/06 Time: 1130 Weather: clear, warm
Stockpile Area: 2" minus subgrade stockpile
Borrow Area: West of CAMU
Type of Construction: subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 113.2
Optimum Moisture: 10.9 Proctor: MWL-SG-001

See Lift Maps

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
MWL-SG5-001	Trench B,	70' from	North	108.8	96.1	10.2	-0.7	2" Minus subgrade
MWL-SG4-003	Trench C,	100' from	North	103.0	91.0	11.1	+0.2	↓
MWL-SG4-004	Trench C,	200' from	North	111.5	98.2	9.6	-1.3	↓

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kelly M Pine

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

See Lift Maps

Project Name:
Date: 11/2/06 Time: 1400 Weather: Clear, Warm
Stockpile Area: 2" Minus Subgrade stockpile
Borrow Area: West of CAMU
Type of Construction: Subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 113.2
Optimum Moisture: 10.9 Proctor MWL-SG-001

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
MWL-SG4-005	5' SE of stake		4025	102.3	90.4	8.9	-2.0	2" Minus Subgrade
MWL-SG6-001	5' SSE of stake		4015	113.2	100	9.2	-1.7	↓
MWL-SG6-002	10' South of stake		4029	110.5	97.6	11.0	+0.1	↓
MWL-SG6-003	5' NE of stake		4043	107.5	95.0	12.1	+1.2	↓

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kelly M Pinl

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

see Lift Map

Project Name:
Date: 11/6/06 Time: 1100 Weather: Clear, Warm
Stockpile Area: 2" Minus Subgrade
Borrow Area: West of CAMU
Type of Construction: subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 113.3
Optimum Moisture: 13.2 Proctor MWL-SG-002

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
MWL-SG7-001	15' NE of 4008			109.8	96.7	11.2	-2.0	

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kelly M Rule

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

Project Name:
Date: 11/7/06 Time: 0930 Weather: Clear/Warm
Stockpile Area: 2" Minus subgrade
Borrow Area: West of CAMU
Type of Construction: subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 113.3 (Proctor MWL-SG-002), 117.4 (Proctor MWL-SG-003)
Optimum Moisture: 13.2 (Proctor MWL-SG-003), 12.9 (Proctor MWL-SG-003)

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
MWL-SG2-001 (Time/proctor # 0930/002)	~~10'~~ SW of	~~NE~~	4009	111.5	98.4 ~~107.4~~	11.5 ~~104.3~~	-1.7	2" minus subgrade
MWL-SG8-002	5' SW of	~~NE~~	4019	107.4	94.8	11.5	-1.7	
MWL-SG8-003	10' East of		4008	104.3	92.1	12.5	-0.7	
MWL-SG4-001 (1430/003)	12' SSW of		4022	107.9	91.6	14.2	+1.3	
MWL-SG4-002	15' SW of		4020	114.1	96.9	11.0	-1.9	
MWL-SG4-003	25' SW of		4008	110.4	93.8	11.0	-1.9	↓

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kelly M Pinel

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

See Last Maps

Project Name:
Date: 11/8/06 Time: 1030 Weather: Clear, Warm
Stockpile Area: 2" minus subgrade stockpile
Borrow Area: West of CAMU
Type of Construction: subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 117.4
Optimum Moisture: 12.9 Proctor MWL-SG-003

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
MWL-SG1-004	25' NW of 4008			108.7	92.3	12.7	-0.2	2" minus subgrade

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature _____

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

Project Name:
Date: 11/9/06 Time: 1500 Weather: Clear, Warm
Stockpile Area: 2" minus subgrade stockpile
Borrow Area: west of C4MU
Type of Construction: Subg.-ade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 118.3 (Proctor MWL-SG-004), 118.7 (Proctor MWL-SG-005)
Optimum Moisture: 12.7 (Proctor MWL-SG-004), 12.4 (Proctor MWL-SG-005)

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
Proctor MWL-SG-004 ↓ MWL-SG-005 ↓ MWL-SG7-005	20' SSW of 4004			113.2	95.7	11.7	-1.0	2" Minus Subgrade ↓
MWL-SG10-001	5' SSE of 4022			111.2	94.0	13.8	+1.1	
MWL-SG10-002	5' NNE of 4019			110.8	93.3	11.3	-1.1	
MWL-SG10-003	10' N of 4008			108.3	91.2	11.7	-0.7	↓

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kelly M Pirl

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

See Left Map

Project Name:
Date: 1/14/06 Time: 0850 Weather: Overcast, High winds
Stockpile Area: 2" minus subgrade stockpile
Borrow Area: West of CAMU
Type of Construction: subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 119.6 (Proctor MWL-SG-006), 115.4 (Proctor MWL-SG-007)
Optimum Moisture: 11.2 (Proctor MWL-SG-006), 12.3 (Proctor MWL-SG-007)

new Proctor
0830 / 006
1400 / 007

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
MWL-SG10-001	15' East of	4011		112.9	94.4	9.6	-1.6	2" minus subgrade
MWL-SG10-002	5' NE of	4012		117.5	98.2	9.6	-1.6	
MWL-SG10-006	15' WSW of	4018		112.9	94.4	12.5	+1.3	
MWL-SG10-007	5' E of	4031		114.6	95.8	9.4	-1.8	
MWL-SG10-008	15' ESE of	4038		118.1	98.7	10.7	-0.3	
MWL-SG10-009	5' NW of	4055		106.5	92.3	13.9	+1.0	
MWL-SG10-010	20' NW of	4038		114.4	99.1	12.4	-0.5	

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kelly M Rich

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

Project Name:
Date: 11/5/06 Time: 1430 Weather: Clear, Cool
Stockpile Area: 2" minus subgrade stockpile
Borrow Area: West of CAMU
Type of Construction: Subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 115.4
Optimum Moisture: 12.4 Proctor MWL-SG-007

See Lift Map

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
MWL-SG11-001	35' NW of 4037			114.6	99.3	11.8	-1.1	
MWL-SG11-002	25' W of 4049			112.9	97.8	14.2	+1.3	

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature _____

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

Project Name:
Date: 11/16/06 Time: 1500 Weather: Overcast, Cool
Stockpile Area: 2" Minus subgrade
Borrow Area: West of CAMU
Type of Construction: subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 116.5 (Proctor MWL-SG-008) 113.5 (Proctor MWL-SG-001)
Optimum Moisture: 13.0 (Both Proctors)

See Left Map

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
Proctor 008								
MWL-SG11-003	15' W of 4038			108.9	93.5	14.1	+1.1	2" Minus subgrade
MWL-SG11-004	20' W of 4050			114.6	98.4	11.5	-1.5	
MWL-SG11-005	10' W of 4051			114.4	98.2	12.7	-0.3	
Proctor 009								
MWL-SG11-006	15' S of 4039			106.6	93.9	11.8	-1.2	
MWL-SG11-007	15' W of 4055			113.0	99.6	14.1	+1.1	
MWL-SG11-008	5' E of 4042			113.5	100	12.6	-0.4	

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kelly M Pail

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

Project Name:
Date: 1/20/06 Time: 1400 Weather: Clear, Warm
Stockpile Area: 2" Minus subgrade
Borrow Area: West of CAMU
Type of Construction: subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 113.5
Optimum Moisture: 13.0 Proctor MWL-SG-009

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
MWL-SG11-009	15' NW of 4026			113.5	100	14.1	+1.1	2" Minus Subgrade
MWL-SG11-010	15' NE of 4013			109.3	96.3	12.0	-1.0	↓

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kelly M Pail

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

Project Name:
Date: 11/21/06 Time: 1400 Weather: Clear, Warm
Stockpile Area: 2' Mins subgrade
Borrow Area: West of CAMU
Type of Construction: Subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 113.6 (Proctor MWL-SG-010) 116.0 (Proctor MWL-SG-013)
Optimum Moisture: 12.6 (Proctor -010) 12.3 (Proctor -013)

Proctor

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
MWL-SG11-011	10' E of	4025		110.0	96.8	14.3	+1.7	
MWL-SG11-012	15' SW of	4010		114.2	100	11.8	-0.8	
MWL-SG11-013	17' W of	4011		105.5	92.9	13.7	+1.1	
MWL-SG11-014	~~5' SE of 4010~~ 17' W of	4023		106.4	93.7	12.3	-0.3	
MWL-SG11-015	5' SE of	4010		113.4	97.8	10.7	-1.6	
MWL-SG11-016	15' SE of	4009		114.2	98.4	11.6	-0.7	
MWL-SG11-017	7' NE of	4032		112.7	97.2	13.9	+1.6	

016 → 013

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kellym Pul

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

Project Name:
Date: 11/22/06 Time: 1000 Weather: Clear, Warm
Stockpile Area: 2" Mining Subgrade
Borrow Area: West of CAMU
Type of Construction: Subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 116.0
Optimum Moisture: 12.3 Proctor MWL-SG-013

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
MWL-SG#1-018	6' W of	4021		116.3	100	13.2	+0.9	

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kellym Price

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

Project Name:
Date: 11/30/06 Time: 0930 Weather: windy, cold
Stockpile Area: 2" minus subgrade
Borrow Area: West of CAMU
Type of Construction: Subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 117.7 (Proctor MWL-SG-014) 118.1 (Proctor MWL-SG-015)
Optimum Moisture: 13.0 (Proctor -014) 13.3 (Proctor -015)

See Left Map

Proctor
-014 ↓
-015 ↓

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
MWL-SG12-001	12' W of	4058		109.4	93.2	12.2	-0.8	
MWL-SG12-002	20' NW of	4049		114.2	96.9	11.7	-1.3	
MWL-SG12-003	20' NW of	4045		117.7	99.7	11.8	-1.5	
MWL-SG12-004	25' SW of	4050		117.0	99.1	12.2	-1.1	

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kelly M Pirl

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

Project Name:
Date: 12/5/06 Time: 1430 Weather: Clear, Cool
Stockpile Area: ~~west of CAMU~~ 2" Minus subgrade
Borrow Area: West of CAMU
Type of Construction: subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 118.4
Optimum Moisture: 12.7 Proctor 020

See Lift Map

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
MWL-SG12-005	15' W of 4039			118.9	>100	12.3	-0.4	2" Minus subgrade
MWL-SG12-006	15' E of 4052			112.0	94.6	12.4	-0.3	"

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kelly M Pirl

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

Project Name:
Date: 12/7/06 Time: 1400 Weather: Clear, Cool
Stockpile Area: ~~East~~ @ 2" Minus subgrade
Borrow Area: West of CAMU
Type of Construction: Subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 112.4 (Proctor 019), 119.0 (Proctor 021)
Optimum Moisture: 13.6 (Proctor 019), 12.0 (Proctor 021)

See Lift Map

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
Proctor 019 ↓ 021 ↓ MWL-SG12-007	25' SE of	4053		112.4	100	13.1	-0.5	2" Minus subgrade
MWL-SG12-008	25' NE of	4042		112.4	100	14.1	+0.5	
MWL-SG12-009	25' SSE of	4027		112.4	94.4	13.6	+1.6	
MWL-SG12-010	20' E of	4014		110.4	97.8	11.9	-0.1	

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kelly M Pike

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

Project Name:
Date: 12/13/06 Time: 1000 Weather: Clear, Warm
Stockpile Area: 2" Minus Subgrade
Borrow Area: West of CAMU
Type of Construction: Subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 115.9
Optimum Moisture: 12.2

See Lift Map

Proctor MWL-SG-022

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
MWL-SG12-011	20' W of	4016		114.8	99.1	10.8	-1.4	
MWL-SG12-012	25' SW of	4025		113.1	97.6	12.1	-0.1	

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kelly M Pond

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

Project Name:
Date: 12/15/06 Time: 1000 Weather: Clear, Warm
Stockpile Area: 2" Minus subgrade stockpile
Borrow Area: West of CAMU
Type of Construction: Subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 115.9 (Proctor 022), 117.9 (Proctor 023)
Optimum Moisture: 12.2 (Proctor 022), 12.1 (Proctor 023)

Proctor

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
022 MWL-SG12-013	20' SW of 4010			112.3	96.9	12.3	+0.1	
023 MWL-SG12-014	15' SSW of 4024			113.2	96.0	13.7	+1.6	

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kelly M Pike

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

LOCATION SKETCH

Project Name: MWL Cover CQA
Date: 12/18/06 Time: 1000 Weather: overcast, Cold, Windy
Stockpile Area: 2" Minus subgrade stockpile
Borrow Area: West of CAMU
Type of Construction: subgrade
(landfill surface and perimeter, subgrade, native soil layer, topsoil layer)
Maximum Dry Density (pcf): 117.9
Optimum Moisture: 12.1

see Lift Map

Proctor MWL-SG-~~022~~ 023

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
MWL-SG12-015	15' SSE of 4024			108.7	92.2	14.0	+1.9	
MWL-SG12-016	20' SE of 4010			111.1	94.2	13.1	+1.0	

NOTES:

CQA Inspector Signature _____ CQA Engineer Signature Kellym Pinil

2009 Testing Inspection Forms

TI-02
TESTING INSPECTION FORM
SUBGRADE FILL FIELD TEST FORM

Project Name Seaside Mixed Waste LF Date 5/22/09 Time 8:30 AM

Lift Number n/a Inspected by Paul Mahrer / Ron Lopez

Borrow Area n/a Weather Cloudy

Compaction Equipment Vibrating Roller

Soil Description Existing Subgrade w/ native Soil

Volume and location of soil placed during shift n/a

Surface area and location covered during shift n/a

(Provide explanatory notes if the answer to any of the following questions is "no." Include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	Yes	
Have field density test locations and elevations been plotted and checked?	Yes	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	No Yes	- will be included when test received from Amec
Have all holes from the soil nuclear density tests been backfilled with like material and hand-tamped?	Yes	

NOTES:

- Additional test data and survey data will be included when received.

All Tests, Density and Moisture content meet Specification Requirements.

Approved: Donald T. Eggett PE, CQA Engineer. May 22, 2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 06/16/2009**

Lift Number: 6:1 Slopes Lift 1& 2 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 120.1

Weather: 3:00 PM (86 deg); Clear Sky — Optimum Moisture (%) 11.6

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Volume and location covered during shift: (Approx. 504 CY) North, East and West 6:1 Slopes:

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Donald T. Ingle PE, 06/16/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Lift Number: 6:1 Slopes Lift 1, 2, 3, &4
Borrow Area: Native Soil Borrow Area
Weather: 3:20 PM (86 deg); Clear Sky

Date: 06/17/2009
Inspected By: Paul Molina
Max Dry Density (pcf) 120.1
Optimum Moisture (%) 11.6

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 792 CY) North, East and West 6:1 Slopes

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(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Daniel T. [illegible] PE 06/17/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 06/18/2009
Lift Number: 6:1 Slopes Lifts # 5, 6, 7, & 8
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 120.1
Weather: 10:09 am PM (76 deg); Clear Sky
Optimum Moisture (%) 11.6

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 1170 CY) North, East and West 6:1 Slopes

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(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Daniel T. [illegible] PE, 06/18/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Lift Number: Wedge Lifts #1 & #2
Borrow Area: Native Soil Borrow Area
Weather: 2:10 PM (85 deg); Clear Sky

Date: 06/19/2009
Inspected By: Paul Molina
Max Dry Density (pcf) 115.8
Optimum Moisture (%) 12.3

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 1080 CY) Northeast Wedge Lifts 1 & 2

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Donald T. [illegible] PE, 06/19/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 06/22/2009

Lift Number: NA
Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 115.8

Weather: 7:38 AM (72 deg); Partly Cloudy
Optimum Moisture (%) 12.3

Compaction Equipment: NA

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 810 CY) MWL Berm To Borrow Area

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(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Ronald T. [illegible] PE, 06/22/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 06/23/2009
Lift Number: Native Soil Lift #3
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 115.8
Weather: 1:21 PM (72 deg); Cloudy
Optimum Moisture (%) 12.3

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 1206 CY) MWL Cover Native Soil Lift #3

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Daniel T. [illegible] PE. 06/23/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 06/24/2009**

Lift Number: Native Soil Lift #3 & 4 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 3:30 PM (87 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 1116 CY) MWL Cover Native Soil Lift #3 & 4

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Randal T. [signature] PE, 06/24/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 06/25/2009
Lift Number: Native Soil Lift #4
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 12:45 PM (82 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 1170 CY) MWL Cover Native Soil Lift #4

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Bendel T. [illegible] PE, 06/25/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 06/26/2009
Lift Number: Native Soil Lift #4
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 3:00 PM (78 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 432 CY) MWL Cover Native Soil Lift #4

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Bonded Ti [signature] PE, 06/26/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 06/29/2009
Lift Number: Native Soil Lift #4
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 7:34 (61 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: NA
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 0 CY) MWL Cover Native Soil Lift #4

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

No soil has been placed today

Bendel T. [illegible] PE, 06/29/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 06/30/2009**

Lift Number: Native Soil Lift #5 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 3:00 PM (86 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 756 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Consol Ti [illegible] PE, 06/30/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Lift Number: Native Soil Lift #5
Borrow Area: Native Soil Borrow Area
Weather: 2:33 PM (88 deg); Partly Cloudy

Date: 07/01/2009
Inspected By: Paul Molina
Max Dry Density (pcf) 117.0
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 792 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Donald T. [illegible] PE, 07/01/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/02/2009

Lift Number: Native Soil Lift #5
Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0

Weather: 9:38 AM (74 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 630 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Daniel T. [illegible] PE, 07/02/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/03/2009
Lift Number: Native Soil Lift #5
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: NA
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 0 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Gerald T. [illegible] PE, 07/03/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 07/06/2009**

Lift Number: Native Soil Lift #5 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 2:34 PM (86 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 756 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Carlos Ti PE 07/06/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/07/2009
Lift Number: Native Soil Lift #5
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 4:30 PM (91 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 756 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	

NOTES:

Gerald T. [illegible] PE, 07/07/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/08/2009
Lift Number: Native Soil Lift #5
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 4:00 PM (92 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 720 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Randal T. [illegible] PE, 07/08/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/09/2009
Lift Number: Native Soil Lift #5
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 3:00 PM (91 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller.
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 522 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	

NOTES:

Gordon T. [illegible] PE, 07/09/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 07/10/2009**

Lift Number: Native Soil Lift #5 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 3:00 PM (90 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 756 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Donald T. [illegible] PE, 07/10/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/13/2009
Lift Number: Native Soil Lift #5
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 3:58 PM (96 deg); Clear Sky
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 738 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Daniel T. Lyon PE, 07/13/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/14/2009

Lift Number: Native Soil Lift #6
Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0

Weather: 7:13 AM (74 deg); Clear Sky
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 1170 CY) MWL Cover Native Soil Lift #6

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Gerald T. [signature] PE, 07/14/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/15/2009
Lift Number: Native Soil Lift #6
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 1:45 PM (93 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 954 CY) MWL Cover Native Soil Lift #6

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Bonded T. [signature] PE, 07/15/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 07/16/2009**

Lift Number: Native Soil Lift #6 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 2:29 PM (93 deg); Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 864 CY) MWL Cover Native Soil Lift #6

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Bandel T. [signature] PE. 07/16/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Lift Number: Native Soil Lift #7
Borrow Area: Native Soil Borrow Area
Weather: 2:29 PM (93 deg); Partly Cloudy

Date: 07/17/2009
Inspected By: Paul Molina
Max Dry Density (pcf) 117.0
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 828 CY) MWL Cover Native Soil Lift #7

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Ronald T. [illegible] PE, 07/17/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/20/2009
Lift Number: Native Soil Lift #7
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 3:05 PM (78 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 1630 CY) MWL Cover Native Soil Lift #7

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Gerald T. [illegible] PE, 07/20/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/21/2009
Lift Number: Native Soil Lift #7
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 4:28 PM (87 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 1606 CY) MWL Cover Native Soil Lift #7

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Candel T. [illegible] PE, July 21, 2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/22/2009
Lift Number: Native Soil Lift #8
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 4:02 PM (87 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 0 CY) MWL Cover Native Soil Lift #8

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Daniel T. [signature] PE, July 22, 2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/23/2009
Lift Number: Native Soil Lift #8
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 3:00 PM (78 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller.
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 1458 CY) MWL Cover Native Soil Lift #8

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

David T. [illegible] PE, 07/23/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/24/2009
Lift Number: Native Soil Lift #8
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 8:39 AM (69 deg); Clear Sky
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 1410 CY) MWL Cover Native Soil Lift #8

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	____
Have field density test locations and elevations been plotted and checked?	YES	____
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	____
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	____
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	____

NOTES:

Donald T. [illegible] PE, 07/24/2009

TI-03
TESTING INSPECTION FORM
NATIVE SOIL LAYER FIELD FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/27/2009
Lift Number: Native Soil Lift #8
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 1:00 PM (87 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller.
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 962 CY) MWL Cover Native Soil Lift #8

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Have in situ soil nuclear density and moisture content tests been performed at the frequency required?	YES	
Have field density test locations and elevations been plotted and checked?	YES	
Have the results of the in situ density and moisture content tests been performed in accordance with ASTM D2922 and ASTM D3017, and recorded on Form TI-07 "Moisture/Density Field Test Results Form?"	YES	
Have all holes from the soil nuclear density tests been backfield with like material and hand-tamped?	YES	
Have the laboratory hydraulic conductivity tests been performed at the specified frequency and the locations plotted?	YES	

NOTES:

Daniel T. [illegible] PE, 07/27/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 06/16/2009**

Lift Number: 6:1 Slopes Lift 1& 2 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 120.1

Time/Weather: 3:00 PM (86 deg); Clear Sky — Optimum Moisture (%) 11.6

Compaction Equipment: Vibrating, Smooth Drum Roller.

Fill Description: Native Soil Located in TA-3 Borrow Area

Volume and location covered during shift: (Approx. 504 CY) North, East and West 6:1 Slopes:

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Gerald T. [illegible] PE, 06/16/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill
Date: 06/17/2009
Lift Number: 6:1 Slopes Lift 1, 2, 3, &4
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 120.1
Weather: 3:20 PM (86 deg); Clear Sky
Optimum Moisture (%) 11.6

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 792 CY) North, East and West 6:1 Slopes

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	
Has gradation been performed in accordance with ASTM C136?	YES	
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	
Do laboratory tests meet the construction specification?	YES	

NOTES:

Daniel T. [signature] PE, 06/17/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 06/18/2009**

Lift Number: 6:1 Slopes Lifts # 5, 6, 7, & 8 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 120.1

Weather: 10:09 am PM (76 deg); Clear Sky — Optimum Moisture (%) 11.6

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 1170 CY) North, East and West 6:1 Slopes

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(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Carl T. [illegible] PE, 06/18/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill
Date: 06/19/2009
Lift Number: Wedge Lifts #1 & #2
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 115.8
Weather: 2:10 PM (85 deg); Clear Sky
Optimum Moisture (%) 12.3

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 1080 CY) Northeast Wedge Lifts 1 & 2

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Conrad T. Lo PE, 06/19/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill
Date: 06/22/2009
Lift Number: NA
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 115.8
Weather: 7:38 AM (72 deg); Partly Cloudy
Optimum Moisture (%) 12.3

Compaction Equipment: NA
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 810 CY) MWL Berm To Borrow Area

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(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Daniel T. [signature] PE 06/22/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill
Date: 06/23/2009
Lift Number: Native Soil Lift #3
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 115.8
Weather: 1:21 PM (72 deg); Cloudy
Optimum Moisture (%) 12.3

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 1206 CY) MWL Cover Native Soil Lift #3

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Donald T. [signature] PE, 06/23/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 06/24/2009**

Lift Number: Native Soil Lift #3 & 4 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 3:30 PM (87 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 1116 CY) MWL Cover Native Soil Lift #3 & 4

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	
Has gradation been performed in accordance with ASTM C136?	YES	
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	
Do laboratory tests meet the construction specification?	YES	

NOTES:

Daniel T. [illegible] PE, 06/24/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill
Date: 06/25/2009
Lift Number: Native Soil Lift #4
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 12:45 PM (82 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 1170 CY) MWL Cover Native Soil Lift #4

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Bradley T. [illegible] PE, 06/25/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 06/26/2009**

Lift Number: Native Soil Lift #4 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 3:00 PM (78 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 432 CY) MWL Cover Native Soil Lift #4

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Randall T. Ley PE, 06/26/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 06/29/2009**

Lift Number: Native Soil Lift #4 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 7:34 (61 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: NA

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 0 CY) MWL Cover Native Soil Lift #4

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	
Has gradation been performed in accordance with ASTM C136?	YES	
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	
Do laboratory tests meet the construction specification?	YES	

NOTES:

No soil has been placed today

Paul T. [signature] PE 06/29/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 06/30/2009**

Lift Number: Native Soil Lift #5 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 3:00 PM (86 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 756 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	
Has gradation been performed in accordance with ASTM C136?	YES	
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	
Do laboratory tests meet the construction specification?	YES	

NOTES:

Bondel T. [signature] PE, 06/30/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/01/2009
Lift Number: Native Soil Lift #5
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 2:33 PM (88 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 792 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Daniel T. [illegible] PE, 07/01/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/02/2009
Lift Number: Native Soil Lift #5
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 9:38 AM (74 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 630 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Daniel T. [illegible] PE, 07/02/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/03/2009
Lift Number: Native Soil Lift #5
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: NA
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 0 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Randal T. [illegible] PE, 07/03/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 07/06/2009**

Lift Number: Native Soil Lift #5 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 2:34 PM (86 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 756 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Gerald T. [signature] PE, 07/06/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/07/2009
Lift Number: Native Soil Lift #5
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 4:30 PM (91 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 756 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Conducted by PE, 07/07/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 07/08/2009**

Lift Number: Native Soil Lift #5 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 4:00 PM (92 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 720 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Donald T. [illegible] PE. 07/08/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill
Lift Number: Native Soil Lift #5
Borrow Area: Native Soil Borrow Area
Weather: 3:00 PM (91 deg); Partly Cloudy

Date: 07/09/2009
Inspected By: Paul Molina
Max Dry Density (pcf) 117.0
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 522 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Randall T. [illegible] PE, 07/09/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 07/10/2009**

Lift Number: Native Soil Lift #5 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 3:00 PM (90 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 756 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Daniel T. [illegible] PE, 07/10/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/13/2009
Lift Number: Native Soil Lift #5
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 3:58 PM (96 deg); Clear Sky
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 738 CY) MWL Cover Native Soil Lift #5

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Donald T. Ly PE, 07/13/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 07/14/2009**

Lift Number: Native Soil Lift #6 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 7:13 AM (74 deg); Clear Sky — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 1170 CY) MWL Cover Native Soil Lift #6

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Randal T. [illegible] PE, 07/14/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill
Lift Number: Native Soil Lift #6
Borrow Area: Native Soil Borrow Area
Weather: 1:45 PM (93 deg); Partly Cloudy

Date: 07/15/2009
Inspected By: Paul Molina
Max Dry Density (pcf) 117.0
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 954 CY) MWL Cover Native Soil Lift #6

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Daniel T. [illegible] PE, 07/15/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 07/16/2009**

Lift Number: Native Soil Lift #6 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 2:29 PM (93 deg); Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 864 CY) MWL Cover Native Soil Lift #6

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	
Has gradation been performed in accordance with ASTM C136?	YES	
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	
Do laboratory tests meet the construction specification?	YES	

NOTES:

Daniel T. [illegible] PE, 07/16/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/17/2009
Lift Number: Native Soil Lift #7
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 2:29 PM (93 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 828 CY) MWL Cover Native Soil Lift #7

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Daniel T. [illegible] PE, 07/17/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/20/2009
Lift Number: Native Soil Lift #7
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 3:05 PM (78 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 1630 CY) MWL Cover Native Soil Lift #7

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Bonded T. [illegible] PE, 07/20/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/21/2009
Lift Number: Native Soil Lift #7
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 4:28 PM (87 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 1606 CY) MWL Cover Native Soil Lift #7

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	
Has gradation been performed in accordance with ASTM C136?	YES	
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	
Do laboratory tests meet the construction specification?	YES	

NOTES:

Carlos T. [illegible] PE, 07/21/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 07/22/2009**

Lift Number: Native Soil Lift #8 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 4:02 PM (87 deg); Partly Cloudy — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 0 CY) MWL Cover Native Soil Lift #8

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Daniel T. [illegible] PE, 07/22/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill
Date: 07/23/2009
Lift Number: Native Soil Lift #8
Inspected By: Paul Molina
Borrow Area: Native Soil Borrow Area
Max Dry Density (pcf) 117.0
Weather: 3:00 PM (78 deg); Partly Cloudy
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 1458 CY) MWL Cover Native Soil Lift #8

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Daniel T. [illegible] PE 07/23/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill — **Date: 07/24/2009**

Lift Number: Native Soil Lift #8 — Inspected By: Paul Molina

Borrow Area: Native Soil Borrow Area — Max Dry Density (pcf) 117.0

Weather: 8:39 AM (69 deg); Clear Sky — Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,

Fill Description: Native Soil Located in TA-3 Borrow Area

Surface volume and location covered during shift: (Approx. 1410 CY) MWL Cover Native Soil Lift #8

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Gordon T. [signature] PE 07/24/2009

TI-05
TESTING INSPECTION FORM
NATIVE SOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill
Lift Number: Native Soil Lift #8
Borrow Area: Native Soil Borrow Area
Weather: 1:00 PM (87 deg); Partly Cloudy

Date: 07/27/2009
Inspected By: Paul Molina
Max Dry Density (pcf) 117.0
Optimum Moisture (%) 12.0

Compaction Equipment: Vibrating, Smooth Drum Roller,
Fill Description: Native Soil Located in TA-3 Borrow Area
Surface volume and location covered during shift: (Approx. 962 CY) MWL Cover Native Soil Lift #8

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has the relationship between moisture content and density been analyzed by the Standard Proctor Test in accordance with ASTM D698?	YES	____
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Has hydraulic conductivity testing been performed in accordance with ASTM rigid wall testing procedure?	YES	____
Do laboratory tests meet the construction specification?	YES	____

NOTES:

Daniel T. [signature] P.E. 07/27/2009

TI-06
TESTING INSPECTION FORM
TOPSOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill

Date: 08/03/2009
Inspected By: Paul Molina

Borrow Area: Topsoil Borrow Area
Weather: 1:06 PM (88 deg); Partly Cloudy

Topsoil Description: Topsoil Located in TA-3 Borrow Area

Volume and location of soil placed during shift: (Approx. 2132 CY) MWL Cover Topsoil

---

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Do laboratory tests meet the construction specifications?	YES	____

NOTES:

Randal T. [signature] PE 08/03/2009

TI-06
TESTING INSPECTION FORM
TOPSOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill

Date: 08/04/2009
Inspected By: Paul Molina

Borrow Area: Topsoil Borrow Area
Weather: 1:45 PM (91 deg); Partly Cloudy

Topsoil Description: Topsoil Located in TA-3 Borrow Area

Volume and location of soil placed during shift: (Approx. 1950 CY) MWL Cover Topsoil

---

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Do laboratory tests meet the construction specifications?	YES	____

NOTES:

Bonded T. [signature] PE, 08/04/2009

TI-06
TESTING INSPECTION FORM
TOPSOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill

Date: 08/05/2009
Inspected By: Paul Molina

Borrow Area: Topsoil Borrow Area
Weather: 2:18 PM (94 deg); Partly Cloudy

Topsoil Description: Topsoil Located in TA-3 Borrow Area

Volume and location of soil placed during shift: (Approx. 2028 CY) MWL Cover Topsoil

---

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Do laboratory tests meet the construction specifications?	YES	____

NOTES:

Daniel T. [signature] PE 08/05/2009

TI-06
TESTING INSPECTION FORM
TOPSOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill

Date: 08/06/2009
Inspected By: Paul Molina

Borrow Area: Topsoil Borrow Area
Weather: 1:54 PM (94 deg); Heavy Rain @ 2:30 PM

Topsoil Description: Topsoil Located in TA-3 Borrow Area

Volume and location of soil placed during shift: (Approx. 2106 CY) MWL Cover Topsoil

---

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Do laboratory tests meet the construction specifications?	YES	____

NOTES:

Daniel T. [illegible] PE 08/06/2009

TI-06
TESTING INSPECTION FORM
TOPSOIL LAYER LABORATORY TEST VERIFICATION FORM

Project Name: Sandia Mixed Waste Landfill

Date: 08/07/2009
Inspected By: Paul Molina

Borrow Area: Topsoil Borrow Area
Weather: 11:47 AM (79 deg)

Topsoil Description: Topsoil Located in TA-3 Borrow Area

Volume and location of soil placed during shift: (Approx. 962 CY) MWL Cover Topsoil

---

(Provide explanatory notes if the answer to any of the following questions is "no." include any remedial steps required.)

	YES/NO	NOTE NO.
Has gradation been performed in accordance with ASTM C136?	YES	____
Has classification been performed in accordance with ASTM D2487 and D4318?	YES	____
Do laboratory tests meet the construction specifications?	YES	____

NOTES:

Gerald T. [illegible] PE, 08/07/2009

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

Project Name: SANDIA MIXED WASTE LANDFILL
Stockpile Area: BORROW AREA TA-3
Borrow Area: TA-3
Type of Construction: Moisture/Density Test Locations 2009 Subgrade Surface
Maximum Dry Density (pcf): 120.1
Optimum Moisture: 11.6
Date: 5/22/2009
Approximate Time: 8:00 AM
Weather: 58 (F)

LOCATION SKETCH:
Figure 21

Test Number (Description/Location)	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
URS Subgrade Surface (Subgrade Surface/Grid Block 5)	1453083.9	411683.3	5381.0	117.3	98	10.6	+/- 2	Light Red Sandy
URS Subgrade Surface (Subgrade Surface/Grid Block 12)	1453008.0	411859.2	5385.8	116.1	97	11.0	+/- 2	Light Red Sandy
URS Subgrade Surface (Subgrade Surface/Grid Block 8)	1452939.2	411755.4	5384.1	118.9	99	10.0	+/- 2	Light Red Sandy
URS Subgrade Surface (Subgrade Surface/Grid Block 1)	1452723.0	411680.2	5381.7	117.9	98	10.0	+/- 2	Light Red Sandy

NOTES:

TI-07

TESTING INSPECTION FORM

MOISTURE/DENSITY FIELD TEST RESULTS FORM

Project Name: SANDIA MIXED WASTE LANDFILL
Stockpile Area: BORROW AREA TA-3
Borrow Area: TA-3
Type of Construction: Moisture/Density Test Locations Side Slope Lifts and Native Soil Wedge Lifts 1&2
Maximum Dry Density (pcf): 120.1 & 115.8
Optimum Moisture: 11.6 & 12.3
Date: 6/19/2009
Approximate Time: 11:00 AM
Weather: 79 (F)

LOCATION SKETCH:
Figures 22 & 23

Test Number (Description/Location)	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
URS Wedge Lift 1 (Native Soil Lift 1/Grid Block 8)	1452939.09	411789.54	5386.80	105.7	91	10.7	+/- 2	Clayey Silty Sand
URS Wedge Lift 1 (Native Soil Lift 1/Grid Block 11)	1452934.55	411879.23	5388.33	107.1	92	11.0	+/- 2	Clayey Silty Sand
URS East Slope Lift 6 (East Slope Lift 6/East Slope)	1453115.79	411912.88	5384.57	117.4	98	10.1	+/- 2	Light Red Sandy
URS East Slope Lift 5 (East Slope Lift 5/East Slope)	1453115.79	411912.88	5384.07	112.3	94	10.3	+/- 2	Light Red Sandy
URS West Slope Lift 6 (West Slope Lift 6/West Slope)	1452721.94	411574.36	5379.92	117.9	98	11.1	+/- 2	Light Red Sandy
URS West Slope Lift 5 (West Slope Lift 5/West Slope)	1452721.94	411574.36	5379.42	115.4	96	10.6	+/- 2	Light Red Sandy
URS Wedge Lift 2 (Native Soil Lift 2/Grid Block 11)	1452928.83	411861.93	5388.23	108.5	94	11.0	+/- 2	Clayey Silty Sand
URS North Slope Lift 8 (North Slope Lift 8/North Slope)	1453129.33	411778.76	5382.30	102.5	89	15.2	+/- 2	Clayey Silty Sand
URS North Slope Lift 7 (North Slope Lift 7/North Slope)	1453129.33	411778.76	5381.80	106.7	92	14.0	+/- 2	Clayey Silty Sand

NOTES:

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

Project Name: SANDIA MIXED WASTE LANDFILL

Stockpile Area: BORROW AREA TA-3
Borrow Area: TA-3
Type of Construction: Moisture/Density Test Locations Side Slope Re-Test
Maximum Dry Density (pcf): 115.8
Optimum Moisture: 12.3
Date: 6/22/2009
Approximate Time: 10:00 am
Weather:72 (F)

LOCATION SKETCH:

Figure 22

Test Number (Description/Location)	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
URS North Slope Lift 8 Re-Test (North Slope Lift 8/Grid Block 13)	1453139.784	411825.3244	5382.30	105.6	91	10.9	+/- 2	Clayey Silty Sand
URS North Slope Lift 8 Re-Test (North Slope Lift 8/Grid Block 10)	1453141.195	411775.7289	5381.31	105.9	92	10.5	+/- 2	Clayey Silty Sand
URS North Slope Lift 8 Re-Test (North Slope Lift 8/Grid Block 5)	1453141.019	411626.7926	5378.87	106.0	92	11.0	+/- 2	Clayey Silty Sand

NOTES:

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

Project Name: SANDIA MIXED WASTE LANDFILL

Stockpile Area: BORROW AREA TA-3
Borrow Area: TA-3
Type of Construction: Moisture/Density Test Locations Native Soil Layer Lift 3
Maximum Dry Density (pcf): 115.8
Optimum Moisture: 12.3
Date: 6/23/2009
Approximate Time: 10:00 AM
Weather: 72 (F)

LOCATION SKETCH

Figure 24

Test Number (Description/Location)	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
URS NS Lift 3 (Native Soil Lift 3/Grid Block 2)	1452875.899	411616.4673	5383.34	115.8	97	10.8	+/- 2	Clayey Silty Sand

NOTES:

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

Project Name: SANDIA MIXED WASTE LANDFILL
Stockpile Area: BORROW AREA TA-3
Borrow Area: TA-3
Type of Construction: Moisture/Density Test Locations native Soil Layer Lift 3
Maximum Dry Density (pcf): 117.0
Optimum Moisture: 12.0
Date: 6/24/2009
Approximate Time: 3:30 PM
Weather: 87 (F)

LOCATION SKETCH
Figure 24

Test Number (Description/Location)	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
URS NS Lift 3 (Native Soil Lift 3/Grid Block 8)	1452990.737	411734.8062	5385.53	110.1	94	10.0	+/- 2	Silty Sand

NOTES:

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

Project Name: SANDIA MIXED WASTE LANDFILL
Stockpile Area: BORROW AREA TA-3
Borrow Area: TA-3
Type of Construction: Moisture/Density Test Locations Native Soil Layer Lift 3 & 4
Maximum Dry Density (pcf): 117.0
Optimum Moisture: 12.0
Date: 6/26/2009
Approximate Time: 3:15
Weather: 78 (F)

LOCATION SKETCH
Figures 24 & 25

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
URS NS Lift 3 (Native Soil Lift 3/Grid Block 11)	1452901.18	411889.1	5388.37	114.4	98	13.7	+/- 2	Silty Sand
URS NS Lift 4 (Native Soil Lift 4/Grid Block 1)	1452711.86	411629.3	5383.83	117.7	100+	14.0	+/- 2	Silty Sand
URS NS Lift 4 (Native Soil Lift 4/Grid Block 3)	1452947.35	411639.1	5383.88	110.9	95	13.5	+/- 2	Silty Sand
URS NS Lift 4 (Native Soil Lift 4/Grid Block 5)	1453124.35	411629.6	5380.70	111.6	95	12.8	+/- 2	Silty Sand
URS NS Lift 4 (Native Soil Lift 4/Grid Block 9)	1453056.44	411736.3	5384.69	115.0	98	11.5	+/- 2	Silty Sand
URS NS Lift 4 (Native Soil Lift 4/Grid Block 7)	1452841.98	411745.1	5385.81	111.9	96	11.6	+/- 2	Silty Sand

NOTES:

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

Project Name: SANDIA MIXED WASTE LANDFILL
Stockpile Area: BORROW AREA TA-3
Borrow Area: TA-3
Type of Construction: Moisture/Density Test Locations Native Soil Layer Lift 4
Maximum Dry Density (pcf): 117.0
Optimum Moisture: 12.0
Date: 6/29/2009
Approximate time: 8:00 am
Weather: 61 (F)

LOCATION SKETCH
Figure 25

Test Number (Description/Location)	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
URS NS Lift 4 (Native Soil Lift 4/Grid Block 13)	1453083.953	411883.6456	5386.65	114.8	98	11.6	+/- 2	Silty Sand
URS NS Lift 4 (Native Soil Lift 4/Grid Block 11)	1452933.739	411835.6811	5387.97	113.0	97	10.1	+/- 2	Silty Sand

NOTES:

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

Project Name: SANDIA MIXED WASTE LANDFILL
Stockpile Area: BORROW AREA TA-3
Borrow Area: TA-3
Type of Construction: Moisture/Density Test Locations Native Soil Layer Lift 5
Maximum Dry Density (pcf): 117.0
Optimum Moisture: 12.0
Date: 7/1/2009
Approximate Time: 8:30 am
Weather: 67 (F)

LOCATION SKETCH
Figure 26

Test Number (Description/Location)	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
URS NS Lift 5 (Native Soil Lift 5/Grid Block 12)	1453028.304	411884.8002	5388.33	108.0	92	10.0	+/- 2	Silty Sand

NOTES:

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

Project Name: SANDIA MIXED WASTE LANDFILL
Stockpile Area: BORROW AREA TA-3
Borrow Area: TA-3
Type of Construction: Moisture/Density Test Locations Native Soil Lift 5
Maximum Dry Density (pcf): 117.0
Optimum Moisture: 12.0
Date: 7/2/2009
Approximate Time: 9:38 am
Weather: 74 (F)

LOCATION SKETCH
Figure 26

Test Number (Description/Location)	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
URS NS Lift 5 (Native Soil Lift 5/Grid Block 10)	1453095.1	411772.2522	5385.29	109.9	94	12.3	+/- 2	Silty Sand
URS NS Lift 5 (Native Soil Lift 5/Grid Block 8)	1452931.527	411771.8425	5387.37	109.0	93	12.8	+/- 2	Silty Sand
URS NS Lift 5 (Native Soil Lift 5/Grid Block 6)	1452705.202	411778.9914	5386.45	113.2	97	13.5	+/- 2	Silty Sand

NOTES:

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

Project Name: SANDIA MIXED WASTE LANDFILL
Stockpile Area: BORROW AREA TA-3
Borrow Area: TA-3
Type of Construction: Moisture/Density Test Locations Native Soil Layer Lift 5
Maximum Dry Density (pcf): 117.0
Optimum Moisture: 12.0
Date: 7/9/2009
Approximate Time: 3:00 pm
Weather: 91 (F)

LOCATION SKETCH
Figure 26

Test Number (Description/Location)	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
URS NS Lift 5 (Native Soil Lift 5/Grid Block 4)	1453022.353	411690.4044	5385.02	117.0	100	10.0	+/- 2	Silty Sand
URS NS Lift 5 (Native Soil Lift 5/Grid Block 2)	1452805.212	411640.3927	5384.18	113.1	97	10.2	+/- 2	Silty Sand

NOTES:

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

Project Name: SANDIA MIXED WASTE LANDFILL
Stockpile Area: BORROW AREA TA-3
Borrow Area: TA-3
Type of Construction: Moisture/Density Test Locations Native Soil Lift 6
Maximum Dry Density (pcf): 117.0
Optimum Moisture: 12.0
Date: 7/14/2009
Approximate Time: 3:17 pm
Weather: 88 (F)

LOCATION SKETCH
Figure 27

Test Number (Description/Location)	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
URS NS Lift 6 (Native Soil Lift 6/Grid Block 11)	1453106.092	411858.5263	5386.88	116.3	99	10.4	+/- 2	Silty Sand
URS NS Lift 6 (Native Soil Lift 6/Grid Block 13)	1452925.644	411808.051	5388.39	116.9	100	12.2	+/- 2	Silty Sand

NOTES:

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

Project Name: SANDIA MIXED WASTE LANDFILL
Stockpile Area: BORROW AREA TA-3
Borrow Area: TA-3
Type of Construction: Moisture/Density Test Locations Native Soil Layer Lift 6
Maximum Dry Density (pcf): 117.0
Optimum Moisture: 12.0
Date: 7/17/2009
Approximate Time: 10:00 am
Weather: 79 (F)

LOCATION SKETCH
Figure 27

Test Number	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
URS NS Lift 6 (Native Soil Lift 6/Grid Block 8)	1452977.748	411717.2438	5386.48	117.5	100	12.8	+/- 2	Silty Sand
URS NS Lift 6 (Native Soil Lift 6/Grid Block 6)	1452762.578	411748.4522	5386.67	108.3	93	10.3	+/- 2	Silty Sand
URS NS Lift 6 (Native Soil Lift 6/Grid Block 2)	1452826.899	411600.6799	5383.91	111.1	95	14.0	+/- 2	Silty Sand
URS NS Lift 6 (Native Soil Lift 6/Grid Block 4)	1452997.604	411636.6782	5384.61	113.9	97	10.9	+/- 2	Silty Sand
URS NS Lift 6 (Native Soil Lift 6/Grid Block 9)	1453021.233	411722.0303	5386.18	118.6	100+	11.4	+/- 2	Silty Sand

NOTES:

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

Project Name: SANDIA MIXED WASTE LANDFILL
Stockpile Area: BORROW AREA TA-3
Borrow Area: TA-3
Type of Construction: Moisture/Density Test Locations Native Soil Lift 7
Maximum Dry Density (pcf): 117.0
Optimum Moisture: 12.0
Date: 7/21/2009
Approximate Time: 10:10 am
Weather: 79 deg

LOCATION SKETCH
Figure 28

Test Number (Description/Location)	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
URS NS Lift 7 (Native Soil Lift 7/Grid Block 11)	1452921.536	411855.486	5389.85	112.8	96	12.0	+/- 2	Silty Sand
URS NS Lift 7 (Native Soil Lift 7/Grid Block 13)	1453112.476	411868.9895	5387.14	114.4	98	12.8	+/- 2	Silty Sand
URS NS Lift 7 (Native Soil Lift 7/Grid Block 9)	1452986.894	411768.0364	5387.79	115.4	99	11.9	+/- 2	Silty Sand
URS NS Lift 7 (Native Soil Lift 7/Grid Block 7)	1452834.201	411767.7785	5387.64	117.3	100	12.4	+/- 2	Silty Sand

NOTES:

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

Project Name: SANDIA MIXED WASTE LANDFILL
Stockpile Area: BORROW AREA TA-3
Borrow Area: TA-3
Type of Construction: Moisture/Density Test Locations Native Soil Layer Lift 7
Maximum Dry Density (pcf): 117.0
Optimum Moisture: 12.0
Date: 7/22/2009
Approximate Time: 8:00 am
Weather: 71 (F)

LOCATION SKETCH
Figures 28

Test Number (Description/Location)	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
URS NS Lift 7 (Native Soil Lift 7/Grid Block 1)	1452735.60	411635.78	5384.90	108.9	93	14.0	+/- 2	Silty Sand
URS NS Lift 7 (Native Soil Lift 7/Grid Block 3)	1452893.88	411703.46	5386.74	108.2	92	10.5	+/- 2	Silty Sand
URS NS Lift 7 (Native Soil Lift 7/Grid Block 5)	1453118.42	411627.18	5382.35	111.0	95	12.2	+/- 2	Silty Sand

NOTES:

TI-07
TESTING INSPECTION FORM
MOISTURE/DENSITY FIELD TEST RESULTS FORM

Project Name: SANDIA MIXED WASTE LANDFILL
Stockpile Area: BORROW AREA TA-3
Borrow Area: TA-3
Type of Construction: Moisture/Density Test Locations Native Soil Layer Lift 8
Maximum Dry Density (pcf): 117.0
Optimum Moisture: 12.0
Date: 7/28/2009
Approximate Time: 1:00 pm
Weather: 93 (F)

LOCATION SKETCH
Figure 29

Test Number (Description/Location)	Approximate Location			In Situ Dry Density (pcf)	Percent Compaction	In Situ Water Content (WC %)	Percent Water Content Variation	Soil Description
	North	East	Elevation					
URS NS Lift 8 (Native Soil lift 8/Grid Block 12)	1453005.689	411858.7063	5389.71	117.0	100	10.0	+/- 2	Silty Sand
URS NS Lift 8 (Native Soil lift 8/Grid Block 6)	1452688.962	411757.9778	5387.23	115.5	99	10.0	+/- 2	Silty Sand
URS NS Lift 8 (Native Soil lift 8/Grid Block 2)	1452809.726	411637.4463	5385.65	116.1	99	10.8	+/- 2	Silty Sand
URS NS Lift 8 (Native Soil lift 8/Grid Block 4)	1453019.746	411603.3982	5384.78	113.3	97	12.1	+/- 2	Silty Sand
URS NS Lift 8 (Native Soil lift 8/Grid Block 8)	1452950.355	411770.4436	5388.56	117.0	100	10.3	+/- 2	Silty Sand
URS NS Lift 8 (Native Soil lift 8/Grid Block 10)	1453105.035	411770.1856	5386.42	116.4	99	11.0	+/- 2	Silty Sand

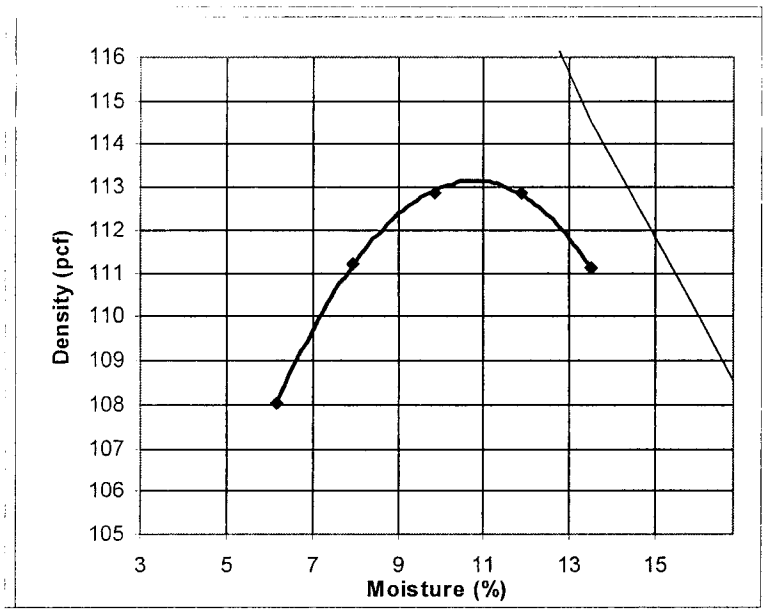
NOTES:

ATTACHMENT 7

Laboratory and Field Test Results and Supporting Data

2006 Standard Proctor, Gradation, and Classification Tests

Client:	URS 6501 Americas Pkwy. NE, Suite 900 Albuquerque, NM 87110-	**Report Date:** October 10, 2006 **Project #:** 6-519-004081 **Work Order #:** 4	
Attn:	Don Lopez	**Lab #:** 6-1444-01 **Sampled By:** Client	
Project Name:	Mixed Waste Landfill Cover KAFB Albuquerque, NM	**Date Sampled:** 10/06/2006 **Visual Description of Material:** **Sample Source:** MWL-SG-001	
Project Manager:	Robert Romero	**SOILS / AGGREGATES**	



Sieve Analysis **(ASTM C117/C136)**

Sieve Size	Passing	Specifications Min	Max
3/4in.	100%		
1/2in.	99%		
3/8in.	99%		
#4	98%		
#8	97%		
#10	97%		
#16	96%		
#30	95%		
#40	94%		
#50	92%		
#100	52%		
#200	24%		

Moisture Density Relationship: **(ASTM D698)** **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.451 **Assumed**
Maximum Density: 113.2
Optimum Moisture: 10.9
Remarks: Sample source revised on 1-30-07

Plasticity Index **(ASTM D4318)**
Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP
Preperation Method: Dry **Liquid Limit Method:** A
Soil Classification (ASTM D2487) SM

Reviewed By: _____
HG

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Fax 5058217371
www.amec.com

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 03, 2006

Project #: 6-519-004081
Work Order #: 8
Lab #: 6-1624
Sampled By: Robert Carr
Date Sampled: 10/31/2006
Visual Description of Material: Light Brown
Sample Source: SW Corner of stockpile, MWL-SG-002

SOILS / AGGREGATES

Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
1/2in.	100%		
3/8in.	99%		
#4	98%		
#8	96%		
#10	95%		
#16	93%		
#30	91%		
#40	89%		
#50	87%		
#100	69%		
#200	32%		

Moisture Density Relationship: (ASTM D698) Method: A
Preparation Method: Dry Rammer Type: Mechanical
Specific Gravity: 2.601 Assumed
Maximum Density: 113.3
Optimum Moisture: 13.2

Plasticity Index (ASTM D4318)
Liquid Limit: 24
Plastic Limit: 19
Plasticity Index: 5
Preperation Method: Dry Liquid Limit Method: A
Soil Classification (ASTM D2487) SC-SM

Reviewed By: _____
ah

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

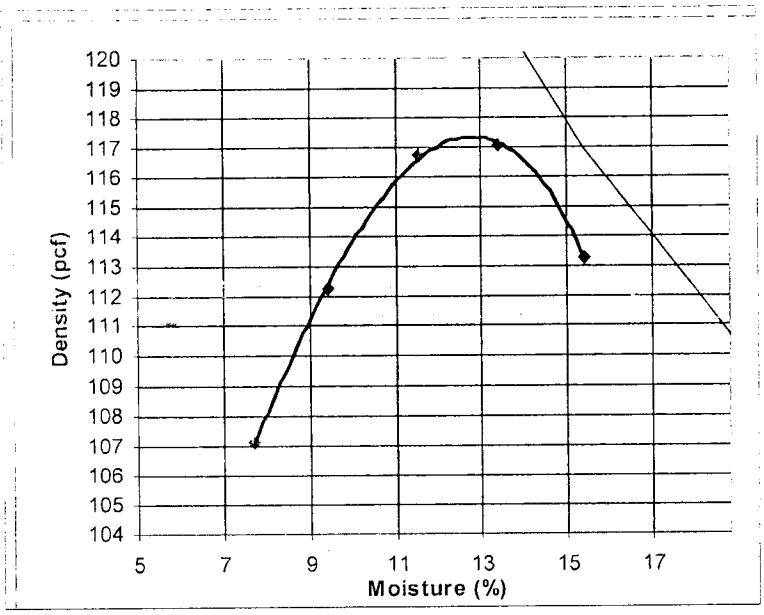
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 03, 2006

Project #: 6-519-004081
Work Order #: 9
Lab #: 6-1625
Sampled By: Robert Carr
Date Sampled: 10/31/2006
Visual Description of Material: Light Brown
Sample Source: Middle of West End of Pile.MWL-SG-003

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
1/2in.	100%		
3/8in.	100%		
#4	98%		
#8	96%		
#10	96%		
#16	93%		
#30	91%		
#40	89%		
#50	87%		
#100	65%		
#200	32%		

Moisture Density Relationship: (ASTM D698) Method: A
Preparation Method: Dry Rammer Type: Mechanical
Specific Gravity: 2.651 Assumed
Maximum Density: 117.4
Optimum Moisture: 12.9

Plasticity Index (ASTM D4318)
Liquid Limit: 25
Plastic Limit: 19
Plasticity Index: 6

Preperation Method: Dry Liquid Limit Method: A

Soil Classification (ASTM D2487) SC-SM

Reviewed By: _____
sna

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

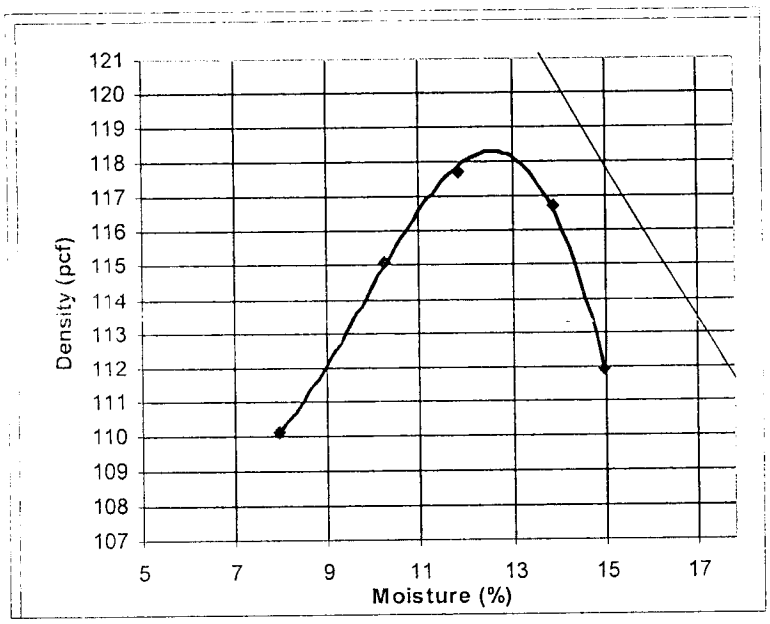
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 03, 2006

Project #: 6-519-004081
Work Order #: 10
Lab #: 6-1626
Sampled By: Robert Carr
Date Sampled: 10/13/2006
Visual Description of Material: Light Brown
Sample Source: North West Corner of Stockpile .MWL-SG-004

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
3/4in.	100%		
1/2in.	100%		
3/8in.	99%		
#4	98%		
#8	96%		
#10	95%		
#16	93%		
#30	91%		
#40	89%		
#50	88%		
#100	68%		
#200	32%		

Moisture Density Relationship: (ASTM D698) Method: A
Preparation Method: Dry Rammer Type: Mechanical
Specific Gravity: 2.651 Assumed
Maximum Density: 118.3
Optimum Moisture: 12.7

Plasticity Index (ASTM D4318)
Liquid Limit: 25
Plastic Limit: 19
Plasticity Index: 6

Preperation Method: Dry Liquid Limit Method: A

Soil Classification (ASTM D2487) SC-SM

Reviewed By: _____
ah

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
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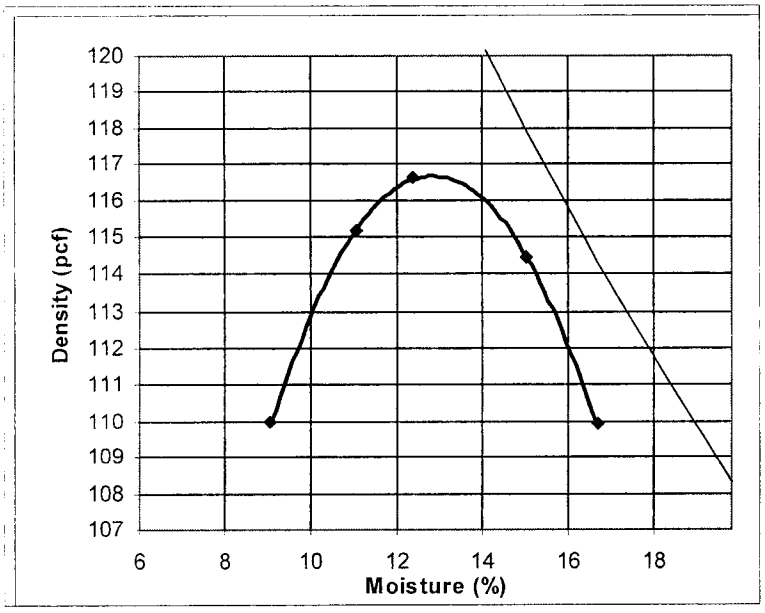
Client:	URS 6501 Americas Pkwy. NE, Suite 900 Albuquerque, NM 87110-	**Report Date:**	November 22, 2006
		Project #:	6-519-004081
		Work Order #:	21
Attn:	Don Lopez	**Lab #:**	6-1780
		Sampled By:	Miguel Chavez
Project Name:	Mixed Waste Landfill Cover KAFB Albuquerque, NM	**Date Sampled:**	11/16/2006
		Visual Description of Material:	Light Red & Rocky
		Sample Source:	MWL-SG-08005
Project Manager:	Robert Romero	**SOILS / AGGREGATES**	



Sieve Analysis **(ASTM C117/C136)**

Sieve Size	Passing	Specifications Min	Max
3/8in.	100%		
#4	98%		
#8	96%		
#10	95%		
#16	94%		
#30	91%		
#40	90%		
#50	88%		
#100	65%		
#200	23%		

Moisture Density Relationship: **(ASTM D698)** **Method:** B
Preparation Method: Moist **Rammer Type:** Manual
Specific Gravity: 2.651 **Assumed**
Maximum Density: 116.7
Optimum Moisture: 12.9
Remarks: Sample source revised on 1/30/07

Plasticity Index **(ASTM D4318)**
Liquid Limit: 25
Plastic Limit: 17
Plasticity Index: 8
Preperation Method: Dry **Liquid Limit Method:** A
Soil Classification (ASTM D2487) SC

Reviewed By: _____
HG

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
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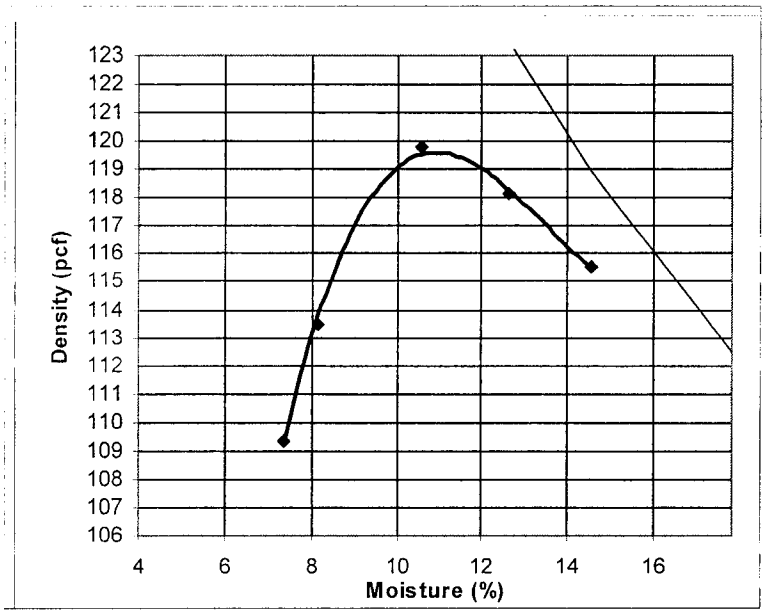
Client:	URS 6501 Americas Pkwy. NE, Suite 900 Albuquerque, NM 87110-	**Report Date:**	November 06, 2006
		Project #:	6-519-004081
		Work Order #:	12
Attn:	Don Lopez	**Lab #:**	6-1646
		Sampled By:	Robert Carr
Project Name:	Mixed Waste Landfill Cover KAFB Albuquerque, NM	**Date Sampled:**	11/02/2006
		Visual Description of Material:	Light Brown
		Sample Source:	MWL-SG-006
Project Manager:	Robert Romero	**SOILS / AGGREGATES**	



Sieve Analysis **(ASTM C117/C136)**

Sieve Size	Passing	Specifications Min	Max
1/2in.	100%		
3/8in.	100%		
#4	98%		
#8	97%		
#10	96%		
#16	94%		
#30	92%		
#40	90%		
#50	88%		
#100	71%		
#200	32%		

Moisture Density Relationship: **(ASTM D698)** **Method:** A

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.651 **Assumed**

Maximum Density: 119.6

Optimum Moisture: 11.0

Remarks: Sample source revised on 1-30-07

Plasticity Index **(ASTM D4318)**

Liquid Limit: 25

Plastic Limit: 17

Plasticity Index: 8

Preperation Method: Dry **Liquid Limit Method:** A

Soil Classification (ASTM D2487) SC

Reviewed By: _____
ah

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

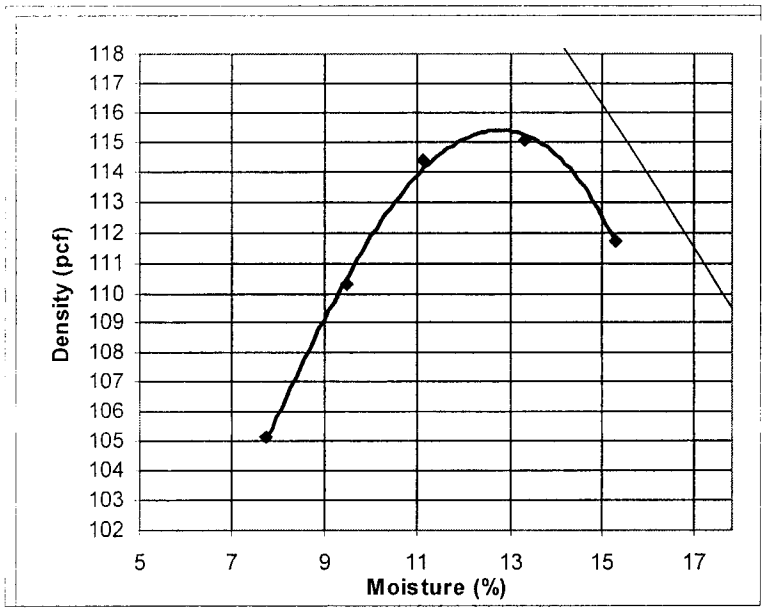
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 08, 2006

Project #: 6-519-004081
Work Order #: 13
Lab #: 6-1647
Sampled By: Robert Carr
Date Sampled: 11/02/2006
Visual Description of Material: Light Brown
Sample Source: MWL-SG-007

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
1/2in.	100%		
3/8in.	99%		
#4	98%		
#8	96%		
#10	96%		
#16	94%		
#30	91%		
#40	90%		
#50	88%		
#100	73%		
#200	33%		

Moisture Density Relationship: (ASTM D698) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.601 **Assumed**
Maximum Density: 115.4
Optimum Moisture: 12.9
Remarks: Sample source revised on 1/30/07

Plasticity Index (ASTM D4318)
Liquid Limit: 25
Plastic Limit: 18
Plasticity Index: 7

Preperation Method: Dry **Liquid Limit Method:** A

Soil Classification (ASTM D2487) SC-SM

Reviewed By: _____
ah

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

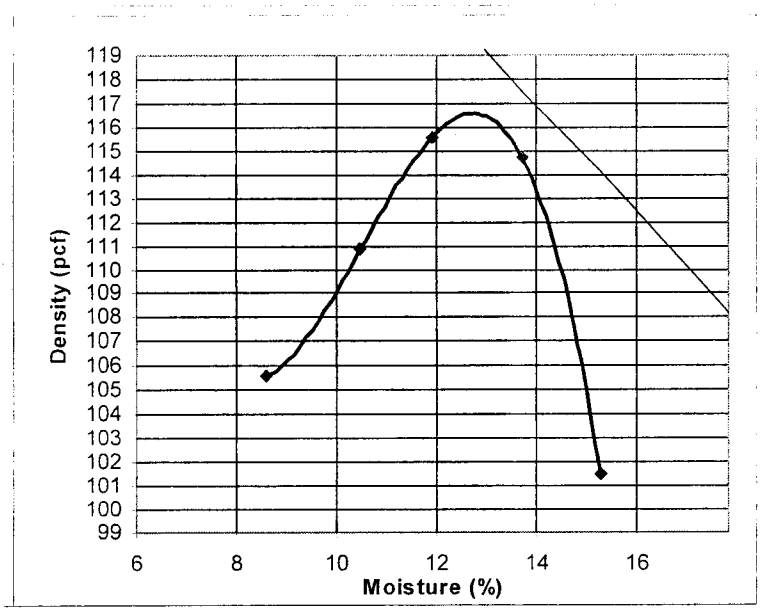
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 14, 2006

Project #: 6-519-004081
Work Order #: 14
Lab #: 6-1690
Sampled By: Robert Carr
Date Sampled: 11/08/2006
Visual Description of Material: Light Brown
Sample Source: MWL-SG-008

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
1/2in.	100%		
3/8in.	100%		
#4	98%		
#8	96%		
#10	96%		
#16	94%		
#30	91%		
#40	90%		
#50	88%		
#100	66%		
#200	33%		

Moisture Density Relationship: (ASTM D698) Method: A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.551 **Assumed**
Maximum Density: 116.6
Optimum Moisture: 12.8
Remarks: Revised 12/8/06 to show correct proctor method used.

Plasticity Index (ASTM D4318)
Liquid Limit: 25
Plastic Limit: 19
Plasticity Index: 6
Preperation Method: Dry **Liquid Limit Method:** A
Soil Classification (ASTM D2487) SC-SM

Reviewed By: _____
HG

Distribution: Client: ✓ File: ✓ Supplier: ✓ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Albuquerque, NM 87110-

Attn: Don Lopez

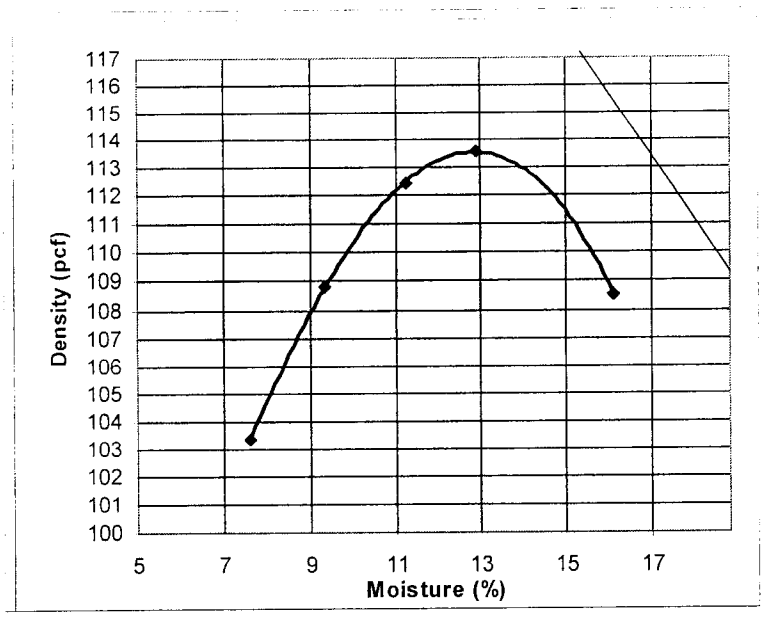
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 13, 2006

Project #: 6-519-004081
Work Order #: 15
Lab #: 6-1691
Sampled By: Robert Carr
Date Sampled: 11/08/2006
Visual Description of Material: Light Brown
Sample Source: MWL-SG-009

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
1 1/2in.	100%		
1in.	96%		
3/4in.	100%		
1/2in.	96%		
3/8in.	95%		
#4	94%		
#8	92%		
#10	91%		
#16	90%		
#30	87%		
#40	86%		
#50	84%		
#100	61%		
#200	31%		

Moisture Density Relationship: (ASTM D698) Method: A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 113.6
Optimum Moisture: 12.9
Remarks: Revised 12/8/06 to show correct proctor method used.

Plasticity Index (ASTM D4318)
Liquid Limit: 24
Plastic Limit: 19
Plasticity Index: 5
Preperation Method: Dry **Liquid Limit Method:** A
Soil Classification (ASTM D2487) SC-SM

Reviewed By: _____
Jr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

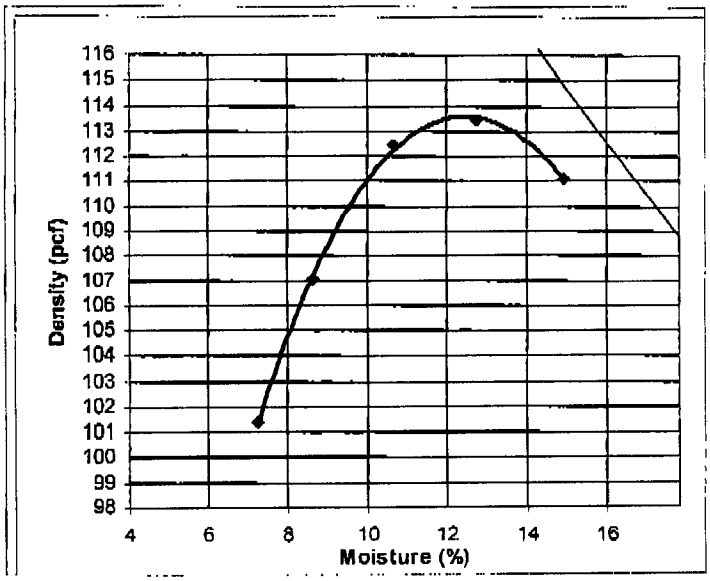
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 13, 2006

Project #: 6-519-004081
Work Order #: 16
Lab #: 6-1692
Sampled By: Robert Carr
Date Sampled: 11/08/2006
Visual Description of Material: light Brown
Sample Source: MWL-SG-010

SOILS / AGGREGATES



Moisture Density Relationship: (ASTM D698) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.551
Maximum Density: 113.6
Optimum Moisture: 12.6

Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Specifications Max
3/4in.	100%		
1/2in.	99%		
3/8in.	99%		
#4	98%		
#8	96%		
#10	96%		
#16	94%		
#30	91%		
#40	90%		
#50	88%		
#100	67%		
#200	33%		

Plasticity Index (ASTM D4318)
Liquid Limit: 25
Plastic Limit: 19
Plasticity Index: 6
Preparation Method: Dry **Liquid Limit Method:** A
Soil Classification (ASTM D2487) SC-SM

Reviewed By:
jr

Distribution: Client ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
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Attn: Don Lopez

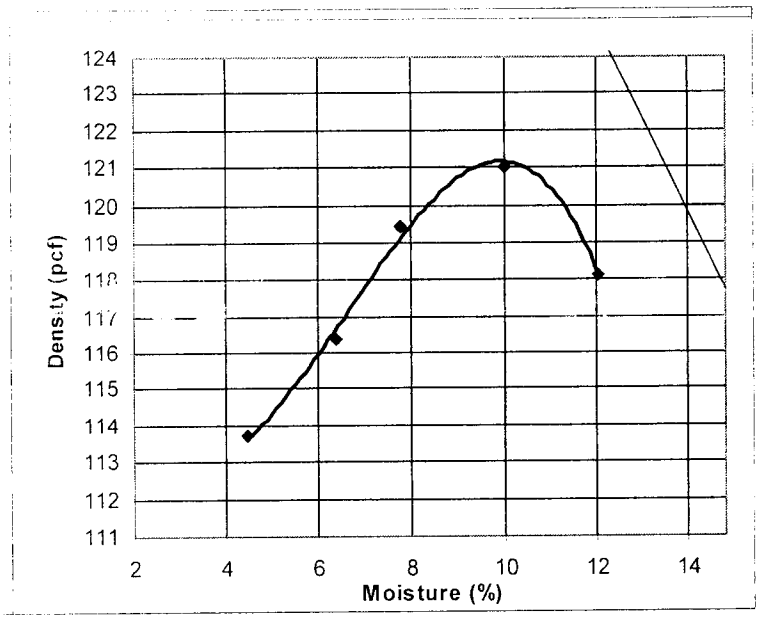
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 21, 2006

Project #: 6-519-004081
Work Order #: 19
Lab #: 6-1743
Sampled By: Miguel Chavez
Date Sampled: 11/14/2006
Visual Description of Material: Light Brown Rocky
Sample Source: MWL-SG-011

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
1 1/4in.	100%		
1in.	100%		
3/4in.	96%		
1/2in.	93%		
3/8in.	92%		
#4	88%		
#8	84%		
#10	83%		
#16	79%		
#30	75%		
#40	72%		
#50	69%		
#100	50%		
#200	15%		

Moisture Density Relationship: (ASTM D698) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 121.2
Optimum Moisture: 10.0

Plasticity Index (ASTM D4318)
Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP
Preperation Method: Dry **Liquid Limit Method:** A
Soil Classification (ASTM D2487) SM

Reviewed By: HG

Distribution: Client: ✔ File: ✔ Supplier: ☑ Other: Addressee (2)
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Attn: Don Lopez

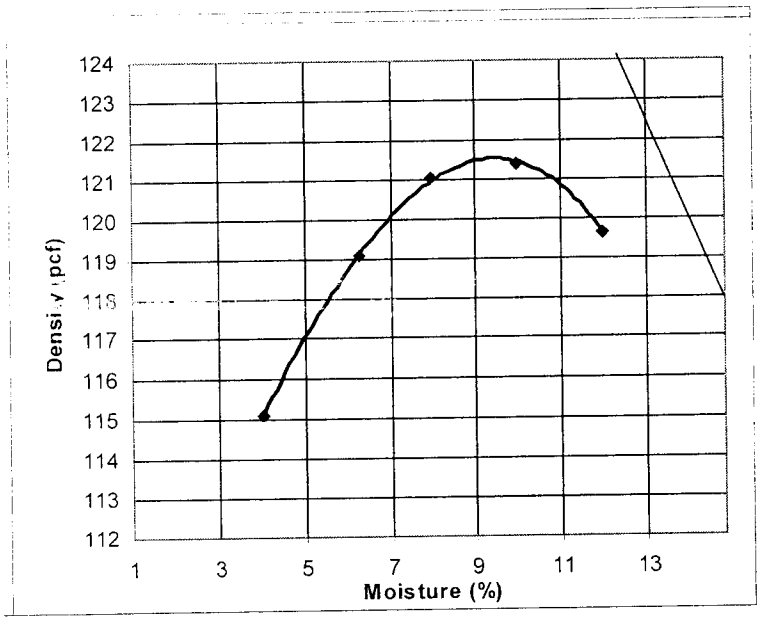
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 21, 2006

Project #: 6-519-004081
Work Order #: 18
Lab #: 6-1742
Sampled By: Miguel Chavez
Date Sampled: 11/14/2006
Visual Description of Material: Light Brown Rocky
Sample Source: MWL-SG-012

SOILS / AGGREGATES



Moisture Density Relationship: (ASTM D698) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 121.5
Optimum Moisture: 9.6

Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
1 1/4in.	100%		
1in.	94%		
3/4in.	94%		
1/2in.	91%		
3/8in.	90%		
#4	86%		
#8	82%		
#10	81%		
#16	77%		
#30	74%		
#40	72%		
#50	70%		
#100	54%		
#200	24%		

Plasticity Index (ASTM D4318)
Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP
Preperation Method: Dry **Liquid Limit Method:** A

Soil Classification (ASTM D2487) SM

Reviewed By: HG

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

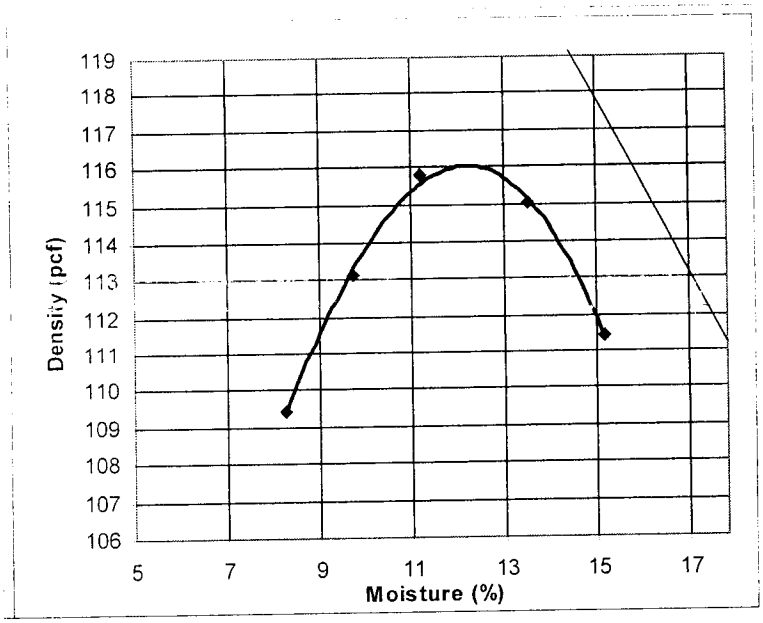
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 21, 2006

Project #: 6-519-004081
Work Order #: 17
Lab #: 6-1740
Sampled By: Miguel Chavez
Date Sampled: 11/14/2006
Visual Description of Material: Light Brown
Sample Source: East Side of South Pul MWL-SG-013

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
3/8in.	100%		
#4	99%		
#8	97%		
#10	97%		
#16	95%		
#30	93%		
#40	91%		
#50	90%		
#100	77%		
#200	36%		

Moisture Density Relationship: (ASTM D698) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 116.0
Optimum Moisture: 12.3

Plasticity Index (ASTM D4318)
Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP
Preperation Method: Dry **Liquid Limit Method:** A

Soil Classification (ASTM D2487) SM

Reviewed By: HG

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

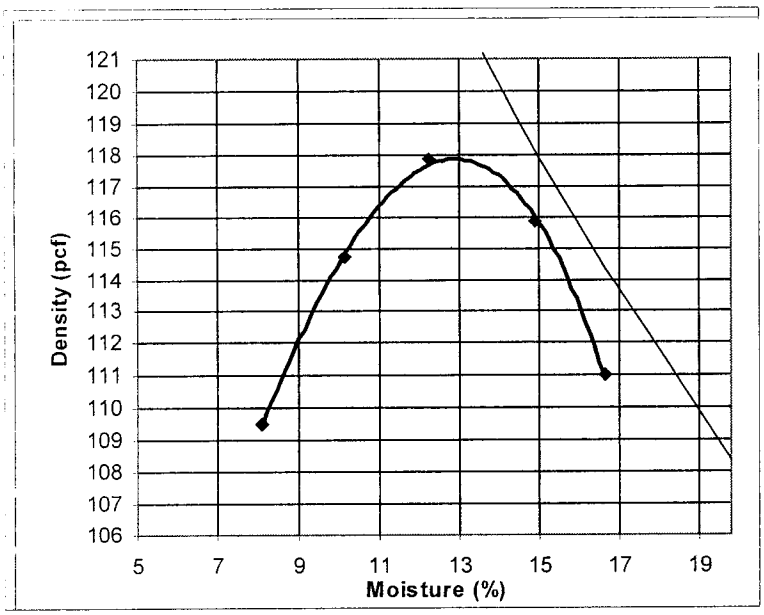
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 28, 2006

Project #: 6-519-004081
Work Order #: 20
Lab #: 6-1779
Sampled By: Miguel Chavez
Date Sampled: 11/16/2006
Visual Description of Material: Light Red & Rocky
Sample Source: MWL-SG-014

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
3/8in.	100%		
#4	98%		
#8	96%		
#10	95%		
#16	94%		
#30	91%		
#40	90%		
#50	88%		
#100	73%		
#200	30%		

Moisture Density Relationship: (ASTM D698) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 117.9
Optimum Moisture: 13.0
Remarks: Sample source revised on 1/30/07

Plasticity Index (ASTM D4318)
Liquid Limit: 23
Plastic Limit: 18
Plasticity Index: 5
Preperation Method: Dry **Liquid Limit Method:** A
Soil Classification (ASTM D2487) SC-SM

Reviewed By: _____
HG

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

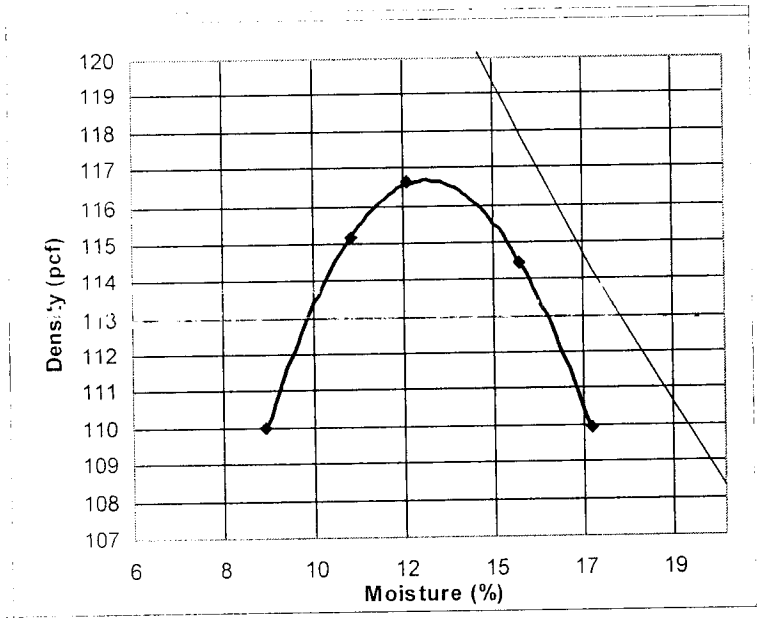
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 22, 2006

Project #: 6-519-004081
Work Order #: 21
Lab #: 6-1780
Sampled By: Miguel Chavez
Date Sampled: 11/16/2006
Visual Description of Material: Light Red & Rocky
C-56-005
Sample Source: South Side of Stock Pile / MWL ~~015~~

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
3/8in.	100%		
#4	98%		
#8	96%		
#10	95%		
#16	94%		
#30	91%		
#40	90%		
#50	88%		
#100	65%		
#200	23%		

Moisture Density Relationship: (ASTM D698) **Method:** B
Preparation Method: Moist **Rammer Type:** Manual
Specific Gravity: 2.651 **Assumed**
Maximum Density: 116.7
Optimum Moisture: 12.9

Plasticity Index (ASTM D4318)
Liquid Limit: 25
Plastic Limit: 17
Plasticity Index: 8
Preperation Method: Dry **Liquid Limit Method:** A
Soil Classification (ASTM D2487) SC

Reviewed By: _____
HG

Distribution: Client: ✓ File: ✓ Supplier: ✓ Other: Addressee (2)
Email: Cory Woods / MKM Engineering (1)

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Client:	URS 6501 Americas Pkwy. NE, Suite 900 Albuquerque, NM 87110-	**Report Date:**	November 27, 2006
Attn:	Don Lopez	**Project #:** **Work Order #:** **Lab #:** **Sampled By:** **Date Sampled:**	6-519-004081 22 6-1809 Miguel Chavez 11/20/2006
Project Name:	Mixed Waste Landfill Cover KAFB Albuquerque, NM	**Visual Description of Material:** **Sample Source:**	Light Red Sandy MWL-SG-016
Project Manager:	Robert Romero	**SOILS / AGGREGATES**	

Sieve Analysis **(ASTM C117/C136)**

Sieve Size	Passing	Specifications Min	Max
3/4in.	100%		
1/2in.	99%		
3/8in.	99%		
#4	99%		
#8	97%		
#10	96%		
#16	94%		
#30	92%		
#40	90%		
#50	88%		
#100	74%		
#200	31%		

Moisture Density Relationship: **(ASTM D698)** **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.625 **Assumed**
Maximum Density: 116.4
Optimum Moisture: 13.2
Remarks: Sample source revised on 1/30/07

Plasticity Index **(ASTM D4318)**
Liquid Limit: 25
Plastic Limit: 21
Plasticity Index: 4
Preperation Method: Dry **Liquid Limit Method:** A
Soil Classification (ASTM D2487) SC-SM

Reviewed By: _____
ah

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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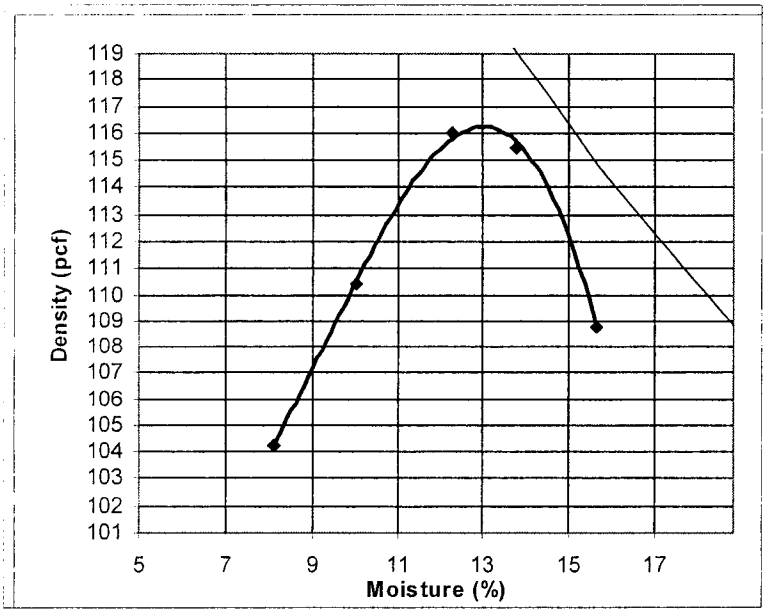
Client:	URS 6501 Americas Pkwy. NE, Suite 900 Albuquerque, NM 87110-	**Report Date:**	November 28, 2006
Attn:	Don Lopez	**Project #:** **Work Order #:** **Lab #:** **Sampled By:** **Date Sampled:**	6-519-004081 23 6-1810 Miguel Chavez 11/20/2006
Project Name:	Mixed Waste Landfill Cover KAFB Albuquerque, NM	**Visual Description of Material:** **Sample Source:**	Light red Sandy MW-SG-017
Project Manager:	Robert Romero	**SOILS / AGGREGATES**	



Sieve Analysis **(ASTM C117/C136)**

Sieve Size	Passing	Specifications Min	Max
3/4in.	100%		
3/8in.	99%		
#4	97%		
#8	96%		
#10	95%		
#16	93%		
#30	91%		
#40	89%		
#50	87%		
#100	73%		
#200	31%		

Moisture Density Relationship: **(ASTM D698)** **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.6 **Assumed**
Maximum Density: 116.2
Optimum Moisture: 13.1
Remarks: Sample source revised on 1/30/07

Plasticity Index **(ASTM D4318)**

Liquid Limit: 24
Plastic Limit: 19
Plasticity Index: 5

Preperation Method: Dry **Liquid Limit Method:** A

Soil Classification (ASTM D2487) SC-SM

Reviewed By: _____
HG

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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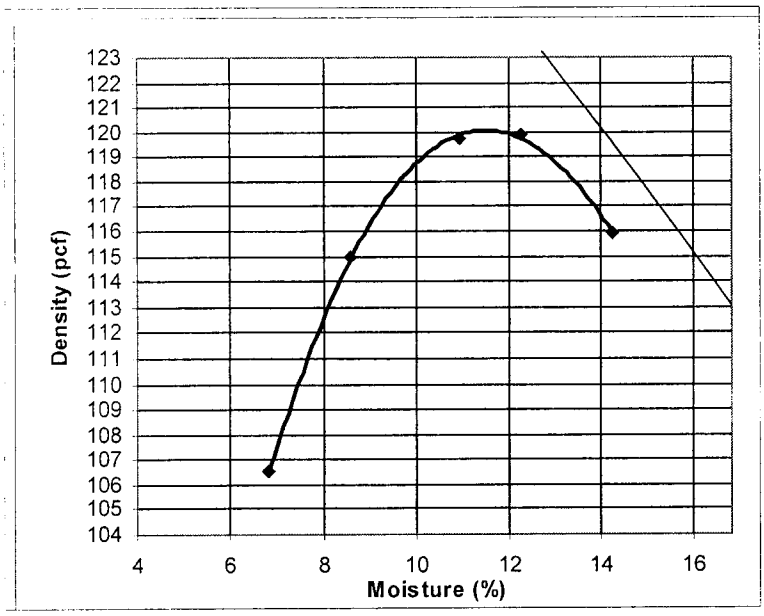
Client:	URS 6501 Americas Pkwy. NE, Suite 900 Albuquerque, NM 87110-	**Report Date:**	November 29, 2006
		Project #:	6-519-004081
		Work Order #:	24
Attn:	Don Lopez	**Lab #:**	6-1811
		Sampled By:	Miguel Chavez
Project Name:	Mixed Waste Landfill Cover KAFB Albuquerque, NM	**Date Sampled:**	11/20/2006
		Visual Description of Material:	Light Red Sandy
		Sample Source:	MWL-SG-018
Project Manager:	Robert Romero	**SOILS / AGGREGATES**	



Sieve Analysis **(ASTM C117/C136)**

Sieve Size	Passing	Specifications Min	Max
1/2in.	100%		
3/8in.	100%		
#4	98%		
#8	96%		
#10	96%		
#16	94%		
#30	91%		
#40	90%		
#50	88%		
#100	74%		
#200	32%		

Moisture Density Relationship: **(ASTM D698)** **Method:** A

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.651 **Assumed**

Maximum Density: 120.1

Optimum Moisture: 11.6

Remarks: Revised 12/8/06 to show correct proctor method used.
**Sample source revised on 1/30/07

Plasticity Index **(ASTM D4318)**

Liquid Limit: 26

Plastic Limit: 19

Plasticity Index: 7

Preperation Method: Dry **Liquid Limit Method:** A

Soil Classification (ASTM D2487) SC-SM

Reviewed By: _____

vs

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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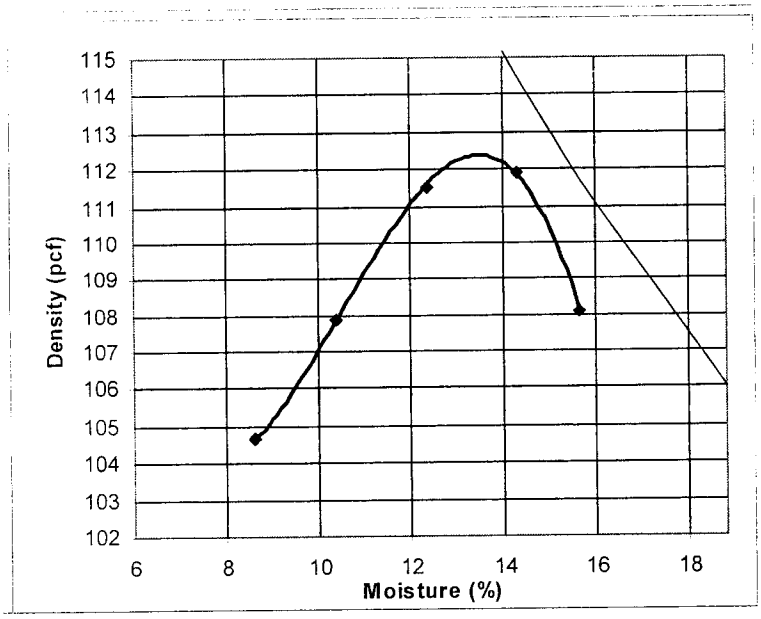
Client:	URS 6501 Americas Pkwy. NE, Suite 900 Albuquerque, NM 87110-	**Report Date:**	December 07, 2006
Attn:	Don Lopez	**Project #:**	6-519-004081
Project Name:	Mixed Waste Landfill Cover KAFB Albuquerque, NM	**Work Order #:** **Lab #:** **Sampled By:** **Date Sampled:** **Visual Description of Material:** **Sample Source:**	25 6-1833 Miguel Chavez 11/27/2006 Light Red & Rocky MWL SG-019 North Side of Pile
Project Manager:	Robert Romero		

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
3/4in.	100%		
1/2in.	100%		
3/8in.	100%		
#4	99%		
#8	98%		
#10	98%		
#16	97%		
#30	94%		
#40	93%		
#50	91%		
#100	78%		
#200	37%		

Moisture Density Relationship: (ASTM D698) **Method:** B

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.501 **Assumed**

Maximum Density: 112.4

Optimum Moisture: 13.6

Plasticity Index (ASTM D4318)

Liquid Limit: 27

Plastic Limit: 19

Plasticity Index: 8

Preperation Method: Dry **Liquid Limit Method:** A

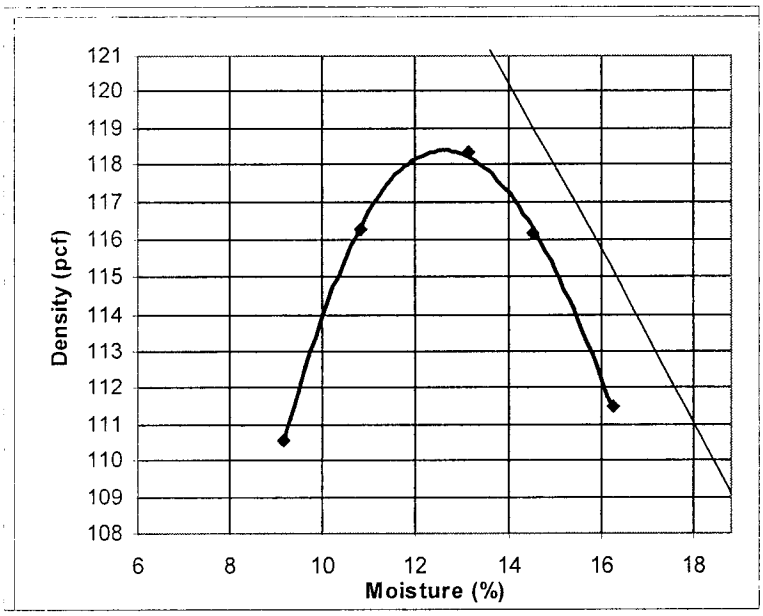
Soil Classification (ASTM D2487) SC

Reviewed By: _____
Jr

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

AMEC Earth .Environmental, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client:	URS 6501 Americas Pkwy. NE, Suite 900 Albuquerque, NM 87110-	**Report Date:**	December 05, 2006
Attn:	Don Lopez	**Project #:**	6-519-004081
Project Name:	Mixed Waste Landfill Cover KAFB Albuquerque, NM	**Work Order #:** **Lab #:** **Sampled By:** **Date Sampled:** **Visual Description of Material:** **Sample Source:**	26 6-1834 Miguel Chavez 11/27/2006 Light Red MWL-SG-020
Project Manager:	Robert Romero	**SOILS / AGGREGATES**	



Sieve Analysis **(ASTM C117/C136)**

Sieve Size	Passing	Specifications Min	Max
3/8in.	100%		
#4	99%		
#8	97%		
#10	96%		
#16	95%		
#30	93%		
#40	91%		
#50	90%		
#100	77%		
#200	33%		

Moisture Density Relationship: **(ASTM D698)** **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 118.4
Optimum Moisture: 12.7
Remarks: Sample source revised on 1/30/07

Plasticity Index **(ASTM D4318)**
Liquid Limit: 24
Plastic Limit: 21
Plasticity Index: 3
Preperation Method: Dry **Liquid Limit Method:** A
Soil Classification (ASTM D2487) SM

Reviewed By: _____
Jr

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

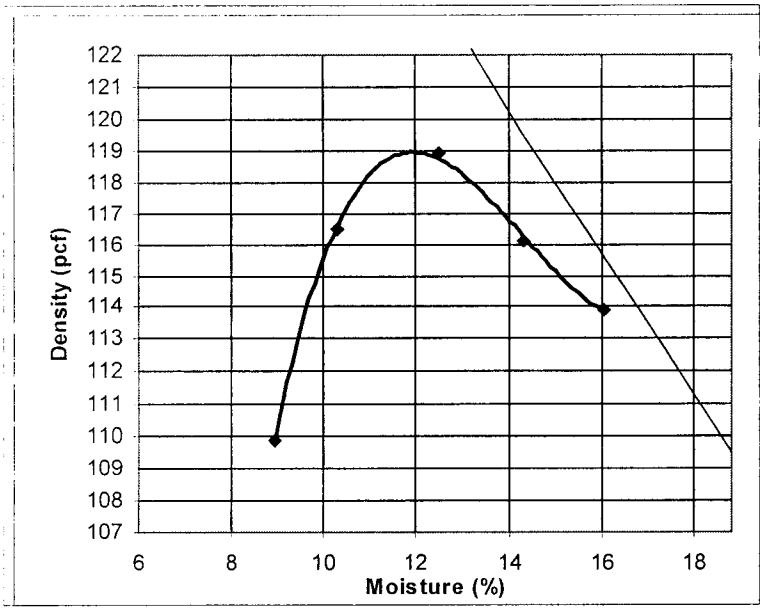
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: December 05, 2006

Project #: 6-519-004081
Work Order #: 27
Lab #: 6-1835
Sampled By: Miguel Chavez
Date Sampled: 11/27/2006
Visual Description of Material: Light Red
Sample Source: MWL-SG-021

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
3/8in.	100%		
#4	99%		
#8	97%		
#10	96%		
#16	94%		
#30	92%		
#40	90%		
#50	88%		
#100	73%		
#200	31%		

Moisture Density Relationship: (ASTM D698) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 119.0
Optimum Moisture: 12.0
Remarks: Sample source revised on 1/30/07

Plasticity Index (ASTM D4318)
Liquid Limit: 25
Plastic Limit: 21
Plasticity Index: 4
Preperation Method: Dry **Liquid Limit Method:** A
Soil Classification (ASTM D2487) SC-SM

Reviewed By: _____
Jr

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

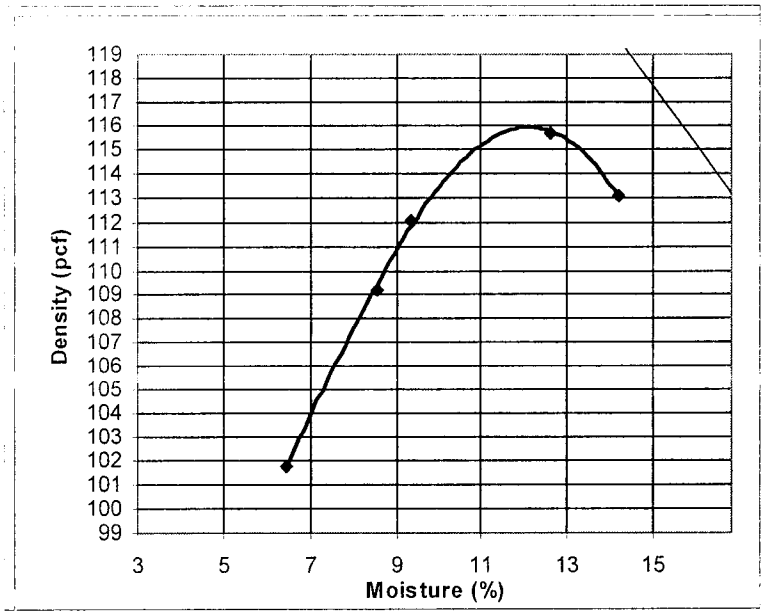
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: December 12, 2006

Project #: 6-519-004081
Work Order #: 28
Lab #: 6-1895
Sampled By: Miguel Chavez
Date Sampled: 12/05/2006
Visual Description of Material: Light Brown
Sample Source: MWL-SG-022

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
1 1/2in.	100%		
1in.	99%		
3/4in.	98%		
3/8in.	98%		
#4	98%		
#8	96%		
#10	96%		
#16	94%		
#30	91%		
#40	87%		
#50	86%		
#100	77%		
#200	30%		

Moisture Density Relationship: (ASTM D698) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 115.9
Optimum Moisture: 12.2
Remarks: Sample source revised on 1/30/07

Plasticity Index (ASTM D4318)
Liquid Limit: 28
Plastic Limit: 16
Plasticity Index: 12

Preperation Method: Dry **Liquid Limit Method:** A

Soil Classification (ASTM D2487) SC

Reviewed By: _____
sna

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

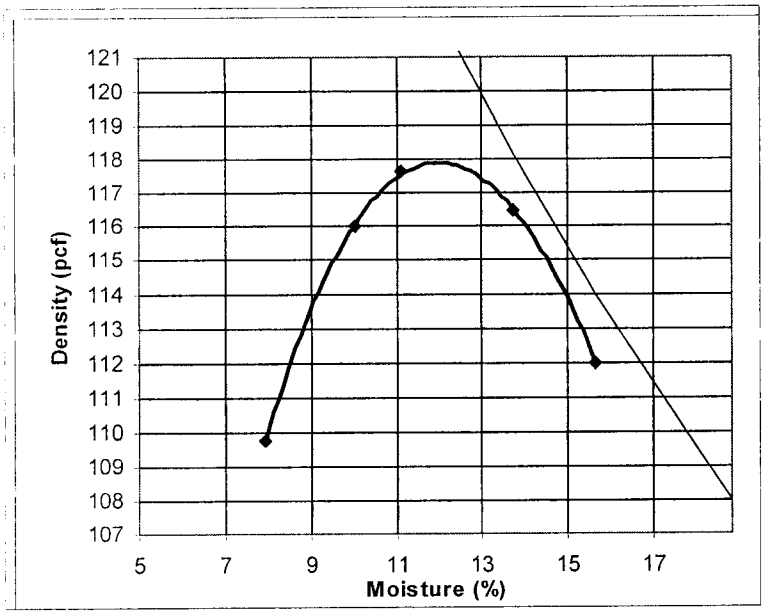
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: December 14, 2006

Project #: 6-519-004081
Work Order #: 29
Lab #: 6-1951
Sampled By: Michael Olson
Date Sampled: 12/12/2006
Visual Description of Material: Light Brown
Sample Source: MWL-SG-023

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
1/2in.	100%		
3/8in.	92%		
#4	90%		
#8	88%		
#10	87%		
#16	85%		
#30	83%		
#50	80%		
#100	63%		
#200	28%		

Moisture Density Relationship: (ASTM D698) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.571 **Assumed**
Maximum Density: 117.9
Optimum Moisture: 12.1
Remarks: Sample source revised on 1/30/07

Plasticity Index (ASTM D4318)
Liquid Limit: 23
Plastic Limit: 20
Plasticity Index: 3
Preperation Method: Dry **Liquid Limit Method:** A
Soil Classification (ASTM D2487) SM

Reviewed By: _____
HG

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

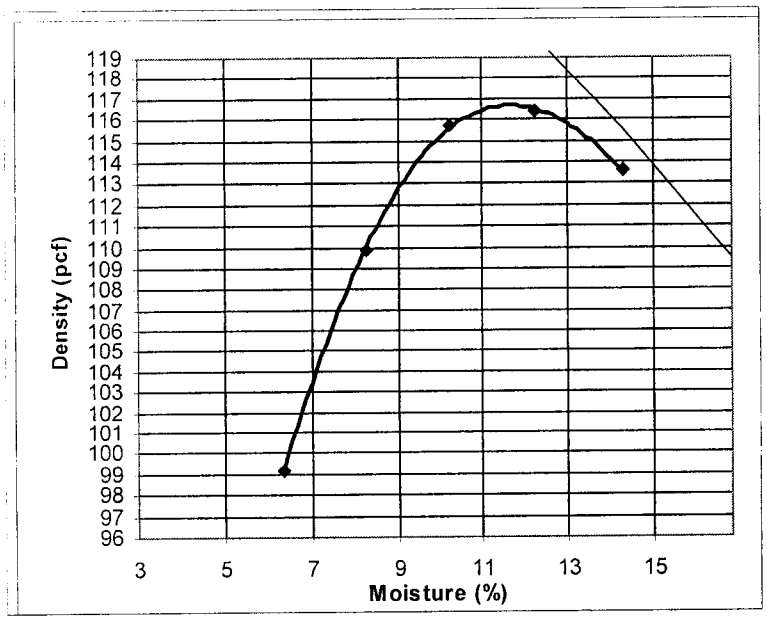
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: December 15, 2006

Project #: 6-519-004081
Work Order #: 30
Lab #: 6-1952
Sampled By: Miguel Chavez
Date Sampled: 12/12/2006
Visual Description of Material: Light Brown
Sample Source: MWL-SG-024

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
1/2in.	100%		
3/8in.	99%		
#4	96%		
#8	92%		
#10	92%		
#30	87%		
#40	85%		
#50	84%		
#100	68%		
#200	28%		

Moisture Density Relationship: (ASTM D698) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.531 **Assumed**
Maximum Density: 116.7
Optimum Moisture: 11.8
Remarks: Sample source revised on 1/30/07

Plasticity Index (ASTM D4318)
Liquid Limit: 23
Plastic Limit: 20
Plasticity Index: 3
Preperation Method: Dry **Liquid Limit Method:** A
Soil Classification (ASTM D2487) SM

Reviewed By: _____
HG

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

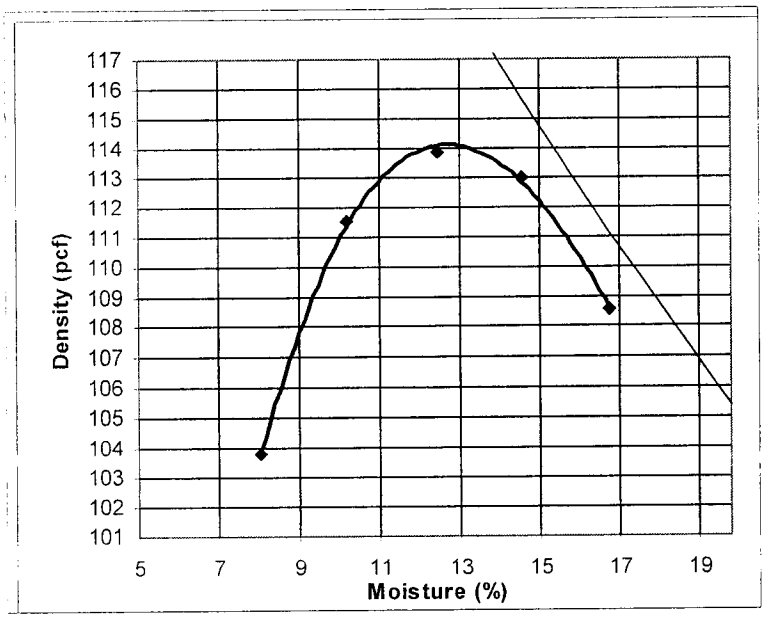
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: December 20, 2006

Project #: 6-519-004081
Work Order #: 32
Lab #: 6-1967
Sampled By: Miguel Chavez
Date Sampled: 12/14/2006
Visual Description of Material: Light Brown
Sample Source: MWL-SG-025

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
3/8in.	100%		
#4	97%		
#8	95%		
#10	94%		
#16	92%		
#30	89%		
#40	87%		
#50	85%		
#100	67%		
#200	30%		

Moisture Density Relationship: (ASTM D698) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.551 **Assumed**
Maximum Density: 114.1
Optimum Moisture: 12.8
Remarks: Sample source revised on 1/30/07

Plasticity Index (ASTM D4318)
Liquid Limit: 25
Plastic Limit: 18
Plasticity Index: 7
Preperation Method: Dry **Liquid Limit Method:** A
Soil Classification (ASTM D2487) SC-SM

Reviewed By: _____
AH

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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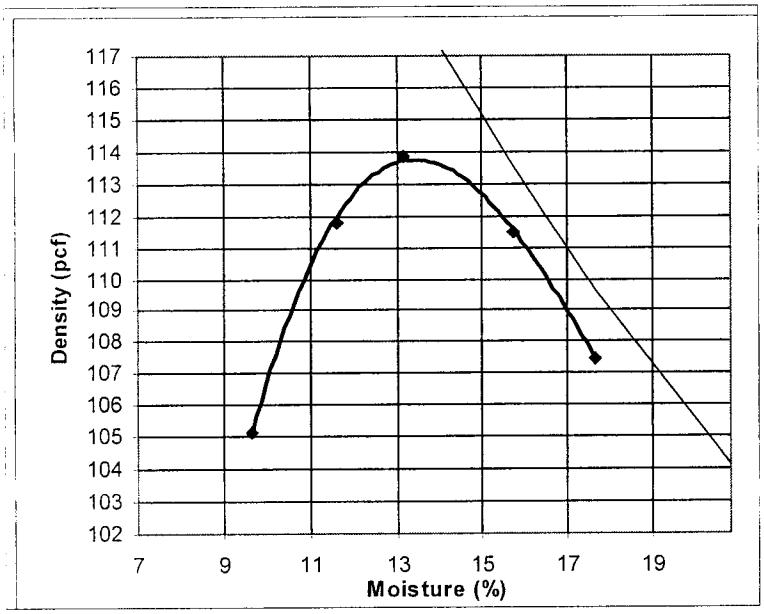
Client:	URS 6501 Americas Pkwy. NE, Suite 900 Albuquerque, NM 87110-	**Report Date:** December 20, 2006	
Attn:	Don Lopez	**Project #:** 6-519-004081 **Work Order #:** 31 **Lab #:** 6-1966	
Project Name:	Mixed Waste Landfill Cover KAFB Albuquerque, NM	**Sampled By:** Miguel Chavez **Date Sampled:** 12/14/2006 **Visual Description of Material:** Light Brown Silty **Sample Source:** MWL-SG-026	
Project Manager:	Robert Romero	**SOILS / AGGREGATES**	



Sieve Analysis **(ASTM C117/C136)**

Sieve Size	Passing	Specifications Min	Max
3/8in.	100%		
#4	98%		
#8	96%		
#10	96%		
#16	94%		
#30	91%		
#40	89%		
#50	87%		
#100	71%		
#200	35%		

Moisture Density Relationship: **(ASTM D698)** **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.561 **Assumed**
Maximum Density: 113.8
Optimum Moisture: 13.5
Remarks: Sample source revised on 1/30/07

Plasticity Index **(ASTM D4318)**
Liquid Limit: 27
Plastic Limit: 21
Plasticity Index: 6
Preperation Method: Dry **Liquid Limit Method:** A
Soil Classification (ASTM D2487) SC-SM

Reviewed By: _____
AH

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn : Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

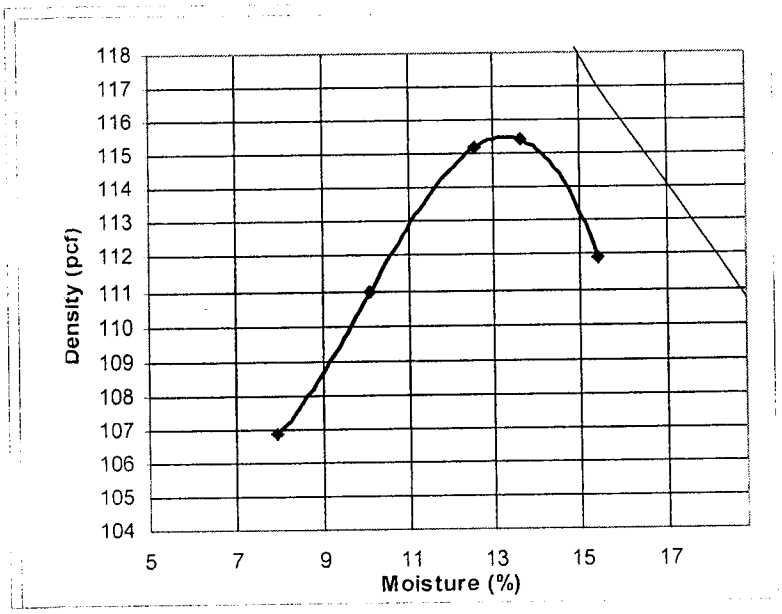
Report Date: October 10, 2006

Project #: 6-519-004081
Work Order #: 4
Lab #: 6-1444-02
Sampled By: Client
Date Sampled: 10/06/2006
Visual Description of Material:
Sample Source: MWL-ES-001

SOILS / AGGREGATES

Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max



Moisture Density Relationship: (ASTM D698) Method: A
Preparation Method: Dry Rammer Type: Mechanical
Specific Gravity: 2.651 Assumed
Maximum Density: 115.5
Optimum Moisture: 13.4

Reviewed By: _____
HG

Distribution: Client ☑ File: ☑ Supplier: ✓ Other: Addressee (2)
Email:
Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

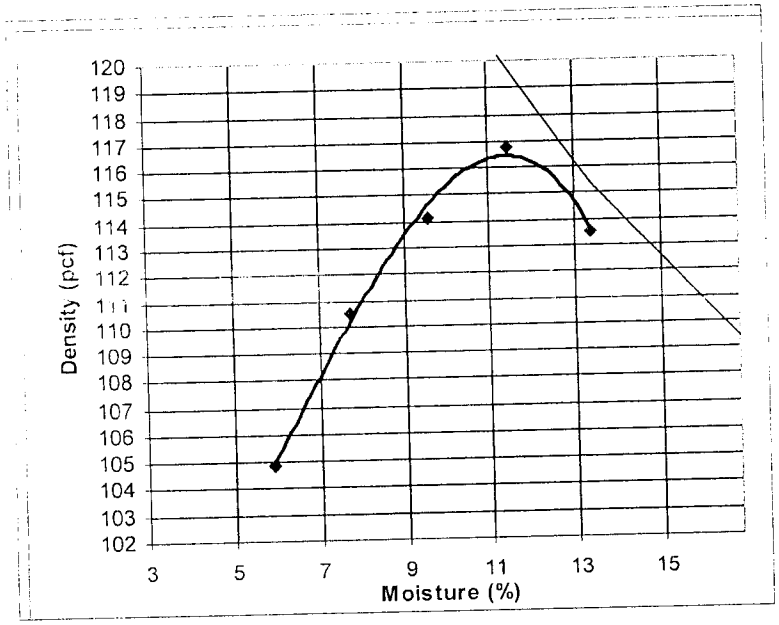
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 02, 2006

Project #: 6-519-004081
Work Order #: 6
Lab #: 6-1588
Sampled By: Wesley Newman
Date Sampled: 10/27/2006
Visual Description of Material: Light Brown Clay
Sample Source: MWL-ES-~~003~~ 002

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
1in.	100%		
3/4in.	98%		
1/2in.	97%		
3/8in.	96%		
#4	94%		
#8	91%		
#10	90%		
#16	88%		
#30	85%		
#40	83%		
#50	81%		
#100	35%		
#200	21%		

Moisture Density Relationship: (ASTM D1557) Method:
Preparation Method: Dry Rammer Type: Mechanical
Specific Gravity: 2.471 Assumed
Maximum Density: 116.5
Optimum Moisture: 11.5

Plasticity Index (ASTM D4318)
Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP
Preperation Method: Dry Liquid Limit Method: A

Soil Classification (ASTM D2487) SM

Reviewed By: SNA

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

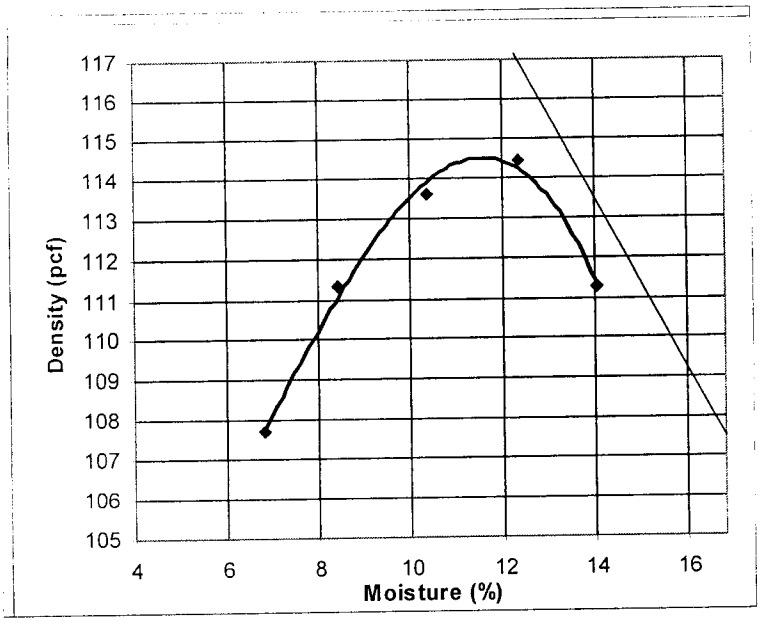
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 02, 2006

Project #: 6-519-004081
Work Order #: 5
Lab #: 6-1589
Sampled By: Wesley Newman
Date Sampled: 10/27/2006
Visual Description of Material: Light Brown Clay
Sample Source: MWL-ES-003

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
1 1/2in.	100%		
1in.	99%		
3/4in.	98%		
1/2in.	97%		
3/8in.	96%		
#4	94%		
#8	91%		
#10	91%		
#16	88%		
#30	85%		
#40	84%		
#50	81%		
#100	25%		
#200	17%		

Moisture Density Relationship: (ASTM D698) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.451 **Assumed**
Maximum Density: 114.5
Optimum Moisture: 11.7
Remarks: Revised 12/8/06 to show correct proctor method used.

Plasticity Index (ASTM D4318)
Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP
Preperation Method: Dry **Liquid Limit Method:** A

Soil Classification (ASTM D2487) SM

Reviewed By: SNA

Distribution: Client: ✓ File: ✓ Supplier: ☑ Other: Addressee (2)
Email:
Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

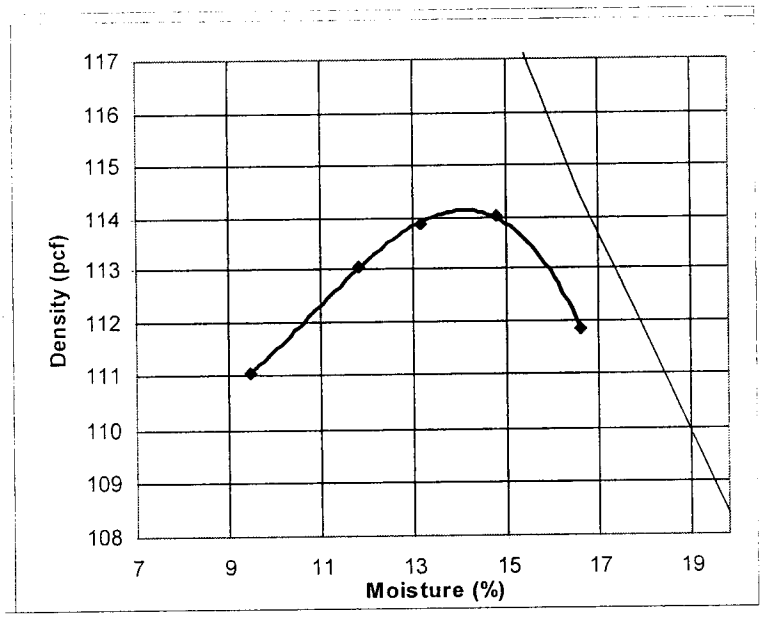
Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 02, 2006

Project #: 6-519-004081
Work Order #: 7
Lab #: 6-1590
Sampled By: Wesley Newman
Date Sampled: 10/27/2006
Visual Description of Material: Light Brown Clay
Sample Source: MWL-ES-004

SOILS / AGGREGATES



Sieve Analysis (ASTM C117/C136)

Sieve Size	Passing	Specifications Min	Max
1in.	100%		
3/4in.	98%		
1/2in.	97%		
3/8in.	96%		
#4	94%		
#8	91%		
#10	90%		
#16	88%		
#30	85%		
#40	83%		
#50	81%		
#100	31%		
#200	19%		

Moisture Density Relationship: (ASTM D698) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 114.1
Optimum Moisture: 14.2
Remarks: Revised 12/8/06 to show correct proctor method used.

Plasticity Index (ASTM D4318)
Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP
Preperation Method: Dry **Liquid Limit Method:** A
Soil Classification (ASTM D2487) SM

Reviewed By: SNA

Distribution: Client: ✓ File: ✓ Supplier: ☑ Other: Addressee (2)
Email: Cory Woods / MKM Engineering (1)

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2006 Density and Moisture Tests

Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: October 31, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13034
Tested By: Wesley Newman
Date Tested: 10/27/2006
Visual Description of Material: Land Fill Field Backfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1444-02	115.5	13.4	ASTM D698-07 / A	

Nuclear Density Gauge
Make: Troxler
Model #: 3440
Serial #: 30282

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max	
01-1	NE Classified Area, 30' S From NE Corner (MWL-ES1-001)	FSG	B		13.8	2	2	118.5	104.1	115.5	90	90		
02-1	Center of Classified Area (MWL-ES1-002)	FSG	B		7.5	2	2	120.2	111.8	115.5	97	90		*
03-1	South End of Classified Area (MWL-ES1-003	FSG	B		7.8	2	2	118.7	110.2	115.5	95	90		*
04-1	East Perimeter of Classified Area (MWL-ES1-004)	FSG	B		10.2	2	2	116.8	106.0	115.5	92	90		*
05-1	NE Cornrer of Unclassified Area (MWL-ES1-005)	FSG	B		7.1	2	2	114.4	106.8	115.5	92	90		*
06-1	NW Corner of Unclassified Area (MWL-ES1-006)	FSG	B		7.4	2	2	115.8	107.8	115.5	93	90		*
07-1	100' S & 30' E of NW Corner of Unclassified Area (MWL-ES1-007)	FSG	B		9.5	2	2	121.5	111.0	115.5	96	90		*
08-1	100' S & 40' W From NE Corner of Unclassified Area (MWL-ES1-008)	FSG	B		10.6	2	2	119.7	108.2	115.5	94	90		*
09-1	200' N & 30' W From SE Corner of Unclassified Area (MWL-ES1-009)	FSG	B		8.0	2	2	117.4	108.7	115.5	94	90		*
10-1	200' N & 40' E From SW Corner of Unclassified Area (MWL-ES1-010)	FSG	B		11.9	2	2	115.8	103.5	115.5	90	90		
11-1	200' N & 5' E From SW Corner W Perimeter of Unclassified Area (MWL-ES1-011)	FSG	B		8.4	2	2	116.8	107.7	115.5	93	90		*

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep

Test Mode = D for Direct Transmission and B for Backscatter Modes

*** Material did not fall within specified tolerances.**

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Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Com-paction	% Com-paction Required Min	% Com-paction Required Max	
12-1	130' N & 25' E From SW Corner of Unclassified Area (MWL-ES1-012)	FSG	B		8.1	2	2	126.8	117.3	115.5	100+	90		*
13-1	130' N & 50' W From SE Corner of Unclassified Area (MWL-ES1-013)	FSG	B		8.8	2	2	124.3	114.2	115.5	99	90		*
14-1	75' N & 40' W From SE Corner of Unclassified Area (MWL-ES1-014)	FSG	B		8.8	2	2	119.8	110.2	115.5	95	90		*
15-1	75' N & 40' E From SW Corner of Unclassified Area (MWL-ES1-015)	FSG	B		11.9	2	2	122.8	109.8	115.5	95	90		

Reviewed By: _____
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Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep

Test Mode = D for Direct Transmission and B for Backscatter Modes

*** Material did not fall within specified tolerances.**

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 03, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13062
Tested By: Robert Carr
Date Tested: 10/31/2006
Visual Description of Material: Backfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1444-01	113.2	10.9	ASTM D698-07 / A	

Nuclear Density Gauge
Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	Trench C, 100' S of N Edge (MWL-SG1-001)	1ST LIFT	B	0	9.1	2	2	123.5	113.2	113.2	100	90	
02-1	Trench B, 110' S of N Edge(MWL-SG1-002)	1ST LIFT	B	0	9.8	2	2	123.9	112.8	113.2	100	90	
03-1	Trench C, N End (MWL-SG2-001)	2ND LIFT	B	0	11.1	2	2	122.9	110.6	113.2	98	90	
04-1	Trench C, S End (MWL-SG2-002)	2ND LIFT	B	0	10.6	2	2	125.0	113.0	113.2	100	90	
05-1	Trench B, N End (MWL-SG4-001)	2ND LIFT	B	0	10.7	2	2	117.6	106.2	113.2	94	90	
06-1	Trench B, S End (MWL-SG4-002)	2ND LIFT	B	0	10.5	2	2	118.0	106.8	113.2	94	90	
07-1	Trench B, S End (MWL-SG3-001)	3RD LIFT	B	0	10.0	2	2	117.0	106.4	113.2	94	90	
08-1	Trench B, N End (MWL-SG3-002)	3RD LIFT	B	0	10.6	2	2	116.5	105.3	113.2	93	90	
09-1	Trench A, N End (MWL-SG3-003)	1ST LIFT	B	0	10.0	2	2	124.3	113.0	113.2	100	90	
10-1	Trench C, N End (MWL-SG3-004)	3RD LIFT	B	0	10.7	2	2	121.3	109.6	113.2	97	90	
11-1	Trench C, S End (MWL-SG3-005)	3RD LIFT	B	0	9.0	2	2	123.4	113.2	113.2	100	90	

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

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Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Com-paction	% Com-paction Required Min	% Com-paction Required Max

Reviewed By: _____
SC

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep

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www.amec.com

Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 03, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13063
Tested By: Robert Carr
Date Tested: 11/01/2006
Visual Description of Material: Backfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1444-01	113.2	10.9	ASTM D698-07 / A	

Nuclear Density Gauge
Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	Trench B, N End (MWL-SG5-001)	5TH LIFT	B	0	10.2	2	2	119.9	108.8	113.2	96	90	
02-1	Trench C, S End (MWL-SG4-003)	4TH LIFT	B	0	11.1	2	2	114.4	103.0	113.2	91	90	
03-1	Trench C, N End (MWL-SG4-004)	4TH LIFT	B	0	9.6	2	2	122.3	111.5	113.2	98	90	

Reviewed By: _____
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Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 03, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13064
Tested By: Robert Carr
Date Tested: 11/02/2006
Visual Description of Material: Backfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1444-01	113.2	10.9	ASTM D698-07 / A	

Nuclear Density Gauge
Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture			Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required	
					Actual	Required (-)	Required (+)					Min	Max
01-1	Trench C, N End (MWL-SG4-005)	4TH LIFT	B	0	8.9	2	2	111.4	102.3	113.2	90	90	
02-1	Trench C, S End (MWL-SG6-001)	6TH LIFT	B	0	9.2	2	2	123.6	113.2	113.2	100	90	
03-1	Trench B, N End (MWL-SG6-002	6TH LIFT	B	0	11.0	2	2	122.7	110.5	113.2	98	90	
04-1	Trench B, S End (MWL-SG6-003)	6TH LIFT	B	0	12.1	2	2	120.5	107.5	113.2	95	90	

Reviewed By: _____
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Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Test Mode = D for Direct Transmission and B for Backscatter Modes

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Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 10, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13107
Tested By: Robert Carr
Date Tested: 11/06/2006
Visual Description of Material: Backfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1624	113.3	13.2	ASTM D698-07 / a	Light Brown

Nuclear Density Gauge
Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	4008 15' Northeast (MWL-SG7-001)	7TH LIFT	B	0	11.2	2	2	122.1	109.8	113.3	97	90	

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Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
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Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 10, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13108
Tested By: Robert Carr
Date Tested: 11/07/2006
Visual Description of Material: Backfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1624	113.3	13.2	ASTM D698-07 / a	Light Brown
6-1625	117.4	12.9	ASTM D698-07 / a	Light Brown

Nuclear Density Gauge
Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	4009 6' West (MWL-SG8-001)	8TH LIFT	B	0	11.5	2	2	124.3	111.5	113.3	98	90	
02-1	4019 4' West (MWL-SG8-002)	8TH LIFT	B	0	11.5	2	2	119.8	107.4	113.3	95	90	
03-1	4008 12' East (MWL-SG8-003(	8TH LIFT	B	0	12.5	2	2	117.7	104.3	113.3	92	90	
04-1	4022 12' SW (MWL-SG9-001)	9TH LIFT	B	0	14.2	2	2	123.1	107.9	117.4	92	90	
05-1	4020 15' SW (MWL-SG9-002)	9TH LIFT	B	0	11.0	2	2	126.7	114.1	117.4	97	90	
06-1	4008 25' SW (MWL-SG9-003)	9TH LIFT	B	0	11.0	2	2	122.5	110.4	117.4	94	90	

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Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 10, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13109
Tested By: Robert Carr
Date Tested: 11/08/2006
Visual Description of Material: Backfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1625	117.4	12.9	ASTM D698-07 / a	Light Brown

Nuclear Density Gauge
Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	4005 25' SW (MWL-SG9-004)	9TH LIFT	B	0	12.7	2	2	1217.0	108.7	117.4	93	90	

Reviewed By: _____
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Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Test Mode = D for Direct Transmission and B for Backscatter Modes

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 10, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13110
Tested By: Robert Carr
Date Tested: 11/09/2006
Visual Description of Material: Backfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1626	118.3	12.7	ASTM D698-07 / a	Light Brown
6-1645	118.7	12.4	ASTM D698-07 / a	Light Brown

Nuclear Density Gauge
Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Com-paction	% Com-paction Required Min	% Com-paction Required Max
01-1	4004 20' SW (MWL-SG9-005)	9TH LIFT	B	0	11.7	2	2	126.4	113.2	118.3	96	90	
02-1	4022 4' S (MWL-SG10-001)	10TH LIFT	B	0	13.8	2	2	126.5	111.2	118.3	94	90	
03-1	4019 6' NE (MWL-SG10-002)	10TH LIFT	B	0	11.3	2	2	123.3	110.8	118.7	93	90	
04-1	4008 10' N (MWL-SG10-003)	10TH LIFT	B	0	11.7	2	2	120.9	108.3	118.7	91	90	

Reviewed By: _____
Jr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
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Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 21, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13233
Tested By: Miguel Chavez
Date Tested: 11/14/2006
Visual Description of Material: Land Fill Cover Backfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1646	119.6	11.0	ASTM D698-07 / a	Light Brown
6-1647	115.4	12.9	ASTM D698-07 / a	Light Brown

Nuclear Density Gauge
Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture			Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Com-paction	% Com-paction Required	
					Actual	Required (-)	Required (+)					Min	Max
01-1	15' W of 4018 10th Lift (MWL-SG10-004)	FSG -1.0'	B	0	9.6	2	2	123.7	112.9	119.6	94	90	
02-1	5' NE of 4012 10th Lift (MWL-SG10-005)	FSG -1.0'	B	0	9.6	2	2	127.6	117.5	119.6	98	90	
03-1	15' E of 4011 10th Lift (MWL-SG10-006)	FSG -1.0'	B	0	12.5	2	2	127.0	112.9	119.6	94	90	
04-1	5' E of 4031 10th Lift (MWL-SG10-007)	FSG -1.0'	B	0	9.4	2	2	128.2	114.6	119.6	96	90	
05-1	15' E of 4038 10th Lift, (MWL-SG10-008	FSG -1.0'	B	0	10.9	2	2	130.9	118.1	119.6	99	90	
06-1	8' NW of 4055 (MWL-SG10-009)	FSG -1.0'	B	0	13.9	2	2	121.3	106.5	115.4	92	90	
07-1	20' NW of 4038 (MWL-SG10-10)	FSG -1.0'	B	0	12.4	2	2	128.7	114.4	115.4	99	90	

Reviewed By: _____
SC

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 21, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13234
Tested By: Miguel Chavez
Date Tested: 11/15/2006
Visual Description of Material: Land Fill Cover Backfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1647	115.4	12.9	ASTM D698-07 / a	Light Brown

Nuclear Density Gauge
Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	34' NW of 4036 (MWL-SG11-01)	FSG -0.5'	B	0	11.8	2	2	128.2	114.6	115.4	99	90	
02-1	25' W of 4049 (MWL-SG11-02)	FSG -0.5'	B	0	14.2	2	2	129.0	112.9	115.4	98	90	

Reviewed By: _____
SC

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 21, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13235
Tested By: Miguel Chavez
Date Tested: 11/16/2006
Visual Description of Material: Land Fill Cover Backfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1690	116.5	13.0	ASTM D698-07 / a	Light Brown
6-1691	113.5	13.0	ASTM D698-07 / A	Light Brown

Nuclear Density Gauge
Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	15' W of 4038 (MWL-SG11-003	FSG -0.5'	B	0	14.1	2	2	124.2	108.9	116.5	93	90	
02-1	20' W of 4050 (MWL-SG11-004)	FSG -0.5'	B	0	11.5	2	2	127.8	114.6	116.5	98	90	
03-1	10' W of 4051 (MWL-SG-005)	FSG -0.5'	B	0	12.7	2	2	128.9	114.4	116.5	98	90	
04-1	15' S of 4039 (MWL-SG11-006)	FSG -0.5'	B	0	11.8	2	2	119.2	106.6	113.5	94	90	
05-1	15' W of 4055 (MWL-SG11-007)	FSG -0.5'	B	0	14.1	2	2	128.9	113.0	113.5	100	90	
06-1	5' E of 4042 (MWL-SG11-008)	FSG -0.5'	B	0	12.6	2	2	127.7	113.5	113.5	100	90	

Reviewed By: _____
SC

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

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8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 28, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13314
Tested By: Miguel Chavez
Date Tested: 11/20/2006
Visual Description of Material: Landfill Cover Backfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1692	113.6	12.6	ASTM D698-07 / a	light Brown

Nuclear Density Gauge

Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	15' Northwest of 4026 (MWL-SG11-09)	FSG -0.5'	B		14.1	2	2	130.1	113.5	113.6	100	90	
02-1	15' Northwest of 4013 (MWL-SG11-10)	FSG -0.5'	B		12.0	2	2	122.5	109.3	113.6	96	90	

Reviewed By: _____
sna

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: November 28, 2006

Project #: 6-519-004081
Report #: 13315
Tested By: Miguel Chavez
Date Tested: 11/21/2006
Visual Description of Material: Landfill Cover Backfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1692	113.6	12.6	ASTM D698-07 / a	light Brown
6-1740	116.0	12.3	ASTM D698-07 / A	Light Brown

Nuclear Density Gauge
Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	10' East of 4025 (MWL-SG11-011)	FSG -0.5'	B		14.3	2	2	125.7	110.0	113.6	97	90	
02-1	15' Southwest of 4010 (MWL-SG11-012)	FSG -0.5'	B		11.8	2	2	127.7	114.2	113.6	100+	90	
03-1	17' West of 4011 (MWL-SG11-013)	FSG -0.5'	B		13.7	2	2	120.0	105.5	113.6	93	90	
04-1	12' West of 4023 (MWL-SG11-014)	FSG -0.5'	B		12.3	2	2	119.4	106.4	113.6	94	90	
05-1	5' Southeast of 4010 (MWL-SG11-015)	FSG -0.5'	B		10.7	2	2	125.5	113.4	116.0	98	90	
06-1	13' Southeast of 4009 (MWL-SG11-016)	FSG -0.5'	B		11.6	2	2	127.5	114.2	116.0	98	90	
07-1	7' Northeast of 4032 (MWL-SG11-017)	FSG -0.5'	B		13.9	2	2	128.3	112.7	116.0	97	90	

Reviewed By: _____
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Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Test Mode = D for Direct Transmission and B for Backscatter Modes

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Client:	URS 6501 Americas Pkwy. NE, Suite 900 Albuquerque, NM 87110-	**Report Date:** November 28, 2006 **Amended Date:** December 22, 2009 **Project #:** 6-519-004081 **Report #:** 13316 **Tested By:** Miguel Chavez **Date Tested:** 11/22/2006 **Visual Description of Material:** Landfill Cover Backfill	
Attn:	Don Lopez		
Project Name:	Mixed Waste Landfill Cover KAFB Albuquerque, NM		
Project Manager:	Robert Romero		

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1740	116.0	12.3	ASTM D698-07 / A	Light Brown

Nuclear Density Gauge

Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	6' West of 4021 (MWL-SG11-018)	FSG -0.5'	B		13.2	2	2	131.6	116.3	116.0	100	90	

Reviewed By: _____
sna

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: December 04, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13361
Tested By: Miguel Chavez
Date Tested: 11/30/2006
Visual Description of Material: Landfill Cover

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1779	117.9	13.0	ASTM D698-07 / A	Light Red & Rocky

Nuclear Density Gauge
Make: Troxler
Model #: 3430
Serial #: 28750

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	12' W of 4058 (MWL-SG12-001)	FSG	D	6	12.2	2	2	123.3	109.9	117.9	93	90	
02-1	20' NW of 4049 (MWL-SG12-002)	FSG	D	6	11.7	2	2	127.6	114.2	117.9	97	90	
03-1	20' NW of 4045 (MWL-SG12-003)	FSG	D	6	11.8	2	2	131.6	117.7	117.9	100	90	
04-1	25' SW of 4050 (MWL-SG12-004)	FSG	D	6	12.2	2	2	131.3	117.0	117.9	99	90	

Reviewed By: _____
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Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: December 07, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13425
Tested By: Miguel Chavez
Date Tested: 12/05/2006
Visual Description of Material: Landfill Cover

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1834	118.4	12.7	ASTM D698-07 / A	Light Red

Nuclear Density Gauge
Make: Troxler
Model #: 3430
Serial #: 28750

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	15' W of 4039 (MWL-SG12-005)	FSG	D	6	12.3	2	2	133.5	118.9	118.4	100	90	
02-1	15' E of 4052 (MWL-SG12-006)	FSG	D	6	12.4	2	2	125.8	112.0	118.4	95	90	

Reviewed By: _____
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Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Test Mode = D for Direct Transmission and B for Backscatter Modes

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: December 08, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13427
Tested By: Robert Carr
Date Tested: 12/07/2006
Visual Description of Material: Landfill Cover

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1833	112.4	13.6	ASTM D698-07 / B	Light Red & Rocky
6-1835	119.0	12.0	ASTM D698-07 / A	Light Red

Nuclear Density Gauge

Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	4053, 25' SE (MWL-SG12-007)	FSG	B	0	13.1			127.1	112.4	112.4	100	90	
02-1	4042, 25' NE (MWL-SG12-008)	FSG	B	0	14.1			128.2	112.4	112.4	100	90	
03-1	4027, 25' SE (MWL-SG12-009)	FSG	B	0	13.6			127.7	112.4	119.0	94	90	
04-1	4014, 20' E (MWL-SG12-010)	FSG	B	0	11.9			123.0	110.4	119.0	93	90	

Reviewed By: _____
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Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: December 14, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13513
Tested By: Miguel Chavez
Date Tested: 12/13/2006
Visual Description of Material: Landfill Cover

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1895	115.9	12.2	ASTM D698-07 / A	Light Brown

Nuclear Density Gauge
Make: Troxler
Model #: 3430
Serial #: 28750

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	Landfill 10' W of 4016 (MWL-SG12-011)	FSG	D	0	10.8	2	2	127.2	114.8	115.9	99	90	
02-1	Landfill 25' SW of 4025 (MWL-SG12-012)	FSG	D		12.1	2	2	126.8	113.1	115.9	98	90	

Reviewed By: _____
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Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: December 18, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13522
Tested By: Miguel Chavez
Date Tested: 12/15/2006
Visual Description of Material: Landfill Cover

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1895	115.9	12.2	ASTM D698-07 / A	Light Brown
6-1951	117.9	12.1	ASTM D698-07 / A	Light Brown

Nuclear Density Gauge
Make: Troxler
Model #: 3430
Serial #: 28750

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Com-paction	% Com-paction Required Min	% Com-paction Required Max
01-1	20' SW of 4010 (MWL-SG12-013)	FSG	B	0	12.3	2	2	126.2	112.3	115.9	97	90	
02-1	15' SW of 4024 (MWL-SG12-14)	FSG	B	0	13.7	2	2	115.0	113.2	117.9	96	90	

Reviewed By: _____
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Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mixed Waste Landfill Cover
KAFB
Albuquerque, NM

Project Manager: Robert Romero

Report Date: December 19, 2006
Amended Date: December 22, 2009
Project #: 6-519-004081
Report #: 13523
Tested By: Robert Carr
Date Tested: 12/18/2006
Visual Description of Material: Landfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1951	117.9	12.1	ASTM D698-07 / A	Light Brown

Nuclear Density Gauge
Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	4024, 15' Southeast (MWL-SG12-015)	FSG	D	6	14.0	2	2	123.9	108.7	117.9	92	90	
02-1	4010, 20' Southeast (MWL-SG12-016)	FSG	D	6	13.1	2	2	125.6	111.1	117.9	94	90	

Reviewed By: _____
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Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐ Cory Woods / MKM Engineering (1)

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2009 Standard Proctor, Gradation, and Classification Tests

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

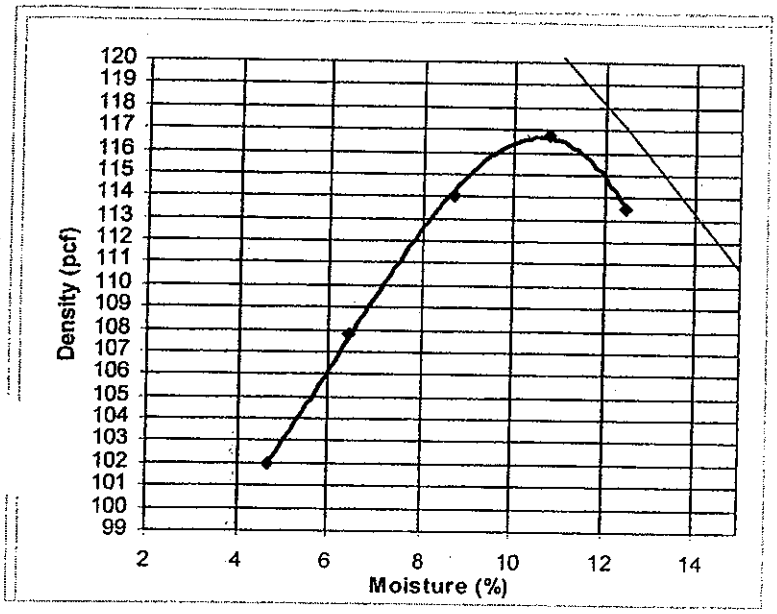
Report Date: May 27, 2009

Project #: 9-517-00022a
Work Order #: 3
Lab #: 9-0589-01
Sampled By: Client
Date Sampled: 05/20/2009
Visual Description of Material: Silty Sand w/Rock
Sample Source: SNL MWL 05-2009-1

SOILS / AGGREGATES

Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing



Moisture Density Relationship: (ASTM D698-00) **Method:** B
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.451 **Assumed**
Maximum Density: 116.7
Optimum Moisture: 10.6

Reviewed By: _____
hg

Distribution: Client ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371

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Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:** June 15, 2009 **Project #:** 9-517-00022D **Work Order #:** 5	
Attn:	Chris Edgmon	**Lab #:** 9-0589a-01	
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Sampled By:** Client	
	ABQ, NM	**Date Sampled:** 05/20/2009 **Visual Description of Material:** Silty Sand w/Rock	
Project Manager:	Vickie Maranville	**Sample Source:** SNL MWL 05-2009-1	

SOILS / AGGREGATES

Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/8in.	100%
#4	98%
#8	96%
#10	95%
#16	92%
#30	89%
#40	87%
#50	85%
#100	74%
#200	34%

(ASTM D2216-05)
Moisture Content (%): 5.7%

Plasticity Index (ASTM D4318-05)

Preperation Method: Dry
Liquid Limit Method: A
Soil Classification (ASTM D2487-06) SC-SM

Liquid Limit: 27
Plastic Limit: 20
Plasticity Index: 7

PI Sample Was Air Dried.

Reviewed By: _____
Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

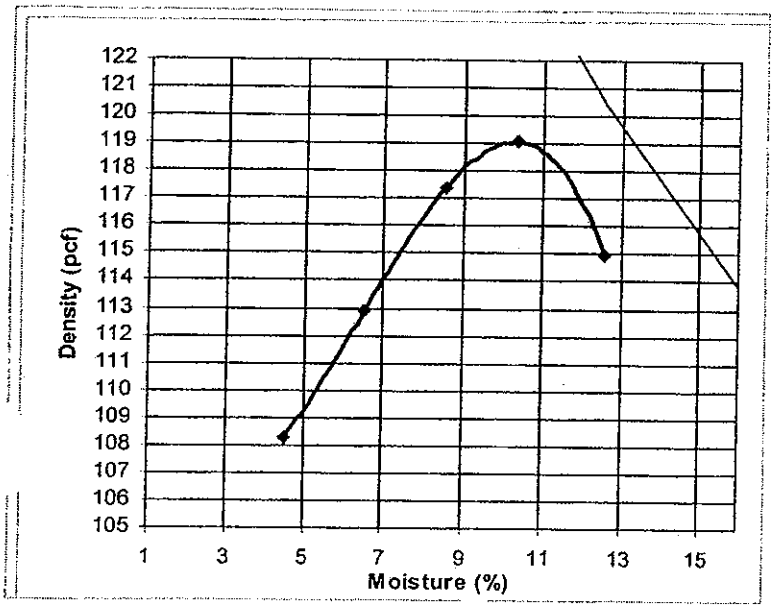
Report Date: May 27, 2009

Project #: 9-517-00022a
Work Order #: 3
Lab #: 9-0589-02
Sampled By: Client
Date Sampled: 05/20/2009
Visual Description of Material: Silty Sand w/Rock
Sample Source: SNL MWL 05-2009-2

SOILS / AGGREGATES

Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing



Moisture Density Relationship: (ASTM D698-00) **Method:** B
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.551 **Assumed**
Maximum Density: 119.1
Optimum Moisture: 10.3

Reviewed By: _____
hg

Distribution: Client ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

AMEC Earth Environmental, Inc.
2439 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:**	June 15, 2009
		Project #:	9-517-00022D
		Work Order #:	5
Attn:	Chris Edgmon	**Lab #:**	9-0589a-02
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Sampled By:**	Client
		Date Sampled:	05/20/2009
	ABQ, NM	**Visual Description of Material:**	Silty Sand w/Rock
		Sample Source:	SNL MWL 05-2009-2
Project Manager:	Vickie Maranville	**SOILS / AGGREGATES**	

Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	98%
3/8in.	97%
#4	94%
#8	90%
#10	90%
#16	86%
#30	83%
#40	81%
#50	79%
#100	67%
#200	26%

(ASTM D2216-05)
Moisture Content (%): 4.2%

Plasticity Index (ASTM D4318-05)

Preperation Method: Dry
Liquid Limit Method: A
Soil Classification (ASTM D2487-06) SC-SM

Liquid Limit: 24
Plastic Limit: 20
Plasticity Index: 4

PI Sample Was Air Dried.

Reviewed By: _____
Jan

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐

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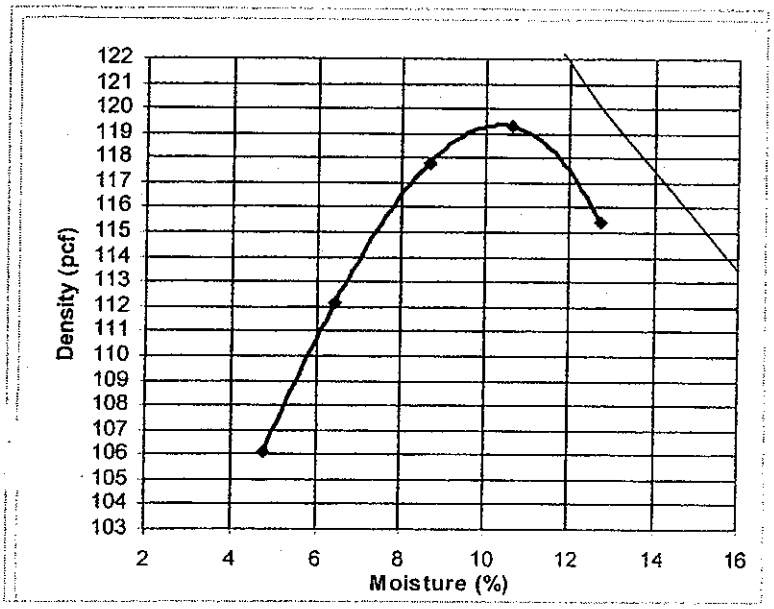
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:**	May 27, 2009
		Project #:	9-517-00022a
		Work Order #:	3
Attn:	Chris Edgmon	**Lab #:**	9-0589-03
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Sampled By:**	Client
		Date Sampled:	05/20/2009
	ABQ, NM	**Visual Description of Material:**	Silty Sand w/Rock
Project Manager:	Vickie Maranville	**Sample Source:**	SNL MWL 05-2009-3

SOILS / AGGREGATES

Sieve Analysis **(ASTM C117-04/C136-06)**
200 Wash Procedure: A

Sieve Size	Passing



Moisture Density Relationship: **(ASTM D698-00)** **Method:** B
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.551 **Assumed**
Maximum Density: 119.3
Optimum Moisture: 10.3

Reviewed By: _____
hg

Distribution: **Client** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐

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Tel 5058211801
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www.amec.com

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Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:**	June 15, 2009
		Project #:	9-517-00022D
		Work Order #:	5
Attn:	Chris Edgmon	**Lab #:**	9-0589a-03
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Sampled By:**	Client
		Date Sampled:	05/20/2009
	ABQ, NM	**Visual Description of Material:**	Silty Sand w/Rock
		Sample Source:	SNL MWL 05-2009-3
Project Manager:	Vickie Maranville	**SOILS / AGGREGATES**	

Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	98%
3/8in.	98%
#4	95%
#8	91%
#10	90%
#16	87%
#30	84%
#40	82%
#50	81%
#100	69%
#200	26%

(ASTM D2216-05)
Moisture Content (%): 4.7%

Plasticity Index (ASTM D4318-05)

Preperation Method: Dry
Liquid Limit Method: A
Soil Classification (ASTM D2487-06) SC-SM

Liquid Limit: 24
Plastic Limit: 20
Plasticity Index: 4

PI Sample Was Air Dried.

Reviewed By: _____
Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

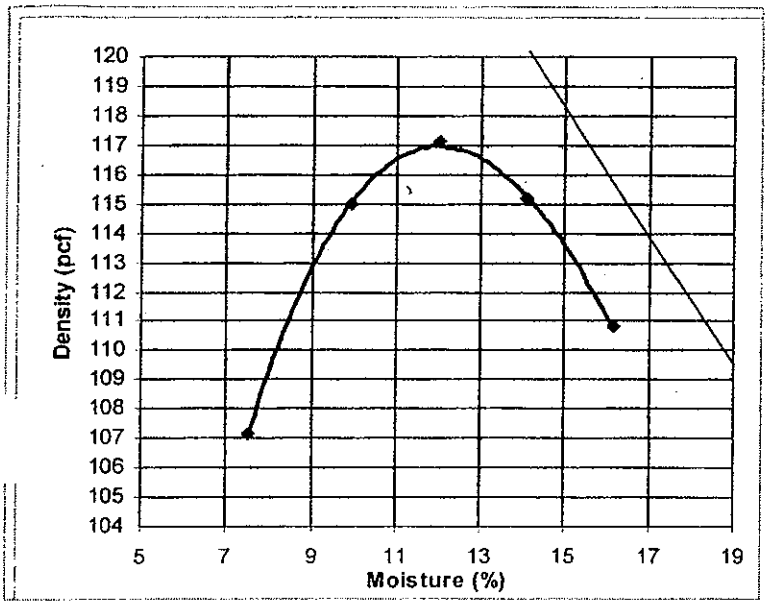
ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 01, 2009

Project #: 9-517-00022D
Work Order #: 1
Lab #: 9-0629-01
Sampled By: Client
Date Sampled: 05/29/2009
Visual Description of Material: Silty Sand
Sample Source: SNLMWL: 052909-4

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
1in.	100%
3/4in.	99%
1/2in.	98%
3/8in.	98%
#4	95%
#8	92%
#10	90%
#16	87%
#30	83%
#40	81%
#50	79%
#100	67%
#200	31%

Moisture Density Relationship: (ASTM D698-00) **Method:** B
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 117.0
Optimum Moisture: 12.0

Plasticity Index (ASTM D4318-05)
Liquid Limit: 23
Plastic Limit: 20
Plasticity Index: 3
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____
hg

Distribution: **Client** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐

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3719 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

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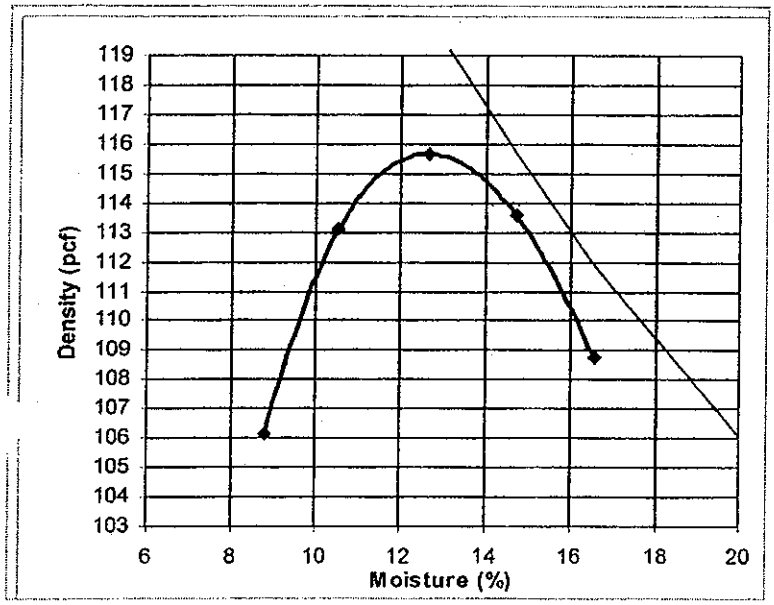
Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:**	June 02, 2009
		Project #:	9-517-00022D
		Work Order #:	1
Attn:	Chris Edgmon	**Lab #:**	9-0629-02
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Sampled By:**	Client
		Date Sampled:	05/29/2009
	ABQ, NM	**Visual Description of Material:**	Clayey Silty Sand
		Sample Source:	SNLMWL: 052909-5
Project Manager:	Vickie Maranville	**SOILS / AGGREGATES**	



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
1in.	100%
3/4in.	98%
1/2in.	98%
3/8in.	97%
#4	95%
#8	93%
#10	92%
#16	90%
#30	87%
#40	86%
#50	84%
#100	74%
#200	36%

Moisture Density Relationship: (ASTM D698-00) Method: B

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.551 Assumed

Maximum Density: 115.7

Optimum Moisture: 12.6

Plasticity Index (ASTM D4318-05)

Liquid Limit: 26

Plastic Limit: 20

Plasticity Index: 6

Preperation Method: Dry **Liquid Limit Method:** A

PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____

hg

Distribution: Client ☑ File: ☑ Supplier: ☑ Other: Addressee (2)

Email: ☐

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Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

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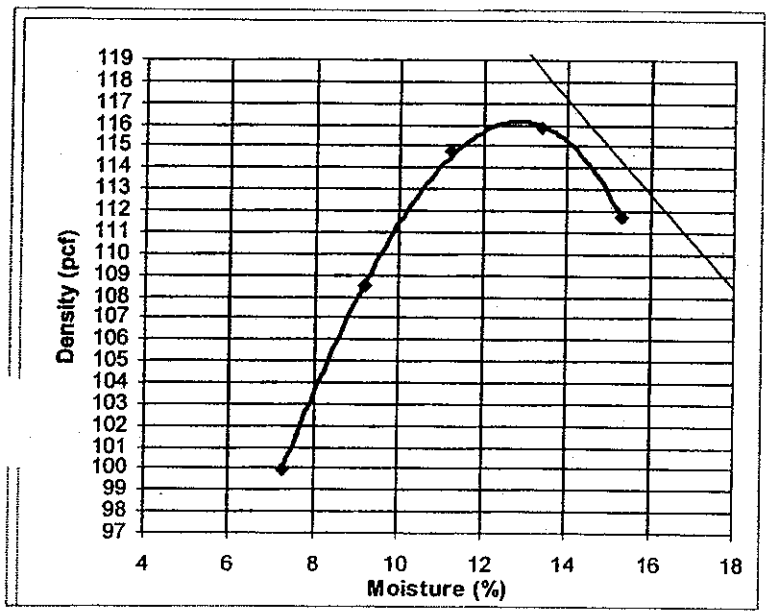
Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-
Attn:	Chris Edgmon
Project Name:	EDI SNL Mixed Waste Landfill Cover ABQ, NM
Project Manager:	Vickie Maranville

Report Date: June 02, 2009

Project #: 9-517-00022D
Work Order #: 1
Lab #: 9-0629-03
Sampled By: Client
Date Sampled: 05/29/2009
Visual Description of Material: Clayey Sandy
Sample Source: SNLMWL: 052909-6

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	100%
3/8in.	99%
#4	98%
#8	96%
#10	96%
#16	94%
#30	91%
#40	90%
#50	88%
#100	78%
#200	38%

Moisture Density Relationship: (ASTM D698-00) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.551 **Assumed**
Maximum Density: 116.2
Optimum Moisture: 12.8

Plasticity Index (ASTM D4318-05)
Liquid Limit: 25
Plastic Limit: 17
Plasticity Index: 8
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC

Reviewed By: _____
hg

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐

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Albuquerque, NM 87113
Tel 5058211801
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www.amec.com

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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

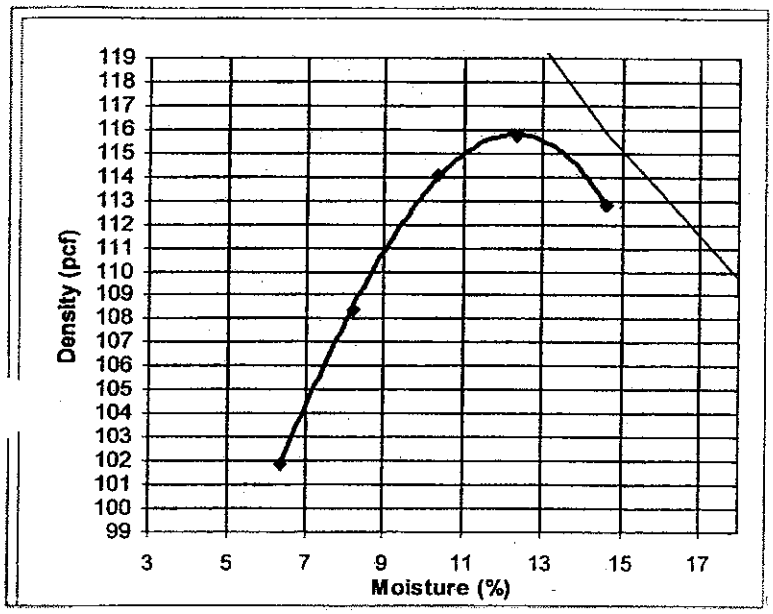
ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 02, 2009

Project #: 9-517-00022D
Work Order #: 1
Lab #: 9-0629-04
Sampled By: Client
Date Sampled: 05/29/2009
Visual Description of Material: Clayey Silty Sand
Sample Source: SNLMWL: 052909-7

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
3/8in.	100%
#4	99%
#8	97%
#10	96%
#16	94%
#30	91%
#40	90%
#50	88%
#100	76%
#200	37%

Moisture Density Relationship: (ASTM D698-00) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.551 **Assumed**
Maximum Density: 115.8
Optimum Moisture: 12.3

Plasticity Index (ASTM D4318-05)
Liquid Limit: 26
Plastic Limit: 20
Plasticity Index: 6
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____
hg

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐

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Albuquerque, NM 87113
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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

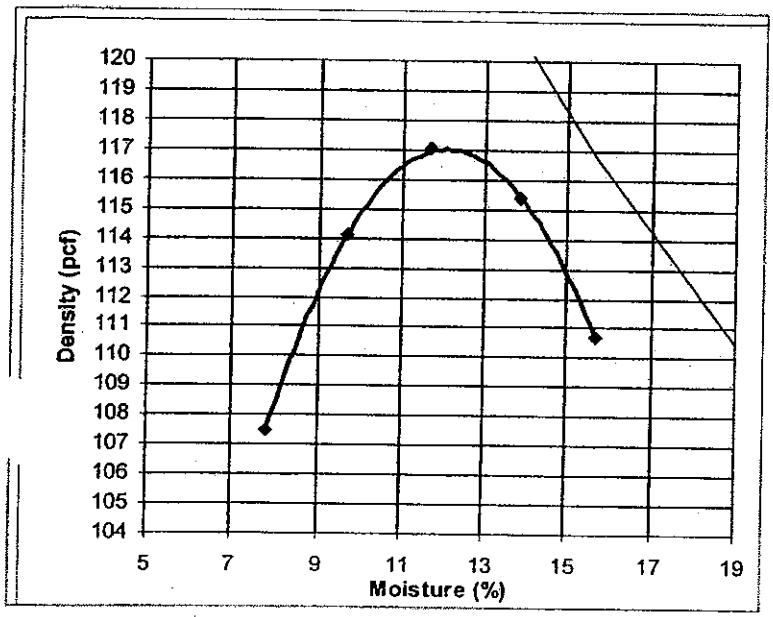
ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 02, 2009

Project #: 9-517-00022D
Work Order #: 1
Lab #: 9-0629-05
Sampled By: Client
Date Sampled: 05/29/2009
Visual Description of Material: Clayey Silty Sand
Sample Source: SNLMWL: 052909-8

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
1in.	100%
3/4in.	99%
1/2in.	99%
3/8in.	98%
#4	97%
#8	94%
#10	94%
#16	91%
#30	88%
#40	87%
#50	85%
#100	73%
#200	32%

Moisture Density Relationship: (ASTM D1557-02) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 Assumed
Maximum Density: 117.0
Optimum Moisture: 12.0

Plasticity Index (ASTM D4318-05)
Liquid Limit: 25
Plastic Limit: 20
Plasticity Index: 5
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____
MBR

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

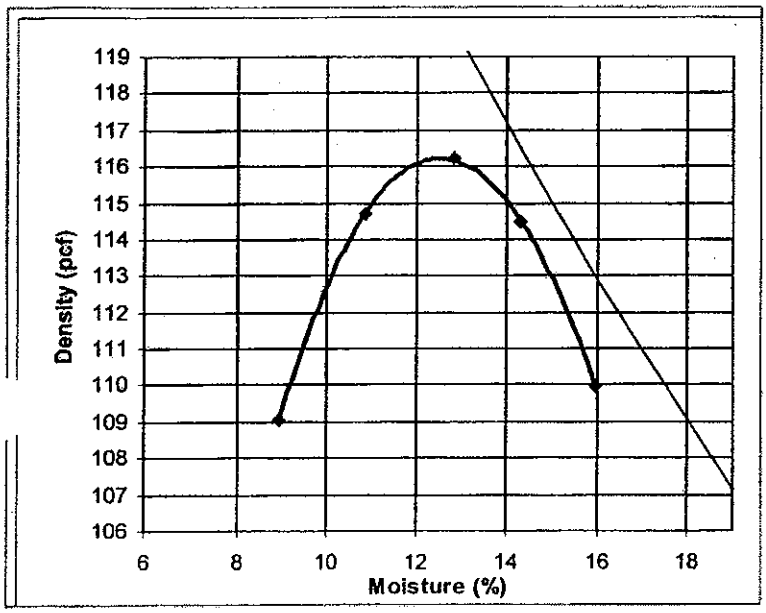
ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 12, 2009

Project #: 9-517-00022D
Work Order #: 6
Lab #: 9-0671-01
Sampled By: Jon Schermerhorn/Client
Date Sampled: 06/09/2009
Visual Description of Material: Brown Silty Sand - From Native Soil
Sample Source: SNL MWL: 060909-009

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
1in.	100%
3/4in.	99%
1/2in.	99%
3/8in.	98%
#4	96%
#8	94%
#10	93%
#16	92%
#30	89%
#40	87%
#50	85%
#100	73%
#200	36%

Moisture Density Relationship: (ASTM D698-07) **Method:** B
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.551 Assumed
Maximum Density: 116.2
Optimum Moisture: 12.5

Plasticity Index (ASTM D4318-05)
Liquid Limit: 27
Plastic Limit: 19
Plasticity Index: 8

Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC

Reviewed By: _____
Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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Albuquerque, NM 87113
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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

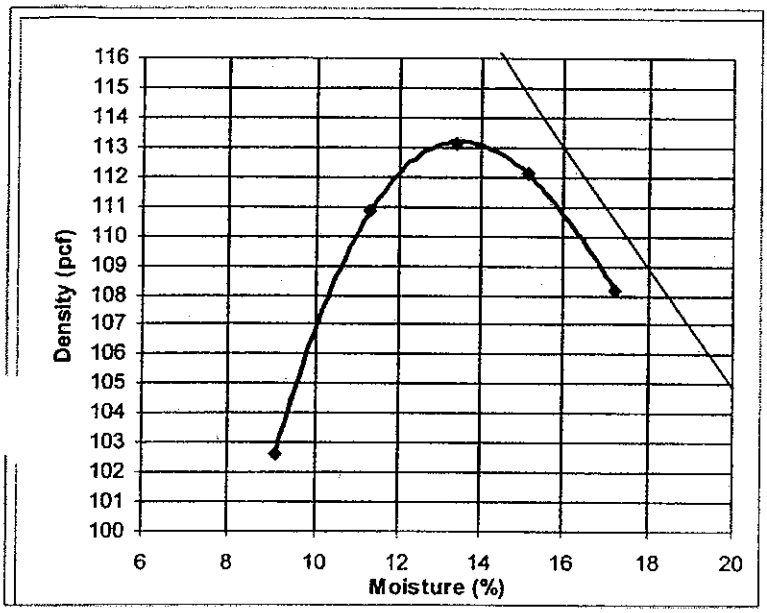
ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 12, 2009

Project #: 9-517-00022D
Work Order #: 6
Lab #: 9-0671-02
Sampled By: Jon Schermerhorn/Client
Date Sampled: 06/09/2009
Visual Description of Material: Brown Silty Sand - From Native Soil
Sample Source: SNL MWL: 060909-010

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
1/2in.	100%
3/8in.	99%
#4	98%
#8	96%
#10	95%
#16	93%
#30	90%
#40	88%
#50	87%
#100	74%
#200	38%

Moisture Density Relationship: (ASTM D698-07) Method: B
Preparation Method: Dry Rammer Type: Mechanical
Specific Gravity: 2.551 Assumed
Maximum Density: 113.2
Optimum Moisture: 13.5

Plasticity Index (ASTM D4318-05)

Liquid Limit: 26
Plastic Limit: 18
Plasticity Index: 8

Preperation Method: Dry Liquid Limit Method: A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC

Reviewed By: _____
hg

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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Albuquerque, NM 87113
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Fax 5058217371
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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

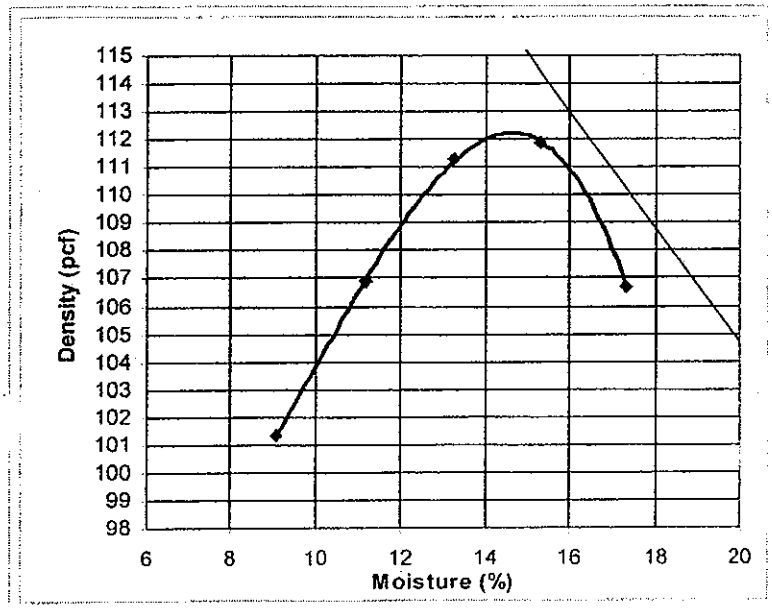
ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 12, 2009

Project #: 9-517-00022D
Work Order #: 6
Lab #: 9-0671-03
Sampled By: Jon Schermerhorn/Client
Date Sampled: 6/9/2009
Visual Description of Material: Brown Silty Sand - From Native Soil
Sample Source: SNL MWL: 060909-011

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
1in.	100%
3/4in.	99%
1/2in.	99%
3/8in.	98%
#4	97%
#8	94%
#10	94%
#16	92%
#30	90%
#40	88%
#50	85%
#100	76%
#200	29%

Moisture Density Relationship: (ASTM D698-07) **Method:** B
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.551 **Assumed**
Maximum Density: 112.2
Optimum Moisture: 14.6

Plasticity Index (ASTM D4318-05)
Liquid Limit: 27
Plastic Limit: 20
Plasticity Index: 7

Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: Jan

Distribution: **Client** ☑ **File:** ☑ **Supplier:** ✓ **Other:** Addressee (2)
Email: ☐

AMEC Earth Environmental, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

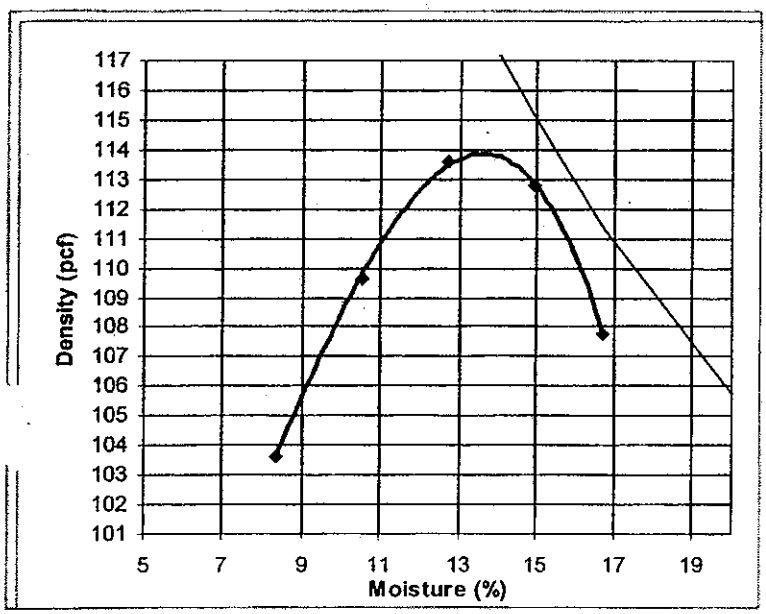
ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 11, 2009

Project #: 9-517-00022D
Work Order #: 6
Lab #: 9-0671-04
Sampled By: Jon Schermerhorn/Client
Date Sampled: 06/09/2009
Visual Description of Material: Brown Silty Sand - From Native Soil
Sample Source: SNL MWL: 060909-012

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	100%
3/8in.	99%
#4	98%
#8	95%
#10	94%
#16	92%
#30	89%
#40	87%
#50	86%
#100	72%
#200	35%

Moisture Density Relationship: (ASTM D698-07) **Method:** B
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.55 Assumed
Maximum Density: 113.9
Optimum Moisture: 13.6

Plasticity Index (ASTM D4318-05)
Liquid Limit: 25
Plastic Limit: 21
Plasticity Index: 4
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____
hg

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐

AMEC Earth Environmental, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

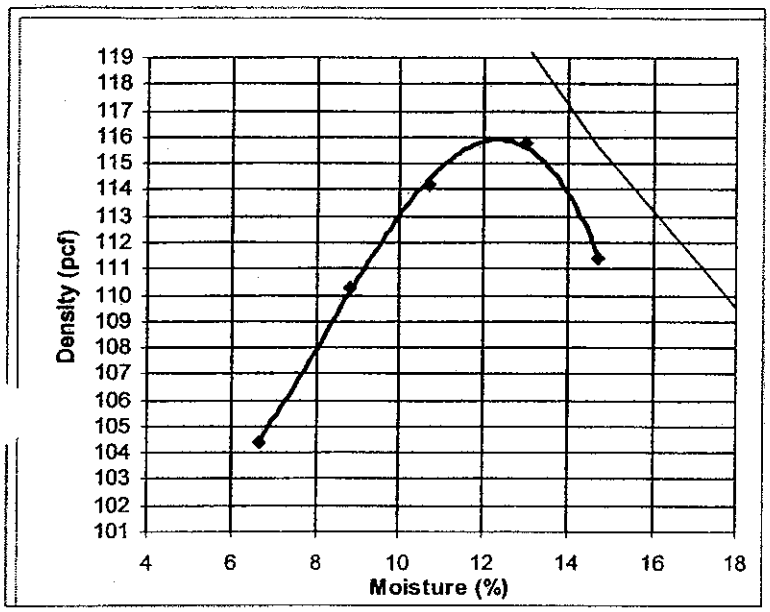
ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 11, 2009

Project #: 9-517-00022D
Work Order #: 6
Lab #: 9-0671-05
Sampled By: Jon Schermerhorn/Client
Date Sampled: 06/09/2009
Visual Description of Material: Brown Silty Sand - From Native Soil
Sample Source: SNL MWL: 060909-013

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	100%
3/8in.	99%
#4	97%
#8	94%
#10	93%
#16	91%
#30	88%
#40	86%
#50	84%
#100	70%
#200	27%

Moisture Density Relationship: (ASTM D698-07) **Method:** B
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.551 Assumed
Maximum Density: 115.9
Optimum Moisture: 12.3

Plasticity Index (ASTM D4318-05)
Liquid Limit: 24
Plastic Limit: 20
Plasticity Index: 4
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____
hg

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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nt: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

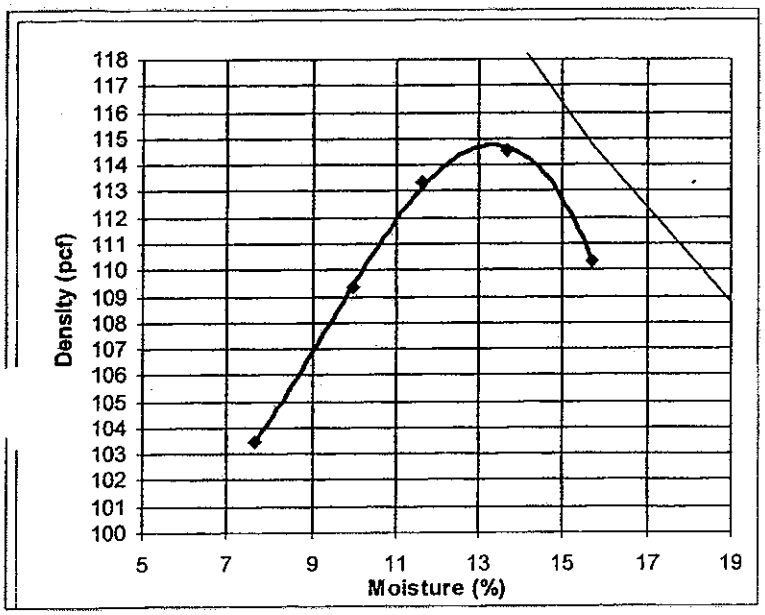
ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 29, 2009

Project #: 9-517-00022D
Work Order #: 10
Lab #: 9-0720-01
Sampled By: David A. Luna
Date Sampled: 06/24/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL-062409-014

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
1/2in.	100%
3/8in.	100%
#4	98%
#8	96%
#10	95%
#16	93%
#30	91%
#40	89%
#50	87%
#100	77%
#200	38%

Moisture Density Relationship: (ASTM D698-07) Method: B
Preparation Method: Dry Rammer Type: Mechanical
Specific Gravity: 2.591 Assumed
Maximum Density: 114.7
Optimum Moisture: 13.3

Plasticity Index (ASTM D4318-05)
Liquid Limit: 25
Plastic Limit: 18
Plasticity Index: 7
Preperation Method: Dry Liquid Limit Method: A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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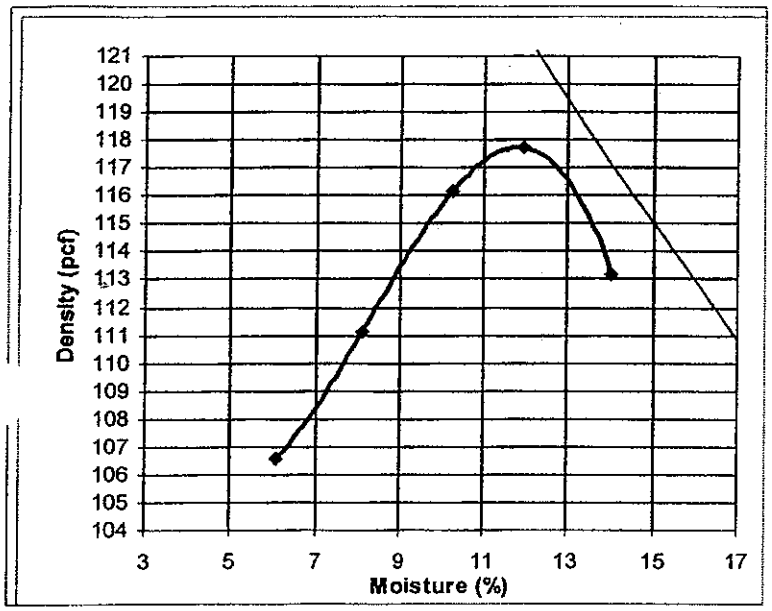
ient:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-
Attn:	Chris Edgmon
Project Name:	EDI SNL Mixed Waste Landfill Cover
	ABQ, NM
Project Manager:	Vickie Maranville

Report Date: June 30, 2009

Project #: 9-517-00022D
Work Order #: 10
Lab #: 9-0720-02
Sampled By: David A. Luna
Date Sampled: 06/24/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL-062409-015

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	100%
3/8in.	99%
#4	98%
#8	95%
#10	95%
#16	92%
#30	90%
#40	89%
#50	87%
#100	76%
#200	35%

Moisture Density Relationship: (ASTM D698-07) Method: B
Preparation Method: Dry Rammer Type: Mechanical
Specific Gravity: 2.551 Assumed
Maximum Density: 117.7
Optimum Moisture: 11.8

Plasticity Index (ASTM D4318-05)
Liquid Limit: 24
Plastic Limit: 18
Plasticity Index: 6
Preperation Method: Dry Liquid Limit Method: A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____
hg

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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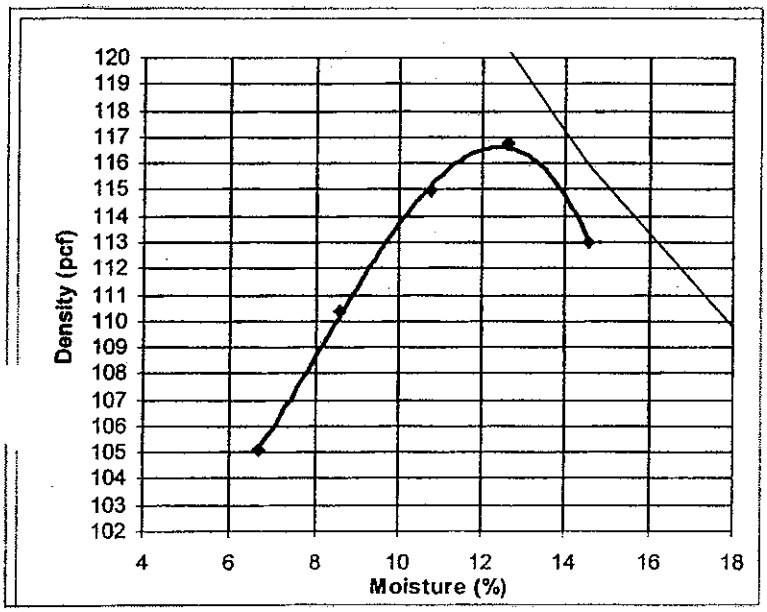
ent:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	Report Date: June 30, 2009 Project #: 9-517-00022D Work Order #: 10	
Attn:	Chris Edgmon	Lab #: 9-0720-03	
Project Name:	EDI SNL Mixed Waste Landfill Cover	Sampled By: David A. Luna Date Sampled: 06/24/2009	
	ABQ, NM	Visual Description of Material: Brown Silty Sand	
Project Manager:	Vickie Maranville	Sample Source: SNL MWL-062409-016	

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	100%
3/8in.	99%
#4	97%
#8	94%
#10	93%
#16	91%
#30	88%
#40	86%
#50	85%
#100	73%
#200	33%

Moisture Density Relationship: (ASTM D698-07) **Method:** B

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.551 **Assumed**

Maximum Density: 116.6

Optimum Moisture: 12.4

Plasticity Index (ASTM D4318-05)

Liquid Limit: 22

Plastic Limit: 19

Plasticity Index: 3

Preperation Method: Dry **Liquid Limit Method:** A

PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____

hg

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)

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'ent: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

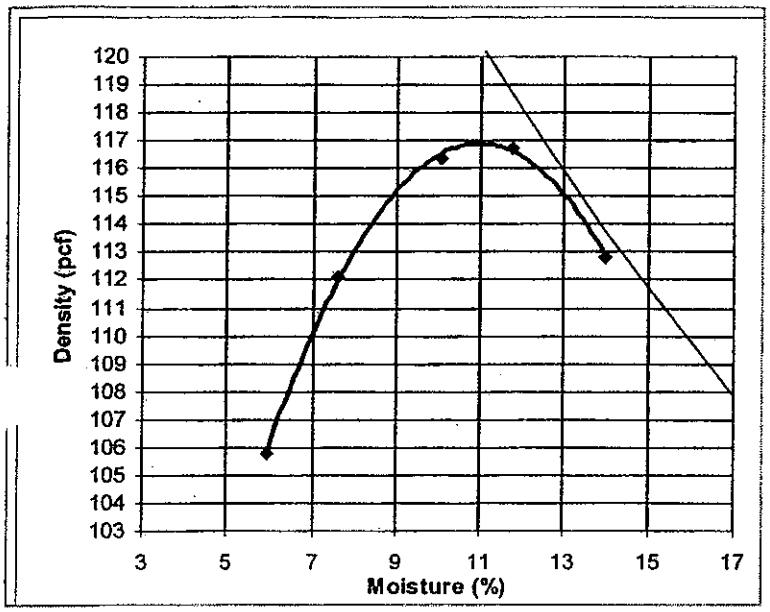
ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 30, 2009

Project #: 9-517-00022D
Work Order #: 10
Lab #: 9-0720-04
Sampled By: David A. Luna
Date Sampled: 06/24/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL-062409-017

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
1/2in.	100%
3/8in.	100%
#4	98%
#8	96%
#10	95%
#16	92%
#30	90%
#40	88%
#50	86%
#100	74%
#200	33%

Moisture Density Relationship: (ASTM D698-07) Method: B
Preparation Method: Dry Rammer Type: Mechanical
Specific Gravity: 2.451 Assumed
Maximum Density: 116.9
Optimum Moisture: 11.0

Plasticity Index (ASTM D4318-05)
Liquid Limit: 23
Plastic Limit: 20
Plasticity Index: 3
Preperation Method: Dry Liquid Limit Method: A
PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
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'ent: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

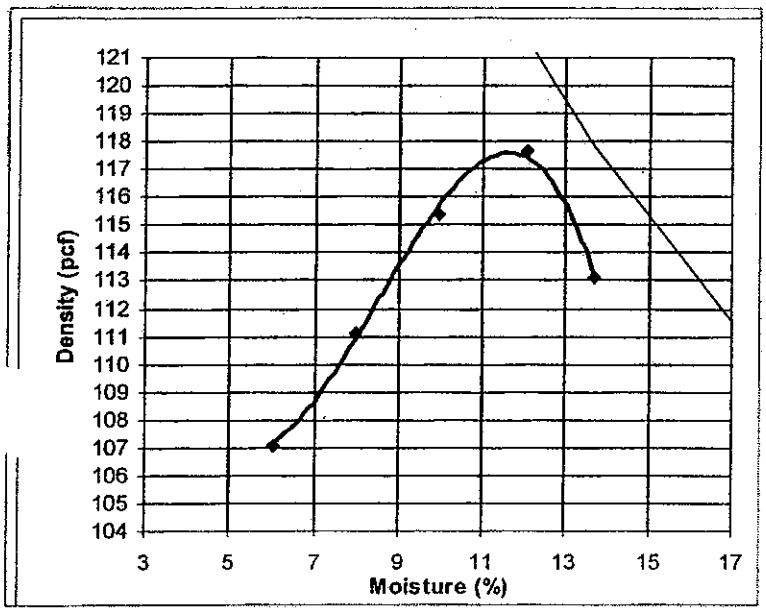
ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 30, 2009

Project #: 9-517-00022D
Work Order #: 10
Lab #: 9-0720-05
Sampled By: David A. Luna
Date Sampled: 06/24/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL-062409-018

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	100%
3/8in.	100%
#4	97%
#8	95%
#10	93%
#16	91%
#30	88%
#40	86%
#50	84%
#100	73%
#200	33%

Moisture Density Relationship: (ASTM D698-07) Method: B
Preparation Method: Dry Rammer Type: Mechanical
Specific Gravity: 2.551 Assumed
Maximum Density: 117.6
Optimum Moisture: 11.6

Plasticity Index (ASTM D4318-05)
Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP
Preperation Method: Dry Liquid Limit Method: A
PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____
Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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www.amec.com

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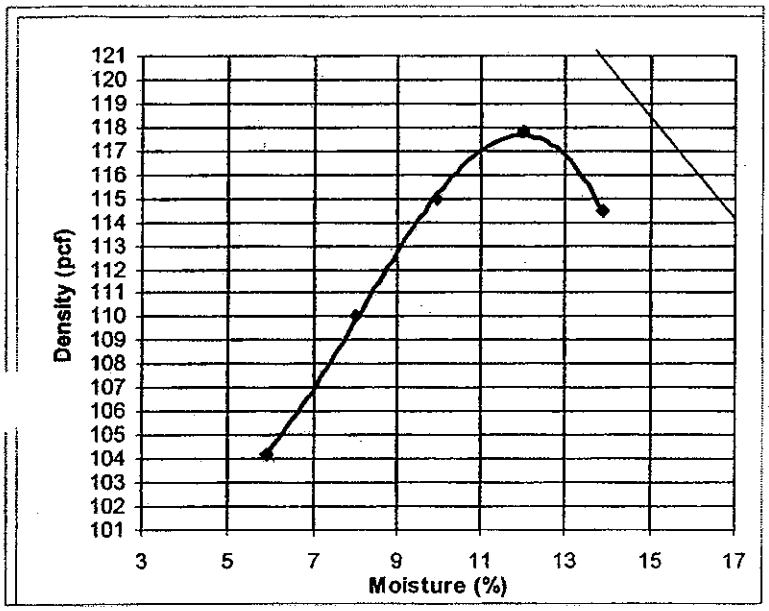
Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	Report Date:	July 09, 2009
		Project #:	9-517-00022D
		Work Order #:	11
Attn:	Chris Edgmon	Lab #:	9-0733-01
Project Name:	EDI SNL Mixed Waste Landfill Cover	Sampled By:	Jon Schermerhorn
		Date Sampled:	06/29/2009
	ABQ, NM	Visual Description of Material:	Brown Silty Sand
		Sample Source:	SNI MWL 062909-19
Project Manager:	Vickie Maranville	SOILS / AGGREGATES	



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
1in.	100%
3/4in.	99%
1/2in.	98%
3/8in.	97%
#4	96%
#8	93%
#10	93%
#16	90%
#30	88%
#40	86%
#50	85%
#100	72%
#200	33%

Moisture Density Relationship: (ASTM D698-07) Method: B

Preparation Method: Dry Rammer Type: Mechanical

Specific Gravity: 2.651 Assumed

Maximum Density: 117.7

Optimum Moisture: 12.0

Plasticity Index (ASTM D4318-05)

Liquid Limit:	23
Plastic Limit:	16
Plasticity Index:	7

Preperation Method: Dry Liquid Limit Method: A

PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____

Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)

Email: ☐

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ənt: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

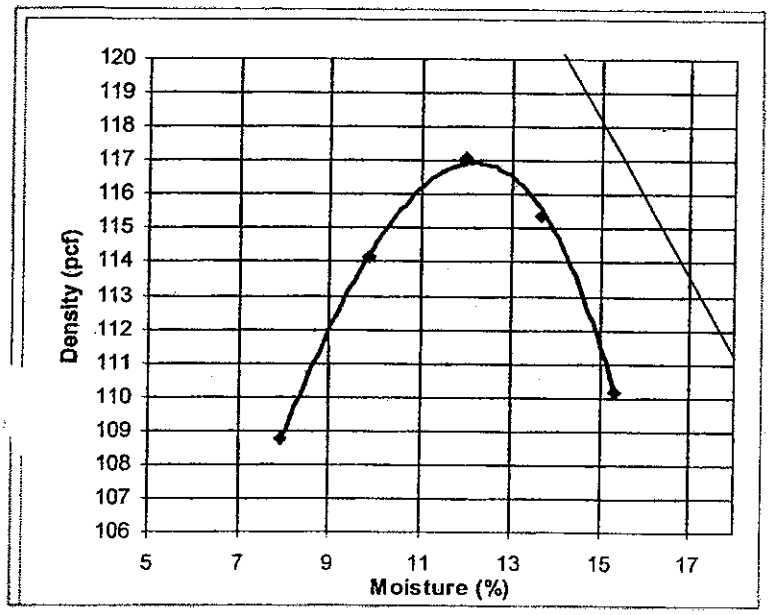
ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 09, 2009

Project #: 9-517-00022D
Work Order #: 11
Lab #: 9-0733-02
Sampled By: Jon Schermerhorn
Date Sampled: 06/29/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL 062909-20

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
1/2in.	100%
3/8in.	100%
#4	98%
#8	96%
#10	96%
#16	93%
#30	91%
#40	90%
#50	88%
#100	75%
#200	36%

Moisture Density Relationship: (ASTM D698-07) Method: B
Preparation Method: Dry Rammer Type: Mechanical
Specific Gravity: 2.651 Assumed
Maximum Density: 116.9
Optimum Moisture: 12.2

Plasticity Index (ASTM D4318-05)

Liquid Limit: 24
Plastic Limit: 17
Plasticity Index: 7

Preperation Method: Dry Liquid Limit Method: A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____
Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
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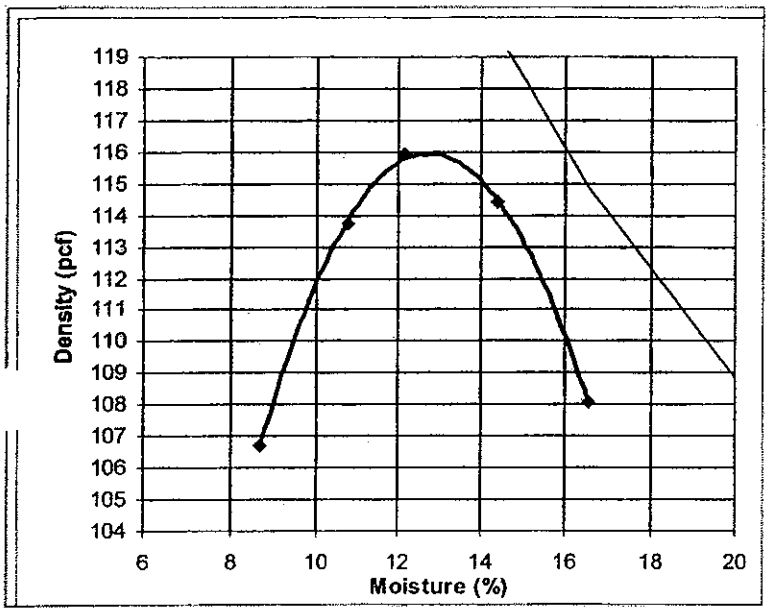
nt:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-
Attn:	Chris Edgmon
Project Name:	EDI SNL Mixed Waste Landfill Cover
	ABQ, NM
Project Manager:	Vickie Maranville

Report Date: July 09, 2009

Project #: 9-517-00022D
Work Order #: 11
Lab #: 9-0733-03
Sampled By: Jon Schermerhorn
Date Sampled: 06/29/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL 062909-21

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	99%
3/8in.	98%
#4	96%
#8	94%
#10	93%
#16	91%
#30	88%
#40	86%
#50	84%
#100	73%
#200	41%

Moisture Density Relationship: (ASTM D698-07) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 115.9
Optimum Moisture: 12.7

Plasticity Index (ASTM D4318-05)
Liquid Limit: 24
Plastic Limit: 17
Plasticity Index: 7
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____
Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

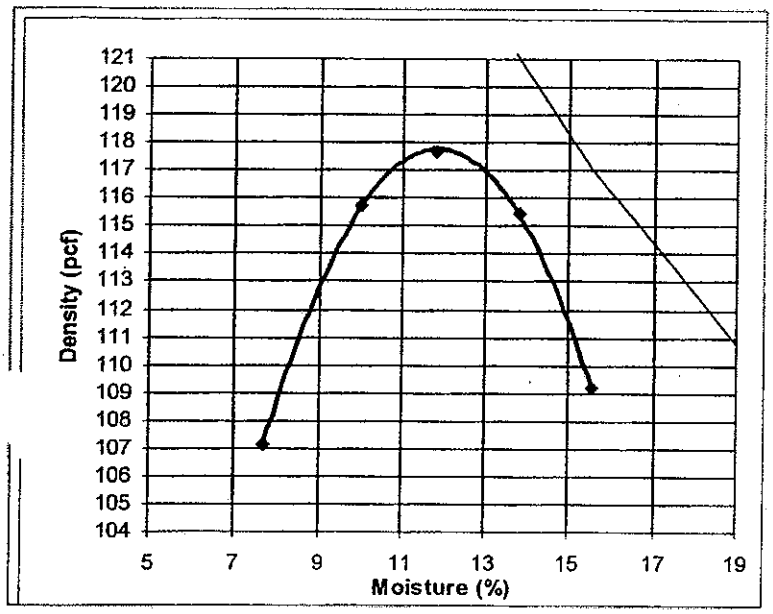
ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 09, 2009

Project #: 9-517-00022D
Work Order #: 11
Lab #: 9-0733-04
Sampled By: Jon Schermerhorn
Date Sampled: 06/29/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL 062909-22

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
1/2in.	100%
3/8in.	100%
#4	99%
#8	97%
#10	96%
#16	94%
#30	92%
#40	90%
#50	89%
#100	75%
#200	36%

Moisture Density Relationship: (ASTM D698-07) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 117.8
Optimum Moisture: 11.8

Plasticity Index (ASTM D4318-05)
Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____
Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

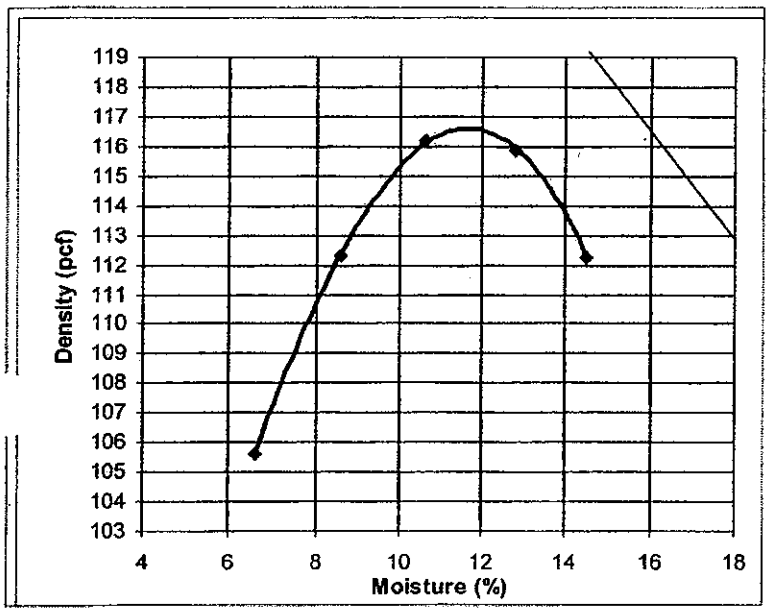
ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 09, 2009

Project #: 9-517-00022D
Work Order #: 11
Lab #: 9-0733-05
Sampled By: Jon Schermerhorn
Date Sampled: 06/29/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL 062909-23

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	99%
3/8in.	99%
#4	97%
#8	94%
#10	93%
#16	91%
#30	89%
#40	88%
#50	86%
#100	74%
#200	36%

Moisture Density Relationship: (ASTM D698-07) Method: B
Preparation Method: Dry Rammer Type: Mechanical
Specific Gravity: 2.651 Assumed
Maximum Density: 116.6
Optimum Moisture: 11.6

Plasticity Index (ASTM D4318-05)
Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP
Preperation Method: Dry Liquid Limit Method: A
PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____
Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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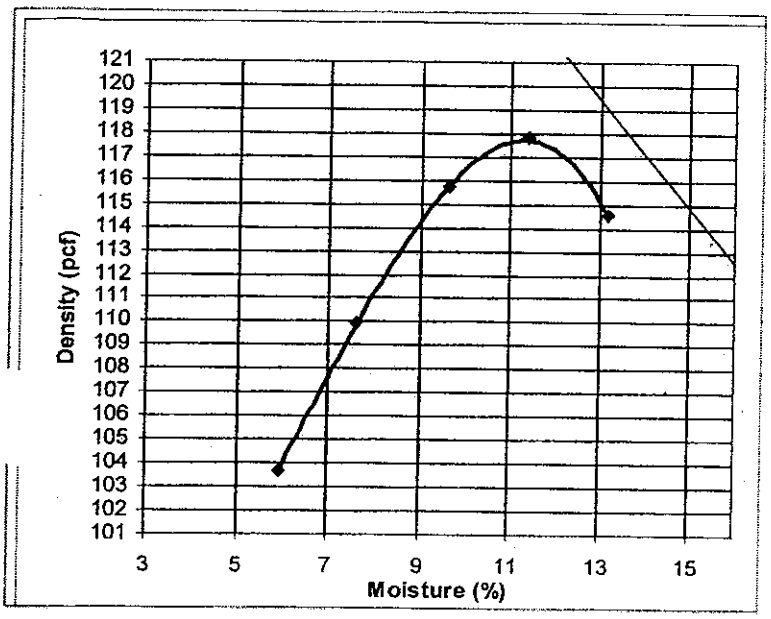
Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-
Attn:	Chris Edgmon
Project Name:	EDI SNL Mixed Waste Landfill Cover ABQ, NM
Project Manager:	Vickie Maranville

Report Date: July 10, 2009

Project #: 9-517-00022D
Work Order #: 11
Lab #: 9-0733-06
Sampled By: Jon Schermerhorn
Date Sampled: 06/29/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL 062909-24

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
1/2in.	100%
3/8in.	99%
#4	97%
#8	95%
#10	94%
#16	92%
#30	90%
#40	88%
#50	86%
#100	74%
#200	34%

Moisture Density Relationship: (ASTM D698-07) Method: B
Preparation Method: Dry Rammer Type: Mechanical
Specific Gravity: 2.551 Assumed
Maximum Density: 117.7
Optimum Moisture: 11.3

Plasticity Index (ASTM D4318-05)
Liquid Limit: 22
Plastic Limit: 15
Plasticity Index: 7
Preperation Method: Dry Liquid Limit Method: A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____
Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

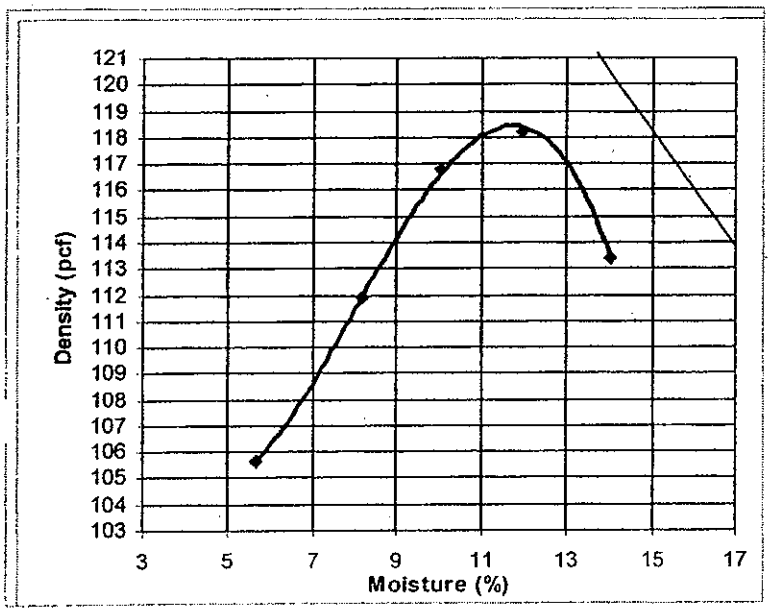
ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 09, 2009

Project #: 9-517-00022D
Work Order #: 13
Lab #: 9-0737-01
Sampled By: Jon Schermerhorn
Date Sampled: 06/30/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL 063009-25

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
1in.	100%
3/4in.	99%
1/2in.	98%
3/8in.	98%
#4	96%
#8	93%
#10	92%
#16	90%
#30	88%
#40	86%
#50	84%
#100	73%
#200	34%

Moisture Density Relationship: (ASTM D698-07) **Method:** B
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 118.4
Optimum Moisture: 11.7

Plasticity Index (ASTM D4318-05)
Liquid Limit: 24
Plastic Limit: 20
Plasticity Index: 4
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By:
Jan

Distribution: Client ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

AMEC Earth Environmental, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
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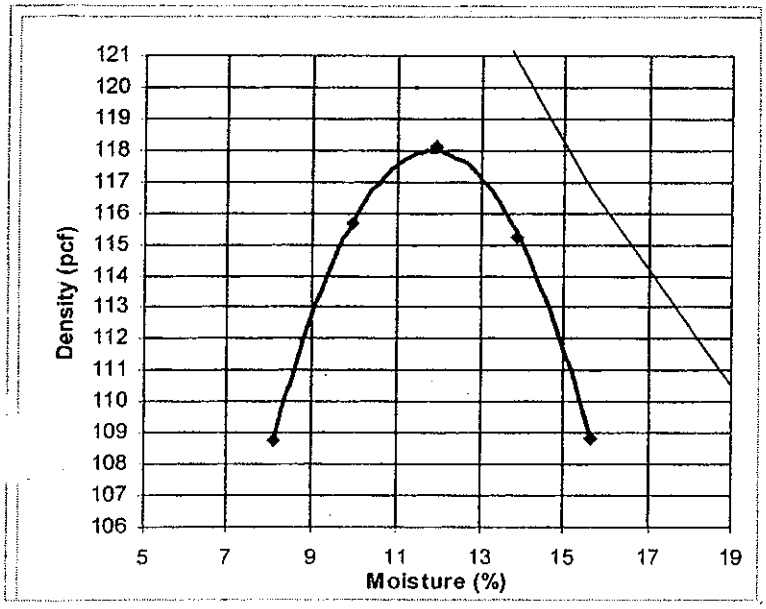
Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:** July 09, 2009	
Attn:	Chris Edgmon	**Project #:** 9-517-00022D **Work Order #:** 13 **Lab #:** 9-0737-02	
Project Name:	EDI SNL Mixed Waste Landfill Cover ABQ, NM	**Sampled By:** Jon Schermerhorn **Date Sampled:** 06/30/2009 **Visual Description of Material:** Brown Silty Sand **Sample Source:** SNL MWL 063009-26	
Project Manager:	Vickie Maranville	**SOILS / AGGREGATES**	



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
1in.	100%
3/4in.	99%
1/2in.	98%
3/8in.	97%
#4	96%
#8	94%
#10	93%
#16	91%
#30	88%
#40	87%
#50	85%
#100	74%
#200	36%

Moisture Density Relationship: (ASTM D698-07) **Method:** B

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.651 **Assumed**

Maximum Density: 118.0

Optimum Moisture: 11.8

Plasticity Index (ASTM D4318-05)

Liquid Limit: 25

Plastic Limit: 20

Plasticity Index: 5

Preperation Method: Dry **Liquid Limit Method:** A

PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: Jan

Distribution: Client ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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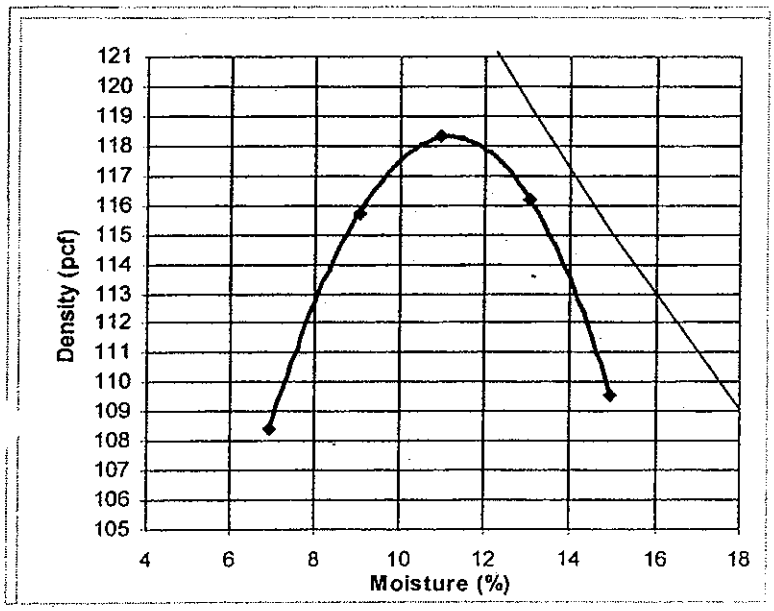
6519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:** July 09, 2009	
Attn:	Chris Edgmon	**Project #:** 9-517-00022D **Work Order #:** 13 **Lab #:** 9-0737-03	
Project Name:	EDI SNL Mixed Waste Landfill Cover ABQ, NM	**Sampled By:** Jon Schermerhorn **Date Sampled:** 06/30/2009 **Visual Description of Material:** Brown Silty Sand **Sample Source:** SNL MWL 063009-27	
Project Manager:	Vickie Maranville	**SOILS / AGGREGATES**	



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
1in.	100%
3/4in.	98%
1/2in.	97%
3/8in.	96%
#4	94%
#8	92%
#10	91%
#16	89%
#30	86%
#40	85%
#50	83%
#100	70%
#200	32%

Moisture Density Relationship: (ASTM D698-07) **Method:** B

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.551 Assumed

Maximum Density: 118.3

Optimum Moisture: 11.2

Plasticity Index (ASTM D4318-05)

Liquid Limit: 22

Plastic Limit: 20

Plasticity Index: 2

Preperation Method: Dry **Liquid Limit Method:** A

PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: Jan

Distribution: Client ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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www.amec.com

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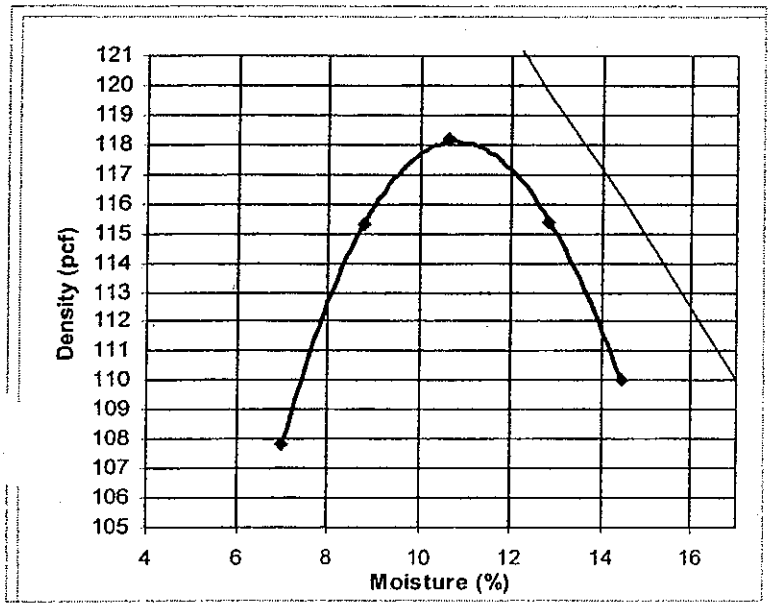
Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:** July 09, 2009	
Attn:	Chris Edgmon	**Project #:** 9-517-00022D **Work Order #:** 13 **Lab #:** 9-0737-04	
Project Name:	EDI SNL Mixed Waste Landfill Cover ABQ, NM	**Sampled By:** Jon Schermerhorn **Date Sampled:** 06/30/2009 **Visual Description of Material:** Brown Silty Sand **Sample Source:** SNL MWL 063009-28	
Project Manager:	Vickie Maranville	**SOILS / AGGREGATES**	



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
1/2in.	100%
3/8in.	99%
#4	98%
#8	95%
#10	95%
#16	92%
#30	90%
#40	88%
#50	86%
#100	73%
#200	33%

Moisture Density Relationship: (ASTM D698-07) **Method:** B

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.551 **Assumed**

Maximum Density: 118.1

Optimum Moisture: 10.8

Plasticity Index (ASTM D4318-05)

Liquid Limit: 23

Plastic Limit: 20

Plasticity Index: 3

Preperation Method: Dry **Liquid Limit Method:** A

PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: Jan

Distribution: Client ☑ File: ☑ Supplier: ☑ Other: Addressee (2)

Email: ☐

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Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371

www.amec.com

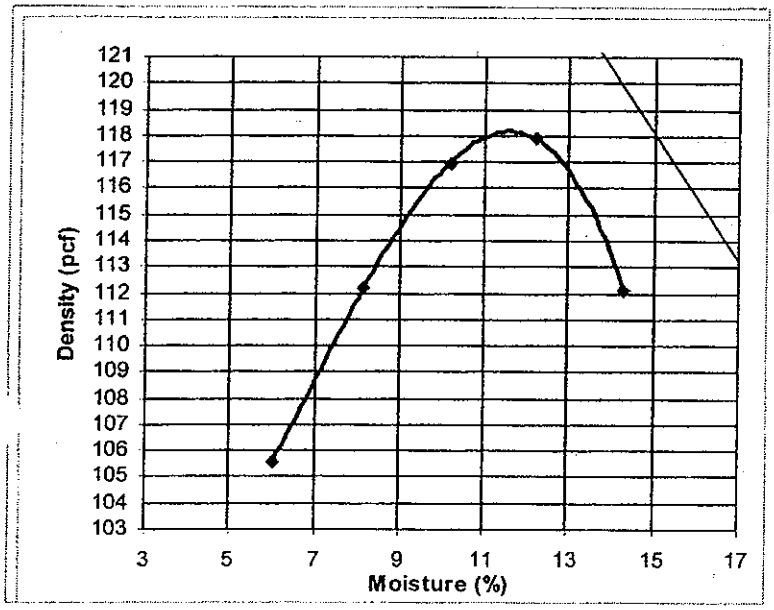
amec

Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-
Attn:	Chris Edgmon
Project Name:	EDI SNL Mixed Waste Landfill Cover ABQ, NM
Project Manager:	Vickie Maranville

Report Date: July 09, 2009

Project #: 9-517-00022D
Work Order #: 13
Lab #: 9-0737-05
Sampled By: Jon Schermerhorn
Date Sampled: 06/30/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL 063009-29

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	99%
3/8in.	99%
#4	97%
#8	95%
#10	94%
#16	92%
#30	89%
#40	88%
#50	86%
#100	72%
#200	33%

Moisture Density Relationship: (ASTM D698-07) **Method:** B
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 118.2
Optimum Moisture: 11.6

Plasticity Index (ASTM D4318-05)
Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By:
Jan

Distribution: Client ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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Tel 5058211801
Fax 5058217371
www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

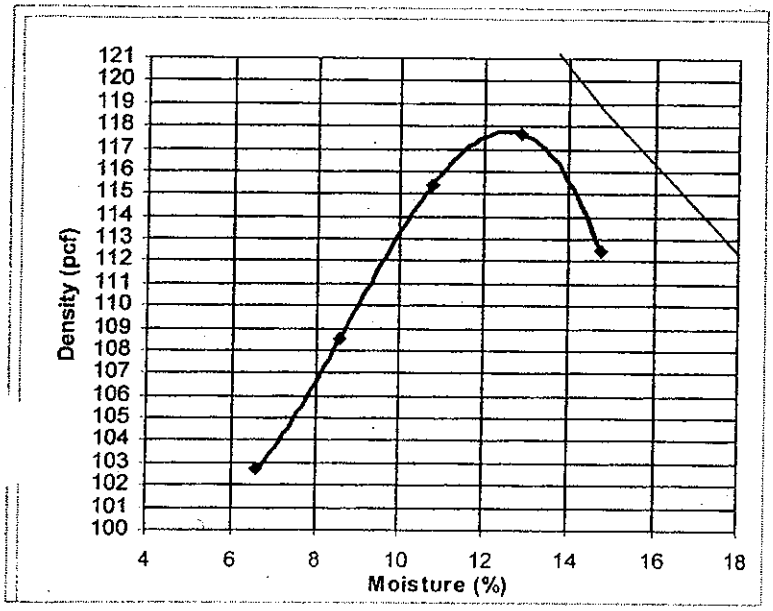
ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 09, 2009

Project #: 9-517-00022D
Work Order #: 13
Lab #: 9-0737-06
Sampled By: Jon Schermerhorn
Date Sampled: 06/30/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL 063009-30

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	100%
3/8in.	99%
#4	98%
#8	97%
#10	96%
#16	94%
#30	92%
#40	91%
#50	89%
#100	78%
#200	39%

Moisture Density Relationship: (ASTM D698-07) **Method:** B
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 Assumed
Maximum Density: 117.8
Optimum Moisture: 12.5

Plasticity Index (ASTM D4318-05)
Liquid Limit: 24
Plastic Limit: 17
Plasticity Index: 7
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By:
Jan

Distribution: Client ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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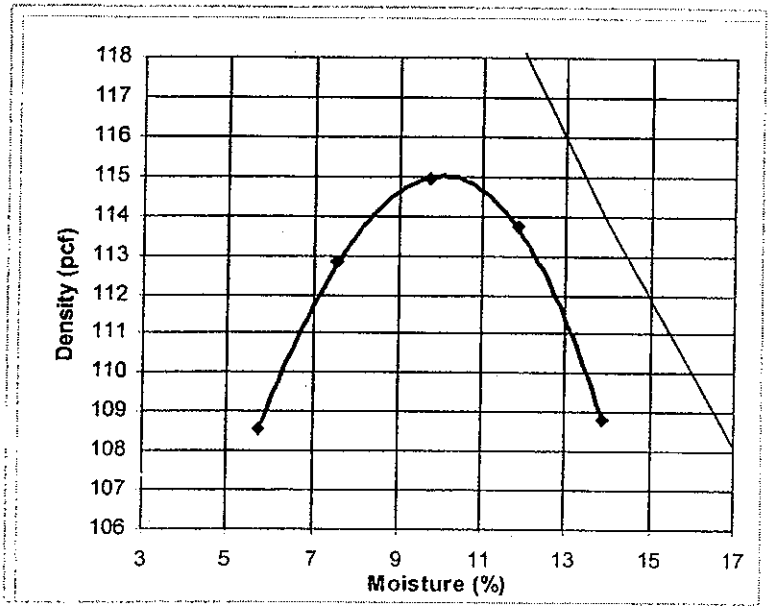
3519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-		**Report Date:** July 07, 2009
Attn:	Chris Edgmon		**Project #:** 9-517-00022D **Work Order #:** 15 **Lab #:** 9-0743-01
Project Name:	EDI SNL Mixed Waste Landfill Cover ABQ, NM		**Sampled By:** Jon Schermerhorn **Date Sampled:** 06/30/2009 **Visual Description of Material:** Brown Silty Sand **Sample Source:** SNL MWL Burm-1
Project Manager:	Vickie Maranville	**SOILS / AGGREGATES**	



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	99%
3/8in.	99%
#4	98%
#8	97%
#10	96%
#16	95%
#30	93%
#40	92%
#50	90%
#100	68%
#200	30%

Moisture Density Relationship: (ASTM D698-07) Method: A

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.451 **Assumed**

Maximum Density: 115.0

Optimum Moisture: 10.0

Plasticity Index (ASTM D4318-05)

Liquid Limit: NV

Plastic Limit: NV

Plasticity Index: NP

Preperation Method: Dry **Liquid Limit Method:** A

PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____

Jan

Distribution: **Client** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)

Email: ☐

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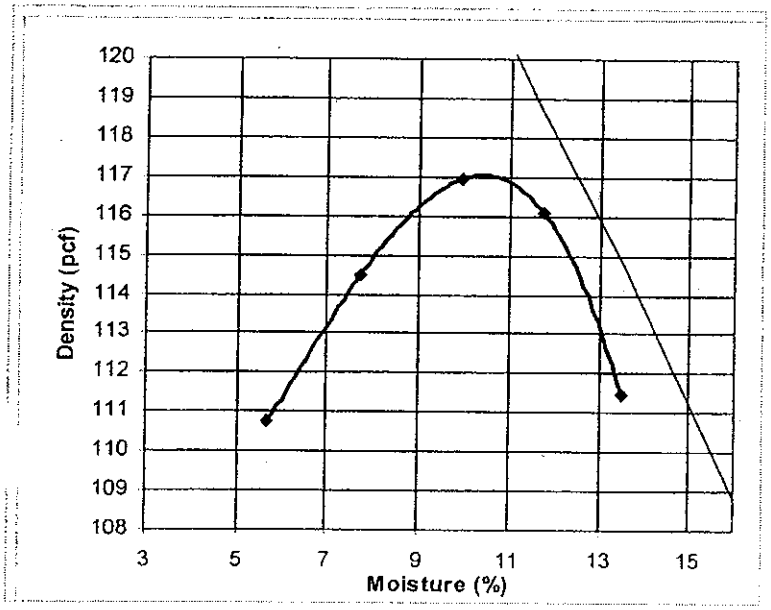
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:** July 07, 2009	
Attn:	Chris Edgmon	**Project #:** 9-517-00022D **Work Order #:** 15 **Lab #:** 9-0743-02	
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Sampled By:** Jon Schermerhorn **Date Sampled:** 06/30/2009	
	ABQ, NM	**Visual Description of Material:** Brown Silty Sand	
Project Manager:	Vickie Maranville	**Sample Source:** SNL MWL Burm-2	

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
1in.	100%
3/4in.	99%
1/2in.	98%
3/8in.	97%
#4	95%
#8	93%
#10	92%
#16	90%
#30	88%
#40	86%
#50	84%
#100	65%
#200	27%

Moisture Density Relationship: (ASTM D698-07) **Method:** A

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.451 **Assumed**

Maximum Density: 117.0

Optimum Moisture: 10.4

Plasticity Index (ASTM D4318-05)

Liquid Limit: NV

Plastic Limit: NV

Plasticity Index: NP

Preperation Method: Dry **Liquid Limit Method:** A

PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____

Jan

Distribution: Client ☑ File: ☑ Supplier: ☑ Other: Addressee (2)

Email: ☐

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19 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371

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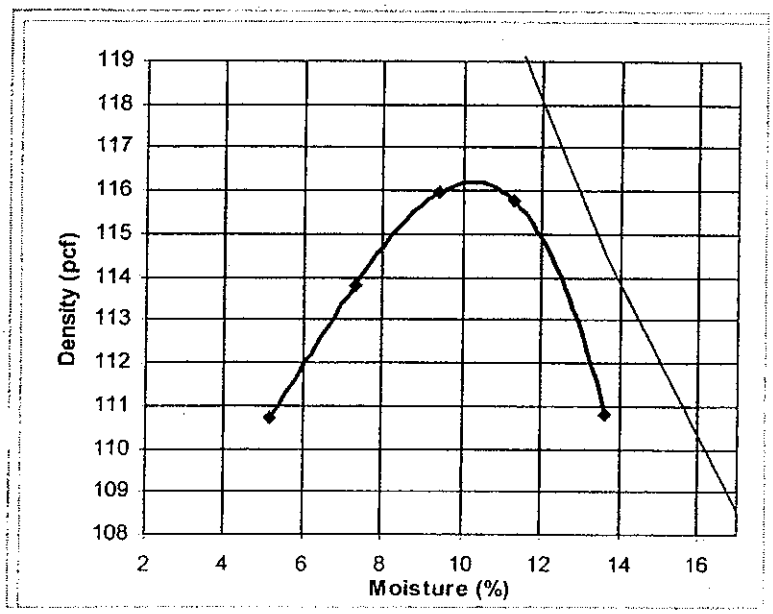
Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:**	July 07, 2009
Attn:	Chris Edgmon	**Project #:**	9-517-00022D
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Work Order #:**	15
	ABQ, NM	**Lab #:**	9-0743-03
Project Manager:	Vickie Maranville	**Sampled By:**	Jon Schermerhorn
		Date Sampled:	06/30/2009
		Visual Description of Material:	Brown Silty Sand
		Sample Source:	SNL MWL Burm-3

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: B

Sieve Size	Passing
1in.	100%
3/4in.	99%
1/2in.	97%
3/8in.	96%
#4	94%
#8	92%
#10	91%
#16	90%
#30	87%
#40	86%
#50	84%
#100	65%
#200	26%

Moisture Density Relationship: (ASTM D698-07) **Method:** A

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.451 Assumed

Maximum Density: 116.2

Optimum Moisture: 10.2

Plasticity Index (ASTM D4318-05)

Liquid Limit: NV

Plastic Limit: NV

Plasticity Index: NP

Preperation Method: Dry **Liquid Limit Method:** A

PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____

Jan

Distribution: Client ☑ File: ☑ Supplier: ☑ Other: Addressee (2)

Email: ☐

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8519 Jefferson NE
Albuquerque, NM 87113
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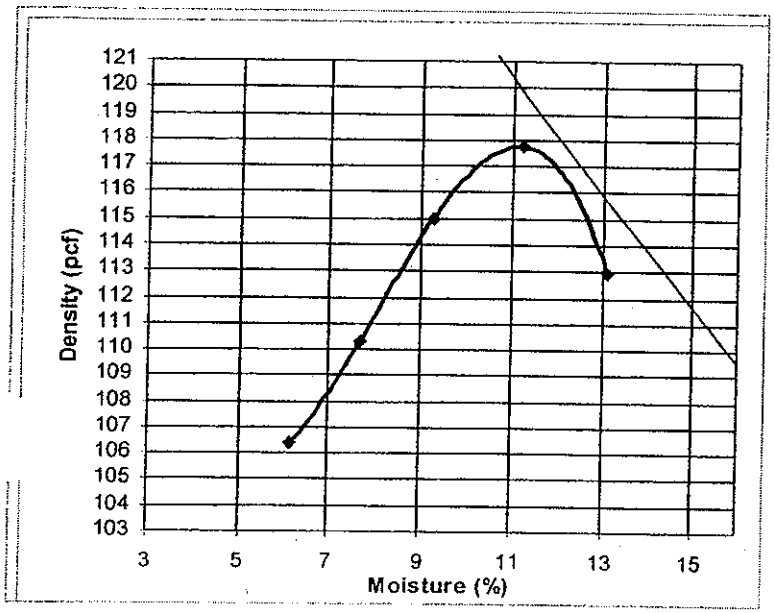
Fax 5058217371
www.amec.com

Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:** July 15, 2009	
Attn:	Chris Edgmon	**Project #:** 9-517-00022D **Work Order #:** 17 **Lab #:** 9-0770-01	
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Sampled By:** Jon Schermerhorn **Date Sampled:** 07/10/2009	
	ABQ, NM	**Visual Description of Material:** Brown Silty Sand	
Project Manager:	Vickie Maranville	**Sample Source:** SNL MWL Berm-4	

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	100%
3/8in.	100%
#4	99%
#8	97%
#10	97%
#16	95%
#30	92%
#40	90%
#50	88%
#100	73%
#200	28%

Moisture Density Relationship: (ASTM D698-07) **Method:** B

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.451 Assumed

Maximum Density: 117.8

Optimum Moisture: 11.1

Plasticity Index (ASTM D4318-05)

Liquid Limit: 25

Plastic Limit: 18

Plasticity Index: 7

Preperation Method: Dry **Liquid Limit Method:** A

PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____

Jan

Distribution: Client ☑ File: ☑ Supplier: ☑ Other: Addressee (2)

Email: ☐

AMEC Earth Environmental, Inc.
6019 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
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www.amec.com

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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

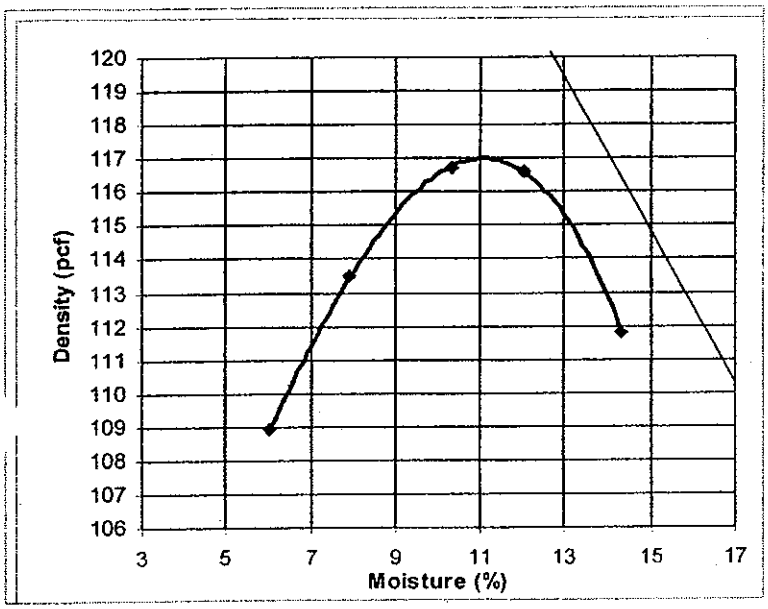
ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 15, 2009

Project #: 9-517-00022D
Work Order #: 17
Lab #: 9-0770-02
Sampled By: Jon Schermerhorn
Date Sampled: 07/10/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL Berm-5

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	98%
3/8in.	97%
#4	94%
#8	92%
#10	91%
#16	89%
#30	86%
#40	85%
#50	82%
#100	65%
#200	24%

Moisture Density Relationship: (ASTM D698-07) **Method:** B
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.551 **Assumed**
Maximum Density: 117.0
Optimum Moisture: 11.1

Plasticity Index (ASTM D4318-05)
Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____
Jan

Distribution: **Client** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐

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Albuquerque, NM 87113
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Fax 5058217371
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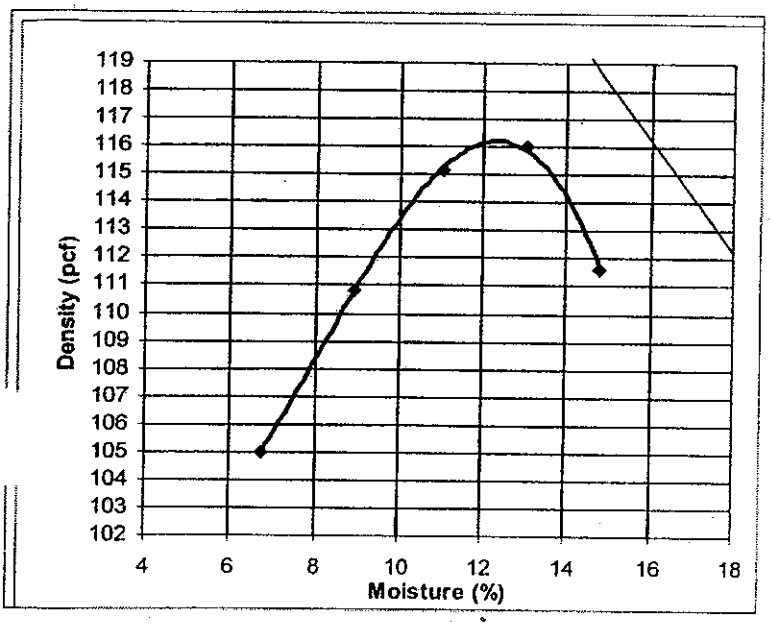
Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:** July 17, 2009	
Attn:	Chris Edgmon	**Project #:** 9-517-00022D **Work Order #:** 18 **Lab #:** 9-0781-02	
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Sampled By:** Jon Schermerhorn **Date Sampled:** 7/14/2009	
	ABQ, NM	**Visual Description of Material:** Brown Silty Sand	
Project Manager:	Vickie Maranville	**Sample Source:** SNL MWL Berm-6	

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	100%
3/8in.	100%
#4	98%
#8	96%
#10	95%
#16	93%
#30	90%
#40	88%
#50	86%
#100	74%
#200	32%

Moisture Density Relationship: (ASTM D698-07) **Method:** B

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.651 Assumed

Maximum Density: 116.2

Optimum Moisture: 12.3

Plasticity Index (ASTM D4318-05)

Liquid Limit: 23

Plastic Limit: 21

Plasticity Index: 2

Preperation Method: Dry **Liquid Limit Method:** A

PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____

hg

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)

Email: ☐

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Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371

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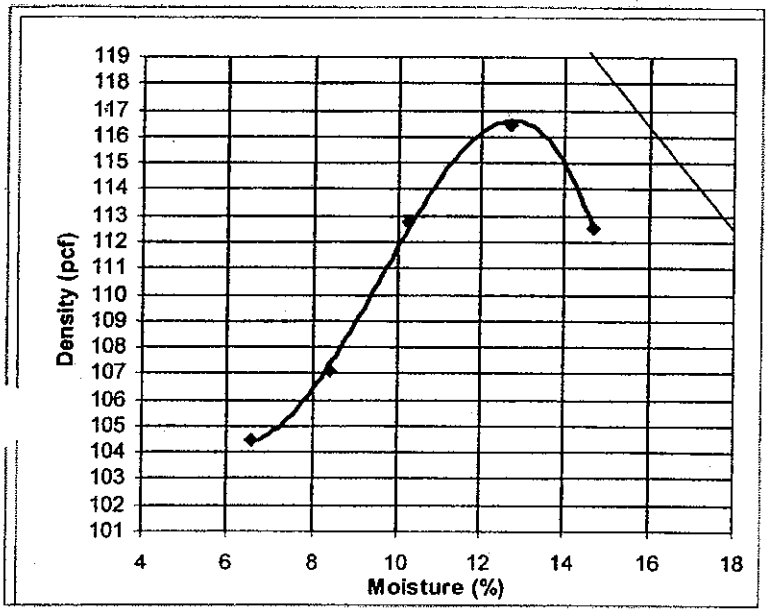
Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:** July 17, 2009	
Attn:	Chris Edgmon	**Project #:** 9-517-00022D **Work Order #:** 18 **Lab #:** 9-0781-03	
Project Name:	EDI SNL Mixed Waste Landfill Cover ABQ, NM	**Sampled By:** Jon Schermerhorn **Date Sampled:** 7/14/2009 **Visual Description of Material:** Brown Silty Sand **Sample Source:** SNL MWL Berm-7	
Project Manager:	Vickie Maranville	**SOILS / AGGREGATES**	



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	99%
3/8in.	99%
#4	97%
#8	95%
#10	94%
#16	92%
#30	89%
#40	88%
#50	86%
#100	73%
#200	32%

Moisture Density Relationship: (ASTM D698-07) **Method:** B

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.651 **Assumed**

Maximum Density: 116.6

Optimum Moisture: 12.7

Plasticity Index (ASTM D4318-05)

Liquid Limit: 23

Plastic Limit: 19

Plasticity Index: 4

Preperation Method: Dry **Liquid Limit Method:** A

PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____

hg

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)

Email: ☐

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Fax 5058217371
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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

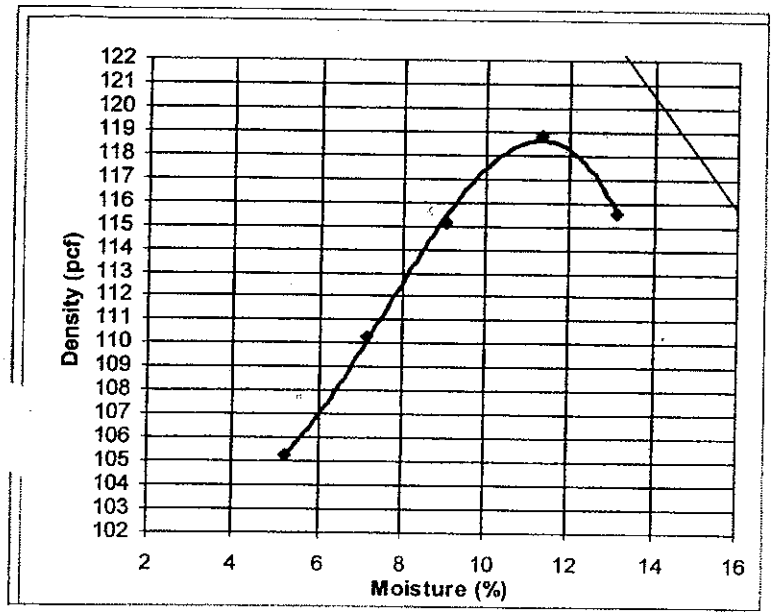
ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 20, 2009

Project #: 9-517-00022D
Work Order #: 18
Lab #: 9-0781-04
Sampled By: Jon Schermerhorn
Date Sampled: 7/14/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL Berm-8

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
1/2in.	100%
3/8in.	99%
#4	98%
#8	96%
#10	95%
#16	93%
#30	91%
#40	89%
#50	87%
#100	74%
#200	36%

Moisture Density Relationship: (ASTM D698-07) **Method:** B
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 118.6
Optimum Moisture: 11.3

Plasticity Index (ASTM D4318-05)
Liquid Limit: 21
Plastic Limit: 17
Plasticity Index: 4
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____
hg

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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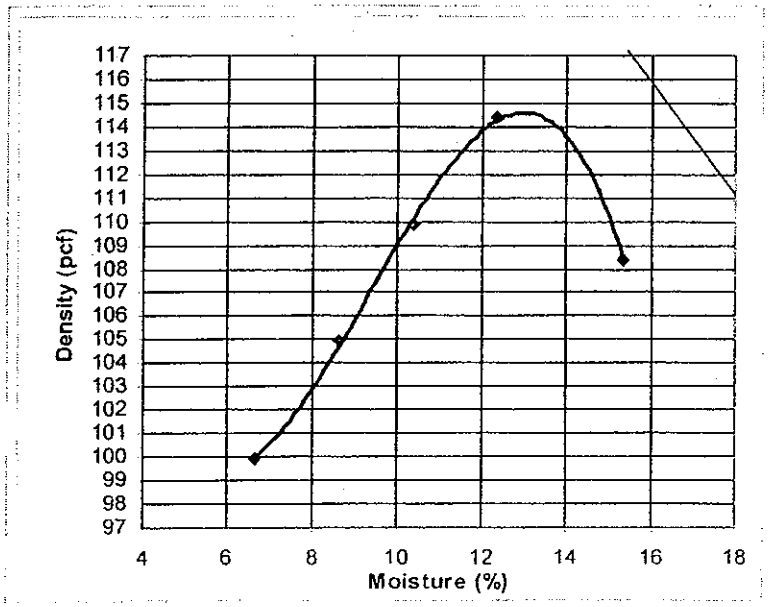
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:** July 22, 2009	
Attn:	Chris Edgmon	**Project #:** 9-517-00022D **Work Order #:** 19 **Lab #:** 9-0798-01	
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Sampled By:** Jon Schermerhorn **Date Sampled:** 7/16/2009	
	ABQ, NM	**Visual Description of Material:** Brown Silty Sand	
Project Manager:	Vickie Maranville	**Sample Source:** SNL MWL Berm-9	

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	99%
3/8in.	99%
#4	98%
#8	97%
#10	97%
#16	96%
#30	94%
#40	92%
#50	91%
#100	79%
#200	38%

Moisture Density Relationship: (ASTM D698-07) **Method:** A

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.651 Assumed

Maximum Density: 114.6

Optimum Moisture: 13.0

Remarks: 8/3/09 Revised 1/2" screen input from 113.4 to 13.4 value

Plasticity Index (ASTM D4318-05)

Liquid Limit: 22

Plastic Limit: 18

Plasticity Index: 4

Preperation Method: Dry **Liquid Limit Method:** A

PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____

Jan

Distribution: Client ☑ File: ☑ Supplier: ☑ Other: Addressee (2)

Email: ☐

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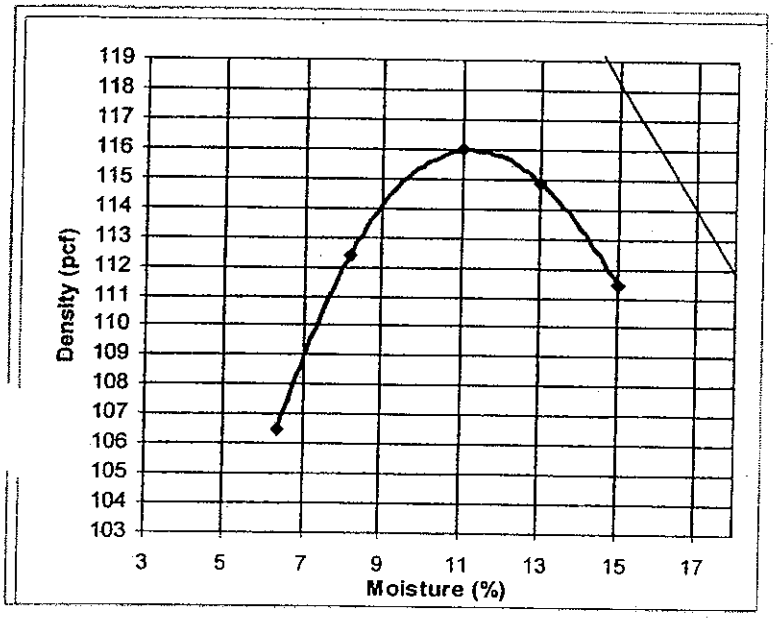
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:** July 21, 2009	
Attn:	Chris Edgmon	**Project #:** 9-517-00022D **Work Order #:** 19 **Lab #:** 9-0798-02	
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Sampled By:** Jon Schermerhorn **Date Sampled:** 07/16/2009	
	ABQ, NM	**Visual Description of Material:** Brown Silty Sand	
Project Manager:	Vickie Maranville	**Sample Source:** SNL MWL Berm-10	

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	100%
3/8in.	99%
#4	98%
#8	95%
#10	95%
#16	93%
#30	91%
#40	90%
#50	88%
#100	75%
#200	30%

Moisture Density Relationship: (ASTM D698-07) **Method:** A

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.651 **Assumed**

Maximum Density: 116.0

Optimum Moisture: 11.2

Plasticity Index (ASTM D4318-05)

Liquid Limit: NV

Plastic Limit: NV

Plasticity Index: NP

Preperation Method: Dry **Liquid Limit Method:** A

PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____

Jan

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)

Email: ☐

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Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371

www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

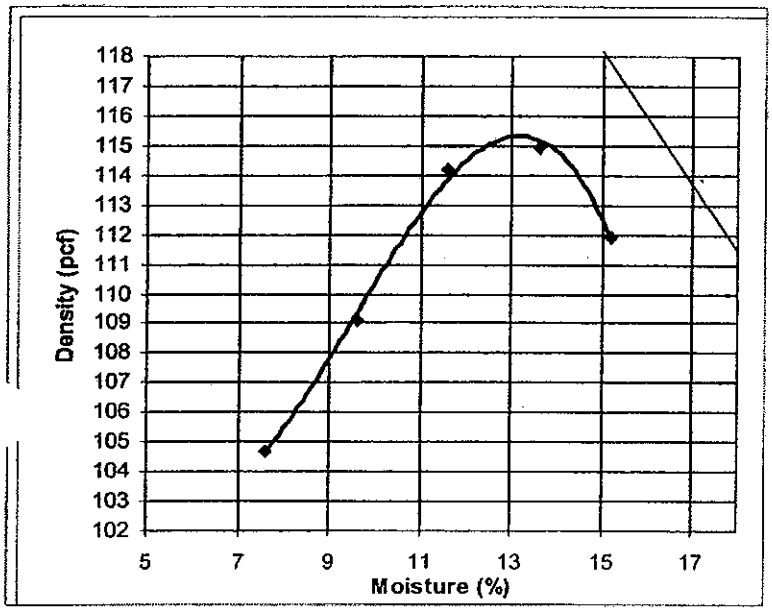
ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 22, 2009

Project #: 9-517-00022D
Work Order #: 19
Lab #: 9-0798-03
Sampled By: Jon Schermerhorn
Date Sampled: 07/16/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL Berm-11

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	100%
3/8in.	100%
#4	98%
#8	97%
#10	96%
#16	95%
#30	92%
#40	91%
#50	89%
#100	77%
#200	36%

Moisture Density Relationship: (ASTM D698-07) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 115.3
Optimum Moisture: 13.2

Plasticity Index (ASTM D4318-05)
Liquid Limit: 23
Plastic Limit: 19
Plasticity Index: 4

Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____
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Email: ☐

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Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

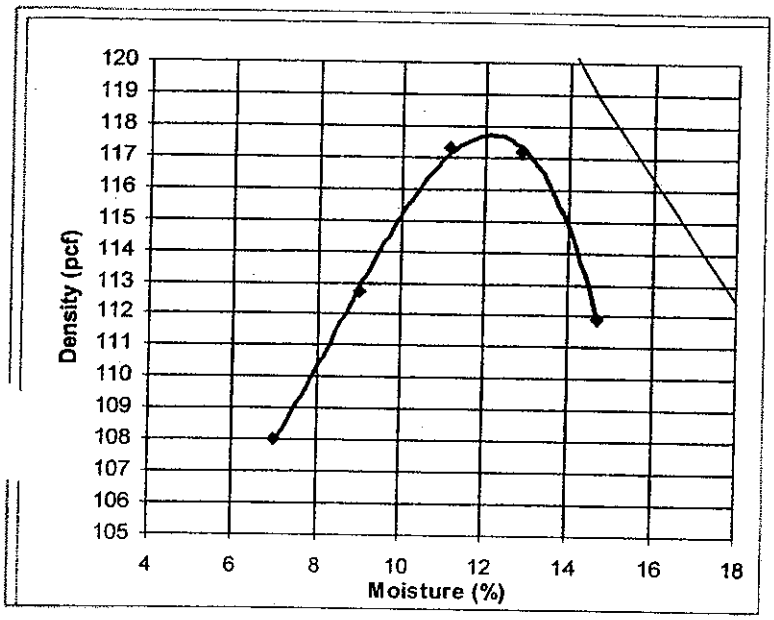
ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 23, 2009

Project #: 9-517-00022D
Work Order #: 19
Lab #: 9-0798-04
Sampled By: Jon Schermerhorn
Date Sampled: 07/16/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL Berm-12

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	99%
3/8in.	98%
#4	97%
#8	95%
#10	94%
#16	92%
#30	90%
#40	89%
#50	87%
#100	74%
#200	32%

Moisture Density Relationship: (ASTM D698-07) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 117.7
Optimum Moisture: 12.1

Plasticity Index (ASTM D4318-05)
Liquid Limit: 24
Plastic Limit: 18
Plasticity Index: 6
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____
Jan

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐

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Fax 5058217371
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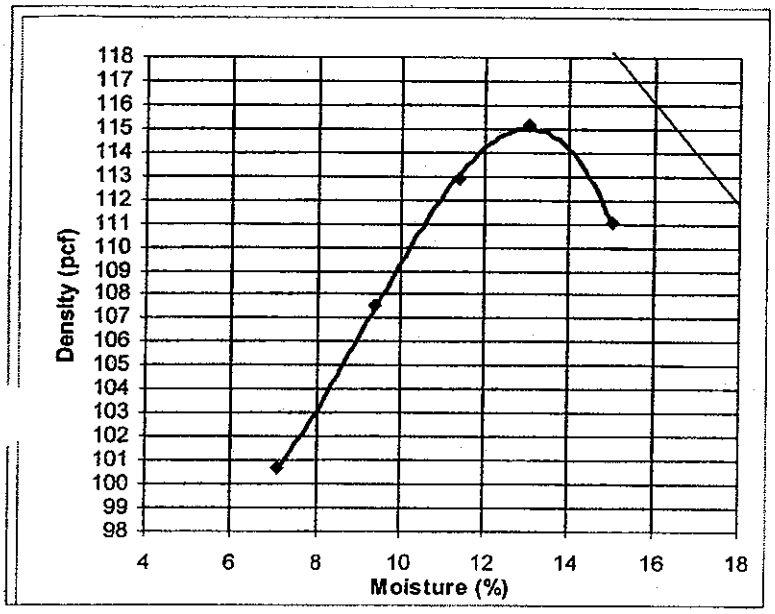
Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:** July 23, 2009	
Attn:	Chris Edgmon	**Project #:** 9-517-00022D **Work Order #:** 19 **Lab #:** 9-0798-05	
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Sampled By:** Jon Schermerhorn **Date Sampled:** 07/16/2009	
	ABQ, NM	**Visual Description of Material:** Brown Silty Sand	
Project Manager:	Vickie Maranville	**Sample Source:** SNL MWL Berm-13	

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
1/2in.	100%
3/8in.	99%
#4	97%
#8	95%
#10	94%
#16	93%
#30	90%
#40	89%
#50	87%
#100	76%
#200	37%

Moisture Density Relationship: (ASTM D698-07) **Method:** A

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.651 Assumed

Maximum Density: 115.0

Optimum Moisture: 13.0

Plasticity Index (ASTM D4318-05)

Liquid Limit: 26

Plastic Limit: 17

Plasticity Index: 9

Preperation Method: Dry **Liquid Limit Method:** A

PI Air Dried.

Soil Classification (ASTM D2487-06) SC

Reviewed By: _____

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Email: ☐

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Albuquerque, NM 87113
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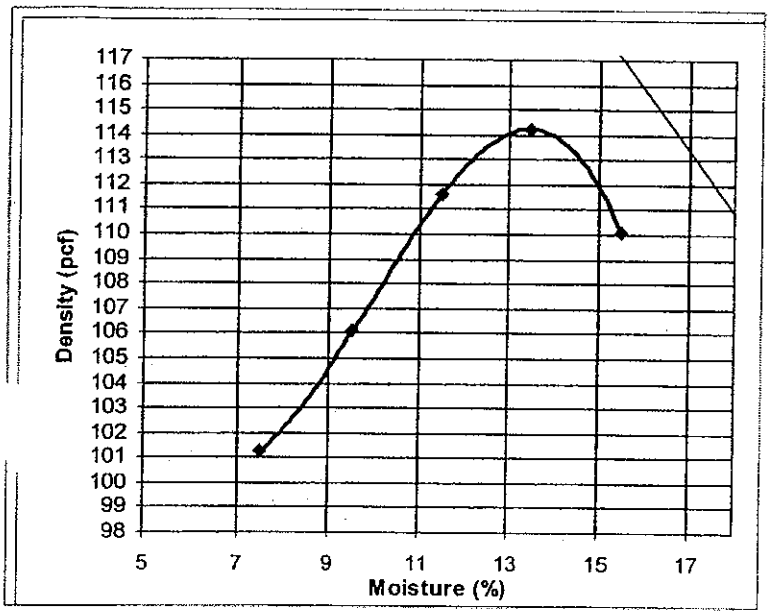
Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:** July 23, 2009	
Attn:	Chris Edgmon	**Project #:** 9-517-00022D **Work Order #:** 19 **Lab #:** 9-0798-06	
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Sampled By:** Jon Schermerhorn **Date Sampled:** 07/16/2009	
	ABQ, NM	**Visual Description of Material:** Brown Silty Sand	
Project Manager:	Vickie Maranville	**Sample Source:** SNL MWL Berm-14	

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	99%
3/8in.	99%
#4	98%
#8	97%
#10	97%
#16	95%
#30	93%
#40	92%
#50	90%
#100	78%
#200	34%

Moisture Density Relationship: (ASTM D698-07) **Method:** A

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.651 **Assumed**

Maximum Density: 114.2

Optimum Moisture: 13.5

Plasticity Index (ASTM D4318-05)

Liquid Limit: NV

Plastic Limit: NV

Plasticity Index: NP

Preperation Method: Dry **Liquid Limit Method:** A

PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____

Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)

Email: ☐

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Albuquerque, NM 87113
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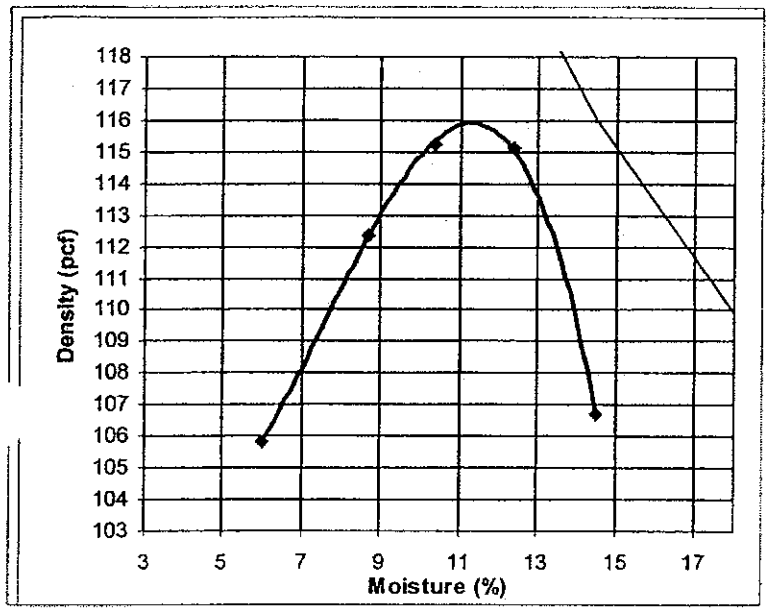
Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:** July 27, 2009	
Attn:	Chris Edgmon	**Project #:** 9-517-00022D **Work Order #:** 19 **Lab #:** 9-0798-07	
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Sampled By:** Jon Schermerhorn **Date Sampled:** 07/16/2009	
	ABQ, NM	**Visual Description of Material:** Brown Silty Sand	
Project Manager:	Vickie Maranville	**Sample Source:** SNL MWL Berm-15	

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
1/2in.	100%
3/8in.	100%
#4	99%
#8	97%
#10	97%
#16	96%
#30	93%
#40	92%
#50	90%
#100	78%
#200	37%

Moisture Density Relationship: (ASTM D698-07) **Method:** A

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.551 Assumed

Maximum Density: 115.9

Optimum Moisture: 11.3

Plasticity Index (ASTM D4318-05)

Liquid Limit: 23

Plastic Limit: 19

Plasticity Index: 4

Preperation Method: Dry **Liquid Limit Method:** A

PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____
Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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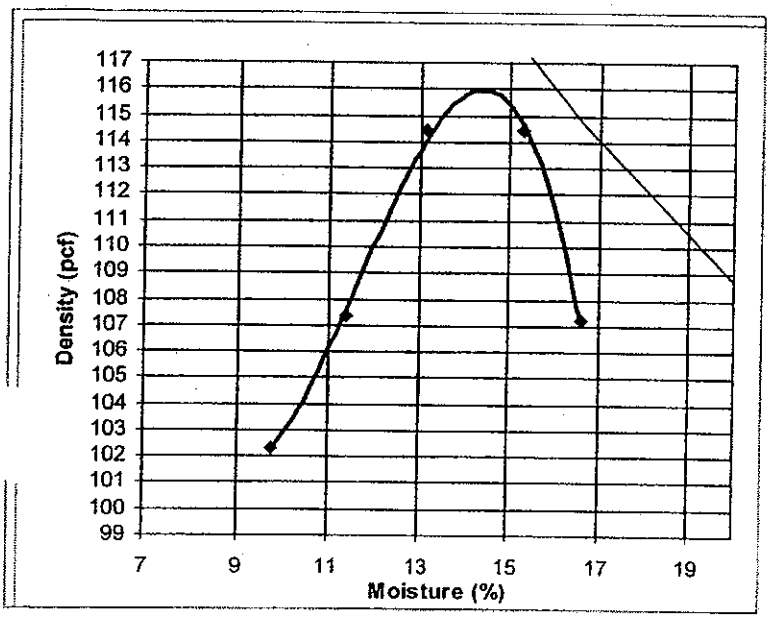
Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:** July 27, 2009	
Attn:	Chris Edgmon	**Project #:** 9-517-00022D **Work Order #:** 19	
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Lab #:** 9-0798-08 **Sampled By:** Jon Schermerhorn **Date Sampled:** 07/16/2009	
	ABQ, NM	**Visual Description of Material:** Brown Silty Sand	
Project Manager:	Vickie Maranville	**Sample Source:** SNL MWL Berm-16	

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	100%
3/8in.	99%
#4	98%
#8	96%
#10	96%
#16	94%
#30	91%
#40	90%
#50	88%
#100	75%
#200	34%

Moisture Density Relationship: (ASTM D698-07) **Method:** A

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.651 **Assumed**

Maximum Density: 116.0

Optimum Moisture: 14.4

Plasticity Index (ASTM D4318-05)

Liquid Limit: 23

Plastic Limit: 19

Plasticity Index: 4

Preperation Method: Dry **Liquid Limit Method:** A

PI Air Dried.

Soil Classification (ASTM D2487-06) SC-SM

Reviewed By: _____
Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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Albuquerque, NM 87113
Tel 5058211801
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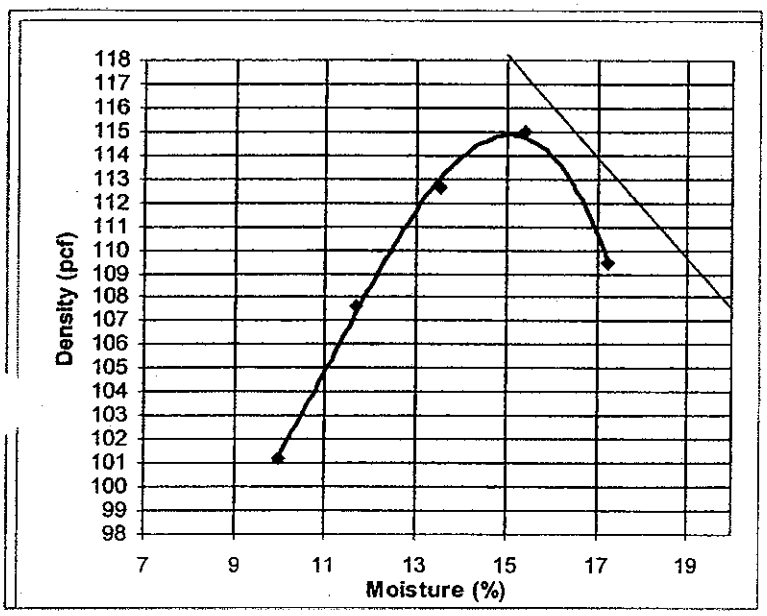
Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-
Attn:	Chris Edgmon
Project Name:	EDI SNL Mixed Waste Landfill Cover ABQ, NM
Project Manager:	Vickie Maranville

Report Date: July 27, 2009

Project #: 9-517-00022D
Work Order #: 22
Lab #: 9-0825-02
Sampled By: Jon Schermerhorn
Date Sampled: 07/23/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL Berm-17

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	98%
3/8in.	98%
#4	97%
#8	94%
#10	93%
#16	91%
#30	89%
#40	87%
#50	85%
#100	74%
#200	34%

Moisture Density Relationship: (ASTM D698-07) Method: A
Preparation Method: Dry Rammer Type: Mechanical
Specific Gravity: 2.651 Assumed
Maximum Density: 114.9
Optimum Moisture: 15.0

Plasticity Index (ASTM D4318-05)

Liquid Limit: 21
Plastic Limit: 19
Plasticity Index: 2

Preperation Method: Dry Liquid Limit Method: A
PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____
Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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Albuquerque, NM 87113
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Fax 5058217371
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'ient: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

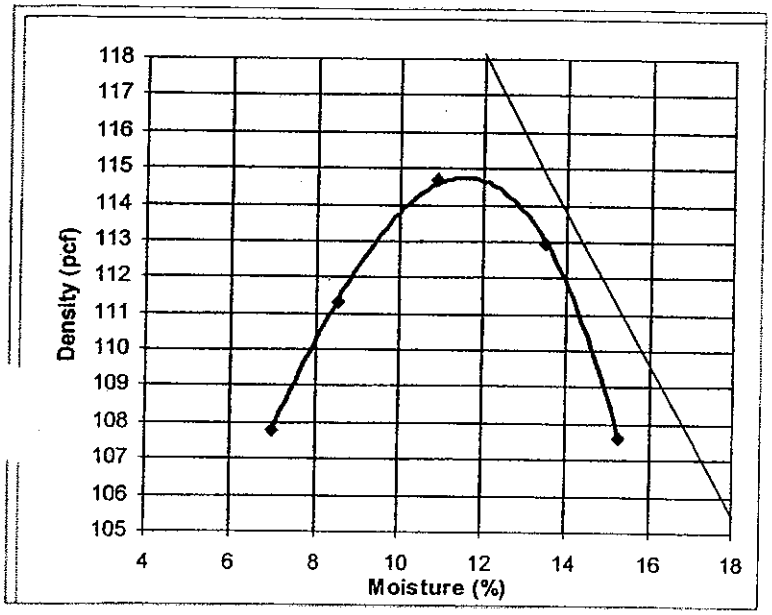
ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 27, 2009

Project #: 9-517-00022D
Work Order #: 22
Lab #: 9-0825-03
Sampled By: Jon Schermerhorn
Date Sampled: 07/23/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL Berm-18

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
1 1/2in.	100%
1in.	98%
3/4in.	97%
1/2in.	95%
3/8in.	94%
#4	93%
#8	91%
#10	91%
#16	89%
#30	87%
#40	86%
#50	84%
#100	72%
#200	26%

Moisture Density Relationship: (ASTM D698-07) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.451 **Assumed**
Maximum Density: 114.7
Optimum Moisture: 11.6

Plasticity Index (ASTM D4318-05)
Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____
Jan

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐

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Albuquerque, NM 87113
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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

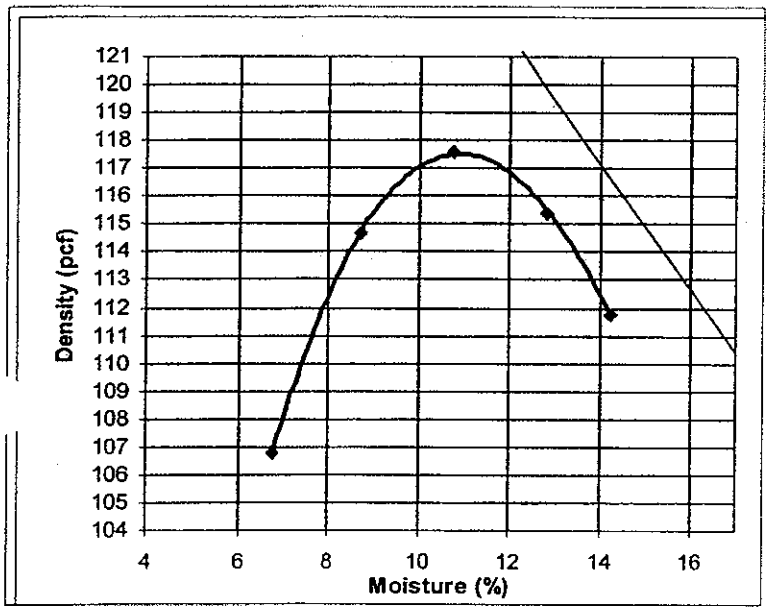
ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 30, 2009

Project #: 9-517-00022D
Work Order #: 22
Lab #: 9-0825-04
Sampled By: Jon Schermerhorn
Date Sampled: 07/23/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL Berm-19

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
1/2in.	100%
3/8in.	100%
#4	99%
#8	98%
#10	97%
#16	96%
#30	94%
#40	92%
#50	91%
#100	80%
#200	34%

Moisture Density Relationship: (ASTM D698-07) **Method:** B
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.551 Assumed
Maximum Density: 117.5
Optimum Moisture: 10.9

Plasticity Index (ASTM D4318-05)
Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____
Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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Albuquerque, NM 87113
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Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:** July 07, 2009	
		Project #: 9-517-00022D	
		Work Order #: 12	
Attn:	Chris Edgmon	**Lab #:** 9-0734-01	
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Sampled By:** Client/C.Timm	
		Date Sampled: 06/02/2009	
	ABQ, NM	**Visual Description of Material:** Silty Sand	
		Sample Source: SNLMWL-060209-4	
Project Manager:	Vickie Maranville	**SOILS / AGGREGATES**	

Moisture Density Relationship: (ASTM D698-07) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.451 **Assumed**
Maximum Density: 118.9
Optimum Moisture: 9.6

Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	100%
3/8in.	100%
#4	99%
#8	98%
#10	98%
#16	96%
#30	93%
#40	92%
#50	90%
#100	77%
#200	32%

MMM 12/21/09

This Gradation test was performed as part of the Standard Proctor test. A separate Gradation test was performed to compare this topsoil material to the CMP specifications. A separate laboratory form is provided and the corresponding Lab Number is 9-0636-04.

Plasticity Index (ASTM D4318-05)

Liquid Limit:	NV
Plastic Limit:	NV
Plasticity Index:	NP

Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____
hg

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

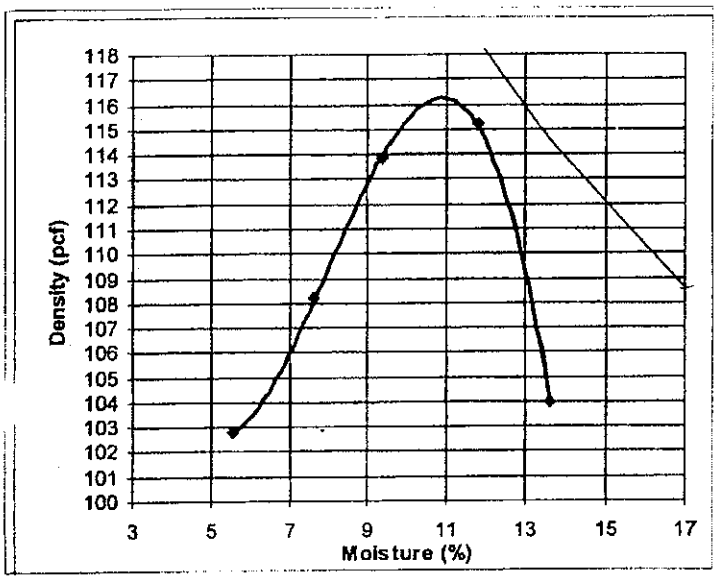
ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 07, 2009

Project #: 9-517-00022D
Work Order #: 12
Lab #: 9-0734-02
Sampled By: Client/C.Timm
Date Sampled: 06/02/2009
Visual Description of Material: Silty Sand
Sample Source: SNLMWL-060209-6

SOILS / AGGREGATES



Moisture Density Relationship: (ASTM D698-07) **Method:** A
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.451 Assumed
Maximum Density: 116.2
Optimum Moisture: 10.9

Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
1/2in.	100%
3/8in.	100%
#4	99%
#8	96%
#10	94%
#16	90%
#30	88%
#40	86%
#50	85%
#100	72%
#200	29%

mmm 12/21/09

This Gradation test was performed as part of the Standard Proctor test. A separate Gradation test was performed to compare this topsoil material to the CMIP specifications. A separate laboratory Rpm is provided and the corresponding Lab Number is 9-0636-06.

Plasticity Index (ASTM D4318-05)
Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP

Preperation Method: Dry Liquid Limit Method: A
PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____
hg

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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

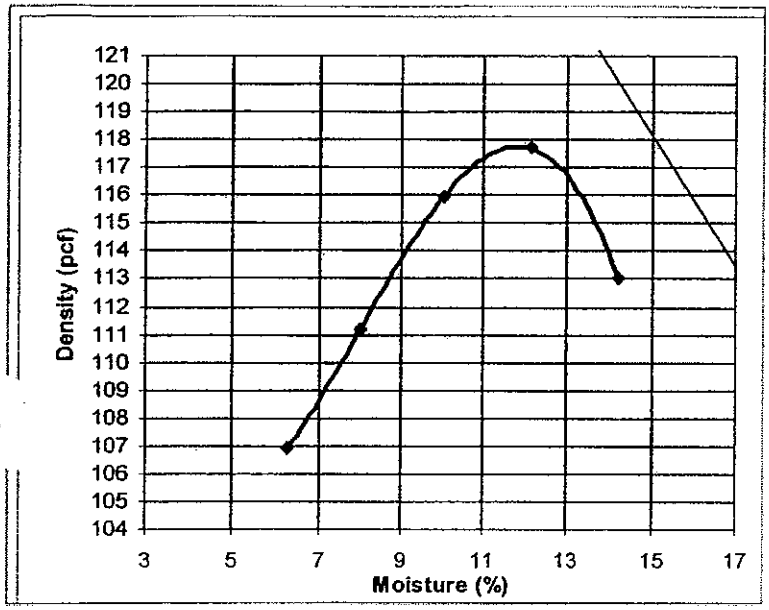
ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 15, 2009

Project #: 9-517-00022D
Work Order #: 17
Lab #: 9-0770-04
Sampled By: Jon Schermerhorn
Date Sampled: 07/10/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL 071009-8

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	99%
3/8in.	99%
#4	98%
#8	96%
#10	95%
#16	93%
#30	91%
#40	89%
#50	87%
#100	70%
#200	21%

Moisture Density Relationship: (ASTM D698-07) Method: B
Preparation Method: Dry Rammer Type: Mechanical
Specific Gravity: 2.651 Assumed
Maximum Density: 117.8
Optimum Moisture: 11.8

Plasticity Index (ASTM D4318-05)
Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP

Preperation Method: Dry Liquid Limit Method: A
PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____
Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
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'ent: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

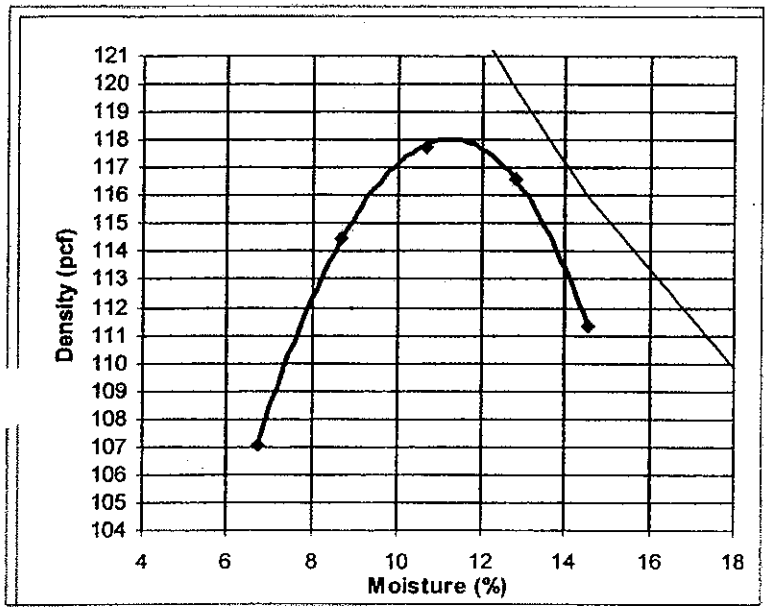
ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 17, 2009

Project #: 9-517-00022D
Work Order #: 18
Lab #: 9-0781-01
Sampled By: Jon Schermerhorn
Date Sampled: 07/14/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL 071409-10

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	99%
3/8in.	99%
#4	97%
#8	96%
#10	95%
#16	93%
#30	91%
#40	89%
#50	87%
#100	74%
#200	31%

Moisture Density Relationship: (ASTM D698-07) Method: B
Preparation Method: Dry Rammer Type: Mechanical
Specific Gravity: 2.551 Assumed
Maximum Density: 118.0
Optimum Moisture: 11.2

Plasticity Index (ASTM D4318-05)
Liquid Limit: 23
Plastic Limit: 21
Plasticity Index: 2
Preperation Method: Dry Liquid Limit Method: A
PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____
hg

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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FISHER INDUSTRIES #2

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Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	Report Date: June 01, 2009 Project #: 9-517-00022D Work Order #: 2	
Attn:	Chris Edgmon	Lab #: 9-0632	
Project Name:	EDI SNL Mixed Waste Landfill Cover	Sampled By: Client	
	ABQ, NM	Date Sampled: Visual Description of Material: 3/8" Aggregate	
Project Manager:	Vickie Maranville	Sample Source: Bar J	

SOILS / AGGREGATES

Type of Specification: Topsoil Layer Fill Specifications for SNL Mixed Waste Landfill Cover

Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing	Specifications Min	Specifications Max
3/4in.	100%		
1/2in.	100%		
3/8in.	93%		
#4	25%	5 *	
#8	2%		
#10	1%		
#16	1%		
#30	1%		
#40	1%		
#50	1%		
#100	1%		
#200	0.7%		

These results represent the 3/8-inch crushed gravel used in the Topsoil Layer (mixed with topsoil at 25% by volume ratio). Sample date was not specified, but within several days of the report date (i.e., ~~within~~ June 1, 2009).

MMM
12/21/09

* Material did not fall within specified tolerances.

Reviewed By: _____
hg

Distribution: Client ✔ File: ✔ Supplier: ✔ Other: Addressee (2)
Email:

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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attention: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 03, 2009

Project #: 9-517-00022D
Work Order #: 3
Sampled By: Client/C.Timm
Date Sampled: 06/02/2009

Sieve Analaysis (ASTM C117-04/C136-06)
Plasticity Index (ASTM D4318-05)
Soil Classification (ASTM D2487-06)

SOILS / AGGREGATES

Sample Location	Soil Class.	L.L.	P.I.	#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	6"	12"	Lab Number
SNLMWL-060209-1	SM	NV	NP	32	77	90	92	93	96	98	98	99		100											9-0636-01
SNLMWL-060209-2	SM	NV	NP	29	72	85	86	88	90	94	96	99		100											9-0636-02
SNLMWL-060209-3	SM	NV	NP	33	78	91	93	95	97	98	98	99		100											9-0636-03
SNLMWL-060209-4	SM	NV	NP	30	75	89	91	93	96	98	98	99		100											9-0636-04
SNLMWL-060209-5	SM	NV	NP	30	75	88	90	91	94	97	97	99		100											9-0636-05
SNLMWL-060209-6	SM	NV	NP	31	73	88	90	92	95	96	97	99		99	100										9-0636-06

Reviewed By:_____

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attention: Chris Edgmon
Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 03, 2009

Project #: 9-517-00022D
Work Order #: 3
Sampled By: Client/C.Timm
Date Sampled: 06/02/2009

Sieve Analaysis (ASTM C117-04/C136-06)
Plasticity Index (ASTM D4318-05)
Soil Classification (ASTM D2487-06)

SOILS / AGGREGATES

Lab Number	Sample Location	Soil Class.	L.L.	P.I.	D10	D30	D60	CC	CU
9-0636-01	SNLMWL-060209-1	SM	NV	NP	0	0	0.114	0	0
9-0636-02	SNLMWL-060209-2	SM	NV	NP	0	0.074	0.122	0	0
9-0636-03	SNLMWL-060209-3	SM	NV	NP	0	0	0.113	0	0
9-0636-04	SNLMWL-060209-4	SM	NV	NP	0	0.074	0.118	0	0
9-0636-05	SNLMWL-060209-5	SM	NV	NP	0	0	0.118	0	0
9-0636-06	SNLMWL-060209-6	SM	NV	NP	0	0	0.119	0	0

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
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Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:**	July 15, 2009
		Project #:	9-517-00022D
		Work Order #:	17
Attn:	Chris Edgmon	**Lab #:**	9-0770-03
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Sampled By:**	Jon Schermerhorn
		Date Sampled:	07/10/2009
	ABQ, NM	**Visual Description of Material:**	Brown Silty Sand
		Sample Source:	SNL MWL 071009-7
Project Manager:	Vickie Maranville	**SOILS / AGGREGATES**	

Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/8in.	100%
#4	99%
#8	98%
#10	97%
#16	97%
#30	94%
#40	92%
#50	90%
#100	77%
#200	27%

Plasticity Index (ASTM D4318-05)

Preperation Method: Dry

Liquid Limit Method: A

Soil Classification (ASTM D2487-06) SM

Liquid Limit: NV

Plastic Limit: NV

Plasticity Index: NP

PI Sample Was Air Dried.

Reviewed By: _____
Jan

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐

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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

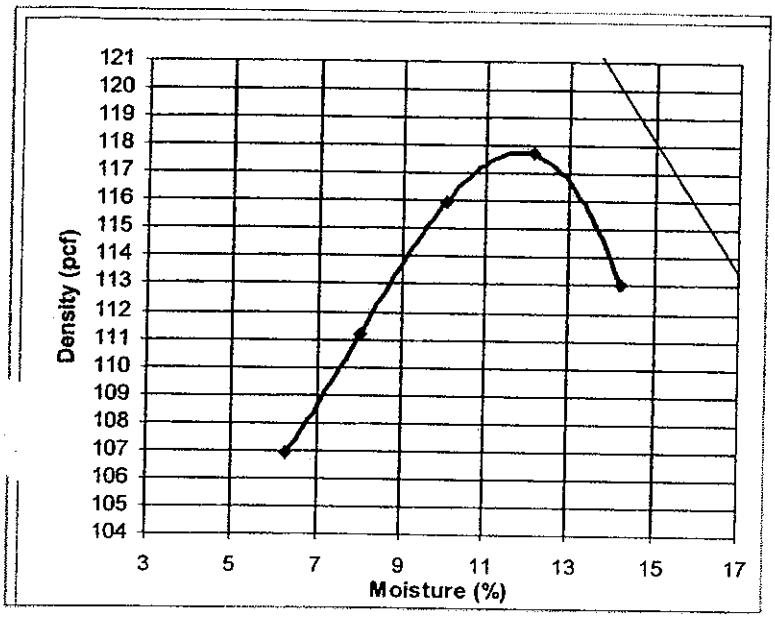
ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 15, 2009

Project #: 9-517-00022D
Work Order #: 17
Lab #: 9-0770-04
Sampled By: Jon Schermerhorn
Date Sampled: 07/10/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL 071009-8

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	99%
3/8in.	99%
#4	98%
#8	96%
#10	95%
#16	93%
#30	91%
#40	89%
#50	87%
#100	70%
#200	21%

Moisture Density Relationship: (ASTM D698-07) **Method:** B
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.651 **Assumed**
Maximum Density: 117.8
Optimum Moisture: 11.8

Plasticity Index (ASTM D4318-05)
Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____
Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
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Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:** July 15, 2009	
Attn:	Chris Edgmon	**Project #:** 9-517-00022D **Work Order #:** 17 **Lab #:** 9-0770-05	
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Sampled By:** Jon Schermerhorn **Date Sampled:** 07/10/2009	
	ABQ, NM	**Visual Description of Material:** Brown Silty Sand	
Project Manager:	Vickie Maranville	**Sample Source:** SNL MWL 071009-9	

SOILS / AGGREGATES

Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	100%
3/8in.	99%
#4	98%
#8	96%
#10	96%
#16	94%
#30	91%
#40	90%
#50	87%
#100	73%
#200	26%

Plasticity Index (ASTM D4318-05)

Preperation Method: Dry
Liquid Limit Method: A
Soil Classification (ASTM D2487-06) SM

Liquid Limit: NV
Plastic Limit: NV
Plasticity Index: NP

PI Sample Was Air Dried.

Reviewed By: _____
jan

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
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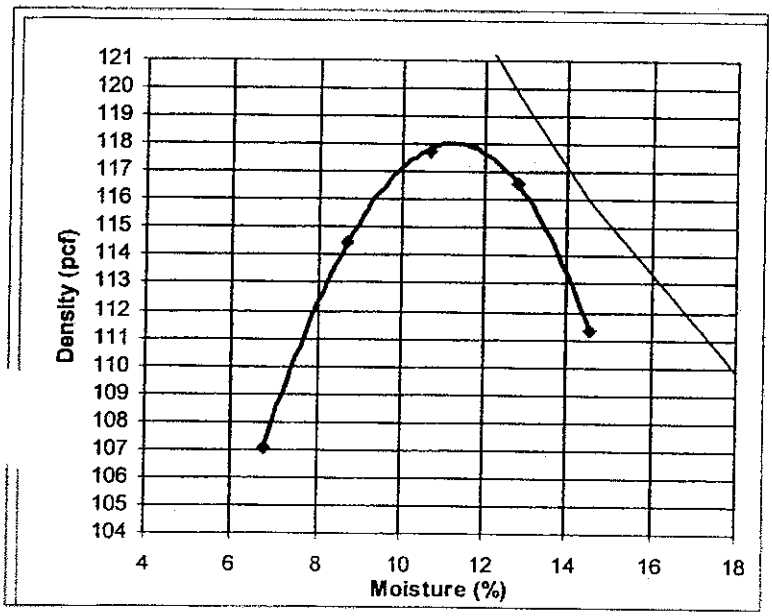
'ient:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-
Attn:	Chris Edgmon
Project Name:	EDI SNL Mixed Waste Landfill Cover
	ABQ, NM
Project Manager:	Vickie Maranville

Report Date: July 17, 2009

Project #: 9-517-00022D
Work Order #: 18
Lab #: 9-0781-01
Sampled By: Jon Schermerhorn
Date Sampled: 07/14/2009
Visual Description of Material: Brown Silty Sand
Sample Source: SNL MWL 071409-10

SOILS / AGGREGATES



Sieve Analysis (ASTM C117-04/C136-06)
200 Wash Procedure: A

Sieve Size	Passing
3/4in.	100%
1/2in.	99%
3/8in.	99%
#4	97%
#8	96%
#10	95%
#16	93%
#30	91%
#40	89%
#50	87%
#100	74%
#200	31%

Moisture Density Relationship: (ASTM D698-07) **Method:** B
Preparation Method: Dry **Rammer Type:** Mechanical
Specific Gravity: 2.551 Assumed
Maximum Density: 118.0
Optimum Moisture: 11.2

Plasticity Index (ASTM D4318-05)
Liquid Limit: 23
Plastic Limit: 21
Plasticity Index: 2
Preperation Method: Dry **Liquid Limit Method:** A
PI Air Dried.

Soil Classification (ASTM D2487-06) SM

Reviewed By: _____
hg

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐

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Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	Report Date:	July 27, 2009
		Project #:	9-517-00022D
		Work Order #:	20
Attn:	Chris Edgmon	Lab #:	9-0805-01
Project Name:	EDI SNL Mixed Waste Landfill Cover	Sampled By:	Jon Schermerhorn
		Date Sampled:	07/16/2009
	ABQ, NM	Visual Description of Material:	Brown Silty Sand
		Sample Source:	SNL MWL 071609-11
Project Manager:	Vickie Maranville	SOILS / AGGREGATES	

Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/8in.	100%
#4	100%
#8	99%
#10	98%
#16	97%
#30	95%
#40	94%
#50	89%
#100	80%
#200	36%

Plasticity Index (ASTM D4318-05)

Preperation Method: Dry

Liquid Limit Method: A

Soil Classification (ASTM D2487-06) SC-SM

Liquid Limit:	24
Plastic Limit:	18
Plasticity Index:	6

PI Sample Was Air Dried.

Reviewed By: _____
Jan

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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Client:	Environmental Dimentions Inc 1901 Candelaria Rd NW ABQ, NM 87107-	**Report Date:** July 27, 2009	
Attn:	Chris Edgmon	**Project #:** 9-517-00022D **Work Order #:** 22 **Lab #:** 9-0825-01	
Project Name:	EDI SNL Mixed Waste Landfill Cover	**Sampled By:** Jon Schermerhorn **Date Sampled:** 07/23/2009	
	ABQ, NM	**Visual Description of Material:** Brown Silty Sand	
Project Manager:	Vickie Maranville	**Sample Source:** SNL MWL 071609-12	

SOILS / AGGREGATES

Sieve Analysis (ASTM C117-04/C136-06)

200 Wash Procedure: A

Sieve Size	Passing
3/8in.	100%
#4	98%
#8	97%
#10	96%
#16	94%
#30	92%
#40	90%
#50	88%
#100	76%
#200	29%

Plasticity Index (ASTM D4318-05)

Preperation Method: Dry
Liquid Limit Method: A
Soil Classification (ASTM D2487-06) SM

Liquid Limit: 22
Plastic Limit: 20
Plasticity Index: 2

PI Sample Was Air Dried.

Reviewed By: _____
Jan

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐

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2009 Density and Moisture Tests

2009 CQC Density and Moisture Tests

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: May 29, 2009
Amended Date: December 22, 2009
Project #: 9-517-00022D
Report #: 22359
Tested By: Miguel Chavez
Date Tested: 5/22/2009
Visual Description of Material: Landfill Cover

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1811	120.1	11.6	ASTM D698-07 / a	Light Red Sandy

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	Gridline #5	FSG	D	6	11.6	2	2	131.6	117.9	120.1	98	90	
02-1	Gridline #9	FSG	D	6	9.7	2	2	128.9	117.5	120.1	98	90	
03-1	Gridline #12	FSG	D	6	10.2	2	2	128.0	116.1	120.1	97	90	
04-1	Gridline #11	FSG	D	6	9.8	2	2	131.5	119.1	120.1	99	90	
05-1	Gridline #8	FSG	D	6	11.5	2	2	131.6	118.0	120.1	98	90	
06-1	Gridline #3	FSG	D	6	9.8	2	2	132.9	121.0	120.1	100+	90	
07-1	Gridline #2	FSG	D	6	9.8	2	2	131.5	119.1	120.1	99	90	
08-1	Gridline #7	FSG	D	6	10.2	2	2	132.0	119.8	120.1	100	90	
09-1	Gridline #6	FSG	D	6	10.5	2	2	130.6	118.1	120.1	98	90	
10-1	Gridline #1	FSG	D	6	11.4	2	2	129.5	116.3	120.1	97	90	
11-1	Gridline #4	FSG	D	6	9.9	2	2	132.9	120.9	120.1	100+	90	
12-1	Gridline #10	FSG	D	6	11.6	2	2	129.2	115.8	120.1	96	90	
13-1	Gridline #13	FSG	D	6	10.2	2	2	129.9	117.8	120.1	98	90	

Remarks: Revised.

Reviewed By: _____
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

AMEC Earth Environmental, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 22, 2009
Amended Date: December 22, 2009
Project #: 9-517-00022D
Report #: 22550
Tested By: Miguel Chavez
Date Tested: 6/18/2009
Visual Description of Material: Landfill Cover

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1811	120.1	11.6	ASTM D698-07 / a	Light Red Sandy

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	1453140.678/411700.30, Edi North Slope Lift 6	5380.11	D	6	11.1	2	2	131.9	118.7	120.1	99	90	
02-1	1453140.678/411700.30, Edi North Slope Lift 5	5380.11	D	12	11.8	2	2	129.8	116.0	120.1	97	90	
03-1	1452871.387/411839.40, Edi Dog Leg Lift 2	5385.25	D	6	11.1	2	2	129.0	116.1	120.1	97	90	
04-1	1452871.387/411839.40, Edi Dpg Leg Lift 1	5385.25	D	12	11.9	2	2	129.8	115.9	120.1	97	90	
05-1	1452720.29/411575.421, Edi West Slope Lift 6	5379.98	D	6	11.9	2	2	131.2	117.2	120.1	98	90	
06-1	1452720.29/411575.421, Edi West Slope Lift 5	5379.48	D	12	11.3	2	2	130.0	116.8	120.1	97	90	
07-1	1453118.61/411913.206, Edi East Slope Lift 6	5384.43	D	6	11.7	2	2	132.3	118.4	120.1	99	90	
08-1	1453118.61/411913.206, Edi East Slope Lift 5	5383.93	D	12	11.3	2	2	128.2	115.1	120.1	96	90	

Remarks: Revised.

Reviewed By: _____
jdr

Distribution: **Client:** ☑ **File:** ☑ **Supplier:** ☑ **Other:** Addressee (2)
Email: ☐

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

AMEC Earth Environmental, Inc.
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Fax 5058217371
www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 22, 2009

Project #: 9-517-00022D
Report #: 22551
Tested By: Miguel Chavez
Date Tested: 6/19/2009
Visual Description of Material: Mixed Waste Landfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GUAGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1811	120.1	11.6	ASTM D698-07 / a	Light Red Sandy
9-0629-04	115.8	12.3	ASTM D698-07 / A	Clayey Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	1452857.354/411788.535, EDi Wedge Lift 1-GB #7	5386.27	D	4	11.1	2	2	127.8	115.0	120.1	96	90	
02-1	1452939.658/411787.773, EDi Wedge Lift 1-GB #8	5386.75	D	4	12.4	2	2	125.9	112.0	115.8	97	90	
03-1	1452937.721/411879.78, EDi Wedge Lift 1-GB #11	5388.28	D	4	12.2	2	2	123.2	109.1	115.8	94	90	

Reviewed By: _____
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

AMEC Earth .Environmental, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
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Fax 5058217371
www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 23, 2009
Amended Date: December 22, 2009
Project #: 9-517-00022D
Report #: 22565
Tested By: Miguel Chavez
Date Tested: 6/17/2009
Visual Description of Material: Landfill Cover

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1811	120.1	11.6	ASTM D698-07 / a	Light Red Sandy

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	1452921.699/411914.751, Edi East Slope Lift 4	5386.69	D	6	11.3	2	2	130.9	117.6	120.1	98	90	
02-1	1452921.699/411914.751, Edi East Slope Lift 3	5386.69	D	12	12.2	2	2	131.2	116.9	120.1	97	90	
03-1	1452823.77/411579.7, Edi West Slope Lift 4	5380.63	D	6	11.1	2	2	129.9	116.9	120.1	97	90	
04-1	1452823.77/411579.7, Edi West Slope Lift 3	5380.63	D	12	11.1	2	2	127.7	114.9	120.1	96	90	
05-1	1453138.757/411644.75, Edi North Slope Lift 4	5378.58	D	6	12.7	2	2	128.0	113.5	120.1	95	90	
06-1	1453138.757/411644.75, Edi North Slope Lift 3	5378.58	D	12	11.8	2	2	129.9	116.1	120.1	97	90	

Remarks: Revised.

Reviewed By: _____
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

AMEC Earth .Environmental, Inc.
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www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 23, 2009

Project #: 9-517-00022D
Report #: 22572
Tested By: Miguel Chavez
Date Tested: 6/19/2009
Visual Description of Material: Landfill Cover

FIELD DENSITY TEST USING NUCLEAR DENSITY GUAGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-04	115.8	12.3	ASTM D698-07 / A	Clayey Silty Sand

Nuclear Density Gauge
Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Com-paction	% Com-paction Required Min	% Com-paction Required Max
01-1	1452928.831/411861.929, Edi Wedge Lift 2 GB #11	5388.23	D	6	11.5	2	2	123.6	110.9	115.8	96	90	
02-1	1452884.006/411800.636, Edi Wedge Lift 2 GB #7	5386.71	D	6	11.7	2	2	125.9	112.7	115.8	97	90	
03-1	1452930.863/411786.160, Edi Wedge Lift 2 GB #8	5386.69	D	6	10.6	2	2	122.5	110.8	115.8	96	90	
04-1	1453129.332/411778.762, Edi North Slope Lift 8	5382.30	D	6	14.2	2	2	122.8	107.6	115.8	93	90	
05-1	1453129.332/411778.762, Edi North Slope Lift 7	5382.30	D	12	14.3	2	2	123.7	108.0	115.8	93	90	

Reviewed By: _____
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 23, 2009
Amended Date: December 22, 2009
Project #: 9-517-00022D
Report #: 22575
Tested By: Miguel Chavez
Date Tested: 6/17/2009
Visual Description of Material: Landfill Cover

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1811	120.1	11.6	ASTM D698-07 / a	Light Red Sandy

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	1453138.995/411843.859, Edi North Slope Lift 2	5381.41	D	6	10.8	2	2	131.8	118.9	120.1	99	90	
02-1	1453138.995/411843.859, Edi North Slope Lift 1	5381.41	D	12	11.2	2	2	129.9	116.8	120.1	97	90	
03-1	1453029.223/411915.938, Edi East Slope Lift 2	5384.52	D	6	11.2	2	2	129.0	116.0	120.1	97	90	
04-1	1453029.223/411915.938, Edi East Slope Lift 1	5384.52	D	12	11.0	2	2	128.9	116.1	120.1	97	90	
05-1	1452969.883/411578.344, Edi West Slope Lift 2	5379.90	D	6	11.8	2	2	131.0	117.1	120.1	98	90	
06-1	1452969.883/411578.344, Edi West Slope Lift 1	5379.90	D	12	11.7	2	2	128.5	115.0	120.1	96	90	

Remarks: Revised.

Reviewed By: _____
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

AMEC Earth Environmental, Inc.
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Fax 5058217371
www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 25, 2009
Amended Date: December 22, 2009
Project #: 9-517-00022D
Report #: 22590
Tested By: Miguel Chavez
Date Tested: 6/24/2009
Visual Description of Material: Landfill Cover

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	1452988.634/411737.606, Edi Lift #3, GB 8	5385.54	D	2	10.9	2	2	122.7	110.7	117.0	95	90	
02-1	1452693.015/411774.812, Edi Lift #3, GB 6	5385.27	D	2	11.6	2	2	126.5	113.4	117.0	97	90	

Remarks: Revised.

Reviewed By: _____
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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Test Mode = D for Direct Transmission and B for Backscatter Modes

AMEC Earth Environmental, Inc.
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Tel 5058211801
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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 25, 2009

Project #: 9-517-00022D
Report #: 22591
Tested By: Miguel Chavez
Date Tested: 6/23/2009
Visual Description of Material: Landfill Cover

FIELD DENSITY TEST USING NUCLEAR DENSITY GUAGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-04	115.8	12.3	ASTM D698-07 / A	Clayey Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture			Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required	
					Actual	Required (-)	Required (+)					Min	Max
01-1	1452875.793/411617.388, Edi NS Lift #3, GB 2	5383.35	D	2	10.3	2	2	129.8	117.9	115.8	100+	90	
02-1	1452775.977/411630.181, Edi NS Lift #3 GB #1	5383.15	D	2	10.7	2	2	131.9	119.2	115.8	100+	90	

Reviewed By: _____
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
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AMEC Earth Environmental, Inc.
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Albuquerque, NM 87113
Tel 5058211801
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www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: June 30, 2009

Project #: 9-517-00022D
Report #: 22688
Tested By: Miguel Chavez
Date Tested: 6/26/2009
Visual Description of Material: Landfill Cover

FIELD DENSITY TEST USING NUCLEAR DENSITY GUAGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	1452902.581/411891.485 Edi NS Lift 3, GB 11 SE	5388.43	D	2	11.4	2	2	128.7	115.6	117.0	99	90	
02-1	1452984.795/411896.276 Edi NS Lift 3 GB 11 NE	5388.55	D	2	12.4	2	2	119.9	106.6	117.0	91	90	
03-1	1452717.578/411628.846 Edi NS Lift 4 GB 1	5383.09	D	4	13.8	2	2	135.7	119.4	117.0	100+	90	
04-1	1452835.983/411659.565 Edi NS Lift 4 GB 2	5384.16	D	4	11.6	2	2	127.9	114.5	117.0	98	90	
05-1	1452941.727/411653.987 Edi NS Lift 4 GB 3	5384.26	D	4	13.8	2	2	124.6	109.5	117.0	94	90	
06-1	1453050.698/411638.477 Edi NS Lift 4 GB 4	5382.93	D	4	12.4	2	2	127.3	113.3	117.0	97	90	
07-1	1453125.331/411628.696 Edi NS Lift 4 GB 5	5380.69	D	4	12.9	2	2	127.6	113.0	117.0	97	90	
08-1	1453114.596/411738.755 Edi NS Lift 4 GB 10	5383.31	D	4	12.0	2	2	127.5	113.9	117.0	97	90	
09-1	1453049.705/411727.447 Edi NS Lift 4 GB 9	5384.54	D	4	12.0	2	2	131.7	117.7	117.0	100+	90	
10-1	1452956.112/411746.608 Edi NS Lift 4 GB 8	5385.93	D	4	12.7	2	2	135.4	117.1	117.0	100	90	
11-1	1452844.073/411750.636 Edi NS Lift 4 GB 7	5385.90	D	4	11.6	2	2	130.0	116.4	117.0	99	90	
12-1	1452717.204/411751.361 Edi NS Lift 4 GB 6	5385.40	D	4	13.5	2	2	133.3	117.4	117.0	100	90	

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Test Mode = D for Direct Transmission and B for Backscatter Modes

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Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Com-paction	% Com-paction Required Min	% Com-paction Required Max

Reviewed By: _____
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep

Test Mode = D for Direct Transmission and B for Backscatter Modes

AMEC Earth Environmental, Inc.
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Albuquerque, NM 87113
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www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 02, 2009

Project #: 9-517-00022D
Report #: 22709
Tested By: Miguel Chavez
Date Tested: 6/29/2009
Visual Description of Material: Land Fill

FIELD DENSITY TEST USING NUCLEAR DENSITY GUAGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	1453087.931/411883.297, Edi NS Lift 4 GB 13	5386.64	D	4	10.9	2	2	126.2	113.8	117.0	97	90	
02-1	1453011.692/411829.950, Edi NS Lift 4 GB 12	5387.18	D	4	13.1	2	2	127.3	112.2	117.0	96	90	
03-1	1452942.355/411842.351, Edi NS Lift 4 GB 11	5387.98	D	4	10.1	2	2	125.7	114.1	117.0	98	90	

Reviewed By: _____
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

AMEC Earth Environmental, Inc.
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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Report Date: July 02, 2009

Project #: 9-517-00022D
Report #: 22710
Tested By: Miguel Chavez
Date Tested: 07/01/2009
Visual Description of Material: Land Fill

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

FIELD DENSITY TEST USING NUCLEAR DENSITY GUAGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max	
01-1	1453089.584/411865.806, Edi NS Lift 5 GB 13	5386.736	D	4	12.1	2	2	124.7	111.3	117.0	95	90		
02-1	1453005.708/411862.029, Edi NS Lift 5 GB 12	5388.433	D	4	11.5	2	2	125.8	112.8	117.0	96	90		
03-1	1452928.388/411870.284, Edi NS Lift 5 GB 11	5389.165	D	4	10.2	2	2	117.3	106.5	117.0	91	90		
04-1	1452764.037/411801.181, Edi NS Lift 5 GB 7 East Edge ~~(Retest) 2~~	5387.15	D	4	7.1	2	2	111.9	104.5	117.0	89	90		*
05-1	1452764.037/411801.181, Edi NS Lift 5 GB 7 East Edge (Retest of #04-1, Dated Today 7/1/09)	5387.15	D	4	10.3	2	2	123.7	112.1	117.0	96	90		

Reviewed By: _____
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep

Test Mode = D for Direct Transmission and B for Backscatter Modes

*** Material did not fall within specified tolerances.**

AMEC Earth Environmental, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 06, 2009

Project #: 9-517-00022D
Report #: 22744
Tested By: Miguel Chavez
Date Tested: 7/2/2009
Visual Description of Landfill Material:

FIELD DENSITY TEST USING NUCLEAR DENSITY GUAGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	1453098.80/411772.287, Edi NS Lift 5, GB 10	5385.18	D	4	11.1	2	2	122.5	110.2	117.0	94	90	
02-1	1453031.124/411773.428, Edi NS Lift 5, GB 9	5386.58	D	4	11.9	2	2	127.9	114.3	117.0	98	90	
03-1	1452934.646/411771.944, Edi NS Lift 5, GB 8	5387.385	D	4	10.8	2	2	125.2	113.1	117.0	97	90	
04-1	1452836.872/411776.795, Edi NS Lift 5, GB 7	5387.113	D	4	13.6	2	2	128.3	112.9	117.0	96	90	
05-1	1452711.127/411778.989, Edi NS Lift 5, GB 6	5386.501	D	4	13.4	2	2	133.8	118.0	117.0	100+	90	

Reviewed By: jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

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www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 10, 2009

Project #: 9-517-00022D
Report #: 22811
Tested By: Miguel Chavez
Date Tested: 7/7/2009
Visual Description of Material: Landfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GUAGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max	
01-1	1453106.816/411648.065, Edi NS, Lift 5, GB 5	5382.41	D	4	6.9	2	2	110.9	103.7	117.0	89	90		*
02-1	1453017.754/411680.674, Edi NS, Lift 5, GB 4	5384.76	D	4	11.9	2	2	123.8	110.6	117.0	95	90		
03-1	1452890.528/411651.069, Edi NS, Lift 5, GB 3	5384.58	D	4	12.2	2	2	117.0	104.3	117.0	89	90		*
04-1	1452807.640/411639.611, Edi NS, Lift 5, GB 2	5384.22	D	4	6.8	2	2	113.3	106.1	117.0	91	90		*
05-1	1452703.661/411666.680, Edi NS, Lift 5, GB 1	5384.08	D	4	12.3	2	2	123.6	110.1	117.0	94	90		

Reviewed By:
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep

Test Mode = D for Direct Transmission and B for Backscatter Modes

*** Material did not fall within specified tolerances.**

AMEC Earth Environmental, Inc.
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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 10, 2009

Project #: 9-517-00022D
Report #: 22812
Tested By: Miguel Chavez
Date Tested: 07/09/2009
Visual Description of Landfill Material:

FIELD DENSITY TEST USING NUCLEAR DENSITY GUAGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	1453106.816/411648.065, Edi NS, Lift 5, GB 5 (Retest of #01-1, Dated 7/7/09)	5382.41	D	4	13.5	2	2	131.5	115.9	117.0	99	90	
02-1	1453017.754/411680.674, Edi NS, Lift 5, GB 4 (Retest)	5384.76	D	4	12.1	2	2	132.3	118.0	117.0	100+	90	
03-1	1452890.528/411651.069, Edi NS, Lift 5, GB 3 (Retest of #03-1, Dated 7/7/09)	5384.58	D	4	12.2	2	2	118.2	115.4	117.0	99	90	
04-1	1452807.640/411639.611, Edi NS, Lift 5, GB 2 (Retest of #04-1, Dated 7/7/09)	5384.22	D	4	10.5	2	2	129.0	116.7	117.0	100	90	
05-1	1452703.661/411666.680, Edi NS, Lift 5, GB 1 (Retest)	5384.08	D	4	10.9	2	2	123.7	111.6	117.0	95	90	

Reviewed By: _____
jdr

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Email: ☐

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Test Mode = D for Direct Transmission and B for Backscatter Modes

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Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 16, 2009

Project #: 9-517-00022D
Report #: 22864
Tested By: Miguel Chavez
Date Tested: 7/14/2009
Visual Description of Material: Landfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GUAGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	1453102.8/411858.290, Edi NS, Lift 6, GB 13	5387.02	D	4	13.2	2	2	130.7	115.5	117.0	99	90	
02-1	1453014.835/411888.254, Edi NS, Lift 6, GB 12	5389.19	D	4	12.7	2	2	130.6	115.5	117.0	99	90	
03-1	1452927.72/411807.645, Edi NS, Lift 6, GB 11	5388.36	D	4	10.9	2	2	128.0	115.5	117.0	99	90	

Reviewed By: _____
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

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Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 22, 2009

Project #: 9-517-00022D
Report #: 22899
Tested By: Miguel Chavez
Date Tested: 7/17/2009
Visual Description of Material: Landfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GUAGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max	
01-1	1452727.365/411659.073, Edi, NS, Lift 6, GB 10	5384.73	D	4	10.5	2	2	130.8	118.4	117.0	100+	90		
02-1	1452827.740/411597.936, Edi, NS, Lift 6, MW 4	5383.85	D	4	9.6	2	2	120.5	109.9	117.0	94	90		*
03-1	1452909.633/411610.716, Edi, NS, Lift 6, GB 8	5384.37	D	4	11.6	2	2	132.2	118.5	117.0	100+	90		
04-1	1452994.019/411636.632, Edi, NS, Lift 6, GB 7	5384.62	D	4	10.0	2	2	117.1	106.5	117.0	91	90		
05-1	1453106.027/411597.539, Edi, NS, Lift 6, GB 6	5382.05	D	4	10.7	2	2	121.7	110.0	117.0	94	90		
06-1	1452766.080/411748.630, Edi, NS, Lift 6, GB 1	5386.65	D	4	14.0	2	2	129.7	113.8	117.0	97	90		
07-1	1452874.222/411765.722, Edi, NS, Lift 6, GB 2	5387.35	D	4	14.0	2	2	128.4	112.2	117.0	96	90		
08-1	1452983.309/411717.119, Edi, NS, Lift 6, GB 3	5386.47	D	4	10.2	2	2	127.3	115.5	117.0	99	90		
09-1	1453020.845/411720.980, Edi, NS, Lift 6, GB 4	5386.19	D	4	10.1	2	2	121.3	110.2	117.0	94	90		
10-1	1453119.012/411768.980, Edi, NS, Lift 6, GB 5	5384.68	D	4	12.5	2	2	130.5	116.0	117.0	99	90		
11-1	1453020.845/411720.980, Edi, NS, Lift 6, GB 9	5386.19	D	4	12.4	2	2	131.4	117.0	117.0	100	90		

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep

Test Mode = D for Direct Transmission and B for Backscatter Modes

*** Material did not fall within specified tolerances.**

AMEC Earth Environmental, Inc.
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Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
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Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max

Reviewed By: jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep

Test Mode = D for Direct Transmission and B for Backscatter Modes

*** Material did not fall within specified tolerances.**

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www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Report Date: July 22, 2009

Project #: 9-517-00022D
Report #: 22900
Tested By: Teri Godinez
Date Tested: 7/21/2009
Visual Description of Landfill Material:

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

FIELD DENSITY TEST USING NUCLEAR DENSITY GUAGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	1453072.143/411748.214, Edi, NS, Lift 6, MW 4 (Retest of #02-1, Dated 7/17/09)	5385.71	D	4	10.3	2	2	118.0	107.0	117.0	91	90	

Reviewed By: jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

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Fax 5058217371
www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 22, 2009

Project #: 9-517-00022D
Report #: 22901
Tested By: Teri Godinez
Date Tested: 7/21/2009
Visual Description of Material: Landfill

FIELD DENSITY TEST USING NUCLEAR DENSITY GUAGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	1452921.950/411855.364, Edi, NS, Lift 7, GB 11	5389.83	D	4	11.9	2	2	129.7	115.9	117.0	99	90	
02-1	1452987.568/411813.348, Edi, NS, Lift 7, GB 12	5388.46	D	4	13.8	2	2	126.2	110.9	117.0	95	90	
03-1	1453110.586/411868.463, Edi, NS, Lift 7, GB 13	5387.18	D	4	11.2	2	2	128.8	115.8	117.0	99	90	
04-1	1453094.991/411768.119, Edi, NS, Lift 7, GB 10	5385.87	D	4	12.6	2	2	132.0	117.2	117.0	100	90	
05-1	1452987.308/411767.206, Edi, NS, Lift 7, GB 9	5387.79	D	4	12.4	2	2	132.2	117.6	117.0	100+	90	
06-1	1452932.077/411730.179, Edi, NS, Lift 7, GB 8	5387.26	D	4	11.0	2	2	125.0	112.6	117.0	96	90	
07-1	1452835.121/411768.504, Edi, NS, Lift 7, GB 7	5387.65	D	4	12.2	2	2	133.0	118.5	117.0	100+	90	
08-1	1452731.647/411796.384, Edi, NS, Lift 7, GB 6	5387.77	D	4	10.6	2	2	131.5	118.9	117.0	100+	90	

Reviewed By: _____
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep

Test Mode = D for Direct Transmission and B for Backscatter Modes

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Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 22, 2009

Project #: 9-517-00022D
Report #: 22906
Tested By: Teri Godinez
Date Tested: 7/22/2009
Visual Description of Material: Landfill Cap

FIELD DENSITY TEST USING NUCLEAR DENSITY GUAGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	1452729.290/411635.888, Edi, NS, Lift 7, GB 1	5384.83	D	4	13.7	2	2	125.1	110.0	117.0	94	90	
02-1	1452807.176/411643.682, Edi, NS, Lift 7, GB 2	5385.21	D	4	13.6	2	2	127.6	112.4	117.0	96	90	
03-1	1452897.243/411705.048, Edi, NS, Lift 7, GB 3	5386.73	D	4	11.4	2	2	122.9	110.3	117.0	94	90	
04-1	1453015.327/411640.438, Edi, NS, Lift 7, GB 4	5384.72	D	4	13.0	2	2	124.8	110.4	117.0	94	90	
05-1	1453116.685/411630.254, Edi, NS, Lift 7, GB 5	5382.44	D	4	11.8	2	2	124.5	111.3	117.0	95	90	

Reviewed By: _____
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

AMEC Earth Environmental, Inc.
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Tel 5058211801
Fax 5058217371
www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 28, 2009

Project #: 9-517-00022D
Report #: 22977
Tested By: Teri Godinez
Date Tested: 7/24/2009
Visual Description of Material: Landfill Cap

FIELD DENSITY TEST USING NUCLEAR DENSITY GUAGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	N1453086.146, E411838.368, Edi, NS, Lift 8, GB 13	5388.09	D	4	10.9	2	2	133.6	120.5	117.0	100+	90	
02-1	N1452997.104, E411841.058, Edi, NS, Lift 8, GB 12	5389.51	D	4	11.9	2	2	131.7	117.7	117.0	100+	90	
03-1	N1452957.031, E411862.485, Edi, NS, Lift 8, GB 11	5390.46	D	4	10.5	2	2	131.3	118.9	117.0	100+	90	

Reviewed By: jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☒

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep

Test Mode = D for Direct Transmission and B for Backscatter Modes

AMEC Earth Environmental, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: July 29, 2009

Project #: 9-517-00022D
Report #: 23040
Tested By: Teri Godinez
Date Tested: 7/28/2009
Visual Description of Material: Landfill Cap

FIELD DENSITY TEST USING NUCLEAR DENSITY GUAGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Com-paction	% Com-paction Required Min	% Com-paction Required Max	
01-1	1453102.688/411770.575, Edi, NS, Lift 8, GB 10	5386.49	D	4	7.6	2	2	122.9	114.2	117.0	98	90		*
02-1	1453070.888/411750.471, Edi, NS, Lift 8, MW 4	5386.89	D	4	8.8	2	2	124.6	114.5	117.0	98	90		*
03-1	1453026.647/411732.295, Edi, NS, Lift 8, GB 9	5387.18	D	4	10.1	2	2	131.3	119.3	117.0	100+	90		
04-1	1452947.698/411770.476, Edi, NS, Lift 8, GB 8	5388.55	D	4	8.6	2	2	124.8	114.9	117.0	98	90		*
05-1	1452846.893/411754.156, Edi, NS, Lift 8, GB 7	5387.95	D	4	10.0	2	2	133.5	121.4	117.0	100+	90		
06-1	4152692.486/411757.965, Edi, NS, Lift 8, GB 6	5387.42	D	4	10.0	2	2	129.2	117.4	117.0	100	90		
07-1	1452706.558/411649.598, Edi, NS, Lift 8, GB 1	5385.48	D	4	10.7	2	2	136.6	123.4	117.0	100+	90		
08-1	1452812.797/411637.497, Edi, NS, Lift 8, GB 2	5385.68	D	4	11.4	2	2	128.4	115.3	117.0	99	90		
09-1	1452945.200/411608.307, Edi, NS, Lift 8, GB 3	5385.29	D	4	12.5	2	2	130.0	115.5	117.0	99	90		
10-1	1453022.769/411603.527, Edi, NS, Lift 8, GB 4	5384.74	D	4	11.4	2	2	128.5	115.3	117.0	99	90		
11-1	1453110.772/411605.064, Edi, NS, Lift 8, GB 5	5383.04	D	4	13.4	2	2	128.1	113.0	117.0	97	90		
12-1	1452947.698/411770.476, Edi, NS, Lift 8, GB 8 (Retest of #04-1, Dated Today 7/28/09)	5388.55	D	4	10.3	2	2	134.7	122.2	117.0	100+	90		
13-1	1453102.688/411770.575, Edi, NS, Lift 8, GB 10 (Retest of #01-1, Dated Today 7/28/09)	5386.49	D	4	11.2	2	2	133.8	120.2	117.0	100+	90		

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Test Mode = D for Direct Transmission and B for Backscatter Modes

*** Material did not fall within specified tolerances.**

AMEC Earth .Environmental, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Com-paction	% Com-paction Required Min	% Com-paction Required Max
14-1	1453070.888/411750.471, Edi, NS, Lift 8, MW 4 (Retest of #02-1, Dated Today 7/28/09)	5386.89	D	4	10.3	2	2	124.8	113.2	117.0	97	90	

Reviewed By: _____

jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☑

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Test Mode = D for Direct Transmission and B for Backscatter Modes

*** Material did not fall within specified tolerances.**

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8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd NW
ABQ, NM 87107-

Attn: Chris Edgmon

Project Name: EDI SNL Mixed Waste Landfill Cover

ABQ, NM

Project Manager: Vickie Maranville

Report Date: September 09, 2009
Amended Date: December 22, 2009
Project #: 9-517-00022D
Report #: 23464
Tested By: Miguel Chavez
Date Tested: 9/3/2009
Visual Description of Material: Landfill Cover

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0734-01	118.9	9.6	ASTM D698-07 / A	Silty Sand

Nuclear Density Gauge
Make: Troxler
Model #: 3440
Serial #: 37046

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max	
01-1	GB 12	FSG	D	4	4.7	2	2	111.4	106.4	118.9	89			*
02-1	GB 12	FSG	D	10	4.9	2	2	116.7	111.2	118.9	94			*
03-1	GB 8	FSG	D	4	3.9	2	2	93.1	89.6	118.9	75			*
04-1	GB 8	FSG	D	6	3.9	2	2	100.9	97.0	118.9	82			*
05-1	GB 2	FSG	D	4	3.8	2	2	109.5	105.5	118.9	89			*
06-1	GB 2	FSG	D	8	3.7	2	2	118.8	114.5	118.9	96			*
07-1	GB 5	FSG	D	4	5.4	2	2	110.2	104.6	118.9	88			*
08-1	GB 5	FSG	D	8	3.8	2	2	116.0	111.8	118.9	94			*

Reviewed By: _____
mbr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (2)
Email: ☐

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Test Mode = D for Direct Transmission and B for Backscatter Modes

*** Material did not fall within specified tolerances.**

AMEC Earth Environmental, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
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www.amec.com

2009 CQA Density and Moisture Tests

Field Density Soils Result

amec

Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-
Attn: Don Lopez

Project Manager: Robert Romero

Report Date: May 25, 2009
Project #: 9-519-005363
Phase: **Task:**
Project Name: Mixed Waste Landfill 2009
Address: KAFB

Report Number: 13718
Tested By: Robert Carr
Date Tested: 2009-05-22
Visual Material Description: Landfill Cover Subgrade

FIELD DENSITY TEST (ASTM D2922-05 and ASTM D3017-05)

Moisture Density Curves Used

Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1811	120.1	11.6	ASTMD698 / A	

Nuclear Density Gauge

Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	%Moisture Actual	%Moisture Required (-)	%Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	%Compaction	%Compaction Required Min	%Compaction Required Max
1	Subgrade Surface, Grid Block 5	5384.06	D	6	10.6	2	2	129.7	117.3	120.1	98	95	
2	Subgrade Surface, Grid Block 12	5381.71	D	6	11.0	2	2	128.9	116.1	120.1	97	95	
3	Subgrade Surface, Grid Block 8	5385.04	D	6	10.0	2	2	130.8	118.9	120.1	99	95	
4	Subgrade Surface, Grid Block 1	5381.04	D	6	10.0	2	2	129.6	117.9	120.1	98	95	

BTSB=Below Top of Subbase, BTOF=Below Top of Fill, FBC=Final Base Course, FSG=Finished Subgrade, FBC=Finished Base Course, BOP Bottom of Pipe, BOB=Bottom of Base, BOF=Bottom of Footing, OGP=Original Ground Prep Test Mode=D for Direct Transmission and B for Backscatter Modes

Reviewed By: AS

Distribution: Client: File: Supplier: Other: Don Lopez (email) (1)

AMEC Earth & Environmental Inc.
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Albuquerque, NM 87113
(505) 821-1801 FAX: (505) 821-7371

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mix Waste Landfill

Albuquerque, NM

Project Manager: Robert Romero

Report Date: June 23, 2009

Project #: 9-519-005363
Report #: 22570
Tested By: Robert Carr
Date Tested: 6/19/2009
Visual Description of Material: Landfill Cap

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
6-1811	120.1	11.6	ASTM D698-07 / a	Light Red Sandy
9-0629-04	115.8	12.3	ASTM D698-07 / A	Clayey Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max	
01-1	Native Soil Lift 1, Grid Block 8	5386.80	D	4	10.7	2	2	117.0	105.7	115.8	91	90		
02-1	Native Soil Lift 1, Grid Block 11	5388.33	D	4	11.0	2	2	118.9	107.1	115.8	92	90		
03-1	East Slope Lift 6	5384.57	D	6	10.1	2	2	129.3	117.4	120.1	98	90		
04-1	East Slope Lift 5	5384.07	D	12	10.3	2	2	123.9	112.3	120.1	94	90		
05-1	West Slope Lift 6	5379.92	D	6	11.1	2	2	131.0	117.9	120.1	98	90		
06-1	West Slope Lift 5	5379.42	D	12	10.6	2	2	127.6	115.4	120.1	96	90		
07-1	Native Soil Lift 2, Grid Block 11	5388.23	D	4	11.0	2	2	120.5	108.5	115.8	94	90		
08-1	North Slope Lift 8	5382.30	D	6	15.2	2	2	118.1	102.5	115.8	89	90		*
09-1	North Slope Lift 7	5381.80	D	6	14.0	2	2	121.7	106.7	115.8	92	90		

Reviewed By:
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (0)
Email: ☐
Don Lopez (email) (1)
Paul Molina (email) (1)

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep

Test Mode = D for Direct Transmission and B for Backscatter Modes

* Material did not fall within specified tolerances.

AMEC Earth Environmental, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mix Waste Landfill
Albuquerque, NM

Project Manager: Robert Romero

Report Date: June 23, 2009

Project #: 9-519-005363
Report #: 22577
Tested By: Robert Carr
Date Tested: 6/22/2009
Visual Description of Material: Landfill Cap, North Slope

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-04	115.8	12.3	ASTM D698-07 / A	Clayey Silty Sand

Nuclear Density Gauge
Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	North Slope Lift 8, Grid Block 13 (Retest)	5382.54	D	6	10.9	2	2	117.1	105.6	115.8	91	90	
02-1	North Slope Lift 8, Grid Block 10 (Retest)	5381.31	D	6	10.5	2	2	117.0	105.9	115.8	91	90	
03-1	North Slope Lift 8, Grid Block 5 (Retest)	5378.87	D	6	11.0	2	2	117.7	106.0	115.8	92	90	

Reviewed By:
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (0)
Email: ☐
Don Lopez (email) (1)
Paul Molina (email) (1)

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

AMEC Earth .Environmental, Inc.
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Albuquerque, NM 87113
Tel 5058211801
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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mix Waste Landfill
Albuquerque, NM

Project Manager: Robert Romero

Report Date: June 25, 2009

Project #: 9-519-005363
Report #: 22595
Tested By: Robert Carr
Date Tested: 6/23/2009
Visual Description of Material: Landfill Cap

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-04	115.8	12.3	ASTM D698-07 / A	Clayey Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	Native Soil Lift 3, Grid Block 2	5383.34	D	2	10.8	2	2	124.3	112.1	115.8	97	90	

Reviewed By:
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (0)
Email: ☐
Don Lopez (email) (1)
Paul Molina (email) (1)

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

AMEC Earth Environmental, Inc.
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Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Report Date: June 25, 2009

Project #: 9-519-005363
Report #: 22596
Tested By: Robert Carr
Date Tested: 6/24/2009
Visual Description of Material: Landfill Cap

Attn: Don Lopez

Project Name: Mix Waste Landfill

Albuquerque, NM

Project Manager: Robert Romero

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	Native Soil Lift 3, Grid Block 8	5385.53	D	2	10.0	2	2	121.1	110.1	117.0	94	90	

Reviewed By: jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (0)
Email: ☐
Don Lopez (email) (1)
Paul Molina (email) (1)

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Test Mode = D for Direct Transmission and B for Backscatter Modes

AMEC Earth Environmental, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client:	URS 6501 Americas Pkwy. NE, Suite 900 Albuquerque, NM 87110-	**Report Date:** June 29, 2009 **Project #:** 9-519-005363 **Report #:** 22659 **Tested By:** Robert Carr **Date Tested:** 6/26/2009 **Visual Description of Material:** Landfill Cap	
Attn:	Don Lopez		
Project Name:	Mix Waste Landfill Albuquerque, NM		
Project Manager:	Robert Romero		

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	Native Soil Lift 3, Grid Block 11	5388.37	D	2	13.7	2	2	130.1	114.4	117.0	98	90	
02-1	Native Soil Lift 4, Grid Block 1	5383.83	D	4	14.0	2	2	134.2	117.7	117.0	100+	90	
03-1	Native Soil Lift 4, Grid Block 3	5383.88	D	4	13.5	2	2	125.9	110.9	117.0	95	90	
04-1	Native Soil Lift 4, Grid Block 5	5380.70	D	4	12.8	2	2	125.9	111.6	117.0	95	90	
05-1	Native Soil Lift 4, Grid Block 9	5384.69	D	4	11.5	2	2	128.3	115.0	117.0	98	90	
06-1	Native Soil Lift 4, Grid Block 7	5385.81	D	4	11.6	2	2	126.0	111.9	117.0	96	90	

Reviewed By:
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (0)
Email: ☐
Don Lopez (email) (1)
Paul Molina (email) (1)

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep

Test Mode = D for Direct Transmission and B for Backscatter Modes

AMEC Earth Environmental, Inc.
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Albuquerque, NM 87113
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www.amec.com

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mix Waste Landfill
Albuquerque, NM

Project Manager: Robert Romero

Report Date: July 02, 2009

Project #: 9-519-005363
Report #: 22719
Tested By: Robert Carr
Date Tested: 6/29/2009
Visual Description of Material: Landfill Cap

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	Native Soil Lift 4, Grid Block 13	5386.65	D	4	11.6	2	2	128.1	114.8	117.0	98	90	
02-1	Native Soil Lift 4, Grid Block 11	5387.97	D	4	10.1	2	2	124.4	113.0	117.0	97	90	

Reviewed By:
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (0)
Email: ☐
Don Lopez (email) (1)
Paul Molina (email) (1)

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

AMEC Earth .Environmental, Inc.
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Tel 5058211801
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www.amec.com

Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mix Waste Landfill

Albuquerque, NM

Project Manager: Robert Romero

Report Date: July 02, 2009

Project #: 9-519-005363
Report #: 22718
Tested By: Robert Carr
Date Tested: 7/1/2009
Visual Description of Landfill Cap Material:

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	Native Soil Lift 5, Grid Block 12	5388.33	D	4	10.0	2	2	118.8	108.0	117.0	92	90	

Reviewed By:
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (0)
Email: ☐
Don Lopez (email) (1)
Paul Molina (email) (1)

BTSB=Below Top of Subbase, BTOF= Below Top of Fill, FBC= Final Base Course, FSG = Finished Subgrade, FBC = Finished Base Course, BOP = Bottom of Pipe, BOB = Bottom of Base, BOF = Bottom of Footing, OGP = Original Ground Prep
Test Mode = D for Direct Transmission and B for Backscatter Modes

AMEC Earth Environmental, Inc.
8519 Jefferson NE
Albuquerque, NM 87113
Tel 5058211801
Fax 5058217371
www.amec.com

Client:	URS 6501 Americas Pkwy. NE, Suite 900 Albuquerque, NM 87110-	**Report Date:** July 07, 2009	
Attn:	Don Lopez	**Project #:** 9-519-005363 **Report #:** 22760 **Tested By:** Robert Carr	
Project Name:	Mix Waste Landfill Albuquerque, NM	**Date Tested:** 7/2/2009 **Visual Description of Material:** Landfill Cap	
Project Manager:	Robert Romero		

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	Native Soil Lift 5, Grid Block 10	5385.29	D	4	12.3	2	2	123.4	109.9	117.0	94	90	
02-1	Native Soil Lift 5, Grid Block 8	5387.37	D	4	12.8	2	2	123.0	109.0	117.0	93	90	
03-1	Native Soil Lift 5, Grid Block 6	5386.45	D	4	13.5	2	2	128.5	113.2	117.0	97	90	

Reviewed By: _____
jdr

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Don Lopez (email) (1)
Paul Molina (email) (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mix Waste Landfill
Albuquerque, NM

Project Manager: Robert Romero

Report Date: July 15, 2009

Project #: 9-519-005363
Report #: 22828
Tested By: Robert Carr
Date Tested: 7/9/2009
Visual Description of Material: Landfill Cap

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	Native Soil Lift 5, Grid Block 4	5385.02	D	4	10.0	2	2	128.7	117.0	117.0	100	90	
02-1	Native Soil Lift 5, Grid Block 2	5384.18	D	4	10.2	2	2	124.6	113.1	117.0	97	90	

Reviewed By:
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (0)
Email: ☐
Don Lopez (email) (1)
Paul Molina (email) (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Report Date: July 20, 2009

Project #: 9-519-005363
Report #: 22883
Tested By: Robert Carr
Date Tested: 7/14/2009
Visual Description of Material: Landfill Cap

Attn: Don Lopez

Project Name: Mix Waste Landfill

Albuquerque, NM

Project Manager: Robert Romero

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	Native Soil Lift 6, Grid Block 11	5386.88	D	4	10.4	2	2	128.4	116.3	117.0	99	90	
02-1	Native Soil Lift 6, Grid Block 13	5388.39	D	4	12.2	2	2	131.2	116.9	117.0	100	90	

Reviewed By: _____
jdr

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Email: ☐
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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mix Waste Landfill
Albuquerque, NM

Project Manager: Robert Romero

Report Date: July 21, 2009

Project #: 9-519-005363
Report #: 22895
Tested By: Robert Carr
Date Tested: 7/17/2009
Visual Description of Material: Landfill Cap

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	Native Soil Lift 6, Grid Block 8	5386.48	D	4	12.8	2	2	132.6	117.5	117.0	100	90	
02-1	Native Soil Lift 6, Grid Block 6	5386.67	D	4	10.3	2	2	119.4	108.3	117.0	93	90	
03-1	Native Soil Lift 6, Grid Block 2	5383.91	D	4	14.0	2	2	126.7	111.1	117.0	95	90	
04-1	Native Soil Lift 6, Grid Block 4	5384.61	D	4	10.9	2	2	126.2	113.9	117.0	97	90	
05-1	Native Soil Lift 6, Grid Block 9	5386.18	D	4	11.4	2	2	132.1	118.6	117.0	100+	90	

Reviewed By:
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (0)
Email: ☐
Don Lopez (email) (1)
Paul Molina (email) (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mix Waste Landfill

Albuquerque, NM

Project Manager: Robert Romero

Report Date: July 22, 2009

Project #: 9-519-005363
Report #: 22915
Tested By: Robert Carr
Date Tested: 7/21/2009
Visual Description of Landfill Cap Material:

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture			Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required	
					Actual	Required (-)	Required (+)					Min	Max
01-1	Native Soil Lift 7, Grid Block 11	5389.85	D	4	12.0	2	2	126.4	112.8	117.0	96	90	
02-1	Native Soil Lift 7, Grid Block 13	5387.14	D	4	12.8	2	2	129.1	114.4	117.0	98	90	
03-1	Native Soil Lift 7, Grid Block 9	5387.79	D	4	11.9	2	2	129.1	115.4	117.0	99	90	
04-1	Native Soil Lift 7, Grid Block 7	5387.64	D	4	12.4	2	2	131.9	117.3	117.0	100	90	

Reviewed By:
jdr

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Email: ☐
Don Lopez (email) (1)
Paul Molina (email) (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mix Waste Landfill

Albuquerque, NM

Project Manager: Robert Romero

Report Date: July 24, 2009

Project #: 9-519-005363
Report #: 22946
Tested By: Robert Carr
Date Tested: 7/22/2009
Visual Description of Material: Landfill Cap

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	Native Soil Lift 7, Grid Block 1	5384.90	D	4	14.0	2	2	124.1	108.9	117.0	93	90	95
02-1	Native Soil Lift 7, Grid Block 3	5386.74	D	4	10.5	2	2	119.5	108.2	117.0	92	90	95
03-1	Native Soil Lift 7, Grid Block 5	5382.35	D	4	12.2	2	2	124.5	111.0	117.0	95	90	95

Reviewed By:
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (0)
Email: ☐
Don Lopez (email) (1)
Paul Molina (email) (1)

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Client: URS
6501 Americas Pkwy. NE, Suite 900
Albuquerque, NM 87110-

Attn: Don Lopez

Project Name: Mix Waste Landfill

Albuquerque, NM

Project Manager: Robert Romero

Report Date: July 29, 2009

Project #: 9-519-005363
Report #: 23041
Tested By: Robert Carr
Date Tested: 7/28/2009
Visual Description of Material: Landfill Cap

FIELD DENSITY TEST USING NUCLEAR DENSITY GAUGE (ASTM D6938-08)

Moisture Density Curves Used

AMEC Lab #	Maximum Density	Optimum Moisture	Test Type / Method	Description
9-0629-01	117.0	12.0	ASTM D698-07 / B	Silty Sand

Nuclear Density Gauge

Make: Troxler
Model #: 3430
Serial #: 35427

Test #	Location	Elevation	Test Mode	Probe Depth (in)	% Moisture Actual	% Moisture Required (-)	% Moisture Required (+)	Wet Density (pcf)	Dry Density (pcf)	Maximum Density (pcf)	% Compaction	% Compaction Required Min	% Compaction Required Max
01-1	Native Soil Lift 8, Grid Block 12	5389.71	D	6	10.0	2	2	128.7	117.0	117.0	100	90	
02-1	Native Soil Lift 8, Grid Block 6	5387.23	D	6	10.0	2	2	127.1	115.5	117.0	99	90	
03-1	Native Soil Lift 8, Grid Block 2	5385.65	D	6	10.8	2	2	128.6	116.1	117.0	99	90	
04-1	Native Soil Lift 8, Grid Block 4	5384.78	D	6	12.1	2	2	127.0	113.3	117.0	97	90	
05-1	Native Soil Lift 8, Grid Block 8	5388.56	D	6	10.3	2	2	129.1	117.0	117.0	100	90	
06-1	Native Soil Lift 8, Grid Block 10	5386.42	D	6	11.0	2	2	129.2	116.4	117.0	99	90	

Reviewed By:
jdr

Distribution: Client: ☑ File: ☑ Supplier: ☑ Other: Addressee (0)
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AMEC Earth Environmental, Inc.
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2009 Saturated Hydraulic Conductivity Tests

Client: Environmental Dimensions, Inc.
1901 Candelaria Rd., NW
Albuquerque, NM 87107

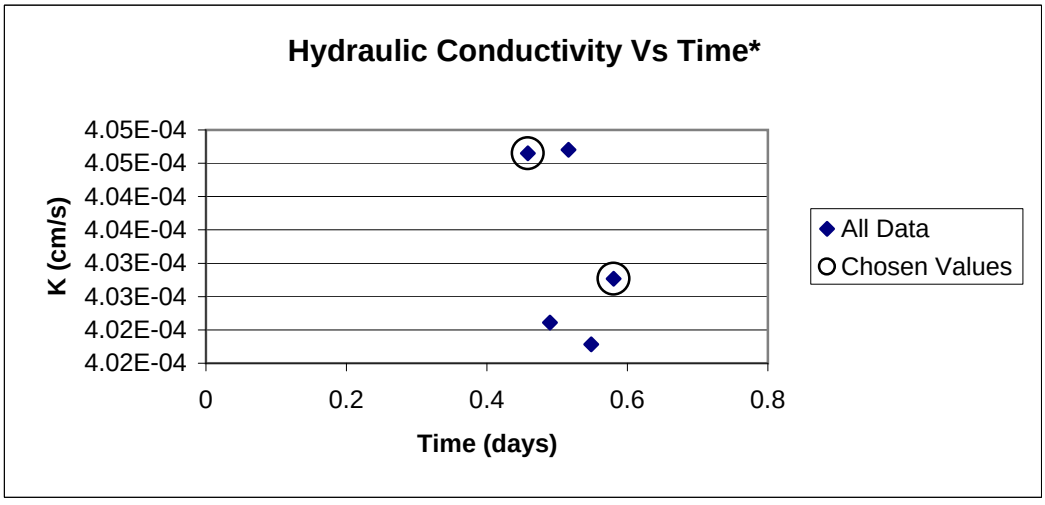
Report Date: 8/13/2009

Project #: 9-517-00022D
Attn: Chris Edgmon
Work Order #: 9
Lab #: 9.0715-01
Project Name: EDi SNL Mixed Waste Landfill Cover
Sampled By: Jon Schermerhorn
Date Sampled: 6/19/2009
Visual Description of Material: Silty Clayey Sand
Sample Source: Wedge Lift 1 GB 8

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.22	**INITIAL GRAVIMETRIC WATER CONTENT**	12.0%
INITIAL LENGTH	7.12	**INITIAL DRY BULK DENSITY**	105.3
FINAL DIAMETER	6.22	**FINAL GRAVIMETRIC WATER CONTENT**	23.4%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	A:Constant Head	**% OF D698 PROCTOR**	90.0%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	100.0%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.9
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	4.03E-04
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	4.02E-04



* All hydraulic conductivity values normalized to a water viscosity at 20° C

Reviewed by _____

AMEC Earth Environmental, Inc.
8519 Jefferson NW
Albuquerque, NM 87113
Phone: (505) 821-1801
Fax: (505) 821-7371 www.amec.com

Client: Environmental Dimensions, Inc.
1901 Candelaria Rd, NW
Albuquerque, NM 87107

Report Date: 7/24/2009

Attn: Chris Edgmon

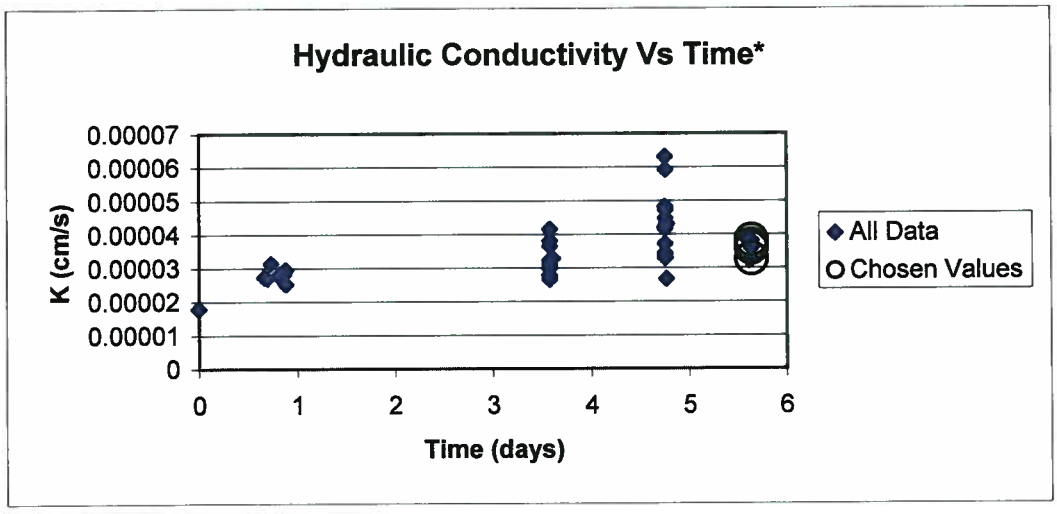
Project Name: EDi SNL Mixed Waste Landfill Cover

Project #: 9-517-00022D
Work Order #: 9
Lab #: 9-0715-02
Sampled By: Jon Schermerhorn
Date Sampled: 6/22/2009
Visual Description of Material: Silty Clayey Sand
Sample Source: Wedge Lift 2 GB 11

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.13	**INITIAL GRAVIMETRIC WATER CONTENT**	15.6%
INITIAL LENGTH	7.62	**INITIAL DRY BULK DENSITY**	104.2
FINAL DIAMETER	6.13	**FINAL GRAVIMETRIC WATER CONTENT**	19.2%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	C: Falling Head/Rising Tail	**% OF D698 COMPACTION:**	89.0%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	87.6%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	1.2
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	3.58E-05
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	3.58E-05



* All hydraulic conductivity values normalized to a water viscosity at 20° C

Reviewed by

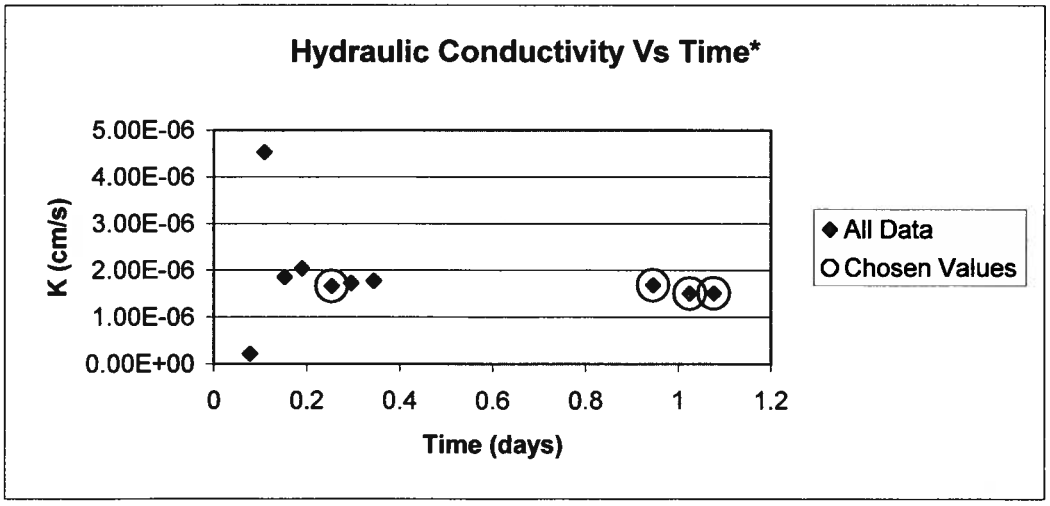
AMEC Earth Environmental, Inc.
8519 Jefferson NW
Albuquerque, NM 87113
Phone: (505) 821-1801
Fax: (505) 821-7371
www.amec.com

Client:	Environmental Dimentions Inc 1901 Candelaria Rd, NW Albuquerque, NM 87107	**Report Date:**	07/24/2009
		Project #:	9-517-00022D
Attn:	Chris Edgmon	**Work Order #:**	7
		Lab #:	9-0694-01
Project Name:	EDi SNL Mixed Waste Landfill Cover	**Sampled By:**	Client
		Date Sampled:	06/17/2009
		Visual Description of Material:	Brown Silty Sand
		Sample Source:	EDI NS Lift 3-1

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.13	**INITIAL GRAVIMETRIC WATER CONTENT**	12.2%
INITIAL LENGTH	7.63	**INITIAL DRY BULK DENSITY**	105.5
FINAL DIAMETER	6.13	**FINAL GRAVIMETRIC WATER CONTENT**	20.9%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	B:Falling Head/Constant Tail	**% OF D698 PROCTOR**	90.2%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	99.5%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.5
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	1.62E-06
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	1.59E-06



* All hydraulic conductivity values normalized to a water viscosity at 20° C

Reviewed by

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Albuquerque, NM 87113
Phone: (505) 821-1801
Fax: (505) 821-7371
www.amec.com

Client: Environmental Dimentions Inc
1901 Candelaria Rd, NW
Albuquerque, NM 87107

Report Date: 07/24/2009

Attn: Chris Edgmon

Project #: 9-517-00022D
Work Order #: 7
Lab #: 9-0694-02

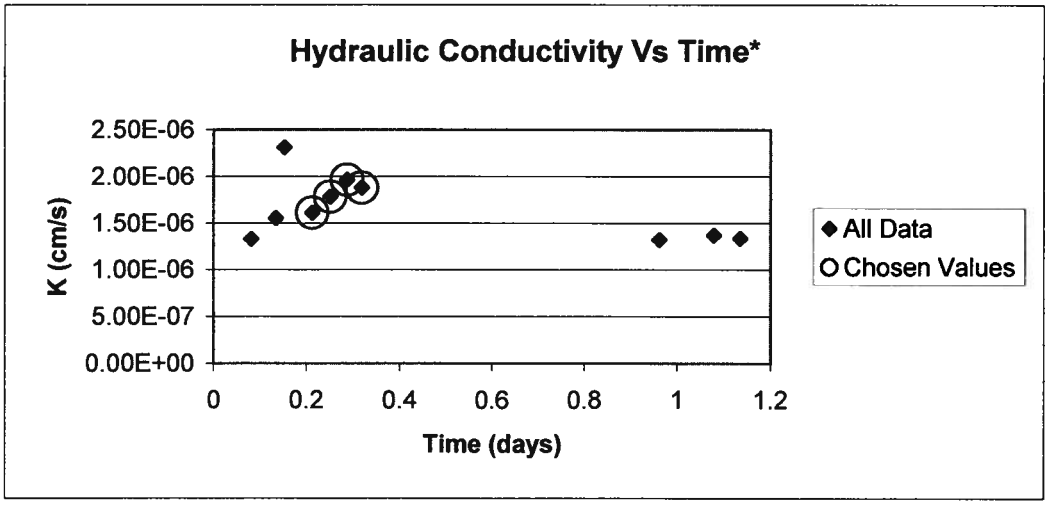
Project Name: EDi SNL Mixed Waste Landfill Cover

Sampled By: Client
Date Sampled: 06/17/2009
Visual Description of Material: Silty Clayey Sand
Sample Source: EDI NS Lift 3-2

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.13	**INITIAL GRAVIMETRIC WATER CONTENT**	12.4%
INITIAL LENGTH	7.63	**INITIAL DRY BULK DENSITY**	105.0
FINAL DIAMETER	6.13	**FINAL GRAVIMETRIC WATER CONTENT**	20.1%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	B:Falling Head/Constant Tail	**% OF D698 PROCTOR**	89.7%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	94.3%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.7
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	1.47E-06
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	1.81E-06



* All hydraulic conductivity values normalized to a water viscosity at 20° C

Reviewed by

AMEC Earth Environmental, Inc.
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Client: Environmental Dimentions Inc
1901 Candelaria Rd, NW
Albuquerque, NM 87107

Report Date: 07/24/2009

Attn: Chris Edgmon

Project #: 9-517-00022D
Work Order #: 7
Lab #: 9-0694-03

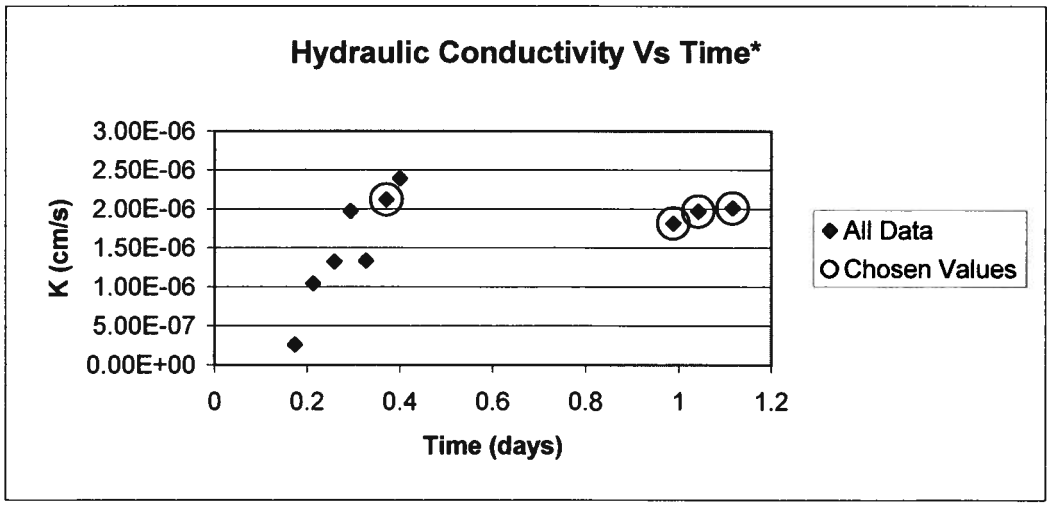
Project Name: EDi SNL Mixed Waste Landfill Cover

Sampled By: Client
Date Sampled: 06/17/2009
Visual Description of Material: Silty Clayey Sand
Sample Source: EDI NS Lift 3-3

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.11	**INITIAL GRAVIMETRIC WATER CONTENT**	11.1%
INITIAL LENGTH	7.60	**INITIAL DRY BULK DENSITY**	106.4
FINAL DIAMETER	6.11	**FINAL GRAVIMETRIC WATER CONTENT**	20.2%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	B:Falling Head/Constant Tail	**% OF D698 PROCTOR**	91.0%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	98.2%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.5
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	2.05E-06
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	1.98E-06



* All hydraulic conductivity values normalized to a water viscosity at 20° C

Reviewed by _____

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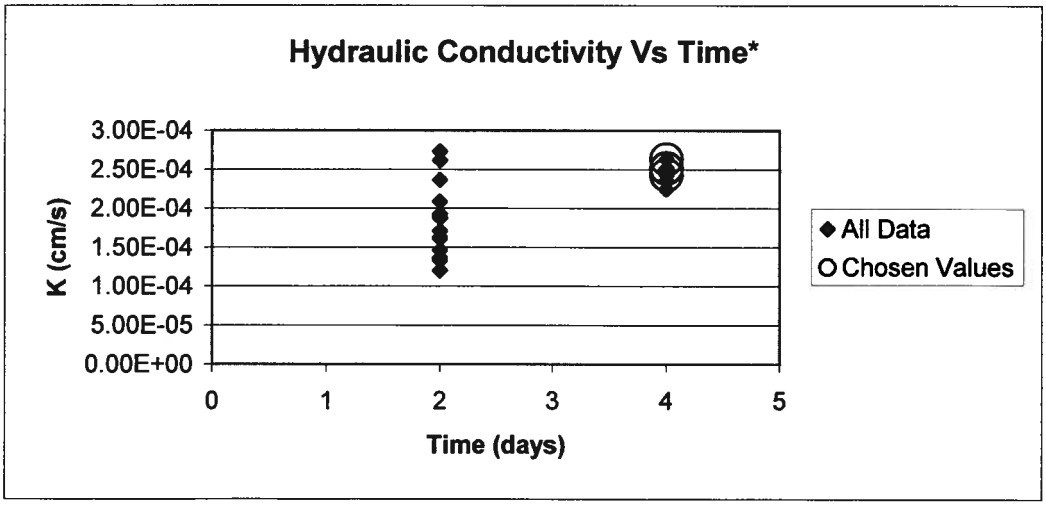
Client:	Environmental Dimensions, Inc. 1901 Candelaria Rd, NW Albuquerque, NM 87107	**Report Date:**	07/24/2009
Attn:	Chris Edgmon	**Project #:** **Work Order #:**	9-517-00022D 14
Project Name:	EDi SNL Mixed Waste Landfill Cover	**Lab #:** **Sampled By:** **Date Sampled:** **Visual Description of Material:** **Sample Source:**	9-0742-01 Jon Schermerhorn 06/30/2009 Silty Clayey Sand EDI NS Lift 4 GB 2

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.11	**INITIAL GRAVIMETRIC WATER CONTENT**	12.0%
INITIAL LENGTH	7.60	**INITIAL DRY BULK DENSITY**	99.0
FINAL DIAMETER	6.11	**FINAL GRAVIMETRIC WATER CONTENT**	20.7%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	C: Falling Head/Rising Tail	**% OF D698 COMPACTION:**	84.6%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	83.0%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	1.0
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	2.52E-04
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	2.52E-04



* All hydraulic conductivity values normalized to a water viscosity at 20° C

Reviewed by _____

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Client: Environmental Dimensions, Inc.
1901 Candelaria Rd, NW
Albuquerque, NM 87107

Report Date: 07/24/2009

Attn: Chris Edgmon

Project #: 9-517-00022D
Work Order #: 14
Lab #: 9-0742-02

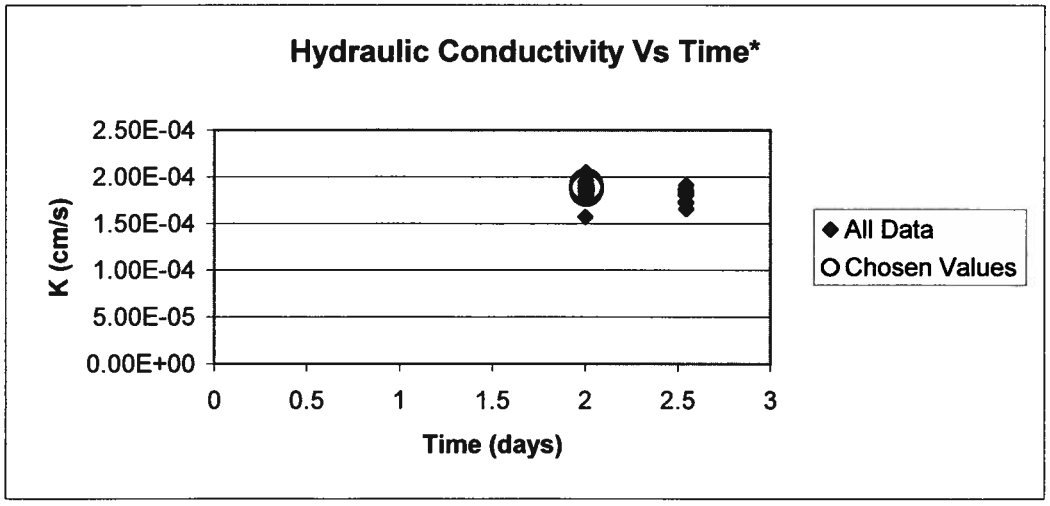
Project Name: EDi SNL Mixed Waste Landfill Cover

Sampled By: Jon Schermerhorn
Date Sampled: 06/30/2009
Visual Description of Material: Silty Clayey Sand
Sample Source: EDI NS Lift 4 GB 6

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.10	**INITIAL GRAVIMETRIC WATER CONTENT**	10.9%
INITIAL LENGTH	7.60	**INITIAL DRY BULK DENSITY**	95.0
FINAL DIAMETER	6.10	**FINAL GRAVIMETRIC WATER CONTENT**	23.0%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	B:Falling Head/Constant Tail	**% OF D698 PROCTOR**	81.2%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	83.7%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.8
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	1.82E-04
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	1.87E-04



* All hydraulic conductivity values normalized to a water viscosity at 20° C

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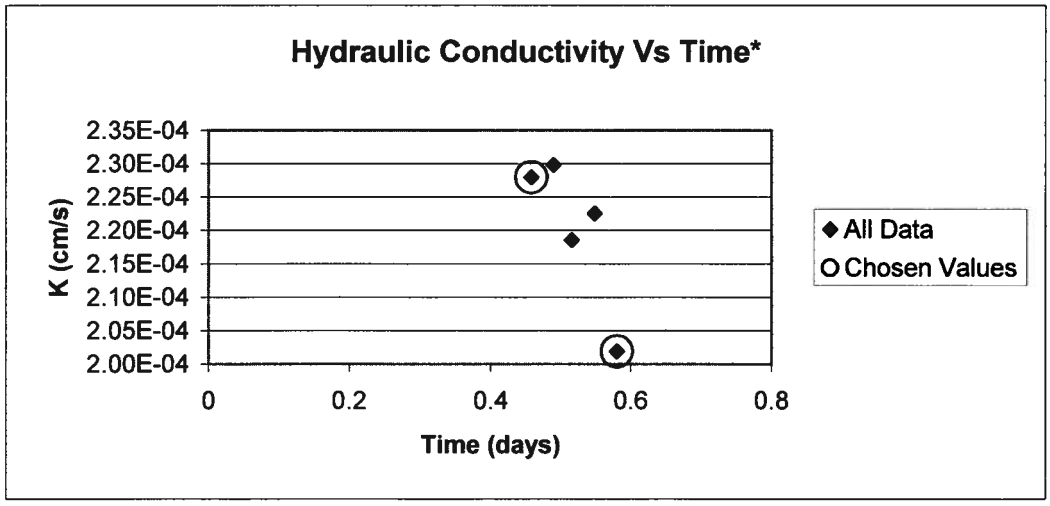
Client:	Environmental Dimensions, Inc. 1901 Candelaria Rd., NW Albuquerque, NM 87107	**Report Date:**	08/13/2009
		Project #:	9-517-00022D
Attn:	Chris Edgmon	**Work Order #:**	14
		Lab #:	9-0742-03
Project Name:	EDi SNL Mixed Waste Landfill Cover	**Sampled By:**	Jon Schermerhorn
		Date Sampled:	06/30/2009
		Visual Description of Material:	Silty Clayey Sand
		Sample Source:	EDI NS Lift 4 GB 9

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.24	**INITIAL GRAVIMETRIC WATER CONTENT**	12.2%
INITIAL LENGTH	6.63	**INITIAL DRY BULK DENSITY**	105.1
FINAL DIAMETER	6.24	**FINAL GRAVIMETRIC WATER CONTENT**	22.5%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	A:Constant Head	**% OF D698 PROCTOR**	89.8%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	100.0%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.5
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	2.18E-04
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	2.14E-04



* All hydraulic conductivity values normalized to a water viscosity at 20° C

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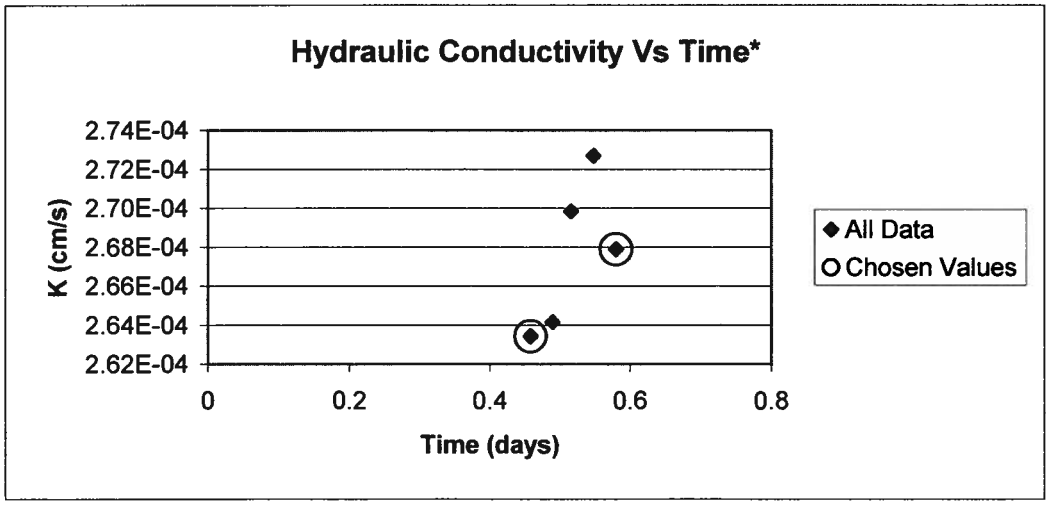
Client:	Environmental Dimensions, Inc. 1901 Candelaria Rd., NW Albuquerque, NM 87107	**Report Date:**	08/07/2009
		Project #:	9-517-00022D
Attn:	Chris Edgmon	**Work Order #:**	16
		Lab #:	9-0766-01
Project Name:	EDi SNL Mixed Waste Landfill Cover	**Sampled By:**	Jon Schermerhorn
		Date Sampled:	07/09/2009
		Visual Description of Material:	Silty Clayey Sand
		Sample Source:	Edi NS Lift 5 GB 1

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.13	**INITIAL GRAVIMETRIC WATER CONTENT**	12.2%
INITIAL LENGTH	7.59	**INITIAL DRY BULK DENSITY**	105.3
FINAL DIAMETER	6.13	**FINAL GRAVIMETRIC WATER CONTENT**	21.1%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	A:Constant Head	**% OF D698 PROCTOR**	90.0%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	98.3%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.6
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	2.69E-04
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	2.66E-04



* All hydraulic conductivity values normalized to a water viscosity at 20° C

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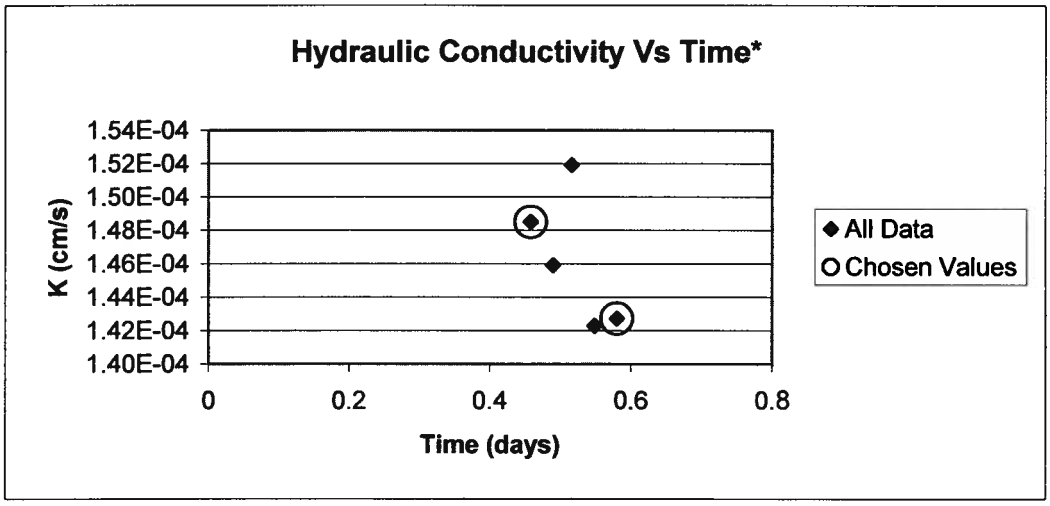
Client:	Environmental Dimensions, Inc. 1901 Candelaria Rd., NW Albuquerque, NM 87107	**Report Date:**	08/24/2009
Attn:	Chris Edgmon	**Project #:** **Work Order #:**	9-517-00022D 24
Project Name:	EDi SNL Mixed Waste Landfill Cover	**Lab #:** **Sampled By:** **Date Sampled:** **Visual Description of Material:** **Sample Source:**	9-0968-01 "9-0766-02" Jon Schermerhorn 07/08/2009 Brown Silty Sand EDI NS Lift 5 GB 4 Retest

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.14	**INITIAL GRAVIMETRIC WATER CONTENT**	11.6%
INITIAL LENGTH	7.59	**INITIAL DRY BULK DENSITY**	111.5
FINAL DIAMETER	6.14	**FINAL GRAVIMETRIC WATER CONTENT**	18.5%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	A:Constant Head	**% OF D698 PROCTOR**	95.3%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	100.0%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.3
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	1.46E-04
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	1.43E-04



* All hydraulic conductivity values normalized to a water viscosity at 20° C

Reviewed by

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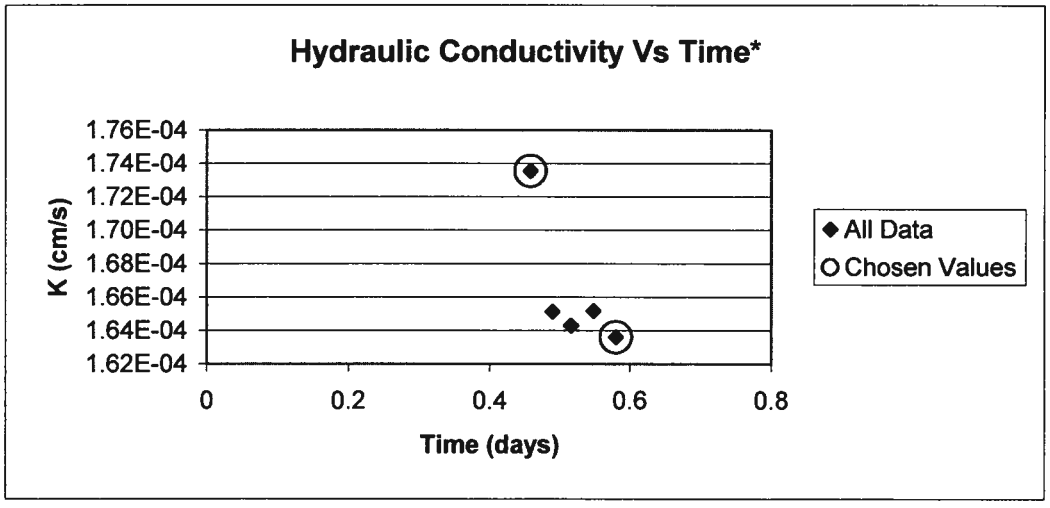
Client:	Environmental Dimensions, Inc. 1901 Candelaria Rd., NW Albuquerque, NM 87107	**Report Date:**	08/24/2009
Attn:	Chris Edgmon	**Project #:** **Work Order #:**	9-517-00022D 24
Project Name:	EDi SNL Mixed Waste Landfill Cover	**Lab #:** **Sampled By:** **Date Sampled:** **Visual Description of Material:** **Sample Source:**	9-0968-02 "9-0766-03" Jon Schermerhorn 07/08/2009 Brown Silty Sand EDI NS Lift 5 GB 8 Retest

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.14	**INITIAL GRAVIMETRIC WATER CONTENT**	12.2%
INITIAL LENGTH	7.58	**INITIAL DRY BULK DENSITY**	110.6
FINAL DIAMETER	6.14	**FINAL GRAVIMETRIC WATER CONTENT**	19.5%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	A:Constant Head	**% OF D698 PROCTOR**	94.6%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	100.0%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.4
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	1.65E-04
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	1.63E-04



* All hydraulic conductivity values normalized to a water viscosity at 20° C

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Client: Environmental Dimensions, Inc.
1901Candelaria Rd., NW
Albuquerque, NM 87107

Report Date: 8/7/2009

Attn: Chris Edgmon

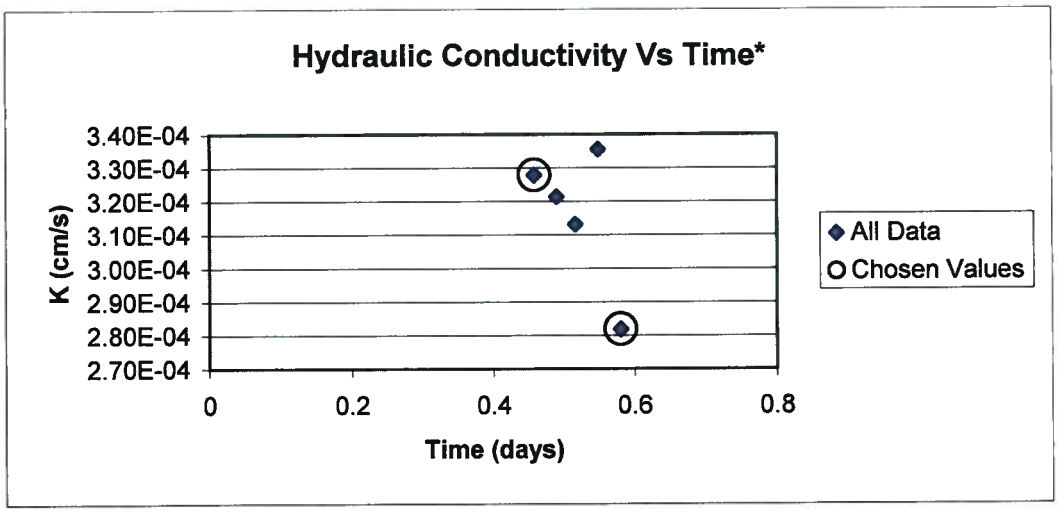
Project Name: EDi SNL Mixed Waste Landfill Cover

Project #: 9-517-00022D
Work Order #: 20
Lab #: 9-0805-02
Sampled By: Jon Schermerhorn
Date Sampled: 7/17/2009
Visual Description of Material: Silty Clayey Sand
Sample Source: Edi NS Lift 6-1

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.13	**INITIAL GRAVIMETRIC WATER CONTENT**	11.7%
INITIAL LENGTH	7.58	**INITIAL DRY BULK DENSITY**	105.6
FINAL DIAMETER	6.13	**FINAL GRAVIMETRIC WATER CONTENT**	21.8%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	A:Constant Head	**% OF D698 PROCTOR**	90.2%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	100.0%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.6
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	3.13E-04
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	3.05E-04



* All hydraulic conductivity values normalized to a water viscosity at 20° C

Reviewed by

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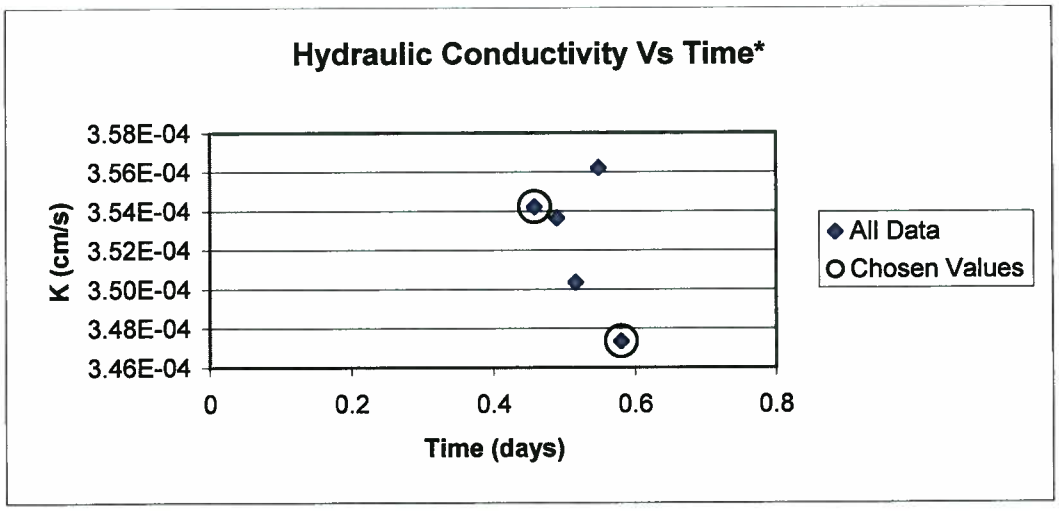
www.amec.com

Client:	Environmental Dimensions, Inc. 1901Candelaria Rd., NW Albuquerque, NM 87107	**Report Date:**	8/7/2009
Attn:	Chris Edgmon	**Project #:** **Work Order #:** **Lab #:**	9-517-00022D 20 9-0805-03
Project Name:	EDi SNL Mixed Waste Landfill Cover	**Sampled By:** **Date Sampled:** **Visual Description of Material:** **Sample Source:**	Jon Schermerhorn 7/17/2009 Silty Clayey Sand Edi NS Lift 6-2

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.12	**INITIAL GRAVIMETRIC WATER CONTENT**	12.2%
INITIAL LENGTH	7.58	**INITIAL DRY BULK DENSITY**	105.6
FINAL DIAMETER	6.12	**FINAL GRAVIMETRIC WATER CONTENT**	22.5%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	A:Constant Head	**% OF D698 PROCTOR**	90.3%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	100.0%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.8
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	3.52E-04
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	3.51E-04



* All hydraulic conductivity values normalized to a water viscosity at 20° C

Reviewed by _____

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Client: Environmental Dimensions, Inc.
1901Candelaria Rd., NW
Albuquerque, NM 87107

Report Date: 8/7/2009

Attn: Chris Edgmon

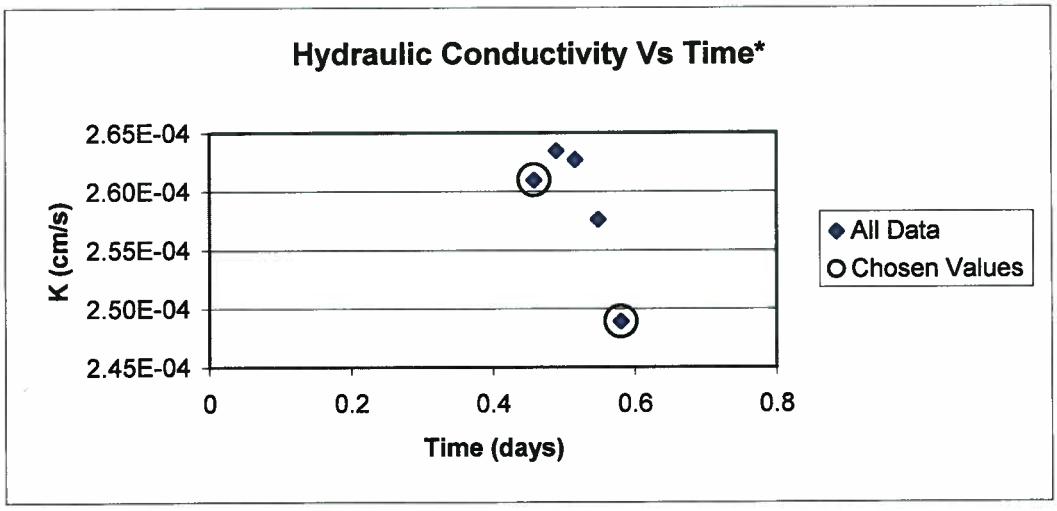
Project Name: EDi SNL Mixed Waste Landfill Cover

Project #: 9-517-00022D
Work Order #: 20
Lab #: 9-0805-04
Sampled By: Jon Schermerhorn
Date Sampled: 7/17/2009
Visual Description of Material: Silty Clayey Sand
Sample Source: Edi NS Lift 6-3

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.13	**INITIAL GRAVIMETRIC WATER CONTENT**	12.7%
INITIAL LENGTH	7.58	**INITIAL DRY BULK DENSITY**	104.7
FINAL DIAMETER	6.13	**FINAL GRAVIMETRIC WATER CONTENT**	21.7%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	A:Constant Head	**% OF D698 PROCTOR**	89.5%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	99.5%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.5
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	2.58E-04
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	2.55E-04



* All hydraulic conductivity values normalized to a water viscosity at 20° C

Reviewed by _____

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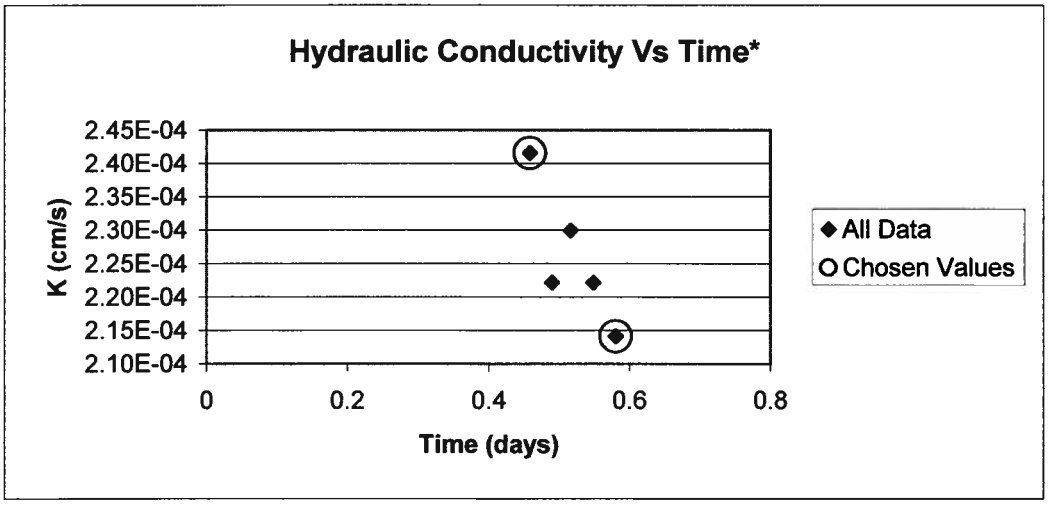
Client:	Environmental Dimensions, Inc. 1901 Candelaria Rd., NW Albuquerque, NM 87107	**Report Date:**	08/24/2009
		Project #:	9-517-00022D
Attn:	Chris Edgmon	**Work Order #:**	24
		Lab #:	9-0968-03 "9-0817-01"
Project Name:	EDi SNL Mixed Waste Landfill Cover	**Sampled By:**	Jon Schermerhorn
		Date Sampled:	07/20/2009
		Visual Description of Material:	Brown Silty Sand
		Sample Source:	EDI NS Lift 7 GB 1 Retest

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.10	**INITIAL GRAVIMETRIC WATER CONTENT**	11.8%
INITIAL LENGTH	7.59	**INITIAL DRY BULK DENSITY**	111.0
FINAL DIAMETER	6.10	**FINAL GRAVIMETRIC WATER CONTENT**	19.7%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	A:Constant Head	**% OF D698 PROCTOR**	94.8%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	100.0%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.5
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	2.22E-04
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	2.18E-04



* All hydraulic conductivity values normalized to a water viscosity at 20° C

Reviewed by

AMEC Earth Environmental, Inc.
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Fax: (505) 821-7371
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Client: Environmental Dimensions, Inc.
1901 Candelaria Rd., NW
Albuquerque, NM 87107

Report Date: 08/24/2009

Attn: Chris Edgmon

Project #: 9-517-00022D
Work Order #: 24
Lab #: 9-0968-04 "9-0817-02"

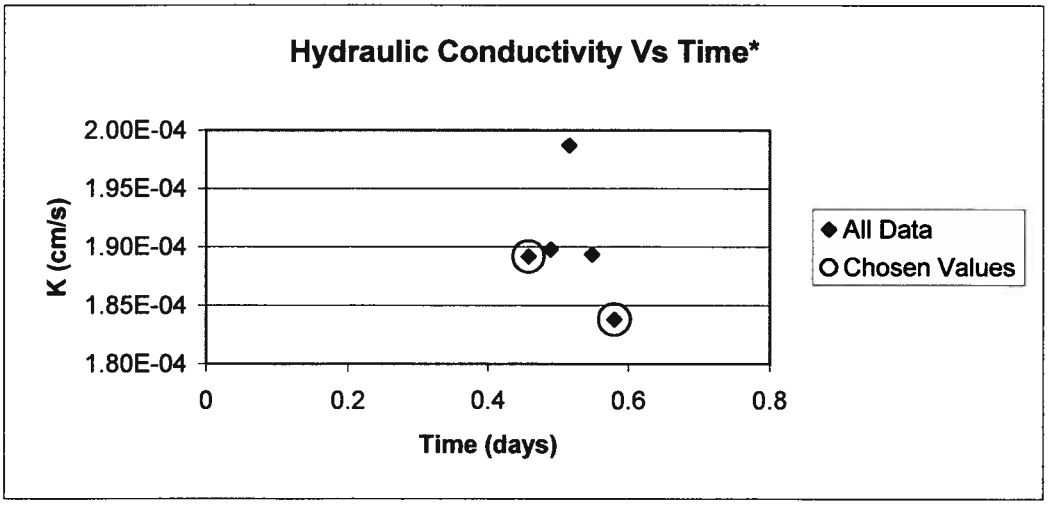
Project Name: EDi SNL Mixed Waste Landfill Cover

Sampled By: Jon Schermerhorn
Date Sampled: 07/20/2009
Visual Description of Material: Brown Silty Sand
Sample Source: EDI NS Lift 7 GB 5 Retest

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.11	**INITIAL GRAVIMETRIC WATER CONTENT**	12.2%
INITIAL LENGTH	7.58	**INITIAL DRY BULK DENSITY**	111.0
FINAL DIAMETER	6.11	**FINAL GRAVIMETRIC WATER CONTENT**	20.1%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	A:Constant Head	**% OF D698 PROCTOR**	94.8%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	100.0%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.4
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	1.90E-04
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	1.87E-04



* All hydraulic conductivity values normalized to a water viscosity at 20° C

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1901 Candelaria Rd., NW
Albuquerque, NM 87107

Report Date: 08/07/2009

Attn: Chris Edgmon

Project #: 9-517-00022D
Work Order #: 21
Lab #: 9-0817-03

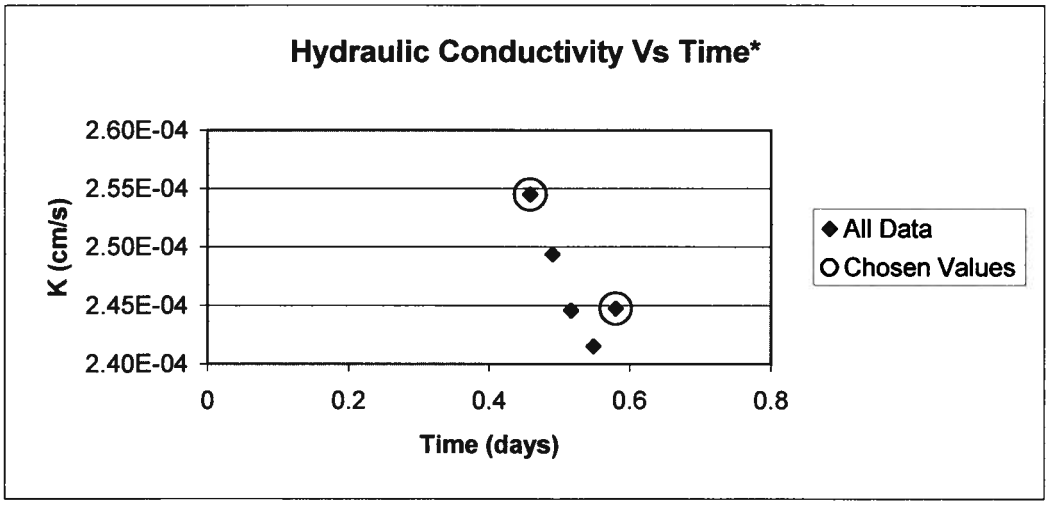
Project Name: EDi SNL Mixed Waste Landfill Cover

Sampled By: Jon Schermerhorn
Date Sampled: 07/22/2009
Visual Description of Material: Silty Clayey Sand
Sample Source: EDI NS Lift 7 GB 13

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.12	**INITIAL GRAVIMETRIC WATER CONTENT**	12.6%
INITIAL LENGTH	7.58	**INITIAL DRY BULK DENSITY**	104.7
FINAL DIAMETER	6.12	**FINAL GRAVIMETRIC WATER CONTENT**	22.3%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	A:Constant Head	**% OF D698 PROCTOR**	89.5%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	100.0%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.5
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	2.45E-04
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	2.50E-04



* All hydraulic conductivity values normalized to a water viscosity at 20° C

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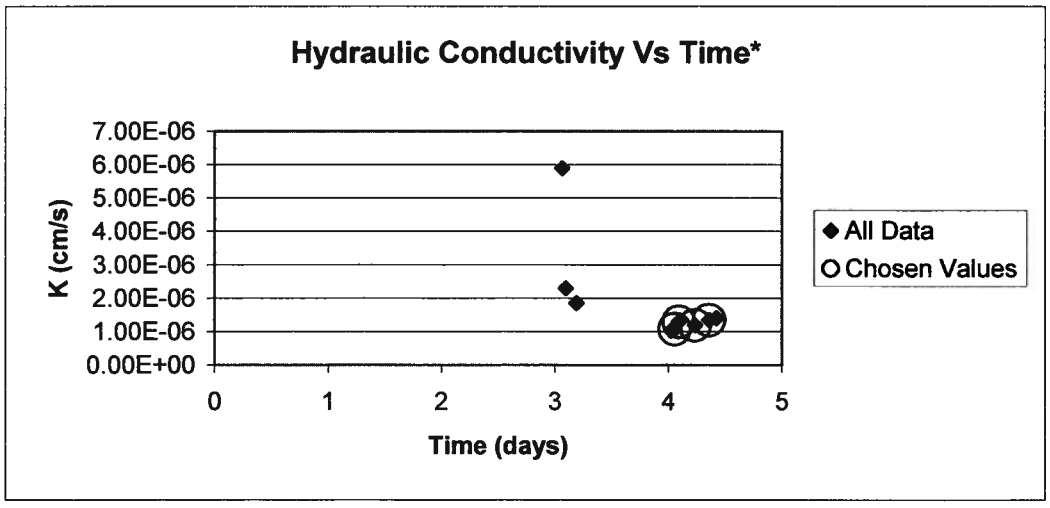
Client:	Environmental Dimentions Inc 1901 Candelaria Rd, NW Albuquerque, NM 87107	**Report Date:**	08/17/2009
Attn:	Chris Edgmon	**Project #:** **Work Order #:** **Lab #:**	9-517-00022D 22 9-0837-01
Project Name:	EDi SNL Mixed Waste Landfill Cover	**Sampled By:** **Date Sampled:** **Visual Description of Material:** **Sample Source:**	Client 07/27/2009 Brown Silty Sand EDI NS Lift 8 GB 2

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.10	**INITIAL GRAVIMETRIC WATER CONTENT**	12.1%
INITIAL LENGTH	7.60	**INITIAL DRY BULK DENSITY**	105.8
FINAL DIAMETER	6.10	**FINAL GRAVIMETRIC WATER CONTENT**	23.2%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	B:Falling Head/Constant Tail	**% OF D698 PROCTOR**	90.4%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	100.0%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.3
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	1.17E-06
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	1.22E-06



* All hydraulic conductivity values normalized to a water viscosity at 20° C

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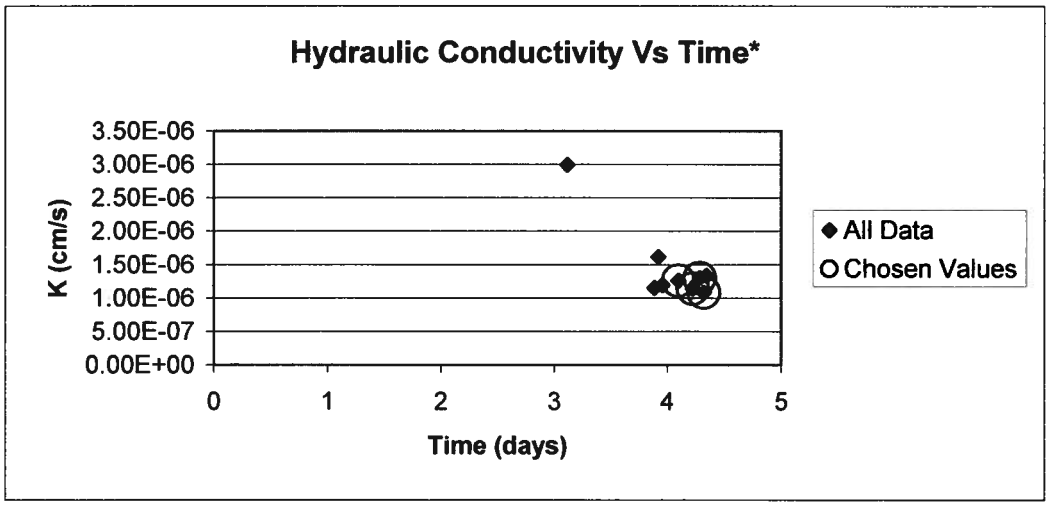
Client:	Environmental Dimentions Inc 1901 Candelaria Rd, NW Albuquerque, NM 87107	**Report Date:**	08/17/2009
		Project #:	9-517-00022D
Attn:	Chris Edgmon	**Work Order #:**	22
		Lab #:	9-0837-02
Project Name:	EDi SNL Mixed Waste Landfill Cover	**Sampled By:**	Client
		Date Sampled:	07/27/2009
		Visual Description of Material:	Brown Silty Sand
		Sample Source:	EDI NS Lift 8 GB 7

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.09	**INITIAL GRAVIMETRIC WATER CONTENT**	12.0%
INITIAL LENGTH	7.60	**INITIAL DRY BULK DENSITY**	105.3
FINAL DIAMETER	6.09	**FINAL GRAVIMETRIC WATER CONTENT**	21.4%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	B:Falling Head/Constant Tail	**% OF D698 PROCTOR**	90.0%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	100.0%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.3
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	1.10E-06
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	1.23E-06



* All hydraulic conductivity values normalized to a water viscosity at 20° C

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Client: Environmental Dimentions Inc
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Albuquerque, NM 87107

Report Date: 08/17/2009

Attn: Chris Edgmon

Project #: 9-517-00022D
Work Order #: 22
Lab #: 9-0837-03

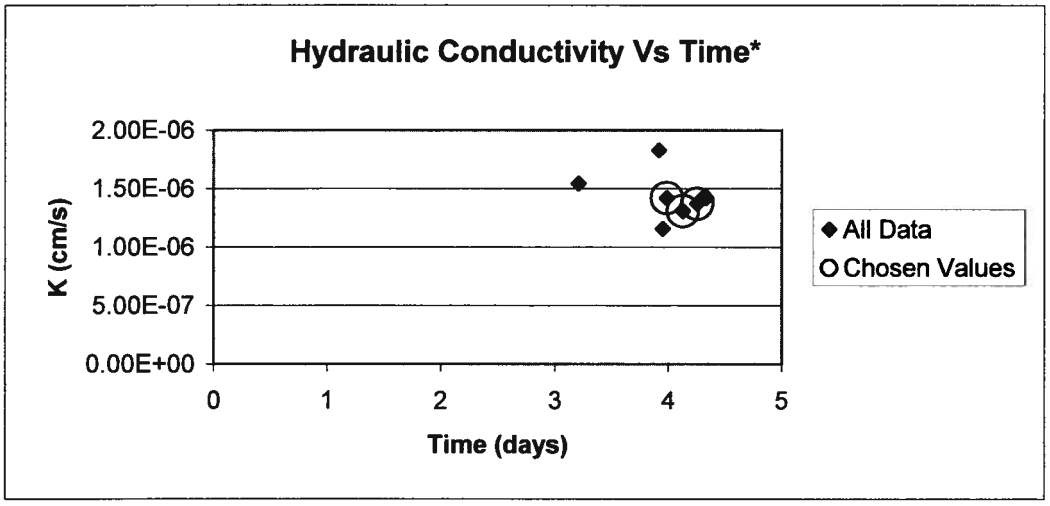
Project Name: EDi SNL Mixed Waste Landfill Cover

Sampled By: Client
Date Sampled: 07/27/2009
Visual Description of Material: Brown Silty Sand
Sample Source: EDI NS Lift 8 GB 9

Measurement of Hydraulic Conductivity of Porous Material Using a Rigid Wall, Compaction-Mold Permeameter (ASTM D5856-95)

INITIAL DIAMETER	6.09	**INITIAL GRAVIMETRIC WATER CONTENT**	12.5%
INITIAL LENGTH	7.60	**INITIAL DRY BULK DENSITY**	105.3
FINAL DIAMETER	6.09	**FINAL GRAVIMETRIC WATER CONTENT**	18.8%
FINAL LENGTH	NO DATA	**FINAL DRY BULK DENSITY**	NO DATA
TEST METHOD USED	B:Falling Head/Constant Tail	**% OF D698 PROCTOR**	90.0%
PERMEANT LIQUID	TAP WATER	**SPECIFIC GRAVITY**	2.65
PERCENT SWELL	NA	**DEGREE OF SATURATION**	89.1%

SPECIFIC GRAVITY ASSUMED? (Y/N)	Y
PERMEAMETER TOP ALLOWS SWELLING? (Y/N)	N
CONTROLLED VERTICAL STRESS APPLIED? (Y/N)	N
TOTAL PORE VOLUMES RUN THROUGH SAMPLE	0.3
AVERAGED K_{sat} VALUE OF LAST FOUR READINGS (cm/s)*	1.38E-06
AVERAGED K_{sat} VALUE OF CHOSEN READINGS (cm/s)*	1.36E-06



* All hydraulic conductivity values normalized to a water viscosity at 20° C

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ATTACHMENT 8

Summary Report for the Extension of Monitoring Well MWL-MW4 at the Mixed Waste Landfill

Sandia National Laboratories

Sandia National Laboratories/New Mexico Environmental Restoration Project

SUMMARY REPORT FOR THE EXTENSION OF MONITORING WELL MWL-MW4 AT THE MIXED WASTE LANDFILL

JANUARY 2010
Revision 1

United States Department of Energy
Sandia Site Office

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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ACRONYMS AND ABBREVIATIONS

bgs	Below ground surface
CMIP	Corrective Measures Implementation Plan
ET	Evapotranspirative
ER	Environmental Restoration
ft	foot (feet)
KAFB	Kirtland Air Force Base
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
OD	outside diameter
PC	protective casing
PVC	polyvinyl chloride
RCT	Radiological Control Technician
SNL/NM	Sandia National Laboratories/New Mexico
WDC	WDC Exploration and Wells

1.0 INTRODUCTION

This report documents the activities for the extension of the well and protective casing (PC) for the existing groundwater monitoring well MWL-MW4 at the Mixed Waste Landfill (MWL) at Sandia National Laboratories/New Mexico (SNL/NM). This activity was performed in May and August 2009 by the SNL/NM Environmental Restoration (ER) Project personnel and the drilling contractor WDC Exploration and Wells (WDC) as part of the MWL Evapotranspirative (ET) Cover Construction project.

1.1 Site Description and History

The MWL is located in the central part of Kirtland Air Force Base (KAFB), south of the City of Albuquerque, New Mexico. Within KAFB, the MWL is located in the north-central part of SNL/NM Technical Area 3, on federally owned land controlled by KAFB and permitted to the U.S. Department of Energy (Figure 1-1). The MWL accepted low-level radioactive waste and minor amounts of mixed waste from SNL/NM research facilities from March 1959 to December 1988. Approximately 100,000 cubic feet of low-level radioactive waste (excluding packaging, containers, demolition and construction debris, and contaminated soil) containing 6,300 curies of activity (at the time of disposal) were disposed of at the MWL.

1.2 Objective

The objective of this project was to extend the inner polyvinyl chloride (PVC) well casing and outer PC of well MWL-MW4 so that the well could be accessed and sampled after the MWL ET Cover installation was completed. The location of MWL-MW4 and the locations of former waste burial trenches and cells are shown in Figure 1-2.

The extension of MWL-MW4 was completed in accordance with specifications contained in Section 02670 of the MWL Corrective Measures Implementation Plan (CMIP) (SNL/NM November 2005, Appendix A), with three minor variances that are described in Section 3.0 of this report. The CMIP received conditional approval from the New Mexico Environment Department (NMED) in December 2008 (Bearzi December 2008), and all conditions related to construction of the ET Cover were incorporated into the CMIP through replacement pages that were submitted to the NMED in February 2009 (Davis February 2009).

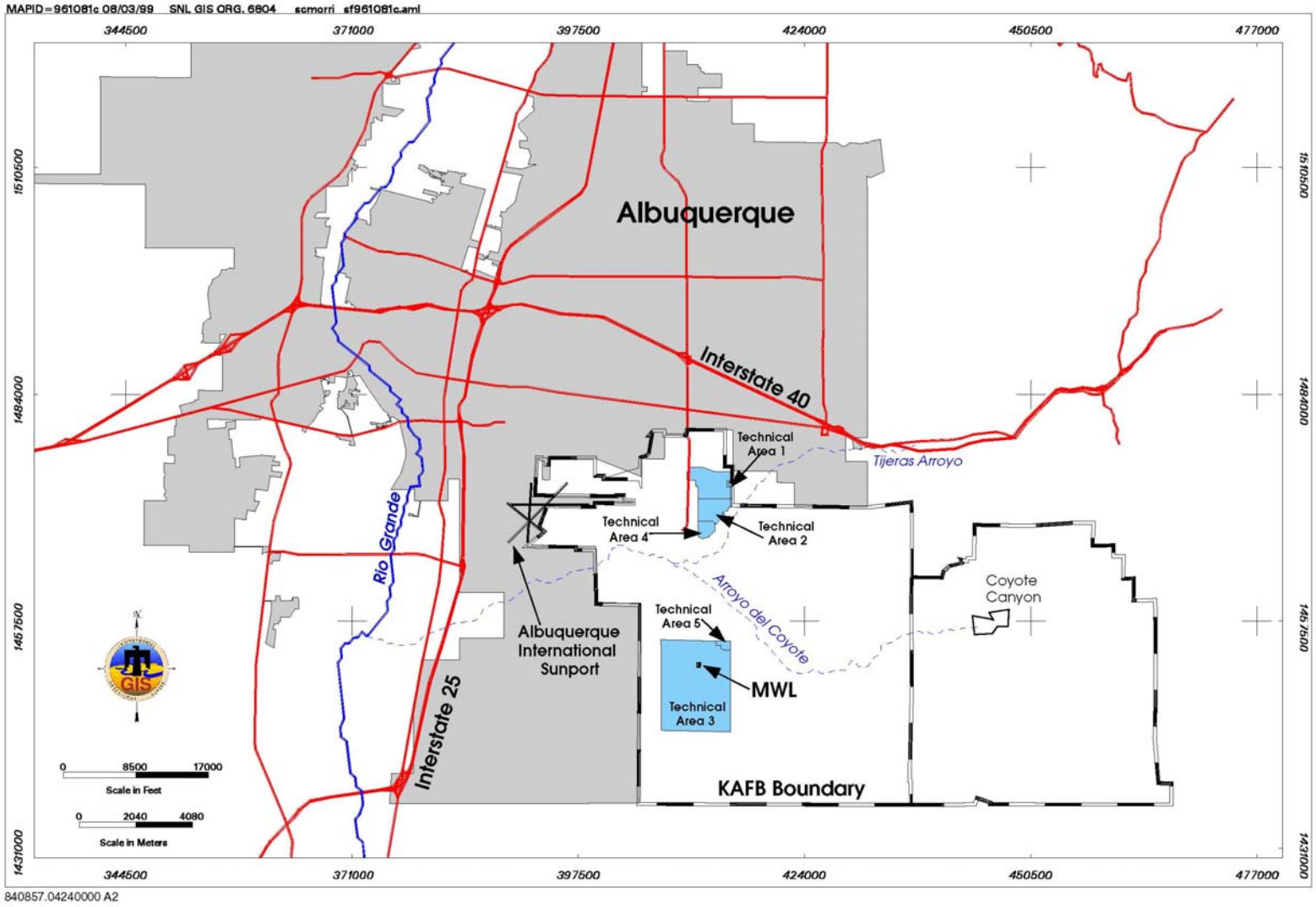

Figure 1-1
Location of Kirtland Air Force Base and Sandia National Laboratories, New Mexico

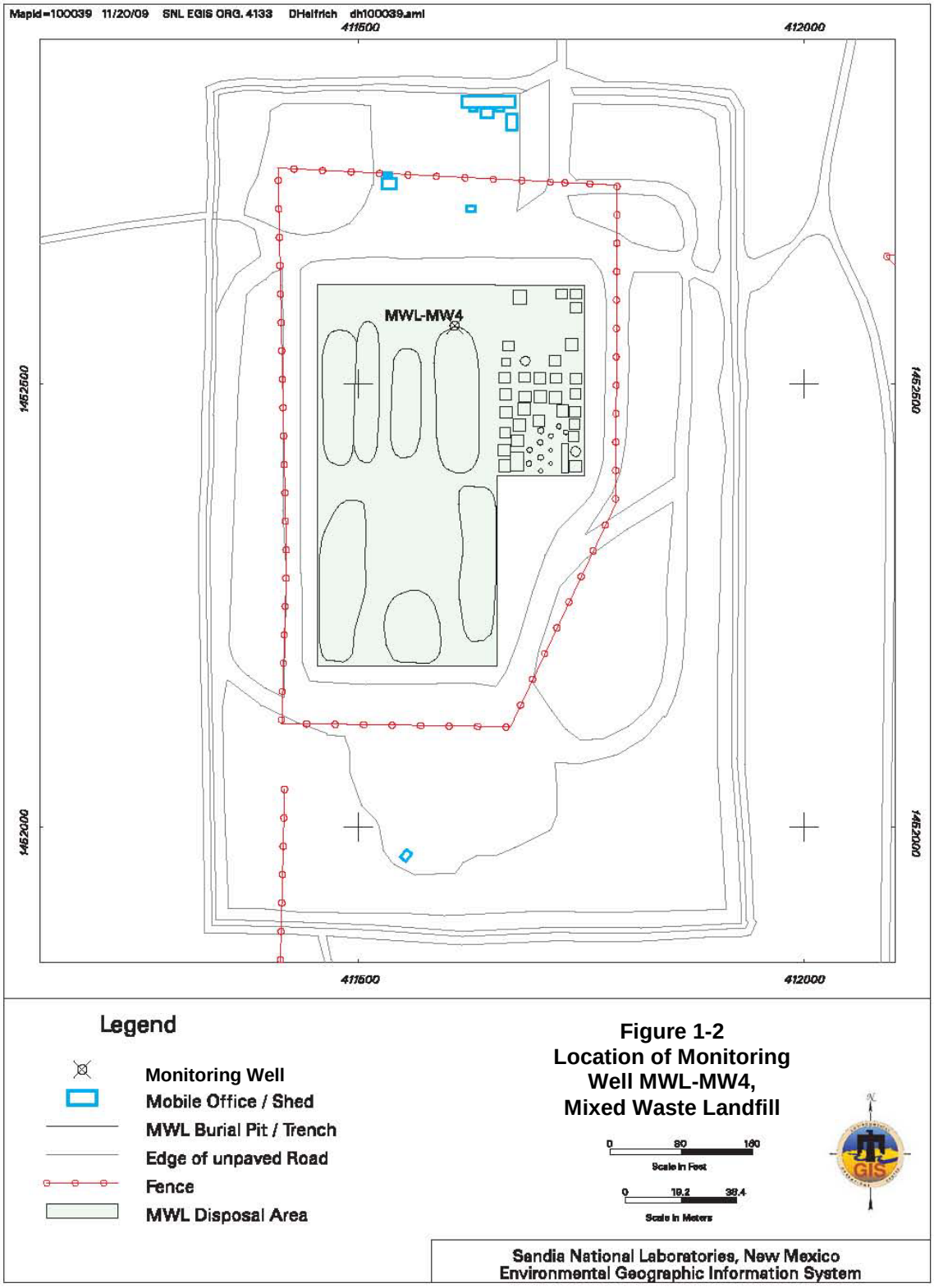

Figure 1-2
Location of Monitoring Well MWL-MW4, Mixed Waste Landfill

2.0 WELL MWL-MW4 CASING EXTENSION

Monitoring well MWL-MW4 was installed in February 1993, and groundwater samples are currently collected from the well on an annual basis. The added thickness of the MWL ET Cover required that the inner PVC well casing and the outer steel PC be extended above the final grade of the ET Cover in order for the well to remain accessible for sampling.

MWL-MW4 was installed at an angle of 6 degrees from vertical, and the well contains two 20-foot-long well screens. Relative to the original MWL ground surface, the upper screen was placed at 482.5 to 502.5 feet (ft) below ground surface (bgs), and the lower screen was placed at 522.5 to 542.5 ft bgs, with 20 ft of blank casing that separates the upper and lower screens. A Baski™ inflatable packer was installed in the well at a depth of approximately 510 ft below the original MWL surface to prevent cross-connection and mixing of groundwater that enters the well through the two well screens. The packer is attached to approximately 510 ft of 2-inch-diameter, galvanized pipe, which is used to remove the packer and reinstall it in the well when maintenance of the unit is required.

As part of the preparation for ET Cover construction, the Subgrade was installed on top of the original MWL surface from October through December 2006. As part the Subgrade Construction phase, the MWL-MW4 protective bollards were removed, and the original concrete well pad was buried under the Subgrade layer. No other modifications to the original MWL-MW4 well completion were made during Subgrade Construction activities.

The MWL-MW4 well extension task consisted of removing the packer and then extending both the inner PVC well casing and the outer steel PC. On May 27, 2009, personnel and a monitoring well development rig provided by WDC were mobilized to the MWL. The development rig was positioned next to MWL-MW4 so that the packer could be pulled from the well. SNL/NM personnel from the ER Field Office assisted in the packer removal operation. The packer bladder was deflated, and the packer and pipe were removed from the well. The packer removal operation is shown in Figure 2-1. An SNL/NM Radiological Control Technician (RCT) also completed a radiological screening survey of the packer and pipe to verify the absence of radiological contamination as the equipment was removed from the well (Figure 2-2). The screening survey confirmed there was no radiological contamination on the packer or pipe.

Following packer removal, preparations to extend the PVC well casing and PC commenced. At the time the extension work was completed, the existing 10.75-inch outside diameter (OD) steel PC for the well extended approximately 1.7 ft above the existing Subgrade surface, and the 5.5-inch OD, Schedule 80 PVC casing extended approximately 0.8 ft above the Subgrade surface. A cutting torch was used to cut the PC to approximately 0.5 ft above the Subgrade. This was done so the top of the PVC well casing could be accessed and extended. Once the height of the PC was reduced and the PVC casing exposed, a 5.5-inch inside diameter by 8-inch-long PVC slip coupling was placed over the existing PVC casing. A new piece of 5.57-ft-long, 5.5-inch OD, Schedule 80 PVC casing was then placed into the slip coupling, and the coupling was secured to the existing and new PVC casing with stainless steel screws (Figure 2-3). No adhesive or glue was used to extend the well casing. The final height of the extended PVC casing is 7.42 ft above the original MWL surface, and 1.53 ft above the completed ET Cover surface.

Figure 2-1
Removing the packer assembly from well MWL-MW4,
May 27, 2009. View to the east.

Figure 2-2
Screening the MWL-MW4 packer for radiological contamination by an RCT,
May 27, 2009. View to the south.

Figure 2-3
Extending the MWL-MW4 PVC well casing, attached to the existing PVC casing with a PVC slip coupling and stainless steel screws, May 27, 2009.
View to the east.

The final well extension step consisted of extending the steel PC above the top of the extended PVC casing. This was accomplished by lowering an approximate 8-ft-length of 10.75-inch OD steel PC over the extended PVC and welding it to the top of the PC (Figure 2-4). The final height of the extended PC is 8.39 ft above the original MWL surface, 2.50 ft above the completed ET Cover surface, and approximately 1 ft above the top of the extended PVC casing. The length of the extended PC was planned such that the new top of the PC would end up at approximately 3 ft above the final finished grade of the ET Cover. A well cap was installed to seal the PVC casing, and the outer locking well cap that was attached to the original well PC was reattached and locked with a keyed padlock.

Construction of the ET Cover commenced on May 20, 2009, and was completed on August 12, 2009. In order to avoid damaging the extended well, the various lifts of the ET Cover Native Soil Layer were compacted using a manually operated compactor within a 3-ft perimeter established around MWL-MW4.

On August 13, 2009, WDC personnel returned to the site and completed the final protective measures around the extended MWL-MW4. This was accomplished after completion of the final ET Cover layer (i.e., the Topsoil Layer) on August 12, 2009, but prior to tilling, seeding, and mulching of the Topsoil Layer. A new 4- by 4-ft by 4-inch-thick concrete well pad was constructed around the PC, and a new brass cap stamped with the well name was placed in the concrete while it was still wet. Three 5-inch-diameter by 5-ft-long protective bollards were installed around the well pad to a depth of 2 ft below the final ET Cover surface. The bollards were anchored by filling the surrounding hole with concrete. The concrete well seal was extended in the well annulus from the top of the preexisting seal up to the approximate final finished ET Cover surface grade. The bollards and surface casing were then painted with high-visibility yellow paint.

On November 12, 2009, a New Mexico-Registered Professional Surveyor with Surveying Control, Inc. established new northing and easting coordinates and elevations for the extended MWL-MW4 well. The new northing and easting coordinates were established for the center of the removable sealing cap placed in the top of the extended PVC casing. Because MWL-MW4 is an angle well, new northing and easting coordinates are slightly different from the original coordinates that were established for this well in 1993. The new elevations were established for the following points:

- Ground surface on the north side of the well pad
- Well pad (measurement taken on the brass cap)
- North side of the extended PVC well casing
- North side of the extended PC, with the locking cover removed

Table 2-1 summarizes the changes to the ground surface and top of well PVC elevations and provides screen depths, total depths, and depths to the groundwater pump inlet resulting from the ET Cover construction and extension of MWL-MW4.

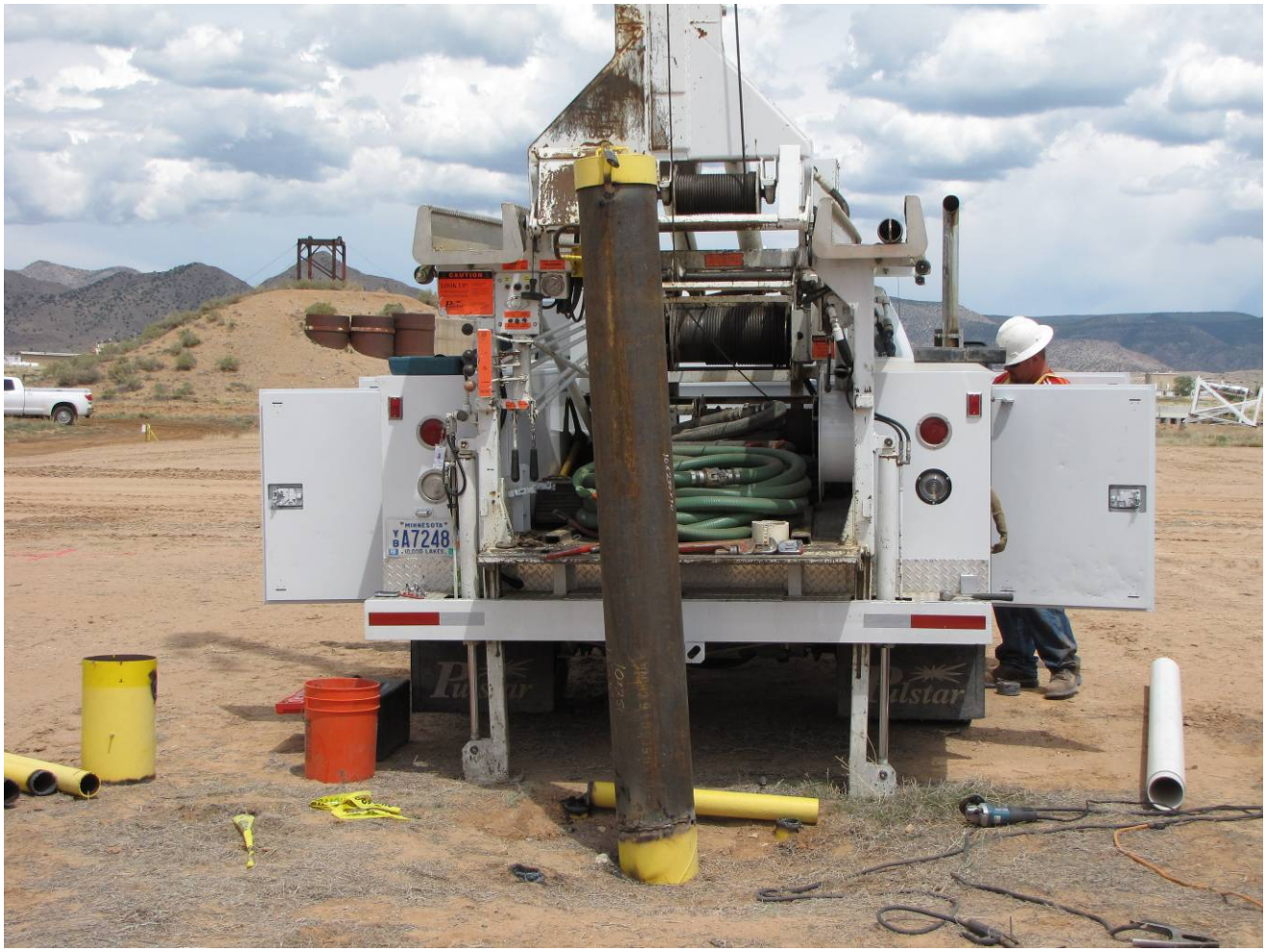

Figure 2-4
MWL-MW4 protective surface casing extension, welded to the existing protective surface casing, May 27, 2009. View to the east.

Table 2-1
Summary of Elevation and Depths Below Ground Surface Changes for the Original and Extended MWL-MW4 Well, Mixed Waste Landfill

	Ground Surface Elevation (famsl)	Top of PVC Casing Elevation (famsl)	Depth to Tops and Bottoms of Screens (ft bgs)	Total Depth of Well (bottom of sump) (ft bgs)	Depth of groundwater sampling pump inlet (set at bottom of upper screen)
MWL-MW4 (original well)	5381.61	5383.46	482.5–502.5, 522.5–542.5	548	502.5 ft bgs, 504.35 ft btoc
MWL-MW4 (extended well)	5387.5 (5.89 ft above original MWL surface)	5389.03 (5.57 ft above top of original PVC well casing)	488.39–508.39, 528.39–548.39	553.89	508.39 ft bgs, 509.92 ft btoc

Note: Depths bgs in this table are measured along the hypotenuse of this 6-degree angled well, and are not converted to vertical distances.
bgs = Below ground surface.
btoc = Below top of (PVC) casing.
famsl = Feet above mean sea level.
ft = Feet.
MWL = Mixed Waste Landfill.
PVC = Polyvinyl chloride.

A schematic profile diagram showing both the constructed configuration of MWL-MW4 when it was installed in 1993 and the well configuration after the PVC casing and PC were extended is provided in Figure 2-5, and a revised well construction diagram that contains the new survey coordinates and elevations is presented in Figure 2-6.

The packer will be reinstalled in MWL-MW4 by WDC in early 2010, after vegetation has been reestablished on the finished ET Cover surface, and the packer has been refurbished by the manufacturer.

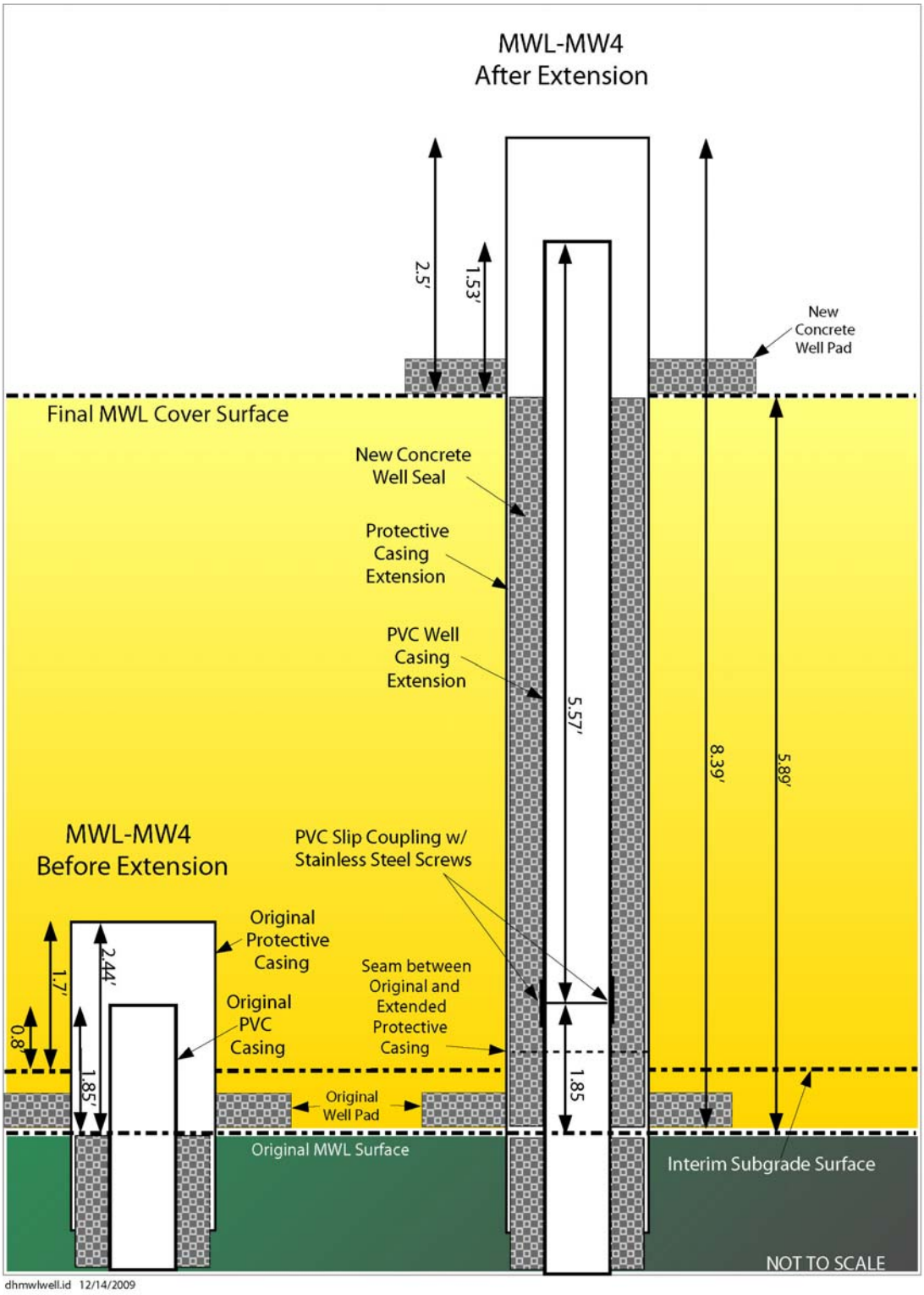

Figure 2-5
Schematic MWL-MW4 PVC Well Casing and Protective Surface Casing Extension Diagram

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA III
ER ADS #:	1289	**Well Completion Date:**	10-FEB-1993
Well Name:	MWL-MW4	**Completion Zone:**	FINE MEDIUM SAND/GRAVELLY SAND
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	16-DEC-1992	**Well Comment:**	MWL-MW4 IS AN ANGLE WELL, INSTALLED AT A 6-DEGREE ANGLE FROM VERTICAL. 2 SCREENED INTERVALS EXIST.
Drilling Contractor:	WATER DEVELOPMENT CORP.		
Drilling Method:	SONIC/DRY		WELL PVC & PROTECTIVE CASING EXTENDED ON 5/27/09 AND RE-SURVEYED 11/12/09. NEW N, E IS TOP CENTER OF PVC CASING.
Borehole Depth:	552.5 FBGS		
Casing Depth:	548 FBGS		

Survey Data

Survey Date: 12-NOV-2009

Surveyed By: SURVEYING CONTROL, INC.

State Plane Coordinates

(X) Easting: 411607.97

(Y) Northing: 1452565.72

Surveyed Elevations (FAMSL)

Protective Casing:	5390
Top of Inner Well Casing:	5389.03
Concrete Pad:	5388.1
Ground Surface:	5387.5

Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4896.46
Initial Depth To Water: (FBGS)	487

Last measured water level was 4888.67 **FAMSL** **measured on** 07-APR-2009

Date Updated: 19-NOV-2009

Date Printed: 19-NOV-2009

Completion Data Measured Depths (FBGS)

Casing Stickup: .93

Interval	**Start**	**Stop**	
GROUT/BACKFILL	0'	473'	
VOLCLAY			
Interval	**Start**	**Stop**	
CASING	0'	548'	
SCH 80 PVC	**I.D.** 4.768"	**O.D.** 5.563"	
Interval	**Start**	**Stop**	
BOREHOLE	0'	552.5'	
		O.D. 11"	
Interval	**Start**	**Stop**	
SECONDARY PACK	473'	508'	
40/60 MESH			
Interval	**Start**	**Stop**	
SCREEN	482.5'	502.5'	
	Slot Size	.01"	
Interval	**Start**	**Stop**	
SEAL	503'	520'	
VOLCLAY/BENTONITE			
Interval	**Start**	**Stop**	
PRIMARY PACK	520'	552.5'	
40/60 MESH			
Interval	**Start**	**Stop**	
SCREEN	522.5'	542.5'	
	Slot Size	.01"	
Interval	**Start**	**Stop**	
SUMP	542.5'	548'	

Figure 2-6
MWL-MW4 Construction Diagram

3.0 VARIANCES

The scope of work for the extension of well MWL-MW4 was provided in Section 02670 of the MWL CMIP (SNL/NM November 2005, Appendix A). There were three minor variances from specifications in Part 3 (Execution) of Section 02670 of the CMIP, as follows:

- Item 1 of Section 3.1 specifies that the Contractor shall remove the existing MWL-MW4 concrete pad, stanchions, protective surface casing, and locking top cap prior to initiation of construction activities. However, when the well extension work commenced, the original concrete well pad had already been covered by the MWL ET Cover Subgrade to create a double anchor for greater stability. In addition, the original protective surface casing was not removed, rather, it was extended as described in Section 2.0 of this report. The original stanchions (bollards) were removed and recycled, and the original locking top cap was removed and reused on the extended protective surface casing. A new concrete well pad was constructed around the extended PC after the ET Cover was completed. The final result is a more stable, double-anchored configuration, with the double anchor formed by the two concrete well pads.

- Item 3 of Section 3.1 specifies that the existing MWL-MW4 Schedule 80 PVC well casing was to be extended such that the top of the PVC well casing is located a minimum of 2.5 ft above the final grade of the constructed ET Cover. As shown in Figure 2-5, the finished height of the extended PVC casing above the finished ET Cover surface is approximately 1.5 ft because the elevation of the finished ET Cover was slightly higher than originally planned (average ET cover thickness is approximately 1.2 ft greater than the minimum cover thickness specifications in the CMIP). MWL-MW4 is still fully functional, and the slightly reduced final height of the extended PVC casing above the ET Cover surface in no way hinders access to the well for future sampling.

- Item 6 of Section 3.1 specifies that the four corners of the new MWL-MW4 concrete well pad will be surveyed. However, in accordance with long-established SNL/NM monitoring well surveying procedures, and as described in Attachment B of SNL/NM FOP [Field Operating Procedure] 94-71 (SNL/NM May 1994), the elevation of the concrete pad was determined by surveying the pad at one point (on the brass cap embedded into the concrete pad), rather than at each of the four corners of the pad.

4.0 REFERENCES

Bearzi, J.P. (New Mexico Environment Department), December 2008. Letter to K. Davis (U.S. Department of Energy) and F. Nimick (Sandia Corporation), "Conditional Approval, Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005, Sandia National Laboratories NM5890110518, SNL-05-025." December 22, 2008.

Davis, K. (U.S. Department of Energy), February 2009. Letter to J. Bearzi (New Mexico Environment Department), submitting requested changes in the form of replacement pages in response to the Mixed Waste Landfill Conditional Approval letter from the New Mexico Environment Department dated December 22, 2008. February 12, 2009.

Sandia National Laboratories/New Mexico, May 1994. "Land Surveying," FOP 94-71, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), November 2005. "Mixed Waste Landfill Corrective Measures Implementation Plan," Environmental Restoration Project, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories

Justification for Class 3 Permit Modification
Corrective Action Complete with Controls
Solid Waste Management Unit 76
Mixed Waste Landfill

October 2014

Volume V of VIII
Long-Term Monitoring and Maintenance Plan

Environmental Restoration Operations

U.S. DEPARTMENT OF ENERGY

United States Department of Energy
Sandia Field Office

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01/15/2009	NMED/Bearzi	SNL/Davis	Notice of Approval: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Wells MWL-MW1, MWL-MW2, MWL-MW3, Installation of Wells MWL-MW7, MWL-MW8, MWL-MW9	VIII	19	2
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Volume V

TAB 1

Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, September 2007

From: SNL/Wagner
To: NMED/Bearzi

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Sandia National Laboratories/New Mexico Environmental Restoration Project

LONG-TERM MONITORING AND MAINTENANCE PLAN FOR THE MIXED WASTE LANDFILL

September 2007

United States Department of Energy
Sandia Site Office

Sandia is a multiprogram laboratory managed and operated by Sandia Corporation, a wholly-owned subsidiary of Lockheed Martin Corporation, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

EXECUTIVE SUMMARY

The Mixed Waste Landfill (MWL) is an inactive landfill, designated as a Solid Waste Management Unit, at Sandia National Laboratories, New Mexico (SNL). The SNL facility is owned by the U.S. Department of Energy (DOE). SNL is managed and operated by Sandia Corporation (Sandia). Both the DOE and Sandia, hereinafter referred to as the DOE/Sandia, are co-permittees of the MWL. The MWL is located in Technical Area III of SNL which is within the boundaries of the federally-owned Kirtland Air Force Base, south of the city of Albuquerque. The MWL is undergoing corrective action in accordance with:

- Resource Conservation and Recovery Act (RCRA) regulations
- Module IV of the RCRA Permit No. NM5890110518
- New Mexico Environment Department (NMED) Class 3 Permit Modification for the MWL (NMED August 2005)
- New Mexico Secretary of the Environment Final Order No. HWB 04-11(M) in the matter of request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill No. HWB 04-11(M) (Curry May 2005)
- NMED Compliance Order on Consent (Consent Order) (NMED April 2004)

In the Final Order on the MWL, the NMED selected a vegetative soil cover with a biointrusion barrier as the final remedy and requested the identification of specific monitoring trigger levels, the exceedance of which initiates an evaluation of the need for further corrective action. This Long-Term Monitoring and Maintenance Plan (LTMMP) addresses monitoring, sampling, maintenance, and physical and institutional controls (ICs) at the MWL following the final remedy implementation (installation of the cover). The purpose of long-term monitoring is to ensure that the final remedy for the MWL is protective of human health and the environment. The DOE/Sandia will meet the long-term monitoring requirements for the MWL through various activities identified in this LTMMP. The scope and frequency of these activities along with prescribed actions to be implemented are detailed.

The DOE/Sandia will monitor air, surface soil, vadose zone, groundwater, and biota to determine whether the MWL cover is performing as designed. The DOE/Sandia have identified parameters to monitor based upon the results of the probabilistic performance-assessment modeling conducted for the MWL (Ho et al. January 2007) and input from the NMED and the public. The following parameters will be monitored:

- Radon concentrations in the air
- Tritium, gamma-emitting radionuclides, and metal concentrations in surface soil
- Soil moisture in the vadose zone
- Volatile organic compound (VOC) concentrations in the vadose zone
- VOC, uranium, and radionuclide concentrations in groundwater
- Gamma-emitting radionuclides in biota

The monitoring and sampling activities, frequencies, and analytical methods are presented for each parameter. Sampling and analysis plans are provided in the appendices detailing specific sampling procedures and applicable data quality objectives. Although monitoring is planned for radionuclides in various media at the MWL, the information related to radionuclides is provided voluntarily by the DOE/Sandia.

Monitoring triggers have been established as the criteria against which the monitoring results will be compared. In the event that a trigger level is exceeded, an evaluation process is in place that allows for sufficient data to be collected to assess trends and determine whether corrective action is warranted. Specific triggers include numerical thresholds derived from U.S. Environmental Protection Agency, DOE, and NMED regulatory standards, as well as NMED-approved background concentrations for select radionuclides.

Routine surveillance and maintenance of the cover and associated facilities will also be performed to ensure the integrity of the cover. Surveillance will be conducted on the following:

- Physical condition (vegetation survey, signs of erosion, settlement, water ponding, intrusion by animals, contiguous areas lacking vegetation)
- Surface-water diversion structures
- Groundwater monitoring wells, soil-vapor sampling wells, and neutron access tubes
- Security fence, signs, gates and locks, and survey benchmarks

Maintenance will be performed to prevent deterioration or failure of any feature of the cover or associated facilities and, if needed, corrective action will be taken to restore conditions to the original specifications.

ICs are a key element of the long-term monitoring and maintenance strategy for the MWL. Categories of ICs in place at the MWL include:

- Government ownership
- Entry restrictions
- Warning notices
- Active controls
- Resource-use management
- Site information systems

The application of multiple ICs at the MWL is consistent with a conservative strategy that incorporates multiple, independent layers of safety to protect human health and the environment. In the event of the temporary failure of a control, others are in place to mitigate significant consequences of the failure.

Contingency procedures are addressed through the trigger evaluation process, which will be used to evaluate any monitoring results that exceed the specified triggers. Potential failure scenarios are presented, along with possible corrective action responses. Any such response will be assessed on a situation-specific basis in cooperation with the NMED.

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ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
CFR	Code of Federal Regulations
Ci	curie(s)
cm	centimeter(s)
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
FLUTe™	Flexible Liner Underground Technologies
g	gram(s)
HSWA	Hazardous and Solid Waste Amendments
HWB	Hazardous Waste Bureau
IC	institutional control
KAFB	Kirtland Air Force Base
L	liter(s)
LTES	Long-Term Environmental Stewardship
LTMMP	Long-Term Monitoring and Maintenance Plan
m^2	square meter
MCL	maximum contaminant level
μg	microgram(s)
mm	millimeter(s)
MP	Monitoring Plan
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
NOD	Notice of Disapproval
P&A	plug and abandonment
PCE	tetrachloroethane
pCi	picocurie(s)
ppb	part(s) per billion
ppmv	part(s) per million by volume
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RWP	Radiological Work Permit
s	second
Sandia	Sandia Corporation
SAP	Sampling and Analysis Plan
SNL	Sandia National Laboratories
SNL/NM	Sandia National Laboratories/New Mexico
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit

ACRONYMS AND ABBREVIATIONS (Concluded)

TA	Technical Area
TCE	trichloroethene
UNM	University of New Mexico
VOC	volatile organic compound
yr	year

1.0 INTRODUCTION

The Mixed Waste Landfill (MWL) at Sandia National Laboratories/New Mexico (SNL/NM) is a Solid Waste Management Unit (SWMU) undergoing corrective action in accordance with the Resource Conservation and Recovery Act (RCRA) regulations, the New Mexico Secretary of the Environment's Final Order in the matter of request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill No. HWB 04-11(M) (Curry May 2005), the New Mexico Environment Department (NMED) Class 3 Permit Modification for the MWL (NMED August 2005), and the Compliance Order on Consent (Consent Order) (NMED April 2004).

On May 26, 2005, the NMED issued the Final Order on the MWL selecting a vegetative soil cover with biointrusion barrier as the final remedy for the MWL. The NMED Final Order and the Class 3 Permit Modification require the development of this Long-Term Monitoring and Maintenance Plan (LTMMP) to address monitoring, maintenance, and physical and institutional controls (ICs) at the MWL following remedy implementation.

1.1 Purpose

This LTMMP describes how the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia), hereinafter referred to as the DOE/Sandia, will meet the long-term monitoring requirements for the MWL. This plan describes the necessary physical controls and ICs to be implemented, the maintenance and monitoring activities for the cover, and the frequencies at which they will be conducted. These activities will be performed to ensure that the MWL vegetative soil cover and biointrusion barrier will perform as designed and will continue to protect human health and the environment.

1.2 Regulatory Background

On November 3, 2005, the DOE/Sandia submitted a Corrective Measures Implementation (CMI) Plan (SNL/NM November 2005) incorporating the final remedy selected by the NMED. The CMI Plan presented the design for a 3-foot-thick, vegetated soil cover, underlain by a 1-foot-thick biointrusion barrier and a subgrade layer that varies from 2 to 40 inches in thickness. The CMI Plan also included detailed engineering design drawings and construction specifications, a construction quality assurance plan, and the results of a fate and transport model with proposed triggers for corrective action.

In November 2006, the NMED submitted a Notice of Disapproval (NOD) on the MWL CMI Plan (NMED November 2006). The NOD contained two sets of comments, requesting 1) clarification regarding the MWL cover design and fate and transport model, and 2) additional triggers for long-term monitoring. The DOE/Sandia responses to the NOD included clarifications regarding the MWL cover design, the fate and transport model, and a revised list of monitoring triggers for long-term monitoring (Sandia Corporation December 2006 and January 2007). The revised triggers for long-term monitoring are discussed in Chapter 5.0 of this document.

Triggers for long-term monitoring have been developed for both hazardous and radioactive constituents; however, the triggers and monitoring for radionuclides are provided voluntarily by the DOE/Sandia. The voluntary inclusion of such radionuclide information shall not be

enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements of the Consent Order. Additional information on radionuclides and the scope of the Consent Order is available in Section III.A of the Consent Order (NMED April 2004).

Although the Class 3 Permit Modification requires the Permittees (DOE/Sandia) to submit this document to the NMED within 180 days after the NMED's approval of the CMI Report, the schedule for this document has been accelerated at the NMED's request. Therefore, preparation and submission of this LTMMP occurs prior to construction of the MWL cover. The actual cover construction will take place once the NMED approves the cover design submitted in the CMI Plan (SNL/NM November 2005). To minimize requirements for future modifications to this plan once the cover is completed, the document is written in the present tense as if the cover were already completed.

The exception to this convention is the discussion of the groundwater monitoring well network. At the writing of this document, several modifications to the groundwater monitoring well network have been proposed. As important details (construction diagrams and locations) of the proposed wells could not be provided in this plan, the DOE/Sandia fully discuss the existing well network with reference to the proposed changes. Efforts have been made to include all proposed wells in the discussion, as these are critical to the long-term monitoring of the groundwater. Because the proposed wells have not yet been installed, the circumstances of their installation may change.

1.3 Legal and Regulatory Requirements

The MWL is designated as an Underground Radioactive Material Area and a Hazardous and Solid Waste Amendments (HSWA) SWMU, subject to corrective action and remedy selection under state regulations. The NMED Hazardous Waste Bureau (HWB) is the lead regulatory agency and oversees corrective action at the MWL under the corrective action provisions of the HSWA Module of the RCRA Part B Permit, issued to the DOE/Sandia by the U.S. Environmental Protection Agency (EPA) Region 6 on August 26, 1993 (EPA August 1993).

A requirement to develop an LTMMP was presented in the NMED Final Order on the MWL (Curry May 2005) and the Class 3 Permit Modification (NMED August 2005). Although the Consent Order (NMED April 2004) governs the remedy selection process for the MWL, it does not contain any requirements related to long-term monitoring, other than requirements for monitoring well replacement. Rather, the Consent Order defers to the RCRA Part B Permit (as revised by the August 2005 Class 3 Permit Modification for the MWL) for implementation of long-term controls for SWMUs.

The Class 3 Permit Modification provides the framework for the LTMMP and states the following in Section V(6):

> A long-term monitoring and maintenance plan, which includes all necessary physical and institutional controls to be implemented in the future shall be submitted by the Permittees to the Administrative Authority for approval within 180 days after the Administrative Authority's approval of the CMI Report. The Administrative Authority may require monitoring, maintenance, and physical and institutional controls different than those specified in the Corrective Measures Study report referenced in V.1 of this section. The plan shall also include contingency procedures that

must be implemented by the Permittees if the remedy set forth in Section V.2 above fails to be protective of human health and the environment.

As discussed in Section 1.2, the Class 3 Permit Modification requires the Permittees (DOE/Sandia) to submit this document to the NMED within 180 days after the NMED's approval of the CMI Report. However, the schedule for the LTMMP has been accelerated at the NMED's request, and this document is being prepared and submitted prior to the NMED's approval of the cover design provided in the MWL CMI Plan (SNL/NM November 2005).

The Class 3 Permit Modification also requires the Permittees to prepare a report every five years, reevaluating the feasibility of excavation and analyzing the continued effectiveness of the MWL remedy. The Five-Year Reevaluation Report will include a review of all major MWL documents, as well as any data collected during long-term monitoring and maintenance at the site. The report will include an update of the fate and transport model for the MWL with current data and a reevaluation of the likelihood of contaminants reaching groundwater. Finally, the Five-Year Reevaluation Report will detail all efforts to ensure any future releases or migration of contaminants are detected and addressed before there is an impact to groundwater quality or increased risk to human health or the environment. The initial Five-Year Reevaluation Report will be submitted within five years after the completion of the remedy.

1.4 Roles of the DOE and Sandia

SNL/NM is owned by the DOE as well as managed and operated by Sandia, a wholly owned subsidiary of Lockheed Martin Corporation. Sandia has a Management and Operating Contract with the DOE for Sandia National Laboratories (SNL). The DOE/Sandia serve as co-permittees for purposes of hazardous waste management and corrective action, in accordance with SNL/NM's RCRA Permit.

The DOE/Sandia are jointly responsible for preparation, revision, and implementation of the LTMMP. If the LTMMP requires amendment, the DOE/Sandia will notify the NMED in writing and will include a copy of the amended LTMMP for review and approval. Interested members of the public will be allowed to review and comment on changes to the LTMMP.

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2.0 FINAL SITE CONDITIONS

This chapter presents general information on the facility and the MWL and provides the context within which long-term monitoring activities will occur.

2.1 Location, Conditions, and Description of the MWL

This section presents a brief history of the disposal activities at the MWL and summarizes the results of the two RCRA facility investigations (RFIs) conducted at the site. Groundwater flow conditions and the MWL monitoring well network are also discussed, and surface features are summarized. Additional MWL characterization data are available in the following documents:

- Report of the Phase 1 RFI of the Mixed Waste Landfill (SNL/NM September 1990)
- Report of the Mixed Waste Landfill Phase 2 RFI, Sandia National Laboratories, Albuquerque, New Mexico (SNL/NM September 1996)
- Mixed Waste Landfill Groundwater Report, 1990 through 2001 (Goering et al. 2002)

2.1.1 Location and Description

SNL/NM is located within the boundaries of Kirtland Air Force Base (KAFB), immediately south of the City of Albuquerque in Bernalillo County, New Mexico (Figure 2.1.1-1). The MWL is located 4 miles south of SNL/NM's central facilities and 5 miles southeast of Albuquerque International Sunport. The landfill is located in the north-central portion of Technical Area (TA)-III at SNL/NM (Figure 2.1.1-2).

The MWL accepted containerized and uncontainerized low-level radioactive waste and minor amounts of mixed waste from SNL/NM research facilities and off-site DOE and U.S. Department of Defense generators from March 1959 to December 1988. Approximately 100,000 cubic feet of low-level radioactive waste (excluding packaging, containers, demolition and construction debris, and contaminated soil) containing 6,300 curies (Ci) of activity (at the time of disposal) were disposed of at the MWL. Disposal cells at the landfill are unlined and were backfilled and compacted to grade with stockpiled soil.

Two distinct disposal areas are present at the MWL: the classified area (occupying 0.6 acres) and the unclassified area (occupying 2.0 acres) (Figure 2.1.1-3). Wastes in the classified area were disposed of in a series of vertical, cylindrical pits. Historical records indicate that early pits were 3 to 5 feet in diameter and 15 feet deep; later pits were 10 feet in diameter and 25 feet deep. Once pits were filled with waste, they were backfilled with soil and capped with concrete. Wastes in the unclassified area were disposed of in a series of parallel, north-south trenches. Records indicate that trenches were 15 to 25 feet wide, 150 to 180 feet long, and 15 to 20 feet deep. Trenches were backfilled with soil on a quarterly basis and, once filled with waste, were capped with the original soil that had been excavated and locally stockpiled.

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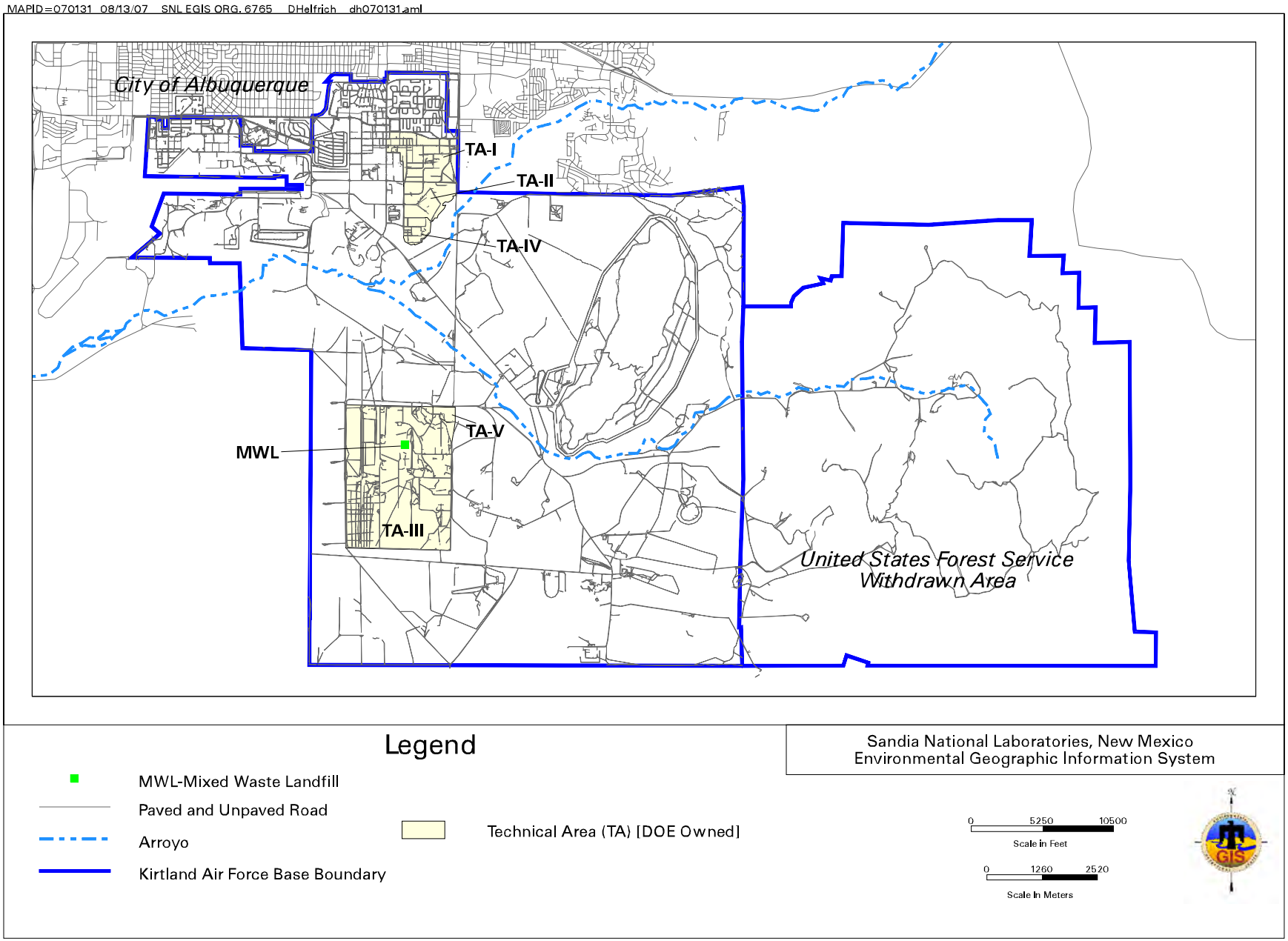


Figure 2.1.1-1 Location of Sandia National Laboratories and Kirtland Air Force Base

Legend

Road

Technical Area

Mixed Waste Landfill

Figure 2.1.1-2
Location of the Mixed Waste Landfill within Technical Area III

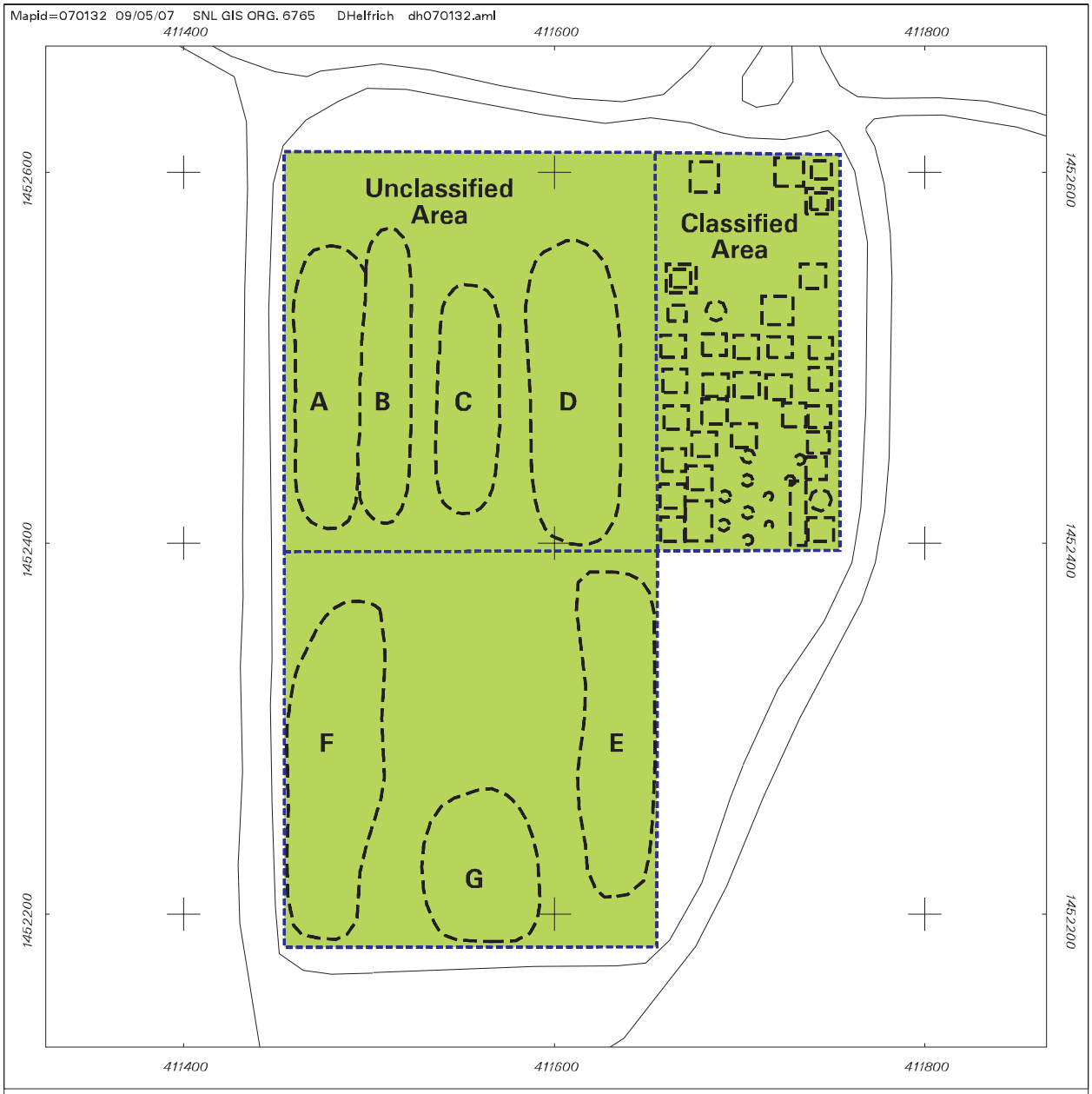
0 1000 2000
Scale in Feet

0 240 480
Scale in Meters

N

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04310000 A9.ai



Legend

- Former MWL Fence
- Pits and Trenches
- Former Road
- MWL Extent

Figure 2.1.1-3
Map of the Mixed Waste Landfill

0 45 90
Scale in Feet

0 10.8 21.6
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04310000 A51

Containment and disposal of routine waste commonly occurred using tied, double-polyethylene bags, sealed A/N cans (military ordnance metal containers of various sizes), fiberboard drums, wooden crates, cardboard boxes, and 55-gallon steel and polyethylene drums. Larger items, such as glove boxes, spent fuel shipping casks, and contaminated soil, were disposed of in bulk without containment. Disposal of free liquids was not allowed at the MWL. Liquids such as acids, bases, and solvents were solidified with commercially available agents before containerization and disposal. A detailed MWL waste inventory, by pit and trench, is provided in the Environmental Restoration (ER) Project "Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation, June 15, 1998" (SNL/NM June 1998).

A Phase 1 RFI was conducted in 1989 and 1990 to determine whether a release of RCRA contaminants had occurred at the MWL (SNL/NM September 1990). A Phase 2 RFI was conducted from 1992 to 1995 to determine the contaminant source, define the nature and extent of contamination, identify potential contaminant transport pathways, evaluate potential risks posed by the levels of contamination identified, and provide remedial action alternatives for the landfill (SNL/NM September 1996).

Both investigations revealed that tritium has migrated from the pits and trenches of the MWL. Tritium was detected during the Phase 2 RFI in surface and near-surface soil in, and around, the classified area of the landfill at levels ranging from 1,100 picocuries (pCi) per gram (g) in surface soil to 206 pCi/g in subsurface soil. The highest tritium levels were found within 30 feet below ground surface (bgs) in soil adjacent to, and directly beneath, classified area disposal pits. At distances greater than 30 feet bgs, tritium levels decrease rapidly to a few pCi/g of soil. Tritium has been detected to a maximum depth of 120 feet bgs beneath the MWL. Tritium also occurs as a diffuse air emission from the landfill. A study conducted in 2003 estimated the annual tritium flux to be 0.09 Ci/year (yr) (URS Corporation February 2004).

2.1.2 Groundwater

Groundwater occurs approximately 500 feet bgs within Santa Fe Group deposits (basin fill), in either fine-grained alluvial fan deposits or coarse-grained Ancestral Rio Grande deposits. Hydraulic conductivities average 1.64×10^{-2} feet/day in the alluvial fan deposits and 1.81 feet/day in the Ancestral Rio Grande deposits. Groundwater flows westward at an average velocity of 0.17 feet/yr in the alluvial fan deposits and 18.5 feet/yr in the Ancestral Rio Grande deposits. Figure 2.1.2-1 shows the regional potentiometric surface of the basin fill aquifer west of the Sandia fault complex. Figure 2.1.2-2 shows the localized potentiometric surface of the basin fill aquifer at TA-III. Groundwater levels beneath the MWL are declining at an average rate of 0.5 feet/yr as a result of pumping from regional production wells.

2.1.3 Surface Features

No permanent aboveground structures are located at the MWL. All disposal pits and trenches were excavated below grade. No perennial streams are present in the immediate area of the MWL. Surface runoff is regionally controlled and generally to the west. The MWL vegetative cover slopes gently and sheds surface runoff to the landfill perimeter. A drainage swale located immediately east of the landfill diverts surface runoff from the landfill. Figure 2.1.3-1 presents the final grading plan for the MWL cover and shows the location of the drainage swale.

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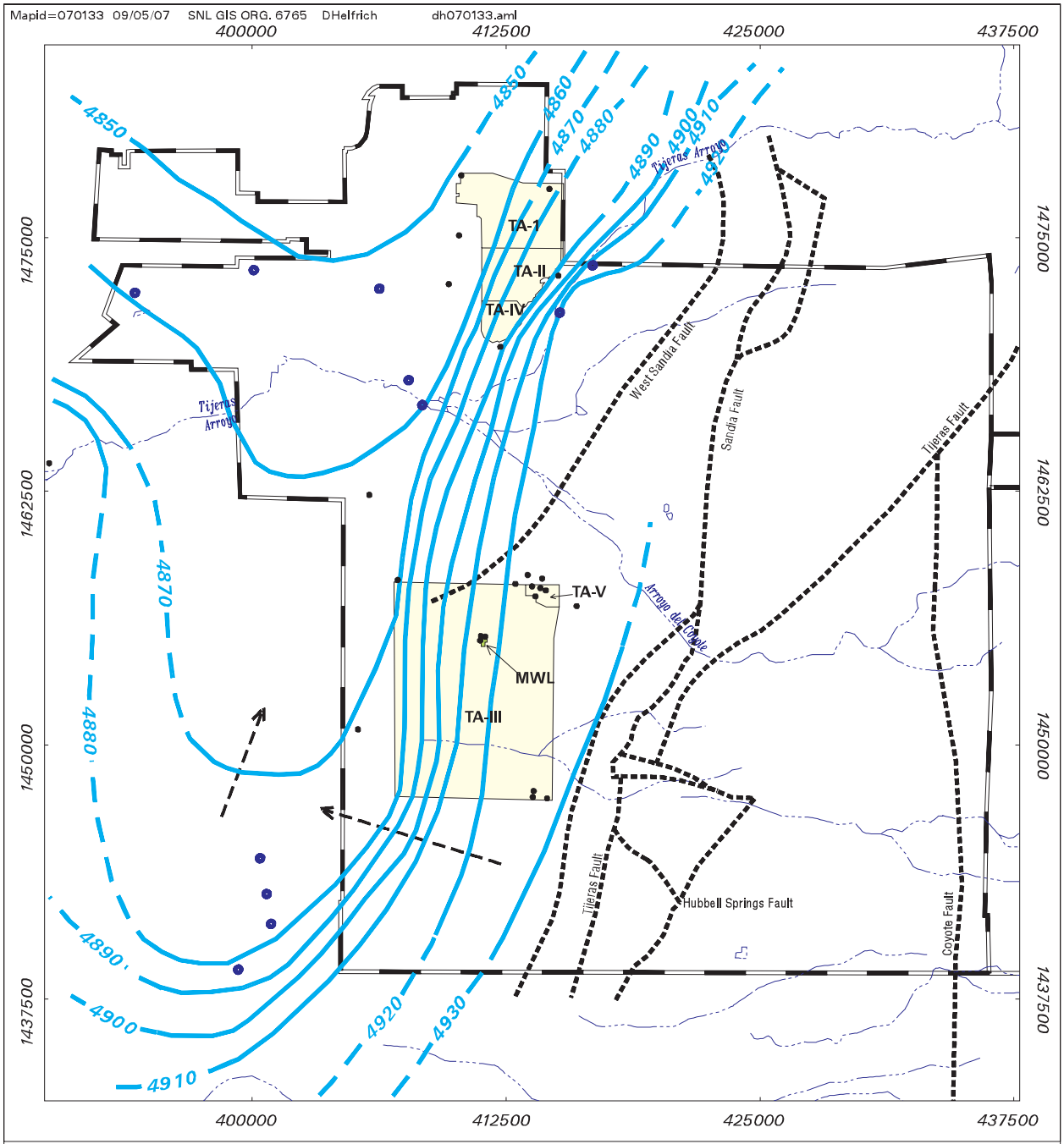

Legend

- Monitoring Well used to construct potentiometric surface (measured Jan. - March 2007)
- Monitoring Well used to construct potentiometric surface (measured July 2006 and March 2007)
- Potentiometric Surface Contour (feet above mean sea level, dashed where approximate)
- Kirtland Air Force Base Boundary
- Direction of groundwater flow
- Surface Drainage
- Fault
- Technical Area
- MWL - Mixed Waste Landfill

Figure 2.1.2-1
Potentiometric Surface of Basin Fill Aquifer West of Fault Complex

0 4000 8000
Scale in Feet

0 960 1920
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

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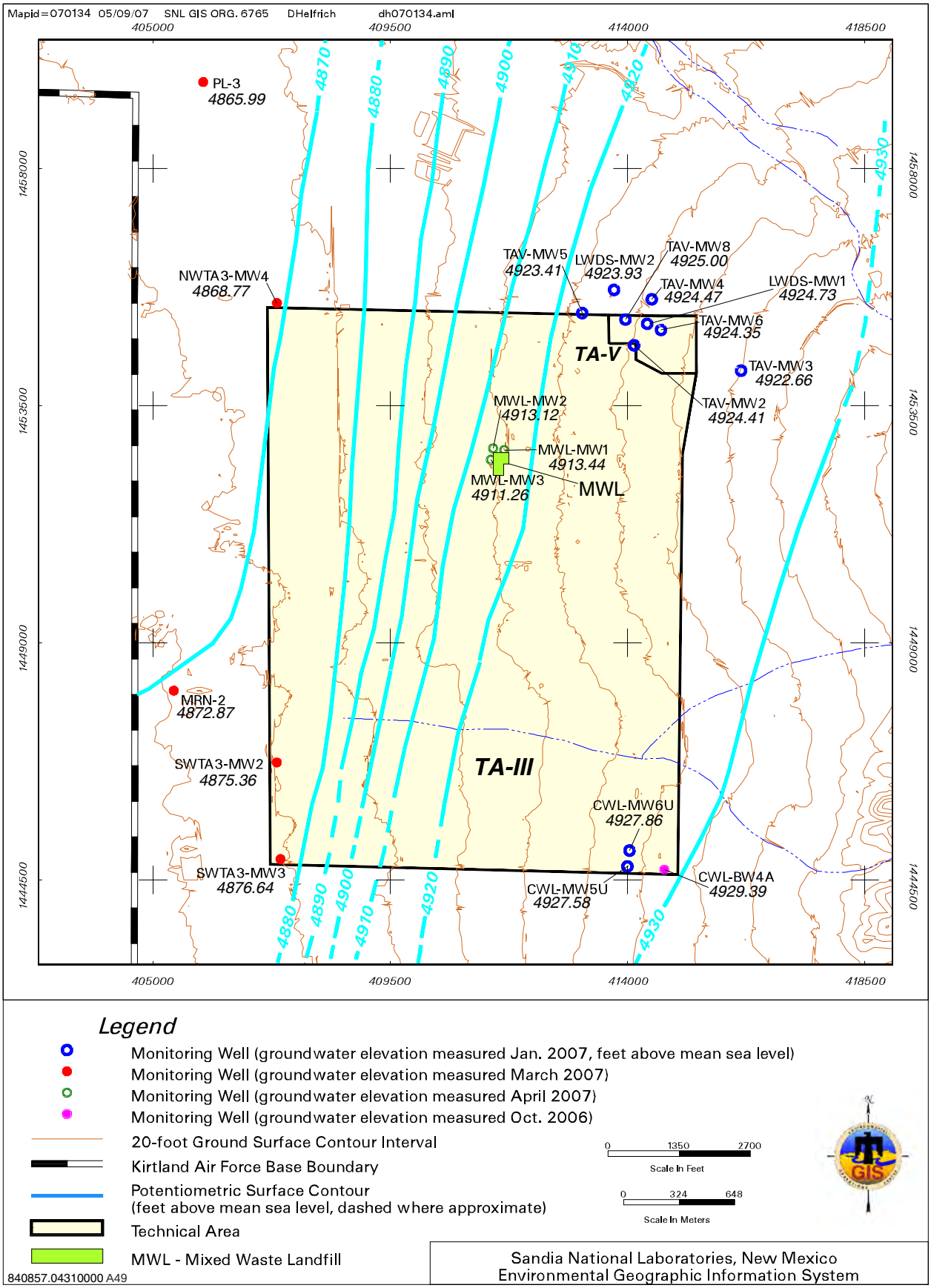

Legend

- Monitoring Well (groundwater elevation measured Jan. 2007, feet above mean sea level)
- Monitoring Well (groundwater elevation measured March 2007)
- Monitoring Well (groundwater elevation measured April 2007)
- Monitoring Well (groundwater elevation measured Oct. 2006)
- 20-foot Ground Surface Contour Interval
- Kirtland Air Force Base Boundary
- Potentiometric Surface Contour (feet above mean sea level, dashed where approximate)
- Technical Area
- MWL - Mixed Waste Landfill

0 1350 2700
Scale In Feet

0 324 648
Scale In Meters

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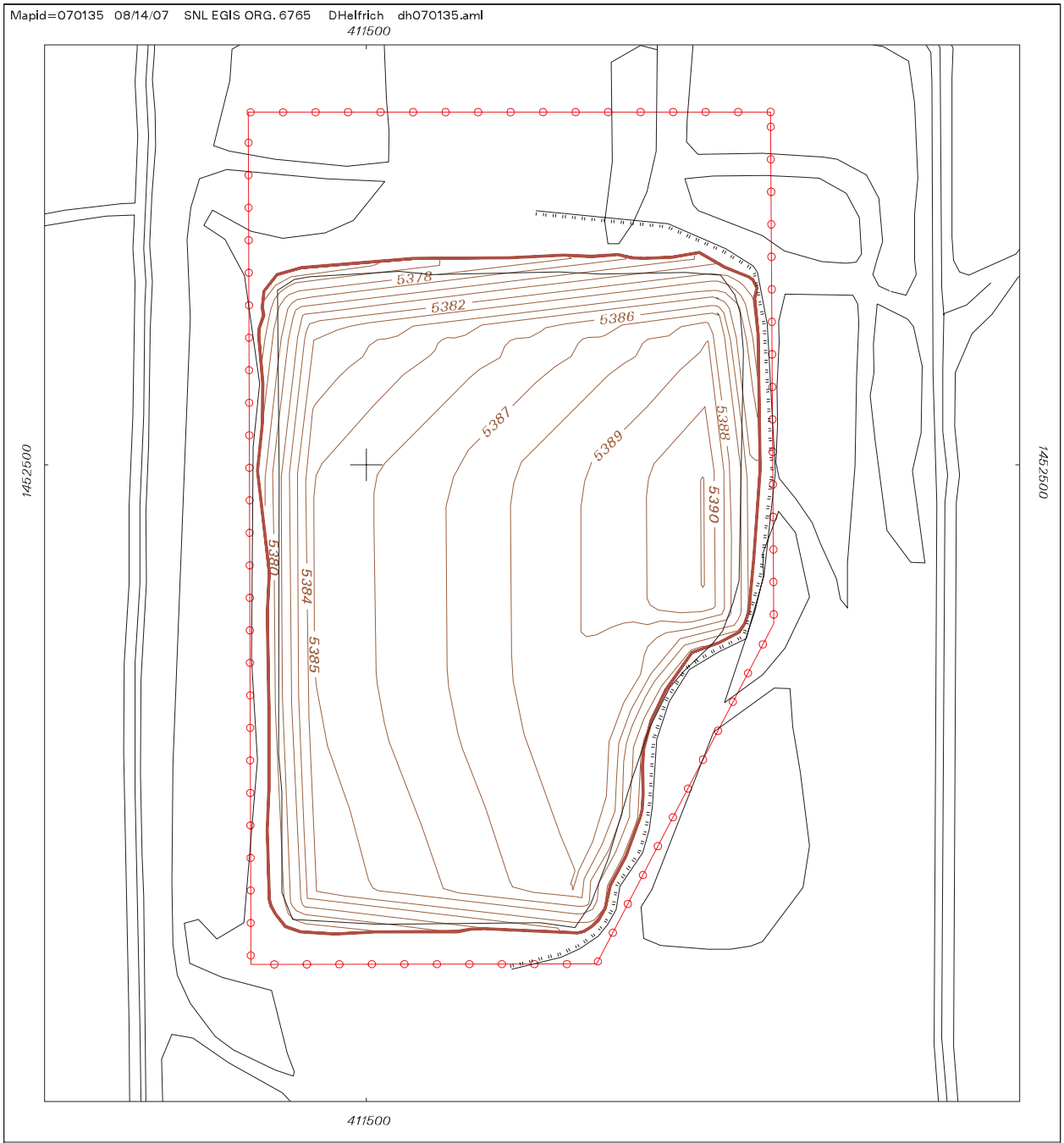
Figure 2.1.2-2 Localized Potentiometric Surface of Basin Fill Aquifer at Technical Area III



Legend

- Drainage Swale
- 1-ft Landfill Cover Contour Interval
- Fence
- Toe of Landfill Cover
- Road and Berm

Figure 2.1.3-1
Mixed Waste Landfill
Final Cover Grading Plan

0 60 120
Scale in Feet

0 14.4 28.8
Scale in Meters

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2.2 Description of the Engineered Cover

The MWL cover occupies 3.6 acres and consists of a 3-foot-thick native soil layer overlying a 1-foot-thick, crushed rock, biointrusion barrier. The biointrusion barrier overlies the subgrade soil and existing landfill surface. The uppermost layer of the cover consists of an 8-inch-thick, vegetated, topsoil layer admixed with 25 percent 3/8-inch crushed gravel. The cover is centrally crowned with a 2-percent slope. A cross-section of the cover is shown in Figure 2.2-1.

The topsoil layer has been seeded with native grasses to mitigate surface erosion and promote evapotranspiration. The native grass species were selected based upon biological assessments of TA-III (Sullivan and Knight 1992, Peace et al. November 2004), and consist of black grama, spike dropseed, galleta grass, and ring muhly. This plant community was designed to approximate the dominant and subdominant species in TA-III and will gradually develop into a climax community indistinguishable from the natural community.

Additional details on the MWL cover are presented in the MWL CMI Plan (SNL/NM November 2005) and the pending CMI Report. The CMI Plan includes engineering design drawings, construction specifications, and the construction quality assurance plan. The CMI report includes a summary of the MWL cover construction activities, as-built drawings and specifications, and the construction quality assurance report.

2.3 Storm-Water Diversion Structures

Surface drainage features designed to control surface-water run-on and runoff are shown in the MWL Final Grading Plan (Plate 4 in the CMI Plan [SNL/NM November 2005]). The primary storm-water diversion structure incorporated into the MWL remedy is a drainage swale along the eastern perimeter of the landfill, schematically shown in Figure 2.1.3-1. This feature prevents storm-water run-on from eroding the cover. The vegetated, gently sloping topography (approximately 2-percent grade from east to west) and crown of the MWL cover and the 6:1 side slopes of the cover prevent significant run-on by directing the upgradient surface water away from the site. Runoff from the MWL cover is accommodated by the gentle slope of the cover and crown towards the eastern swale or western perimeter of the landfill, away from the MWL.

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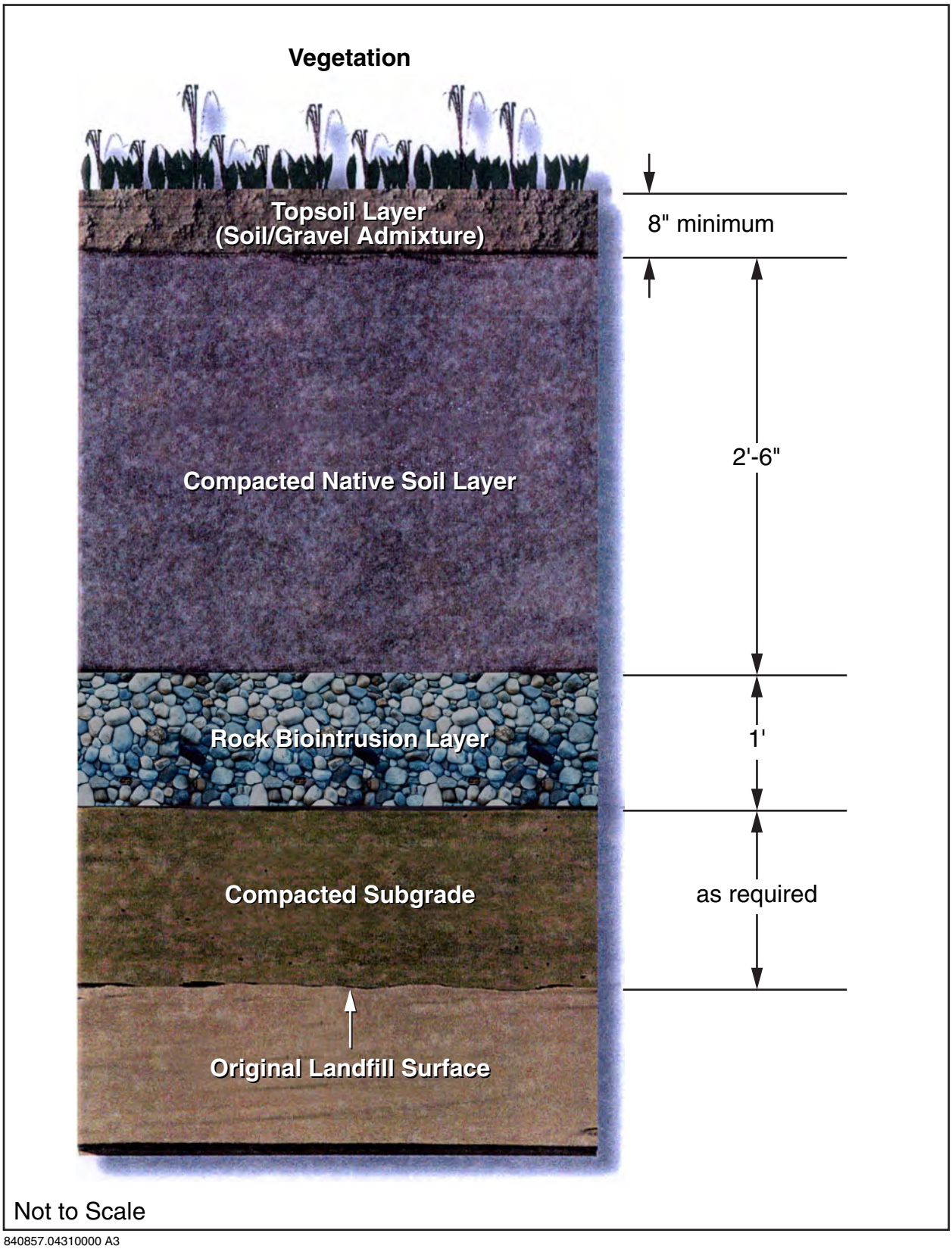

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Figure 2.2-1
Schematic of the Mixed Waste Landfill Vegetative Cover and Biointrusion Barrier

3.0 MONITORING ACTIVITIES AND FREQUENCIES

This section describes all monitoring activities to be conducted at the MWL as part of the LTMMP. The activities include monitoring of air, surface soil, vadose zone, groundwater, and biota. Monitoring frequencies are also provided.

3.1 Introduction

The primary objective of the monitoring activities at the MWL is to ensure that the final remedy is protective of human health and the environment. Long-term monitoring is planned for air, surface soil, the vadose zone, groundwater, and biota at the MWL. Air will be monitored for radon; surface soil will be monitored for tritium; the vadose zone will be monitored for volatile organic compounds (VOCs) and moisture; groundwater will be monitored for tritium, VOCs, and RCRA metals; and soil from animal burrows and ant hills will be monitored for RCRA metals and gamma-emitting radionuclides, and vegetation will be monitored for gamma-emitting radionuclides.

Although monitoring is planned for radionuclides in various media at the MWL, the information related to radionuclides is provided voluntarily by the DOE/Sandia. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements imposed by the NMED, as specified in Section III.A of the Consent Order (NMED April 2004).

A summary of the long-term monitoring frequency, parameters, and analytical methods is presented in Table 3.1-1. Monitoring activities and frequencies are discussed in Sections 3.2 through 3.6. Sampling and Analysis Plans (SAPs) and Monitoring Plans (MPs) for each type of monitoring are presented in Appendices A through E.

Changes to sampling parameters and monitoring frequencies may be warranted as trends are established and as additional data needs are identified. If changes to the monitoring program are warranted, the DOE/Sandia will submit a request in writing to the NMED to modify the LTMMP. Once NMED approval has been obtained, portions of the LTMMP, including SAPs and MPs, will be revised and submitted to the NMED for final approval, prior to incorporating any changes in monitoring parameters or frequencies.

3.2 Air Monitoring

Air monitoring for radon shall be conducted at the MWL along the perimeter and at select locations on the engineered cover. This section discusses why air monitoring for radon will be conducted, while air monitoring for tritium and other radionuclides will not be performed. The monitoring method and sampling locations for radon are also discussed.

Table 3.1-1
Summary of Long-Term Monitoring Parameters, Frequencies, and Methods
Mixed Waste Landfill, Sandia National Laboratories/New Mexico

Sampling Media	Monitoring Parameters[a]/ Constituents of Concern	Monitoring Frequency[a]	Number of Samples Per Event	Locations	Monitoring Method	Comments
Air	Radon	Year 1 – Quarterly Year 2 – Quarterly Year 3 – Semiannual Year 4 – Semiannual Year 5 and subsequent years – Annual	17	10 detectors placed at corners and midpoints of perimeter fence 5 detectors placed on completed cover 2 detectors at background locations (TBD)	Track-etch detectors (at breathing level) Sampling and analysis per Appendix A	Samples are time-weighted average, and will be collected over a 3-month period.
Surface Soil	Tritium	Annual	4	One sample collected from each corner of the MWL	Grab samples of soil collected; moisture extracted and tritium analyzed using liquid scintillation	Samples collected by the SNL/NM Terrestrial Monitoring Program. Program to be continued at current level of effort.
Vadose Zone	VOCs in soil vapor	Year 1 – Quarterly Year 2 – Quarterly Year 3 – Semiannual Year 4 – Semiannual Year 5 and subsequent years – Annual	15	Samples collected from 3 FLUTe™ wells at depths of 50, 100, 200, 300, and 400 ft	Sampling and analysis per Appendix B (Compendium Method TO-14 VOCs[b])	VOCs to be collected from 3 FLUTe™ wells installed in vertical boreholes outside landfill perimeter.
Vadose Zone	Moisture content in underlying vadose zone	Year 1 – Quarterly Year 2 – Quarterly Year 3 – Semiannual Year 4 – Semiannual Year 5 and subsequent years – Annual	171	Three soil-moisture monitoring access tubes Measurements made at 1-ft increments from 4 ft to 25 ft, then 5-ft increments to total depth of the access tube (200 linear ft)	Soil-moisture monitoring per Appendix C	Moisture content in vadose zone beneath the cover to be measured using neutron probe.

Refer to footnotes at end of table.

Table 3.1-1 (Concluded)
Summary of Long-Term Monitoring Parameters, Frequencies, and Methods
Mixed Waste Landfill, Sandia National Laboratories/New Mexico

Sampling Media	Monitoring Parameters[a]/ Constituents of Concern	Monitoring Frequency[a]	Number of Samples Per Event	Locations	Monitoring Method	Comments
Groundwater	VOCs by EPA Method 8260[c] and metals by EPA Methods 6020[c] and 7470[c]	Annual	6	MWL monitoring well network (except MWL-MW4, which will not be sampled routinely during long-term monitoring)	Sampling and Analysis per Appendix D	Continuation of MWL current groundwater monitoring program. Sampling recommended using low-flow pumps, with NMED approval.
Biota	Distribution of ant hills and animal burrows RCRA metals and gamma spectroscopy Cover vegetation[d] diversity and growth Gamma-emitting radionuclides in vegetation	Annual surveys for distribution of ant hills and animal burrows. Sampling of soil from ant hills (if they exist) and animal burrows and every two years for RCRA metals and gamma spectroscopy. Cover vegetation[d] diversity and growth monitoring will be conducted quarterly until established, then annually. Sampling of vegetation for gamma-emitting radionuclides every two years.	Up to 6 ant hills (if they exist on the cover) Up to 6 animal burrows (if they exist on the cover)	Ant hills and animal burrows on the MWL vegetated soil cover (if they exist) Vegetation[d] on the cover	GPS surveying of ant hill and animal burrow locations. Grab samples of soil from ant hills and animal burrows, and vegetation.	Biota sampling is planned to address potential for mobilization of contaminants by biota.

[a]Monitoring frequency and parameters will be reevaluated every five years in the Five-Year Reevaluation Reports.
[b]EPA January 1999.
[c]EPA November 1986.
[d]Cover vegetation monitoring is discussed in Section 4.2.1.

EPA = U.S. Environmental Protection Agency.
FLUTe™ = Flexible Liner Underground Technologies.
ft = Foot (feet).
GPS = Global positioning system.
MWL = Mixed Waste Landfill.
NMED = New Mexico Environment Department.
RCRA = Resource Conservation and Recovery Act.
SNL/NM = Sandia National Laboratories/New Mexico.
TBD = To be determined.
TO-14 = EPA Method TO-14.
VOC = Volatile organic compound.

3.2.1 Radon

The MWL fate and transport model predicts no potential for release of radon-222 into the atmosphere in excess of regulatory standards, as long as the sealed sources containing radium-226 within the MWL inventory remain intact (Ho et al. January 2007). This modeling prediction is consistent with the results from a study conducted in 1997 to measure radon surface flux from the MWL (Haaker January 1998). The 1997 study, which involved placement of 89 4-inch-diameter activated charcoal radon canisters across the MWL surface, evaluated radon surface fluxes in the vicinity of the MWL and at background locations. The results showed that the measured radon fluxes above the MWL were not significantly different from the background values (Haaker January 1998). The median radon flux in the vicinity of the MWL was 0.33 pCi/square meter (m^2)/second (s), while the median background flux was 0.35 pCi/m^2/s. The maximum measured fluxes for the MWL and background were 1.02 and 0.664 pCi/m^2/s, respectively.

The MWL fate and transport model also predicts that if the sealed sources containing radium-226 degrade over time, a potential exists for radon to be emitted to the atmosphere in concentrations above regulatory standards. For this reason, radon monitoring at the landfill surface will be conducted to determine whether significant quantities of radon are being emitted from the MWL. Commercially-available track-etch radon detectors (referred to as detectors) will be utilized to measure the radon concentration in air. These detectors provide an integrated average concentration of radon in air over long exposure periods, on the order of three to six months. The alternative monitoring detectors, charcoal canisters, are only useful for short exposure periods, on the order of a few days.

The detectors will be placed on posts at approximately breathing level (5 feet) along the MWL perimeter and at five locations on the surface of the MWL. Radon monitoring locations within the MWL boundary were selected based upon the MWL inventory. Table 3.2.1-1 list pits and trenches containing radium-226, also based upon the MWL inventory (SNL/NM June 1998). Figure 3.2.1-1 shows the relative locations of these pits and trenches within the MWL. As Table 3.2.1-1 indicates, four of the MWL pits contain millicurie quantities of radium-226 (a potential source for radon at the MWL). Because these pits contain the highest concentrations of radium-226, radon emissions from these pits would have the greatest potential to exceed the regulatory standard, should the sealed sources degrade over time. For this reason, these pits will be monitored for radon emissions.

The fifth radon sampling point within the MWL perimeter will be located over Trench D, where a broken radium-226 source was disposed. The exact location of the source in Trench D is unknown, and the detector will be placed above the middle of the trench.

Figure 3.2.1-2 shows the radon sampling locations. The detectors will be placed along the MWL perimeter and at the five locations on the surface of the MWL as discussed.

Radtrak® radon gas track-etch detectors, or equivalent, will be used and are designed to monitor radon exposure over long exposure periods to obtain long-term average concentrations over time. Radtrak® measures the average radon concentration at the location of the detector during the monitoring period. The alpha-track detector has a radiosensitive element that records alpha particle emissions (alpha tracks) from the natural radioactive decay of radon.

Table 3.2.1-1
Pits and Trenches Containing Radium-226 at the Mixed Waste Landfill
Sandia National Laboratories/New Mexico

Location	Ra-226 Quantity (mCi)	MWL Inventory Listing[a]
Trench D	Unknown	Broken Ra-226 source in plastic holder
Pit 33	250	Ten each 25-mCi Ra-226 sources encapsulated in concrete-filled, 55-gallon drums
Pit 31	4.01	One each 10-microCi Ra-226 ionostat; one each 4-mCi Ra-226/Be source
Pit 16	3.12	Two each nonfunctional 1.5-mCi Ra-226 ionization alphatron gauges encapsulated in a concrete-filled A/N can; twenty each 5-microCi Ra-226/Be sources in lead container encapsulated in concrete-filled, A/N can; two each 10-microCi Ra-226/Be sources in lead container encapsulated in a concrete-filled, 5-gallon, A/N can
Pit 24	1.5	Three each 500-microCi Ra-226
Pit 32	<1.0	Ra-226, Na-22, Ba-133, Co-60, Co-57, Mo-54, mixed isotopes (1.0 mCi) in lead pig
Pit 26	0.86	Four each 10-microCi Ra-226/Be sources in a lead container encapsulated in concrete-filled, 55-gallon drum; five each sealed 160-microCi Ra-226 sources; two each sealed 10-microCi Ra-226 check sources; eighteen each 1.8-microCi Ra-226 ionization alphatron gauges encapsulated in concrete-filled, 32-gallon, A/N can
Pit 17	0.5	One each 0.5-mCi Ra-226/Be source
Pit 13	0.1103	One each 98-microCi Ra-226 source, one each 1.3-microCi Ra-226 source, two each 5-microCi Ra-226 sources, and one each 1-microCi Ra-226 source encapsulated in concrete-filled, A/N can.
Pit 15	0.107	One each 102.1-microCi Ra-226/Be source and one each 5.5-microCi source in a encapsulated in concrete-filled, 55-gallon drum; fume hood filters and filter housings
Trench C	0.1	One each 0.1-mCi Ra-226/Be source encapsulated in concrete-filled, A/N can
Pit 18	0.07	Seven each 10-microCi Ra-226/Be sources in a lead container encapsulated in concrete-filled, 55-gallon drum
Pit 25	0.0516	One each 11.6-microCi Ra-226 dew pointer in brass cylinder, four each 10-microCi Ra-226/Be sources in a lead container encapsulated in concrete-filled, 55-gallon drum

[a]SNL/NM June 1998.
Ba = Barium.
Be = Beryllium.
Ci = Curie(s).
Co = Cobalt.
mCi = Millicurie(s)
Mo = Molybdenum.
MWL = Mixed Waste Landfill.
Na = Sodium.
Ra = Radium.

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Legend

- Mixed Waste Landfill
- Pit without Ra-226
- 31 / 4.01 — Pit Number (upper left) with Ra-226 Activity (lower right - millicuries)
- Trench with Ra-226 Activity (millicuries)

Figure 3.2.1-1
Pits and Trenches Containing Radium-226 at the Mixed Waste Landfill

0 20 40
Scale in Feet

0 4.8 9.6
Scale in Meters

N

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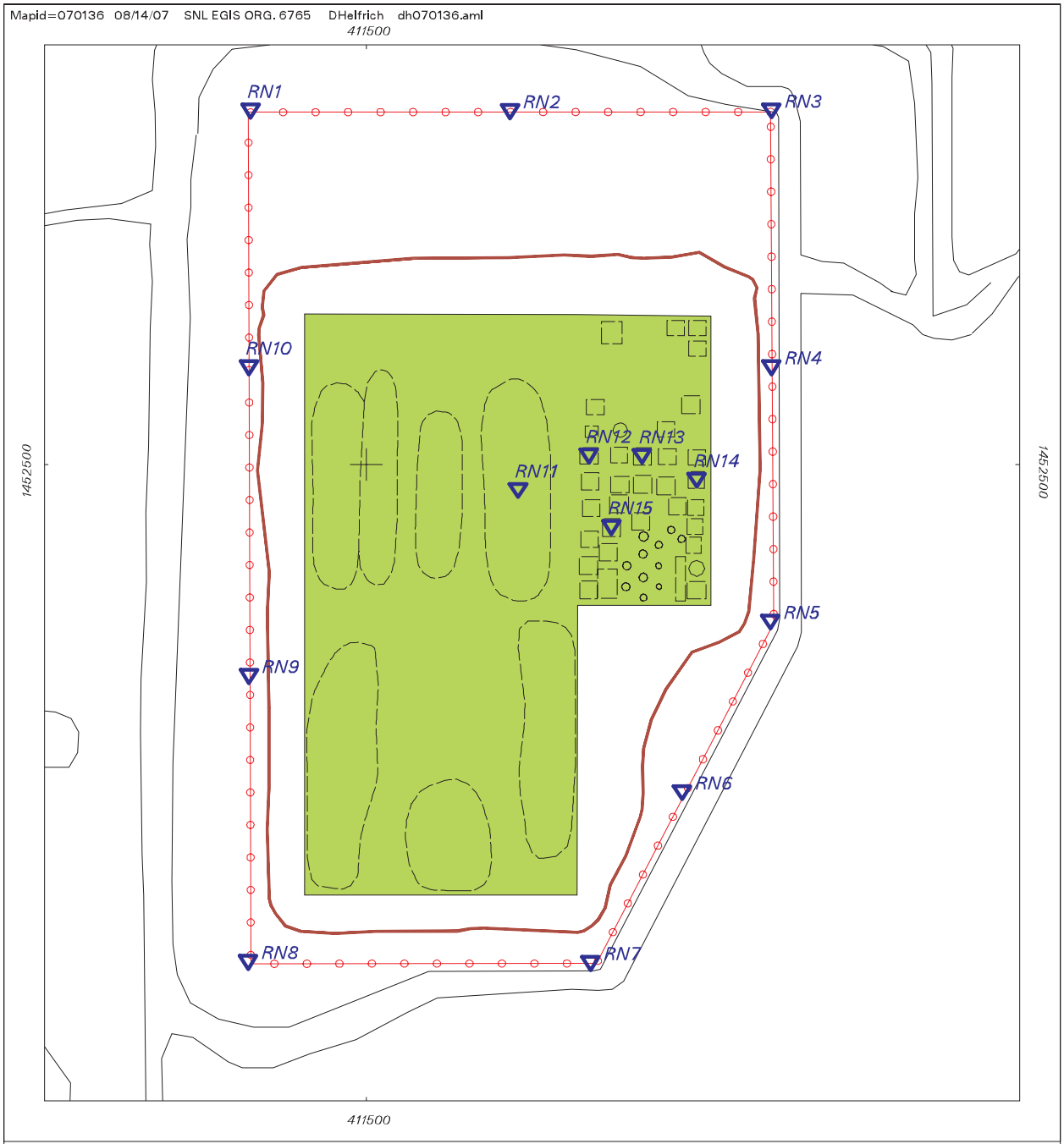

Legend

- Radon Sampling location and name
- Fence
- Trench and Pit
- Toe of Landfill Cover
- Road
- MWL Extent

Figure 3.2.1-2
Radon Sampling Locations at the Mixed Waste Landfill

0 60 120
Scale in Feet

0 14.4 28.8
Scale in Meters

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After exposure, the detectors are returned to the manufacturer for analysis, and the alpha tracks are counted using computer-assisted image analysis equipment. The number of alpha tracks along with the deployment time period provides the basis for calculating the average radon concentration. The resulting data are reported in pCi of radon per liter (L) of air.

Radon monitoring will be conducted on a quarterly basis following cover completion to establish initial concentration data, then on a semiannual basis, and later on an annual basis if no significant trends are observed in radon concentrations over time. Additional details of the radon monitoring to be conducted at the MWL are presented in Appendix A, "Air Sampling and Analysis Plan for the Mixed Waste Landfill."

3.2.2 Tritium and Other Radionuclides

Air monitoring for tritium and radionuclides other than radon will not be conducted due to the significant decline in tritium emissions from the MWL over the last decade, as well as the lack of a reasonable transport scenario to the atmosphere for other radionuclides. Although the MWL is a diffuse source for tritium to the environment, studies conducted during 1992, 1993, and 2003 revealed that tritium concentrations released to the atmosphere are at low levels and do not pose a threat to human health or the environment (Radian Corporation September 1992, November 1992, and 1994; URS Corporation February 2004). These studies indicate that, as expected, tritium concentrations released from the landfill to the atmosphere declined significantly during the 10-year period from 1993 to 2003. The estimated tritium emitted from the MWL to the atmosphere in 1993 was 0.486 Ci/yr, while the estimated tritium emitted from the MWL in 2003 was 0.090 Ci/yr. This significant reduction reflects the natural radioactive decay of tritium and its relatively short half-life of 12.3 years. Because tritium levels in the MWL inventory will continue to decline due to radioactive decay, concentrations released to the atmosphere will continue to decline as well.

The maximum predicted dose to an exposed site worker and an off-site worker was orders of magnitude below regulatory limits in 1993 (Phase 2 RFI), and even lower in 2003. Because it is highly unlikely that tritium could be released from the MWL to the atmosphere above regulatory limits, long-term monitoring of tritium in air at the MWL will not be conducted.

Similarly, there is no reasonable scenario for the transport of other radionuclides from the MWL to the air pathway. Tritium is the primary radionuclide disposed of at the MWL with the potential to move through vapor transport upward into the atmosphere. Radon has some potential to be released from the landfill contents and could potentially migrate to the atmosphere. For this reason, radon will be monitored (Section 3.2.1). The remaining radionuclides within the MWL inventory are relatively immobile and are buried under 3 or more feet of backfill, 2 to 40 inches of subgrade soil, 1 foot of rock biointrusion barrier, and 3 feet of soil. Because there is no reasonable scenario for transport of radionuclide contaminants upward through the engineered cover and into the atmosphere, there is no rationale for air monitoring of other radionuclides at the MWL.

3.3 Surface Soil Monitoring

The SNL/NM Terrestrial Surveillance Program has monitored concentrations of tritium and gamma-emitting radionuclides in surface soil at the MWL on an annual basis since 1985. Terrestrial surveillance activities are conducted in accordance with SNL/NM Terrestrial

Surveillance Field Operating Procedure (FOP 95-03) (SNL/NM 2006), available at the Sandia National Laboratories Customer-Funded Records Center. As part of the SNL/NM Terrestrial Surveillance Program, soil samples are collected annually at the four corners of the MWL (outside the fence), and analyzed for tritium and gamma-emitting radionuclides. Tritium is routinely detected in soil samples collected at the corners of the landfill, with highest concentrations most often detected at the northeastern corner of the MWL (Section 5.2.2.1). These concentrations have been diminishing with time due to natural radioactive decay of tritium, and although elevated above background levels, they do not pose a threat to human health or the environment.

The DOE/Sandia will continue to sample soil at the four corners of the landfill on an annual basis for long-term monitoring at the site. Figure 3.3-1 shows surface soil sampling locations for tritium at the MWL. Tritium is very mobile and should a significant release of tritium from the landfill contents occur, increased tritium would be detected in soil samples during the annual sampling events.

3.4 Vadose Zone Soil-Vapor and Soil-Moisture Monitoring

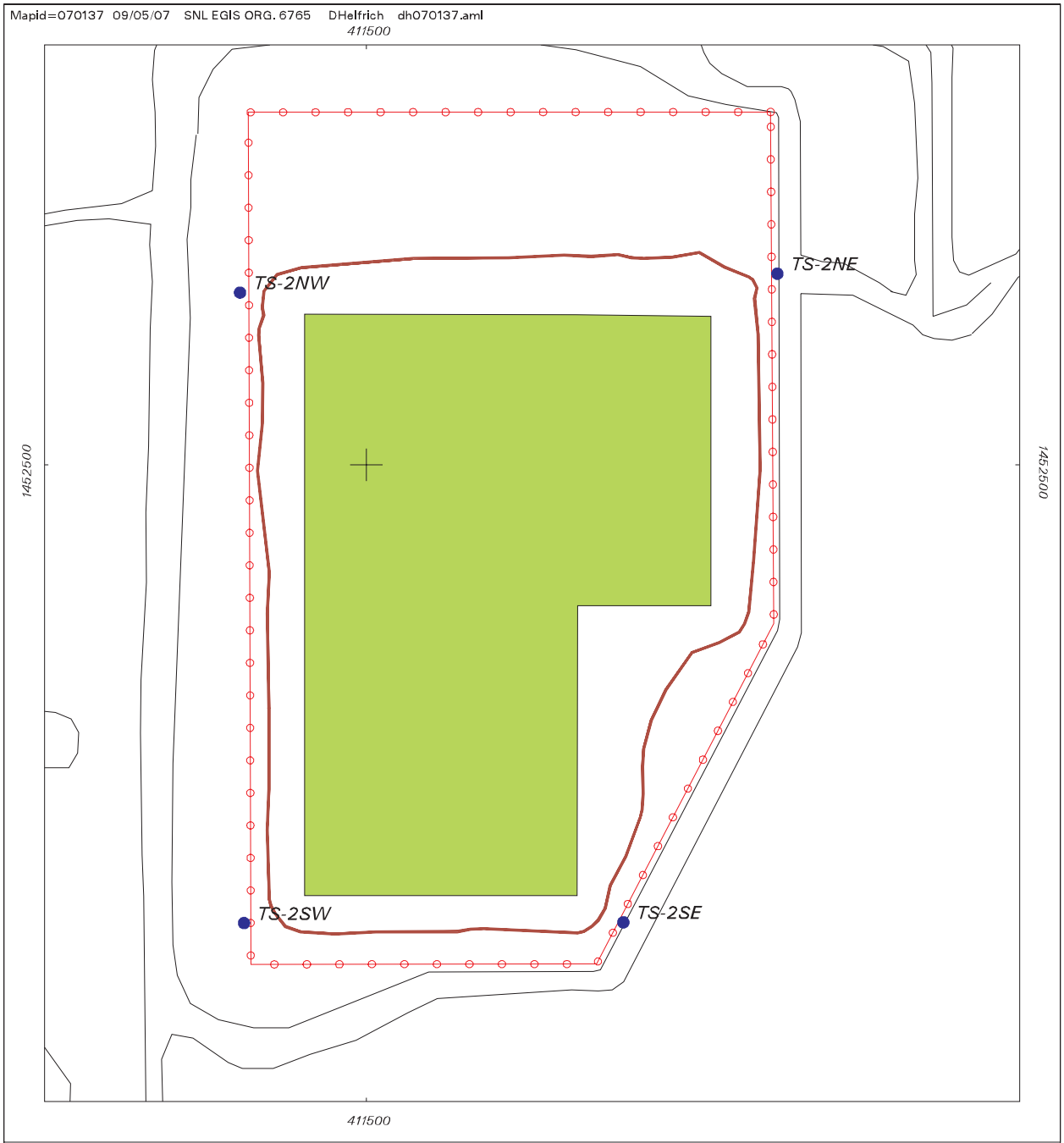
The vadose zone beneath the MWL extends nearly 500 feet from ground surface to groundwater. Because VOCs released from the MWL have the potential to migrate via the soil-vapor phase to groundwater (Ho et al. January 2007), a monitoring system is planned for the vadose zone at the MWL to serve as an early warning system for protecting groundwater. This system will provide early evidence of potential threats to groundwater and will allow corrective action to be initiated long before groundwater contamination occurs.

Long-term monitoring of the vadose zone is planned for both soil vapor (VOCs) and moisture content to provide assurance that the MWL remedy remains protective of human health and the environment. The details of the monitoring systems for VOCs and moisture content are presented in the following sections.

3.4.1 Vadose Zone Soil-Vapor Monitoring for VOCs

VOCs are the most mobile of the hazardous constituents detected in the soil beneath the MWL. During the MWL Phase 2 RFI, two passive and three active soil-gas surveys at the MWL showed the presence of low concentrations of VOCs in soil gas (soil vapor) (SNL/NM September 1996). Low concentrations of VOCs were also detected in subsurface soil samples collected from boreholes drilled during the MWL Phase 2 RFI (SNL/NM September 1996).

VOC concentrations with depth shall be monitored using three Flexible Liner Underground Technologies (FLUTe™) soil-vapor monitoring wells (hereinafter referred to as FLUTe™ wells) that provide data regarding VOC concentrations versus depth. The FLUTe™ wells are constructed in vertical boreholes located immediately outside the perimeter of the MWL cover with the locations selected near areas where the highest concentrations of VOCs were detected during earlier studies at the MWL. Figure 3.4.1-1 shows the locations of the three FLUTe™ wells. Soil-vapor sampling ports were installed in each FLUTe™ well at depths of 50, 100, 200, 300, and 400 feet. Soil-vapor data collected from the FLUTe™ wells will be used to assess current VOC distributions with depth and to monitor VOC concentrations over time, allowing early identification of any potential threats to groundwater. The VOC data from the FLUTe™ wells will also be included in the MWL fate and transport model updated every five years, as



Legend

- Terrestrial Surveillance Soil Sampling location
- Fence
- Toe of Landfill Cover
- Road
- MWL Extent

Figure 3.3-1
Soil Sampling Locations for Tritium at the Mixed Waste Landfill

0 60 120
Scale in Feet

0 14.4 28.8
Scale in Meters

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Legend

- Soil-Moisture Monitoring Access Tube (showing horizontal extent of tube)
- FLUTe™ Well
- Fence
- Toe of Landfill Cover
- Road
- MWL Extent

Figure 3.4.1-1
FLUTe™ Well Locations and Soil-Moisture Monitoring Access Tubes at the Mixed Waste Landfill

0 60 120
Scale in Feet

0 14.4 28.8
Scale in Meters

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required in the NMED Final Order (Curry May 2005). The soil-vapor SAP for the MWL is presented in Appendix B.

3.4.2 Soil-Moisture Monitoring

A soil-moisture monitoring system has been installed beneath the landfill and consists of three soil moisture access tubes drilled at a 30-degree angle (from vertical) directly below waste disposal cells. The monitoring system functions as an early warning system, providing infiltration and cover performance information as well as evidence of potential contaminant migration from the landfill, and establishes background and trend analysis information.

In August 2003, three angled, 4.5-inch-outside-diameter, 3.75-inch-inside-diameter steel access tubes were installed in the shallow vadose zone directly beneath the MWL: two to the west and one to the east of the cover (Figure 3.4.1-1). The access tube locations were selected to provide optimal coverage beneath the MWL. The tubes are spaced at equal increments in a north-south direction, with the east access tube halfway between the two west access tubes. The tubes were installed using the Resonant Sonic drilling technique. Resonant Sonic is the preferred drilling technique for this application because it fluidizes and displaces the surrounding soil as the drill string advances, creating a very tight fit between the drill string and the formation.

Each access tube is collared approximately 10 feet outside the toe of the cover side slopes. Each borehole was drilled 200 linear feet at 30 degrees to a true vertical depth of 173 feet (Figure 3.4.2-1). Each tube remains open to the vadose zone at the bottom, and a protective cover constructed of steel pipe extends 2 feet bgs and 3 feet above grade. Each protective cover is fitted with a locking cap. A 3- by-3-foot concrete pad was constructed around each protective cover to prevent preferential flow down the annulus, and protective stanchions were placed at the outer corners of each concrete pad.

Moisture content with depth shall be monitored using a neutron probe, a technique developed in the 1950s that provides an efficient and reliable method for monitoring soil moisture. The neutron probe consists of a source of fast (energized) neutrons, a detector of slow (thermalized) neutrons, and an electronic gauge to monitor the flux of slow neutrons scattered by the soil. The probe is lowered into the access tube, and the emitted neutrons interact with soil water surrounding the tube and are detected by the instrument. Because energized neutrons can easily travel through steel, the steel access tube is essentially invisible to the neutrons, allowing measurement of moisture in the surrounding soil without interference from the tube itself.

Infiltration through the cover shall be indirectly monitored via the moisture content in the vadose zone beneath the MWL. A significant increase in moisture content beneath the landfill may indicate that the engineered cover may not be performing as originally designed and that infiltration through the cover is greater than originally predicted.

Moisture content shall be measured using neutron logging, and data can be compared to baseline moisture content data collected prior to deployment of the MWL cover. This noninvasive method allows cover performance to be assessed without damaging the integrity of the engineered cover. A significant increase in moisture content within the vadose zone may indicate that corrective action is warranted in order to prevent the downward movement of water through the waste. Moisture content data shall be evaluated to ensure that the performance

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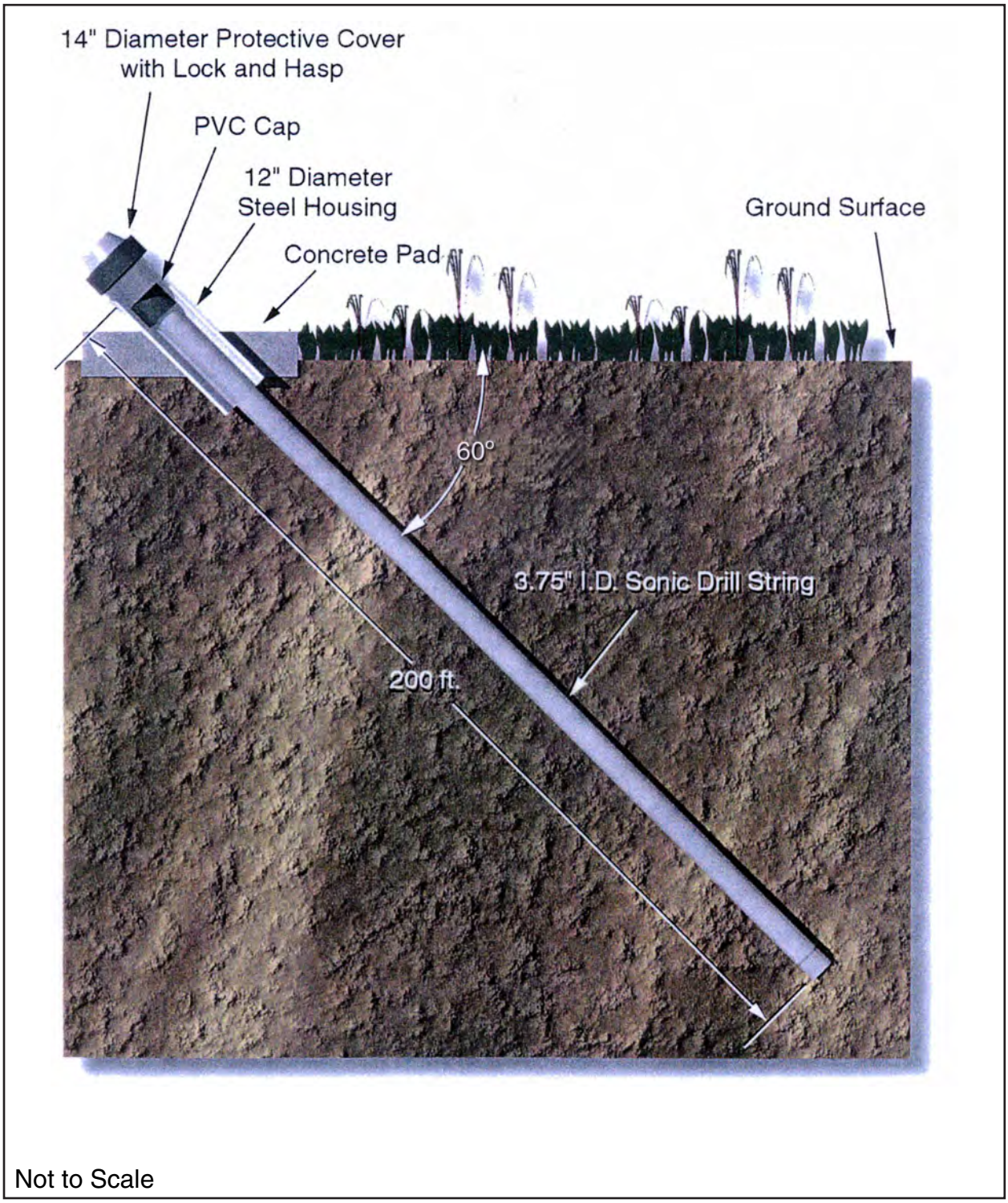

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Figure 3.4.2-1
Soil-Moisture Monitoring Access Tube,
Mixed Waste Landfill

objective of infiltration through the MWL cover is less than the EPA-prescribed technical equivalence criteria of 10^{-7} centimeters (cm)/s (31.5 millimeters [mm]/yr), as detailed below. Appendix C presents the Soil-Moisture MP; Section 5.2.3.2 provides additional information on the trigger for soil moisture beneath the MWL.

3.5 Groundwater Monitoring

Groundwater in the area of the MWL has been extensively characterized since 1990 for major ion chemistry, VOCs, semivolatile organic compounds (SVOCs), nitrate, metals, radionuclides, and perchlorate. Data collected indicate that groundwater has not been contaminated by releases from the MWL (Goering et al. 2002; SNL/NM July 2001, November 2001, January 2002, April 2002, July 2002, October 2002, April 2003, September 2003, April 2004; Lyon and Goering April 2005; SNL/NM April 2006).

3.5.1 MWL Monitoring Well Network

The MWL monitoring well network (Figure 3.5.1-1) currently (as of September 2007) consists of seven wells completed within interfingering, fine-grained alluvial fan deposits and coarse-grained Ancestral Rio Grande deposits (Goering et al. 2002). This network includes one background well (MWL-BW1), one on-site well (MWL-MW4), and five downgradient or cross-gradient wells (MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW5, and MWL-MW6). All seven wells are constructed of 5-inch, Schedule 80 polyvinyl chloride (PVC) casing. Wells MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3 have screens composed of slotted Type 304 stainless steel. Wells MWL-MW4, MWL-MW5, and MWL-MW6 have screens composed of slotted Schedule 80 PVC. Table 3.5.1-1 presents well construction information and recent water levels measured in existing monitoring wells. Well database summary sheets showing monitoring well completion diagrams are presented in Appendix F.

Monitoring well MWL-MW4 was installed in 1993 directly beneath a disposal trench in which 204,000 gallons of coolant wastewater from the SNL/NM Engineering Reactor Facility were disposed of in 1967 (Peace et al. September 2002). MWL-MW4 was completed at an angle of 6 degrees from vertical and is screened at two discrete intervals 20 feet apart to evaluate vertical anisotropy, vertical potentiometric gradients, and changes in aquifer parameters with depth. The approximate horizontal extent of MWL-MW4 is shown in Figure 3.5.1-1. An inflatable packer separates the screened intervals, and pressure is maintained in the packer to prevent the mixing of water from the two screened sections of the aquifer.

The monitoring well network is being updated in preparation for long-term monitoring at the MWL. The four oldest wells, MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3, were installed in 1988 and 1989, and although they have provided excellent quality data over the years, they are becoming increasingly problematic.

Two of these wells, MWL-BW1 and MWL-MW3, are nearly dry due to declining water levels in the regional aquifer. Groundwater levels beneath the MWL declined an average rate of 0.5 feet/yr between April 2001 and October 2006. As of April 2007, approximately 1 foot of water remained above the well screen in MWL-BW1, and approximately 3 feet of water remained above the well screen in MWL-MW3 (Table 3.5.1-1).

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Legend

- Existing Monitoring Well Proposed for Plug and Abandonment
- Angled Monitoring Well (showing horizontal extent)
- Replacement Monitoring Well (location shown schematically)
- Existing Monitoring Well
- Road
- Fence
- Toe of Landfill Cover
- MWL Extent

Figure 3.5.1-1
Mixed Waste Landfill
Groundwater Monitoring Wells

0 100 200
Scale in Feet

0 24 48
Scale in Meters

N

GIS

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

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Table 3.5.1-1
Monitoring Well Construction Details and Recent Water Levels
Mixed Waste Landfill, Sandia National Laboratories/New Mexico

Monitoring Well	Top of Inner Casing[a] (FAMSL)	Ground Surface Elevation (FAMSL)	Well Depth (FBGS)	Top of Well Screen (FBGS)	Bottom of Well Screen (FBGS)	Bottom of Well Screen (FAMSL)	April 2007 Measured Depth to Water (FBGS)	April 2007 Water Level (FAMSL)	Screened Lithology	Comments
MWL-BW1	5384.51	5382.70	477.17	452.2	472.2	4910.53	472.94	4911.57	Alluvial Fan	Well to be plugged and abandoned and replaced.
MWL-MW1	5381.54	5379.12	478.00	456.0	476.0	4903.12	468.10	4913.44	Alluvial Fan	Well to be plugged and abandoned and replaced.
MWL-MW2	5377.26	5375.71	477.00	452.0	472.0	4903.71	464.14	4913.12	Alluvial Fan	Well to be plugged and abandoned and replaced.
MWL-MW3	5381.32	5378.97	476.30	451.3	471.3	4907.67	470.06	4911.26	Alluvial Fan	Well to be plugged and abandoned and replaced.
MWL-MW4[b] (upper)	5383.46	5381.61	520.00	482.5	502.5	4881.86	494.19	4889.27	Alluvial Fan	Well contains two screens, hydraulically separated by a pneumatic packer.
MWL-MW4[b] (lower)	5383.46	5381.61	520.00	522.5	542.5	4842.08	NM	NM	Alluvial Fan/ Ancestral Rio Grande	
MWL-MW5	5379.89	5377.65	521.50	496.5	516.5	4861.15	492.31	4887.58	Alluvial Fan/ Ancestral Rio Grande	
MWL-MW6	5372.64	5369.96	530.50	505.5	525.5	4844.46	486.25	4886.39	Ancestral Rio Grande	

[a]Top of inner casing is the measurement point for the well.
[b]Well MWL-MW4 is screened at two intervals and is angled 6 degrees from vertical.
BW = Background well.
FAMSL = Feet above mean sea level.
FBGS = Feet below ground surface.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
NM = Not measured.

The NMED requested that MWL-BW1 be plugged and abandoned and replaced (NMED March 2007). A Monitoring Well Plug and Abandonment (P&A) Plan and Replacement Well Construction Plan for MWL-BW1 was submitted to the NMED on April 17, 2007 (SNL/NM April 2007). However, the NMED submitted a Notice of Disapproval regarding this plan in June 2007 (NMED June 2007), and DOE/Sandia resubmitted a P&A and Replacement Well Construction Plan for MWL-BW1 in July 2007 (SNL/NM July 2007a).

On July 2, 2007, the NMED requested replacement of monitoring wells MWL-MW1 and MWL-MW3 due to low water levels in MWL-MW3 and to problems with corrosion of the stainless-steel screens in these wells (NMED July 2007). DOE/Sandia submitted a P&A and Replacement Well Construction Plan for both of these wells in July 2007 (SNL/NM July 2007b). In addition, DOE/Sandia plan to replace MWL-MW2 in the near future because of corrosion of its stainless-steel screen.

The proposed replacement wells for MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3 are shown in Figure 3.5.1-1 as MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9. The well MWL-BW2 will serve as an upgradient background well and MWL-MW7, MWL-MW8, and MWL-MW9 will serve as point-of-compliance wells located at the downgradient toe of the landfill cover.

The DOE/Sandia intend to leave MWL-MW4 in place but not include it in annual sampling because it is not a point-of-compliance well. The packer pressure will be maintained and the well will be available for discretionary sampling.

Therefore, the groundwater monitoring well network proposed to be in place for long-term monitoring includes six wells (existing wells MWL-MW5 and MWL-MW6 and proposed wells MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9).

3.5.2 Monitoring Well Plugging and Abandonment Guidance

Requirements for monitoring well replacement are presented in the Consent Order (NMED April 2004). MWL monitoring wells will be plugged and abandoned when they are no longer required in the monitoring network, no longer provide representative groundwater samples because of declining water levels or insufficient productivity, or become damaged beyond repair. The goal of well abandonment is to seal the well in such a manner that it cannot act as a conduit for the migration of contaminants from either the ground surface to the saturated zone or between saturated zones. Well P&A plans will be prepared for any wells that meet these criteria and will be submitted to the NMED for approval. No groundwater monitoring wells at the MWL will be abandoned without prior written approval of the NMED.

3.5.3 Monitoring Well Replacement

At the request of the NMED, additional wells may be necessary to replace wells that require P&A. Additional monitoring wells will be constructed to the specifications provided in Sections VIII.A and VIII.B of the Consent Order (NMED April 2004).

Replacement wells for long-term monitoring at the MWL will have 30-foot PVC screens to maximize the monitoring life of the wells. Replacement wells will comply with the requirements

of the Consent Order (NMED April 2004) as well as the guidelines established in EPA guidance, including, but not limited to, the following:

- "RCRA Groundwater Monitoring: Draft Technical Guidance," EPA/530-R-93-001 (EPA November 1992)
- "RCRA Groundwater Monitoring Technical Enforcement Guidance Document," OSWER-9950.1 (EPA September 1986)
- "Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells," EPA 600/4-89/034 (Aller et al. 1991)

3.5.4 Groundwater Monitoring Parameters and Frequency

Groundwater monitoring at the MWL was initiated in September 1990 and continues to occur on an annual basis to meet the requirements of the Consent Order (NMED April 2004). Groundwater has been characterized for major ion chemistry, VOCs, SVOCs, nitrate, metals, radionuclides, and perchlorate. The extensive data collected to date indicate that groundwater beneath the MWL has not been contaminated by wastes disposed at the MWL.

Table 3.5.4-1 summarizes analytical requirements and EPA Test Methods (EPA November 1986) applicable to groundwater monitoring at the MWL. Sampling for parameters for which triggers apply (Section 5.2.4) is considered required. Sampling for the remaining parameters will be conducted on an as-needed basis to characterize major ion chemistry and determine groundwater characteristics.

Perchlorate screening is required by the Consent Order (NMED April 2004) for all newly installed groundwater monitoring wells for four consecutive quarters, unless perchlorate is detected. If detected, a sampling frequency for continued monitoring will be negotiated with the NMED.

The long-term groundwater monitoring network discussed in Section 3.5.1 (or the most current version) will be sampled annually according to the Groundwater SAP for the MWL provided in Appendix D. The groundwater surface elevation, hydraulic gradient, and flow direction will also be determined annually (groundwater flow rate can be calculated from these data). The Groundwater SAP provides guidance, methods, and analytical protocols for collecting and analyzing groundwater samples during the long-term monitoring period.

The groundwater monitoring network will be used to determine whether groundwater beneath the former MWL meets the regulatory standards for the constituents of concern being monitored. Groundwater samples from the MWL monitoring wells will be analyzed for VOCs, total uranium, gamma-emitting radionuclides, tritium, and gross alpha and beta activity. Samples collected from replacement monitoring wells will also be analyzed for perchlorate during the first four quarters of sampling to meet the requirements of the Consent Order (NMED April 2004). Additional samples may be collected on an as-needed basis to assess changes in groundwater major ion chemistry.

Table 3.5.4-1
Groundwater Monitoring Parameters, Test Methods, and Selection Criteria
Mixed Waste Landfill, Sandia National Laboratories/New Mexico

Parameter	Required or Optional?	EPA Method[a]	Selection Criteria
Volatile Organic Compounds	Required	SW846-8260	Screening for VOCs
Total Uranium	Required	SW846-6020	Screening for uranium
Gamma Spectroscopy (short list)	Required	EPA 901.1 or Equivalent	Screening for radionuclides
Gross alpha/beta	Required	EPA 900.0 or Equivalent	Screening for radionuclides
Tritium	Required	EPA 906.0 or Equivalent	Screening for tritium
Perchlorate[b]	Required for the first four quarters for new wells	EPA 314.0	Required by Consent Order
Total TAL[c] Metals	Optional	SW846-6020/7470	Major Ion Chemistry; screening for RCRA metals
Filtered TAL[c] Metals (filtered in the field)	Optional	SW846-6020/7470	Major Ion Chemistry; screening for RCRA metals
Nitrate plus Nitrite	Optional	EPA 353.2	Major ion chemistry
Major Anions	Optional	SW846-9056	Major ion chemistry
Total Alkalinity	Optional	EPA 310.1	Major ion chemistry
Total Dissolved Solids	Optional	EPA 160.1	General groundwater chemistry
Field Alkalinity	Optional	HACH 8203	Major ion chemistry

[a]EPA November 1986.
[b]Perchlorate screening is required by the Consent Order (NMED April 2004) for all newly installed groundwater monitoring wells for four consecutive quarters, unless perchlorate is detected. If detected, a sampling frequency for continued monitoring will be negotiated with the NMED.
[c]TAL metals = Aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, cyanide, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.
EPA = U.S. Environmental Protection Agency.
HACH = Hach Company.
NMED = New Mexico Environment Department.
RCRA = Resource Conservation and Recovery Act.
SW = Solid waste.
TAL = Target Analyte List.
VOC = Volatile organic compound.

3.5.5 Transition to Low-Flow Purging and Sampling Techniques

In order to obtain the most representative samples possible, the DOE/Sandia will use dedicated low-flow pumps and sampling techniques in MWL wells during long-term monitoring. Low-flow purging and sampling techniques are recommended for all MWL wells because the hydrogeologic environment is well suited for this type of groundwater sampling. In the past, low-flow sampling techniques have been successful at other sites across SNL/NM. However, on October 23, 2003, the NMED requested that all DOE/Sandia low-flow sampling (which the NMED termed "micropurging") be ceased for all RCRA-compliant groundwater monitoring at SNL/NM (NMED October 2003).

The low-flow purging method has been approved by the EPA (Puls and Barcelona 1996) and offers the following advantages over conventional sampling methods currently used at the MWL:

- Low-flow sampling causes less well disturbance, minimizing the disturbance of the fine-grained sediments that have collected in the wells. As a result, samples collected using low-flow purging and sampling methods typically have lower sample turbidity and variability of sampling results.

- Low-flow sampling minimizes the required purge volume by up to 95 percent, reducing the time and labor required for purging and sampling and minimizing waste.

- Low-flow purging reduces problems related to excessive drawdown and pumped volumes.

- Dedicated equipment for low-flow sampling saves field time and eliminates contamination from other wells and equipment handling.

The NMED has issued a position paper, "Use of Low-Flow and Other Non-Traditional Sampling Techniques for RCRA Compliant Groundwater Monitoring" (NMED October 2001), which allows low-flow purging and sampling techniques to be used if the monitoring wells meet the Low-Flow Well Selection Criteria (described in the position paper).

Low-flow purging and sampling techniques will be performed in accordance with the approach outlined in the NMED Position Paper and presented by the EPA (Puls and Barcelona 1996).

3.6 Biota Monitoring

Baseline soil and vegetation environmental monitoring data, collected from soil samples from animal burrows and ant hills and plant material of deep-rooted vegetation growing on the MWL, indicate that a potential exists for transport of radionuclides by biota (SNL/NM 2007, pending). Samples of soil from on-site animal burrows and ant hills showed elevated concentrations of cesium-137 above established background levels, suggesting that burrowing animals and ants may have the potential to transport contaminants to the ground surface. Plant material (stems and leaves) collected from one four-wing saltbush growing over Trench B showed detectable activities of cobalt-60 and cesium-137.

These data indicate that biotic mobilization of contaminants is a potential contaminant transport mechanism that should be considered during long-term monitoring at the MWL. The

construction of the MWL biointrusion barrier considerably reduces this potential. The intent of the rock barrier is to prevent any intrusion by burrowing animals, and it should also restrict plant root growth as long as the underlying materials are relatively dry (Anderson and Forman September 2002). The potential for biotic mobilization of contaminants is also reduced by the addition of 2 to 40 inches of compacted subgrade soil underneath the biointrusion barrier, as well as the addition of 3 feet of compacted soil above the biointrusion barrier.

The potential for mobilization of contaminants by plants will be further reduced by the removal of deep-rooted vegetation growing on the cover during routine maintenance (Section 4.2.1).

Although the potential for biotic mobilization of contaminants by plants is significantly reduced by the engineered cover, rock biointrusion barrier and removal of deep-rooted vegetation, the DOE/Sandia will sample vegetation on the cover every two years to determine whether radionuclides (other than tritium) are being taken up by plants. The vegetation samples will be analyzed for gamma-emitting radionuclides.

Although the potential for biotic mobilization of contaminants by burrowing animals and ants is also low due to the addition of the engineered cover and rock biointrusion barrier, the DOE/Sandia will monitor animal burrows and ant hills to confirm that they do not represent a significant transport mechanism in the future. The locations of animal burrows and ant hills (if they exist) will be surveyed using a global positioning system on an annual basis, and surface soil samples will be collected from up to six animal burrows and ant hills every two years to determine whether contaminants have been mobilized by biota. The soil samples will be analyzed for RCRA metals and gamma-emitting radionuclides. The SAP for monitoring of biota is presented in Appendix E.

4.0 INSPECTION/MAINTENANCE/REPAIR ACTIVITIES AND FREQUENCIES

Surveillance and maintenance will be conducted on the following elements of the MWL final design:

- The MWL cover
- The surface-water diversion structures
- The groundwater and soil-vapor monitoring networks
- The perimeter security fence, security signs, gate locks, and survey benchmarks and/or monuments

Inspection and maintenance of these systems will be conducted on a regularly scheduled basis to ensure the integrity of the cover; surface-water diversion structures; groundwater and vadose zone monitoring network; and perimeter security fence, signs, gate locks, and survey benchmarks. These surveillance and maintenance details are discussed in the following sections.

4.1 Criteria for Successful Revegetation of the Engineered Cover

In addition to routine inspection and maintenance, the cover will be monitored to ensure the revegetation effort is successful, a critical element in the long-term performance of the cover.

The following information summarizes a climax plant community typical of the undisturbed east mesa ecosystem of TA-III (Peace et al. November 2004).

- Total percent foliar coverage equals 22.5 percent (i.e., 22.5 percent of the land surface is covered with living plants versus 77.5 percent bare surface area).
- Of the 22.5 percent of total foliar coverage, 19.2 percent is comprised of native perennial species and 3.3 percent is comprised of annual species, which includes native annual species and nonnative, transitory (or invasive) plant species.
- Considering only the total percentage of foliar coverage, 85.3 percent consists of native perennial species, and 14.7 percent comprises annual species (the majority of the annual species are nonnative, transitory species).

Based upon this information, the operational criteria for achieving successful revegetation for the MWL cover under average annual precipitation conditions are presented as follows:

- Total percent foliar coverage equals 25 percent (i.e., 25 percent of the land surface is covered with living plants versus 75 percent bare surface area).
- Of the 25 percent total foliar coverage, 50 percent or greater comprises native perennial species and less than 50 percent comprises annual species.

- No contiguous bare spots greater than 200 square feet (approximately 14 by 14 feet) are present.

If these criteria are met under average precipitation conditions, it will be concluded that the native community is successfully reestablished. These criteria do not apply under periods of drought conditions.

Successful revegetation is projected to take three to five years. The cover monitoring, inspection, and maintenance/repair activities described in Section 4.2 will allow assessment of the cover revegetation effort and determine whether or not the criteria are met. Local climate trends will have a major impact on plant growth and health and will be documented, evaluated, and summarized along with vegetation survey results in the annual MWL long-term monitoring and maintenance report.

4.2 Final Cover System Inspection/Maintenance/Repair

This section describes the inspection, maintenance, and repair process for the final engineered cover. It includes details for the cover vegetation monitoring, the process for cover inspections, and cover maintenance and repairs.

4.2.1 Vegetation Inspection

Cover vegetation monitoring will be accomplished using a two-phase approach. The first phase will concentrate on establishing the vegetation on the cover from seed to a mature plant community. This phase is anticipated to take from three to ten or more years, depending on the degree of compaction of the soil cover. Normal succession processes should occur and continue once native flora has been established over greater than 50 percent of the foliar coverage. During this period, a staff biologist will inspect and document the inventory of the main flora populating the cover on a quarterly basis, inspect the cover for contiguous areas lacking vegetation in excess of 200 square feet, and recommend soil augmentations, surface scarification, reseeding, or other corrective actions as deemed appropriate to establish a long-term sustainable native plant community. Deep-rooted plants such as fourwing saltbush and other shrubs and trees will be removed if they are present on the cover.

During this monitoring period, the staff biologist will be responsible for noting and interpreting signs of animal intrusion. These inspections will be documented on the Biology Checklist for the MWL Cover inspection form (Appendix G). At the end of the fourth quarter of each year, the staff biologist will compile the results of the quarterly inspections in a summary report that will be included in the annual MWL long-term monitoring and maintenance report submitted to the NMED.

Once native flora are established and self-sustaining, the second phase of monitoring will begin. Cover vegetation will be monitored by the staff biologist on an annual basis to gauge the overall health of the cover vegetation. Based upon these observations, the staff biologist will submit in writing any recommendations for soil augmentation, surface scarification, and reseeding as necessary to maintain established vegetation. The presence of deep-rooted plants growing on the cover will be noted, and the plants will be removed by field technicians (Section 4.2.3). The results of the staff biologist inspections will be reported in the long-term monitoring and maintenance report submitted annually to the NMED.

4.2.2 Cover Inspection

A field technician and a staff biologist will perform cover inspections on a quarterly basis. Settlement of the cover surface in excess of 6 inches, erosion of the cover soil in excess of 6 inches deep, areas of ponding water, animal intrusion burrows in excess of 4 inches in diameter, contiguous areas lacking vegetation in excess of 200 square feet, and any other conditions that may impact the cover integrity will be noted on the Cover Inspection Checklist (Appendix G). Documentation of animal intrusion burrows in excess of 4 inches in diameter and contiguous areas lacking vegetation in excess of 200 square feet will be noted quarterly on the Biology Checklist for the MWL Cover (Appendix G) instead of the Cover Inspection Checklist.

4.2.3 Cover Maintenance/Repair

Field technicians will perform soil augmentations, surface scarification, reseeding, or other vegetation maintenance/repair (such as removal of deep-rooted plants) as necessary. Damage to cover vegetation that exceeds the criteria listed in Section 4.2.2 will be repaired within 60 days of notation on the Cover Inspection Checklist (Appendix G) to a condition that meets or exceeds the original design. Repairs to the cover will be done using materials consistent with the cover installation specifications, according to soil classification and gradation specifications in the MWL CMI Plan (SNL/NM November 2005). Repair specifications include, but are not limited to, the following:

- Soil augmentations, surface scarification, reseeding, or other corrective actions for areas lacking vegetation in excess of 200 square feet and reestablishing the topsoil layer to provide a suitable seedbed

- Backfilling, compacting, and reseeding settlement areas, areas of ponding water, animal intrusion burrows, and areas of erosion in excess of 6 inches deep using either stockpiled clean soil from the cover installation or locally derived clean fill with properties meeting the criteria for the soil used to construct the MWL cover

Supplemental watering should not be necessary to establish the long-term sustainable native plant community on the MWL cover. In the unlikely event that the staff biologist deems supplemental watering to be necessary to establish the native grasses, the NMED will be notified prior to conducting supplemental watering, and care will be taken to minimize the volume of water applied.

4.3 Storm-Water Diversion Structure Inspection/Maintenance/Repair

This section describes the inspection, maintenance, and repair process for the storm-water diversion structures associated with the final engineered cover.

4.3.1 Inspection

The function of storm-water diversion structures associated with the cover is to prevent storm-water run-on and runoff from eroding the cover and to reduce the amount of water that could potentially infiltrate the cover. The storm-water diversion structures will be inspected by a field

technician on a quarterly basis to verify structural integrity and ensure adequate performance. These inspections will be documented on the MWL Long-Term Monitoring Checklist form (Appendix G). Inspections will document erosion of the channels or sidewalls in excess of 6 inches deep and accumulations of silt greater than 6 inches deep or debris that blocks more than one-third of the channel width.

4.3.2 Maintenance/Repair

Based upon the results from the storm-water diversion structure inspections, erosion that exceeds the 6-inch inspection limits will be repaired within 60 days of notation on the Cover Inspection Checklist (Appendix G) to a condition that meets or exceeds the original design. Sediment and debris accumulations that exceed these limits will be removed within 60 days of notation on the Cover Inspection Checklist (Appendix G). Reseeding of the surface drainage features may also be performed to facilitate revegetation and erosion resistance, if necessary.

4.4 Groundwater and Vadose Zone Monitoring Network Inspection/Maintenance/Repair

This section describes the inspection, maintenance, and repair process for groundwater and vadose zone monitoring networks. These include groundwater monitoring wells, FLUTe™ wells, and soil-vapor monitoring access tubes.

4.4.1 Inspection

The groundwater monitoring wells, FLUTe™ wells, and soil-moisture monitoring access tubes will be inspected during regularly scheduled groundwater, soil-vapor, and soil-moisture monitoring events. These inspections will be documented on the MWL Long-Term Monitoring Checklist form (Appendix G). The inspection will note the condition of the components including protective casings and stanchions, wellhead covers/caps, soil-vapor sampling ports, and well identification markings. Groundwater pumps and sample tubing will be inspected annually during each sampling event. Pump replacement and maintenance and tubing replacement will be performed on an as-needed basis based upon pump performance and tubing inspections.

4.4.2 Maintenance/Repair

The groundwater monitoring wells, FLUTe™ wells, and soil-moisture monitoring access tubes will be maintained annually, as needed, based upon inspection and analytical results. Maintenance activities will also include ensuring that all system components are protected from the weather.

4.5 Fence Inspection/Maintenance/Repair

This section describes the inspection, maintenance, and repair process for the fence, gates, locks, warning signs, and survey benchmarks and monuments.

4.5.1 Inspection

The fence, gates, locks, warning signs, and survey benchmarks and monuments will be routinely inspected. The inspections will document the condition of the fence, including fence wires, posts, gates, gate locks, and warning signs using the MWL Long-Term Monitoring Inspection Form included in Appendix G. Excessive accumulations of wind-blown plants and debris that would obscure warning signs, block access to the MWL, or interfere with any monitoring and sampling events also will be documented.

4.5.2 Maintenance/Repair

The fence, gates, warning signs, and survey benchmarks and/or monuments will be maintained and/or repaired within 60 days of discovery of a problem by routine inspections. Activities may include, but are not limited to, removing excessive accumulations of wind-blown plants and debris, repairing broken wire sections and posts, repairing and oiling gates, cleaning or replacing locks, repairing or replacing warning signs, and removing excess soil and/or vegetation covering survey monuments. Maintenance records will be maintained with the MWL Long-Term Monitoring Inspection Forms.

4.6 Inspection Schedule, Corrective Actions, and Recorded Results

A schedule for implementing inspections and prescribed maintenance of the MWL cover, surface-water drainage features, monitoring network, and access controls is provided in Table 4.6-1. Inspection results for the MWL monitoring systems will be recorded on the Long-Term Monitoring Inspection Forms included in Appendix G. Inspection results will be summarized in the annual MWL long-term monitoring and maintenance report.

Repairs and maintenance will be undertaken to ensure the integrity of the MWL cover, protect human health and the environment, and mitigate any potential hazards. If an inspection of the MWL reveals that a nonemergency problem has developed, the necessary repairs, maintenance, or replacement will be initiated within three days of notation on the Cover Inspection Checklist (Appendix G), unless circumstances beyond the control of the DOE/Sandia cause further delay. The DOE/Sandia will limit any such delays to as short a time period as reasonably possible. Repairs should not take longer than 60 days to complete. If an unexpected event or issue outside of DOE/Sandia control causes the repairs to take longer than 60 days to complete, then NMED will be consulted to discuss the impacts to the schedule. If a hazard appears imminent or a hazardous situation already exists, remedial action will be initiated immediately. Any remedial action taken pursuant to an inspection will be noted on the MWL Long-Term Monitoring Inspection Form. If any identified hazard meets the definition of an emergency, standard notification procedures will be followed.

Table 4.6-1
Long-Term Monitoring, Inspection, and Maintenance Schedule
Mixed Waste Landfill, Sandia National Laboratories/New Mexico

MWL System to be Inspected	Inspection Parameters	Inspection Frequency	Maintenance Implementation	Maintenance/ Repair Frequency[a]
Final Cover Surface	Vegetation Inventory	Quarterly until vegetation is established, annually thereafter by a staff biologist[b]	Soil augmentations and/or reseeding	Within 60 days of discovery of needed repairs
	Contiguous areas of no vegetation >200 ft^2		Revegetate barren areas that exceed prescribed limits	
	Animal intrusion burrows in excess of 4 inches in diameter		Repair cover system damage that exceeds prescribed limits	
Final Cover Surface	Settlement of cover surface in excess of 6 inches	Quarterly by a field technician	Repair cover system damage that exceeds prescribed limits	Within 60 days of discovery of needed repairs
	Erosion of cover soil in excess of 6 inches deep			Within 60 days of discovery of needed repairs
	Animal intrusion burrows in excess of 4 inches in diameter			Within 60 days of discovery of needed repairs
	Contiguous areas of no vegetation >200 ft^2 [c]		Revegetate barren areas that exceed prescribed limits[c]	Within 60 days of discovery of needed repairs
Surface-Water Drainage Features	Channel or sidewall erosion in excess of 6 inches deep	Quarterly by a field technician	Repair erosion that exceeds prescribed limits	Within 60 days of discovery of needed repairs
	Accumulations of sediment in excess of 6 inches deep or debris that blocks more than 1/3 of the channel width		Remove sediment and debris accumulations that exceed prescribed limits	
FLUTe™ Soil-Vapor Monitoring Wells, Soil-Moisture Monitoring Wells, and Groundwater Monitoring Wells	Concrete pads, stanchions, and protective casings	Groundwater and Vadose Zone Network Components: annually by a field technician during sampling events	Maintain, clean, repair, replace, re-label, as appropriate	Within 60 days of discovery of needed repairs
	Well cover caps and Swagelok® (or equivalent) dust caps			
	Monitoring wells and soil-vapor sampling port labels			
	Locks			
	Sampling pumps and tubing			

Refer to footnotes at end of table.

Table 4.6-1 (Concluded)
Long-Term Monitoring, Inspection, and Maintenance Schedule
Mixed Waste Landfill, Sandia National Laboratories/New Mexico

MWL System to be Inspected	Inspection Parameters	Inspection Frequency	Maintenance Implementation	Maintenance/ Repair Frequency[a]
Fence	Presence of wind-blown plants and debris	Quarterly by a field technician	Remove wind-blown plants and debris	Within 60 days of discovery of needed repairs
	Condition of fence wires, posts, gates, gate locks, warning signs, and survey monuments in the local area		Repair broken wire sections and posts, repair/oil gates, clean/replace locks, repair/replace warning signs, clear dirt/debris from monuments	

[a]Maintenance/repairs will be performed as necessary, based upon the results of inspections.
[b]As explained in Section 4.2.1, the transition from quarterly to annual inspections by a staff biologist is based upon the establishment of native flora in a self-sustaining manner as determined by the staff biologist.
[c]Barren areas exceeding >200 ft^2 will not require corrective action after the native vegetation is established in a self-sustaining manner; however, these areas will be noted and tracked during inspections after the 3- to 5-year time frame is completed and reviewed annually by the staff biologist to determine whether corrective action is required based upon comparison to surrounding vegetation.
ft^2 = Square feet.
MWL = Mixed Waste Landfill.

4.7 Record Keeping and Reporting

The following active records shall be maintained at the SNL/NM Customer-Funded Records Center:

1. Current and complete copy of the MWL LTMMP, including all appendices
2. Current written versions of operating procedures (administrative, standard, and laboratory) and related guidance referenced in the MWL LTMMP
3. A written Operating Record that includes the following:
    a. All completed inspection forms
    b. Long-Term Monitoring and Maintenance Annual Reports
    c. All waste management documentation for the last three years
    d. Emergency or incident response records and reports
4. Site-specific health and safety plan

Additionally, the following MWL records shall be maintained at the SNL/NM Customer-Funded Records Center:

1. All correspondence and other documents from the NMED and any other governmental agencies related to long-term monitoring and maintenance
2. All training records for current employees and training records for any former employee for a minimum of three years from the last date the employee worked at the MWL
3. All completed long-term monitoring and maintenance reports
4. All groundwater monitoring results and records, including full laboratory data packages/reports
5. All soil-vapor monitoring results and records, including full laboratory data packages/reports
6. All vadose zone moisture monitoring results and records, including full laboratory data packages/reports
7. All air monitoring results and records, including full laboratory data packages/reports
8. All biota monitoring results and records, including full laboratory data packages/reports
9. All records of actions taken to prevent or mitigate releases of hazardous waste or hazardous constituents to the environment

The DOE/Sandia will comply with the record-keeping provisions of Title 40, Code of Federal Regulations (CFR), Section 264.74, concerning the availability, retention, and disposition of records.

4.7.1 Annual Long-Term Monitoring and Maintenance Reports

During the long-term monitoring and maintenance period, the DOE/Sandia will submit an MWL long-term monitoring and maintenance report to the NMED on an annual basis. The report will include calendar year data and will:

1. Summarize inspection, maintenance, and repair activities, and indicate whether any implemented repairs were effective and met the original specifications

2. Provide groundwater, vadose zone soil vapor and soil moisture, air, and biota monitoring results

3. Indicate whether trigger levels were exceeded for any constituent

4. Summarize any problems that either endangered or presented significant potential to endanger human health and the environment for the reporting period and what was done to mitigate such problems

The annual reports are due by April 30 of each calendar year and will cover the previous calendar year.

4.7.2 Five-Year Reevaluation Reports

The DOE/Sandia will also submit a report every five years reevaluating the feasibility of excavation and analyzing the continued effectiveness of the selected remedy. The report will include a review of the annual long-term monitoring and maintenance reports and any other pertinent data, as well as additional documentation required by the NMED. In each five-year report, the DOE/Sandia will:

1. Update the fate and transport model for the MWL with current data

2. Reevaluate any likelihood of contaminants reaching groundwater

3. Detail all efforts to ensure that any future releases or mobilization of contaminants are detected and addressed well before any effect on groundwater or increased risk to public health or the environment occurs

4.8 Potential for Exposure

The MWL vegetative soil cover provides a significant barrier between the surface environment and the buried wastes beneath the cover. The following measures have been implemented to reduce the risk of exposure from the wastes buried at the MWL:

- The engineered cover is designed to minimize the potential for the migration of liquid into the MWL.
- Monitoring of the vadose zone will be conducted to determine whether contaminants are being released that pose a threat to groundwater.
- Security and IC measures will be maintained to restrict access to the area.
- Federal ownership and the industrial land-use designation will help prevent inappropriate use of the MWL site.
- Inspections, maintenance, and repairs (as necessary) will be performed on a regularly scheduled basis and in accordance with the LTMMP.

4.9 Potential for Emergency

Due to the current conditions at the MWL, the potential for fire, explosion, or unplanned sudden release of radionuclides or RCRA-regulated hazardous waste or hazardous waste constituents that would significantly threaten human health or the environment is low. In the unlikely event of an emergency, the SNL/NM Emergency Operations Center will provide coordination, resources, and appropriate emergency equipment on an as-needed basis.

5.0 TRIGGERS FOR LONG-TERM MONITORING

The NMED Class 3 Permit Modification (NMED August 2005) required that the MWL CMI Plan (SNL/NM November 2005) include triggers for future action (e.g., increased monitoring, contaminant mitigation, etc.) that identify and detail specific monitoring results that may require additional testing or corrective action. Based upon the results of the probabilistic performance-assessment modeling for the MWL (Ho et al. January 2007), the following parameters were identified as important for long-term monitoring:

- Surface emissions of tritium and radon
- Infiltration through the MWL cover
- Concentrations of uranium in groundwater
- Concentrations of VOCs in the soil vapor and groundwater

Monitoring triggers are established for these parameters to ensure that the MWL performance metrics and corrective action objectives are met. These triggers were derived from EPA, DOE, and NMED regulatory standards, as well as NMED-approved background concentrations. To address concerns regarding potential mobilization of contaminants by biota, additional monitoring triggers are established for metals and radionuclides in surface soil near animal burrows and ant hills.

The trigger evaluation process is described in Section 5.1. This process will be initiated if a trigger is exceeded during long-term monitoring at the MWL. The logic and rationale for specific triggers are presented in Section 5.2. The triggers discussed in Section 5.2 have been revised from the original triggers presented in the MWL CMI Plan (SNL/NM November 2005) to address regulatory and public concerns expressed in the CMI Plan review process.

5.1 Trigger Evaluation Process

A trigger evaluation process will be utilized during long-term monitoring activities at the site (Figure 5.1-1). The process will be a phased approach designed to ensure the protection of human health and the environment, while allowing adequate data collection to evaluate whether corrective action is warranted.

In the event that a trigger level is exceeded, the process shown in Figure 5.1-1 will be used to ensure that adequate data are collected to determine whether additional corrective action is warranted. The increased frequency of data collection (see Step 3 in Figure 5.1-1) and the corresponding explanation will ensure that adequate data are collected to eliminate field sampling error, laboratory error, and to identify short-term exceedances that do not reflect long-term trends. Thus, any recommendations for corrective action because of trigger exceedances will be based upon data trends rather than upon single detection values above the trigger level. If the monitored parameters indicate an established trend above the trigger level, the process requires that a technical letter report be submitted to the NMED identifying the trend and recommending whether or not corrective action should be implemented.

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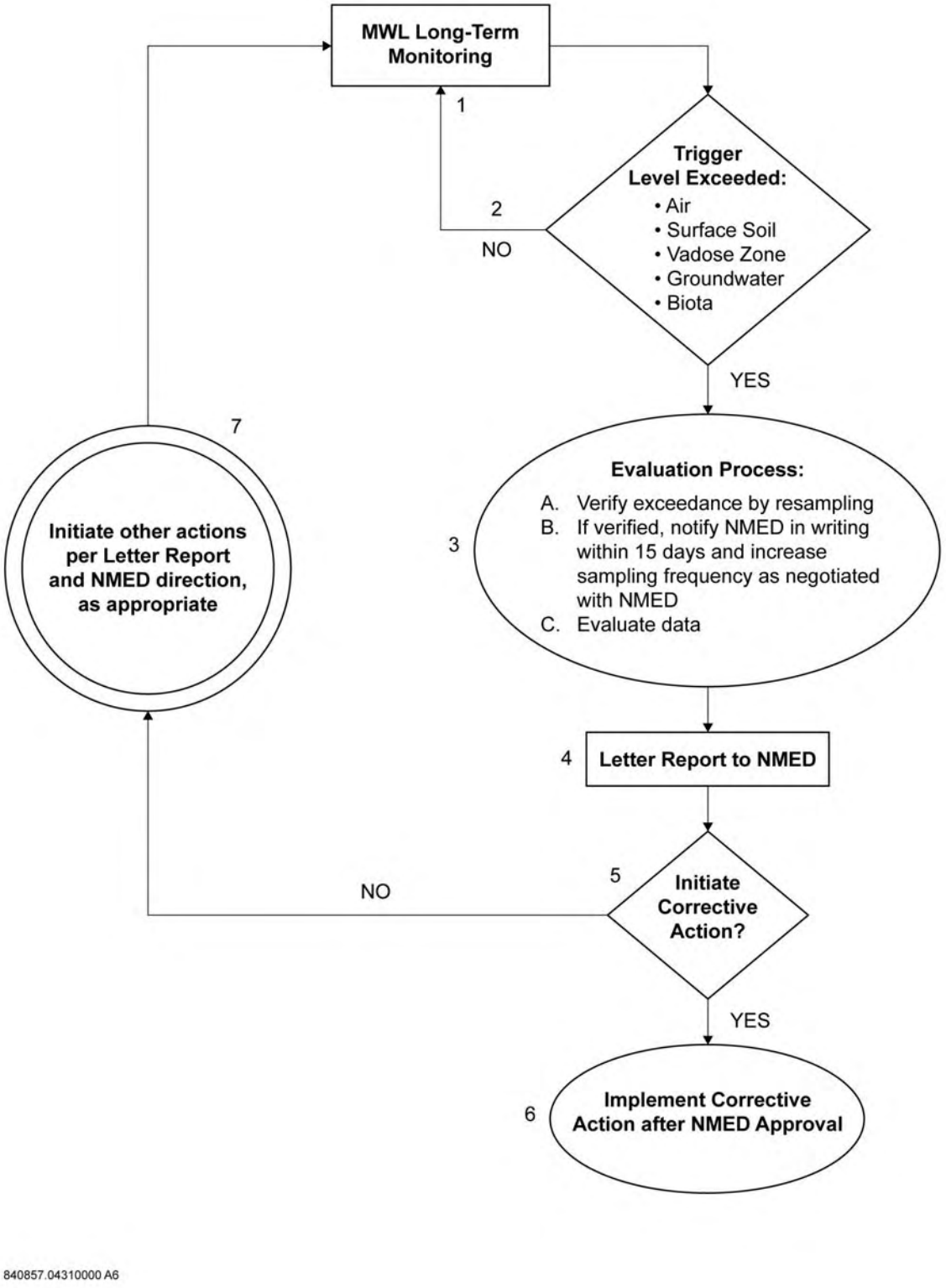

Figure 5.1-1
Trigger Evaluation Process for the Mixed Waste Landfill

The steps outlined in Figure 5.1-1 are explained as follows:

1. Long-term monitoring of the air, surface soil, vadose zone, and groundwater at the MWL.

2. Exceedance of one or more trigger levels initiates the specific actions described in the following steps.

3. Step A of the evaluation process initiates resampling to verify the result(s) that exceeded the trigger level. If the trigger exceedance is verified, the NMED will be notified of the exceedance in writing within 15 days. Step B is based upon the conceptual model for the MWL. Because infiltration through the MWL cover is expected to be very low, and contaminant transport times in the vadose zone and groundwater are anticipated to be relatively slow, a longer period for data collection at an increased sampling frequency is recommended to determine trends. The length of this period and the increased sampling frequency will be negotiated with the NMED. Once the increased sampling data have been collected, the data and any resulting trends will be evaluated to determine the significance of the exceedance (Step C).

4. After the trends have been evaluated, a brief technical letter report will be prepared and submitted to the NMED, presenting the results of the increased monitoring, and providing recommendations regarding corrective action.

5. NMED Decision Point: after the technical letter report is submitted to the NMED, a meeting will be held to discuss the data evaluation and the recommendations regarding corrective action. If the NMED determines that further investigation of the trigger exceedance is needed, the NMED may require corrective action based upon a finding that releases of contaminants have occurred or are occurring.

6. If the data trend is increasing and higher than the trigger value, corrective action may be necessary. The technical letter report will address appropriate options and form the basis for further discussion with the NMED to determine the final corrective action.

7. If the data trend is not clear or is decreasing, corrective action may not be necessary, but other actions may be required as proposed in the technical letter report or requested by the NMED.

5.2 Monitoring Triggers

Based upon both the results of the probabilistic performance-assessment modeling conducted for the MWL (SNL/NM November 2005, Ho et al. January 2007) and subsequent input received from the NMED and the public, monitoring triggers are established for the air, soil, vadose zone, and groundwater at the MWL. These triggers are listed in Table 5.2-1 and are discussed in the following sections.

Although triggers for long-term monitoring have been developed for both hazardous and radioactive constituents, the triggers and monitoring for radionuclides are provided voluntarily by the DOE/Sandia. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements of the Consent Order. Additional information on radionuclides and the scope of the Consent Order is available in Section III.A of the Consent Order (NMED April 2004).

5.2.1 Air Monitoring Triggers

The trigger for radon is based upon the results of the probabilistic performance-assessment modeling (Ho et al. January 2007). The modeling indicates that a possibility exists that the radon-222 flux from the MWL to the atmosphere will exceed the design standard of 20 pCi/m^2/s at the landfill surface.

The trigger for radon in air is 4 pCi/L, and the point of compliance is the MWL perimeter. This value is the EPA action threshold for radon in household air (EPA September 2005). This value is significantly lower than the simulated radon-gas concentrations (greater than 10,000 pCi/L) at the surface of the MWL which yielded fluxes that exceeded the design standard of 20 pCi/m^2/s (Ho et al. January 2007). Should the radon trigger of 4 pCi/L be exceeded in air at the MWL point of compliance, then the trigger evaluation process shown in Figure 5.1-1 will be implemented.

5.2.2 Surface Soil and Biota Monitoring Triggers

The surface soil and biota monitoring triggers include a trigger for tritium concentrations in soil collected at select locations along the MWL perimeter. Several additional triggers have been established to address concerns regarding potential mobilization of contaminants by biota. These include triggers for radionuclides and metals in surface soil near animal burrows and ant hills, and triggers for gamma-emitting radionuclides in vegetation growing on the cover.

5.2.2.1 Tritium in Surface Soil

Tritium is the most mobile radionuclide disposed of at the MWL, and the performance-assessment model (Ho et al. January 2007) indicates a low (2 percent) probability that tritium emitted from the MWL may exceed the performance objective of 10 millirem/yr dose to the public via the air pathway. For this reason, a trigger was developed for tritium emitted from the MWL. Based upon the modeling results, the maximum simulated surface

Table 5.2-1
Monitoring Triggers for the Mixed Waste Landfill
Sandia National Laboratories/New Mexico

Environmental Medium	Monitoring Parameter	Main Potential Receptors	Trigger Value[a]	Sampling Points	Performance Objective	Basis for Performance Objective
Air	Radon[a]	Humans	4 pCi/L (measured by track-etch radon detectors)	MWL Perimeter	Average flux of radon-222 gas shall be less than 20 pCi/m^2/s at the landfill surface (design standard)	EPA Action Threshold for radon in air (EPA September 2005)
Surface Soil	Tritium[a]	Humans and ecological receptors	20,000 pCi/L tritium in soil moisture	MWL Perimeter	Dose to the public via the air pathway shall be less than 10 mrem/yr	DOE Order 5400.5 (DOE 1993), 10 CFR 61 Subpart H, 40 CFR 141.66
Surface Soil	Cs-137[a]	Humans and ecological receptors	0.664 pCi/g	Animal burrows and ant hills on the cover	Radionuclide concentrations in soil shall not exceed NMED-approved maximum background concentrations	NMED-Approved Maximum Background Concentrations (Dinwiddie September 1997)
Surface Soil	Ra-226[a]	Humans and ecological receptors	2.30 pCi/g	Animal burrows and ant hills on the cover	Radionuclide concentrations in soil shall not exceed NMED-approved maximum background concentrations	NMED-Approved Maximum Background Concentrations (Dinwiddie September 1997)
Surface Soil	Th-232[a]	Humans and ecological receptors	1.01 pCi/g	Animal burrows and ant hills on the cover	Radionuclide concentrations in soil shall not exceed NMED-approved maximum background concentrations	NMED-Approved Maximum Background Concentrations (Dinwiddie September 1997)
Surface Soil	U-235[a]	Humans and ecological receptors	0.16 pCi/g	Animal burrows and ant hills on the cover	Radionuclide concentrations in soil shall not exceed NMED-approved maximum background concentrations	NMED-Approved Maximum Background Concentrations (Dinwiddie September 1997)
Surface Soil	U-238[a]	Humans and ecological receptors	1.4 pCi/g	Animal burrows and ant hills on the cover	Radionuclide concentrations in soil shall not exceed NMED-approved maximum background concentrations	NMED-Approved Maximum Background Concentrations (Dinwiddie September 1997)
Surface Soil	Arsenic	Humans and ecological receptors	17.7 mg/kg	Animal burrows and ant hills on the cover	RCRA metal concentrations in soil shall not exceed NMED industrial/occupational SSLs	NMED Industrial/Occupational SSLs (NMED June 2006)

Refer to footnotes at end of table.

Table 5.2-1 (Continued)
Monitoring Triggers for the Mixed Waste Landfill
Sandia National Laboratories/New Mexico

Environmental Medium	Monitoring Parameter	Main Potential Receptors	Trigger Value[a]	Sampling Points	Performance Objective	Basis for Performance Objective
Surface Soil	Barium	Humans and ecological receptors	100,000 mg/kg	Animal burrows and ant hills on the cover	RCRA metal concentrations in soil shall not exceed NMED industrial/occupational SSLs	NMED Industrial/Occupational SSLs (NMED June 2006)
Surface Soil	Cadmium	Humans and ecological receptors	564 mg/kg	Animal burrows and ant hills on the cover	RCRA metal concentrations in soil shall not exceed NMED industrial/occupational SSLs	NMED Industrial/Occupational SSLs (NMED June 2006)
Surface Soil	Chromium	Humans and ecological receptors	3,400 mg/kg	Animal burrows and ant hills on the cover	RCRA metal concentrations in soil shall not exceed NMED industrial/occupational SSLs	NMED Industrial/Occupational SSLs (NMED June 2006)
Surface Soil	Lead	Humans and ecological receptors	800 mg/kg	Animal burrows and ant hills on the cover	RCRA metal concentrations in soil shall not exceed NMED industrial/occupational SSLs	NMED Industrial/Occupational SSLs (NMED June 2006)
Surface Soil	Mercury	Humans and ecological receptors	100,000 mg/kg	Animal burrows and ant hills on the cover	RCRA metal concentrations in soil shall not exceed NMED industrial/occupational SSLs	NMED Industrial/Occupational SSLs (NMED June 2006)
Surface Soil	Selenium	Humans and ecological receptors	5,680 mg/kg	Animal burrows and ant hills on the cover	RCRA metal concentrations in soil shall not exceed NMED industrial/occupational SSLs	NMED Industrial/Occupational SSLs (NMED June 2006)
Surface Soil	Silver	Humans and ecological receptors	5,680 mg/kg	Animal burrows and ant hills on the cover	RCRA metal concentrations in soil shall not exceed NMED industrial/occupational SSLs	NMED Industrial/Occupational SSLs (NMED June 2006)
Biota	Gamma Spectroscopy	Ecological receptors	No regulatory standards available	Deep-rooted plants on the cover	Protection of natural resources, including biota	No regulatory guidelines apply

Refer to footnotes at end of table.

Table 5.2-1 (Continued)
Monitoring Triggers for the Mixed Waste Landfill
Sandia National Laboratories/New Mexico

Environmental Medium	Monitoring Parameter	Main Potential Receptors	Trigger Value[a]	Sampling Points	Performance Objective	Basis for Performance Objective
Vadose Zone	Moisture Content	Humans via groundwater	23 percent by volume	Linear depths of 10 to 100 ft along neutron probe access holes beneath the MWL	Infiltration through the cover shall be less than the EPA-prescribed technical equivalence criterion of 31.5 mm/yr [10E-7 cm/s]	RCRA 40 CFR Part 264.301
Vadose Zone	PCE	Humans via groundwater	20 ppmv	Soil Vapor from Deepest Sampling Port in FLUTe™ well	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Vadose Zone	TCE	Humans via groundwater	20 ppmv	Soil Vapor from Deepest Sampling Port in FLUTe™ well	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Vadose Zone	Total VOCs	Humans via groundwater	25 ppmv	Soil Vapor from Deepest Sampling Port in FLUTe™ well	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	Uranium	Humans via groundwater	15 μg/L	Downgradient monitoring well locations	Uranium concentrations in groundwater shall not exceed the EPA MCL of 30 μg/L	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	1,1,1-TCA	Humans via groundwater	100 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	1,1,2-TCA	Humans via groundwater	2.5 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	1,1-Dichloroethene	Humans via groundwater	3.5 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	1,2-Dichloroethane	Humans via groundwater	2.5 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	1,2-Dichloropropane	Humans via groundwater	2.5 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)

Refer to footnotes at end of table.

Table 5.2-1 (Continued)
Monitoring Triggers for the Mixed Waste Landfill
Sandia National Laboratories/New Mexico

Environmental Medium	Monitoring Parameter	Main Potential Receptors	Trigger Value[a]	Sampling Points	Performance Objective	Basis for Performance Objective
Groundwater	Benzene	Humans via groundwater	2.5 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	Carbon tetrachloride	Humans via groundwater	2.5 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	Chlorobenzene	Humans via groundwater	50 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	Ethyl benzene	Humans via groundwater	350 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	Methylene chloride	Humans via groundwater	2.5 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	Styrene	Humans via groundwater	50 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	PCE	Humans via groundwater	2.5 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	Toluene	Humans via groundwater	500 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	TCE	Humans via groundwater	2.5 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	Vinyl Chloride	Humans via groundwater	1.0 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	Xylenes (Total)	Humans via groundwater	5,000 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)

Refer to footnotes at end of table.

Table 5.2-1 (Concluded)
Monitoring Triggers for the Mixed Waste Landfill
Sandia National Laboratories/New Mexico

Environmental Medium	Monitoring Parameter	Main Potential Receptors	Trigger Value[a]	Sampling Points	Performance Objective	Basis for Performance Objective
Groundwater	cis-1,2-Dichloroethene	Humans via groundwater	35 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	Trans-1,2-Dichloroethene	Humans via groundwater	50 μg/L	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA MCLs	EPA National Primary Drinking Water Regulations (40 CFR 141)
Groundwater	EPA Method 8260 VOCs with no MCLs	Humans via groundwater	EPA Region 6 Human Health Medium-Specific Screening Levels	Downgradient monitoring well locations	VOC concentrations in groundwater shall not exceed EPA Region 6 Human Health Medium-Specific Screening Levels	EPA Region 6 Human Health Medium-Specific Screening Levels (EPA December 2006)

[a]Although triggers for long-term monitoring have been developed for both hazardous and radioactive constituents, the triggers and monitoring for radionuclides are provided voluntarily by DOE/Sandia. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements of the Consent Order. Additional information on radionuclides and the scope of the Consent Order is available in Section III.A of the Consent Order.

CFR = Code of Federal Regulations.
cm = Centimeter(s).
DOE = U.S. Department of Energy.
EPA = U.S. Environmental Protection Agency.
FLUTe™ = Flexible Liner Underground Technologies.
ft = Foot (feet).
g = Gram(s).
kg = Kilogram(s).
L = Liter(s).
m^2 = Square meter(s).
MCL = Maximum contaminant level.
μg = Microgram(s).
mg = Milligram(s).
mm = Millimeter(s).
mrem = Millirem.
MWL = Mixed Waste Landfill.
NMED = New Mexico Environment Department.
PCE = Tetrachloroethane.
pCi = Picocurie(s).
ppmv = Parts per million by volume.
RCRA = Resource Conservation and Recovery Act.
s = Second(s).
SSL = Soil screening level.
TCA = Trichloroethane.
TCE = Trichloroethene.
VOC = Volatile organic compound.
yr = Year.

concentration of tritium for the realizations that yielded the peak doses via air are on the order of 10^9 to 10^{10} pCi/L. Therefore, a conservative trigger value of 20,000 pCi/L in surface soil at the MWL perimeter will be used.

The tritium trigger applies to surface soil samples collected annually at select locations outside the MWL perimeter fence by the SNL/NM Terrestrial Surveillance Program. Soil samples have been collected from these locations and analyzed for tritium on an annual basis since 1985. Soil moisture is extracted from these samples, and tritium concentrations in the soil moisture are determined using liquid scintillation. Any increase in tritium emissions from the MWL will be indicated by elevated tritium concentrations in these soil samples.

Figure 5.2.2-1 shows a comparison between historical tritium concentrations measured in samples from the four perimeter locations and the trigger value of 20,000 pCi/L. All exceedances of the trigger value occurred prior to 1998, and exceedances are not anticipated in the future due to radioactive decay and the relatively short (12.3-year) half-life of tritium. These concentrations have been diminishing with time due to natural radioactive decay of tritium, and although elevated above the background value, they do not pose a threat to human health or the environment. If measured concentrations of tritium at the surface exceed 20,000 pCi/L, this would indicate a significant increase relative to present-day values, and the trigger evaluation process (Figure 5.1-1) would be followed. Because the trigger value is four to five orders of magnitude less than simulated concentrations that yielded exceedances in the dose via air, the trigger value serves as a conservative early-warning indicator for potential exceedances of tritium dose via air.

5.2.2.2 Biota Monitoring Triggers

Surface soil from animal burrows and ant hills will be monitored for radionuclides and heavy metals, with samples collected every two years. Triggers for gamma-emitting radionuclides are the NMED-approved background values (Dinwiddie September 1997). Triggers for RCRA metals concentrations in surface soil are the NMED industrial/occupational soil screening levels (NMED June 2006). These triggers are shown in Table 5.2-1.

Vegetation growing on the cover will be sampled every two years for gamma-emitting radionuclides. However, no triggers are established for gamma-emitting radionuclides because no regulatory standards are available.

5.2.3 Vadose Zone Monitoring Triggers

Long-term monitoring of the vadose zone is planned for both soil vapor and moisture content to ensure that the MWL remedy remains protective of human health and the environment. The trigger values for vadose zone soil vapor and moisture content are discussed in the following sections. Additional details regarding the frequency and extent of long-term monitoring activities are included in the Soil-Vapor SAP (Appendix B) and the Soil-Moisture MP for the MWL (Appendix C).

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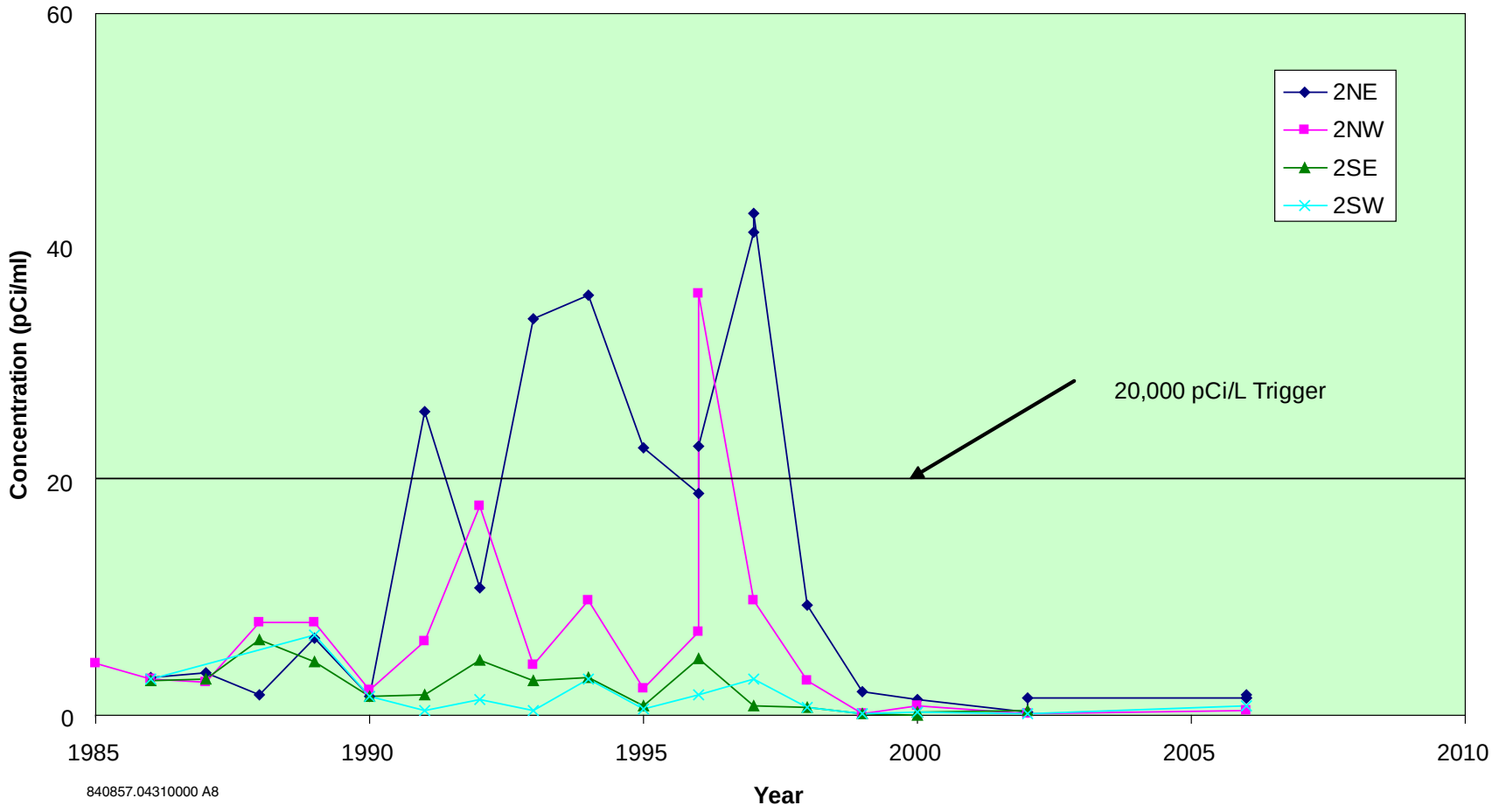

Figure 5.2.2-1
Comparison Between Historical Tritium Concentrations Measured in Samples from the Four Perimeter Locations and the Trigger Value of 20,000 pCi/L, Mixed Waste Landfill

5.2.3.1 Volatile Organic Compounds in Soil Vapor

Triggers for tetrachloroethane (PCE), trichloroethene (TCE), and total VOCs in soil vapor at the MWL are 20 parts per million by volume (ppmv) for PCE and TCE, and 25 ppmv for total VOCs. All triggers apply to samples collected from the deepest sampling port (i.e., 400 feet bgs) in each FLUTe™ well. Should the triggers for PCE, TCE, or total VOCs in soil vapor be exceeded in samples from the deepest sampling port, then the trigger evaluation process (Figure 5.1-1) will be implemented.

5.2.3.2 Moisture Content

Moisture content with depth will be monitored using a neutron moisture probe in three soil-moisture monitoring access tubes that were installed to a linear depth of 200 feet at a 30-degree angle directly beneath the waste disposal cells. The moisture content data will be used to evaluate infiltration through the MWL disposal cell cover. Infiltration is an important parameter for determining whether or not MWL performance objectives are met.

Infiltration through the cover will be indirectly monitored by monitoring the moisture content in the vadose zone beneath the MWL. A significant increase in moisture content beneath the landfill may indicate that the disposal cell cover may not be performing as originally designed, and that infiltration through the cover is greater than originally predicted.

Moisture content will be measured using neutron logging, and data will be compared to baseline moisture content data collected prior to deployment of the MWL cover. This noninvasive method allows cover performance to be assessed without damaging the integrity of the engineered cover. A significant increase in moisture content within the vadose zone may indicate that corrective action is warranted in order to prevent the downward movement of water through the waste. Moisture content data will be evaluated to ensure that the performance objective of infiltration through the MWL cover is less than the EPA-prescribed technical equivalence criteria of 10^{-7} cm/s (31.5 mm/yr), as detailed below.

Infiltration may be estimated indirectly using Darcy's Law (Darcy 1856). The method is based upon soil-physics and the relationship between unsaturated hydraulic conductivity and volumetric moisture content of subsurface soils. The method is described in detail in the MWL Phase 2 RFI SAND Report (Peace et al. September 2002). Assumptions required for this method include one-dimensional, steady-state flow and a vertical hydraulic gradient of unity.

Applying these assumptions, the downward flux at a particular depth is equivalent to the unsaturated hydraulic conductivity as a function of the moisture content at that depth. Thus, by monitoring the moisture content of the vadose zone beneath the MWL, the downward flux through the vadose zone can also be indirectly monitored. If infiltration through the cover increases significantly, then the downward flux through the vadose zone would increase as well, resulting in higher moisture content in the vadose zone beneath the landfill. Hence, by monitoring moisture content in the vadose zone, the performance of the MWL cover can be indirectly monitored. A significant increase in moisture content beneath the MWL may indicate that the cover is not performing as designed.

Figure 5.2.3-1 shows the calculated unsaturated hydraulic conductivity curves for 18 subsurface soil samples collected from near-surface soil approximately 500 feet west of the MWL (Peace and Goering February 2005). Based upon the data presented in this figure and assuming a unit gradient in the vadose zone, if infiltration through the MWL cover exceeds the EPA-prescribed technical equivalence criteria of 10^{-7} cm/s (31.5 mm/yr), then volumetric moisture content in the underlying soil will exceed approximately 23 percent.

The established trigger level is the moisture content that corresponds to an unsaturated hydraulic conductivity equal to the EPA-prescribed technical equivalence criteria of 10^{-7} cm/s (31.5 mm/yr). The moisture content at which this occurs is 23 percent by volume, and the trigger level for moisture content in the vadose zone is, therefore, 23 percent by volume. This value is based on the EPA-prescribed technical equivalence criteria and does not necessarily indicate that hazardous constituents or radionuclides are migrating from the landfill.

The 23-percent trigger applies to linear depths of 10 and 100 feet (vertical depths of 8.7 to 86.6 feet) along the neutron probe access tubes in the vadose zone beneath the MWL. This interval is the "regulated interval" because it lies beneath the root zone, yet is shallow enough that a response would be detected fairly rapidly if infiltration through the cover significantly increases. Should this 23-percent trigger level be exceeded in the regulated interval, then the trigger evaluation process (Figure 5.1-1) will be implemented. Additional details regarding long-term monitoring of the vadose zone for moisture content is presented in the Soil-Moisture MP (Appendix C).

5.2.4 Groundwater Monitoring Triggers

Monitoring triggers for uranium and VOCs in groundwater at the MWL are discussed in the following sections.

5.2.4.1 Uranium

Uranium occurs naturally in MWL groundwater at concentrations ranging from 1.34 to 9.23 micrograms (μg)/L and averaging 5.97 μg/L. Total uranium concentrations in groundwater beneath the MWL are well within the total uranium ranges (0.1 to 86 μg/L) established by the U.S. Geological Survey for the Middle Rio Grande Basin (USGS 2002). Isotopic analyses of uranium have demonstrated that it is of natural origin (Goering et al. 2002).

The probabilistic performance-assessment modeling for the MWL (Ho et al. January 2007) indicates the possibility that uranium will reach the groundwater (although none of the simulations showed the uranium concentrations exceeding the EPA Primary Drinking Water Standard of 30 μg/L). For this reason, a monitoring trigger of 15 μg/L (one-half of the EPA maximum contaminant level [MCL]) is established for uranium in MWL groundwater at the point of compliance. The point of compliance is at each downgradient monitoring well. Should the uranium trigger value be exceeded in MWL groundwater at the point of compliance, then the trigger evaluation process (Figure 5.1-1) will be implemented.

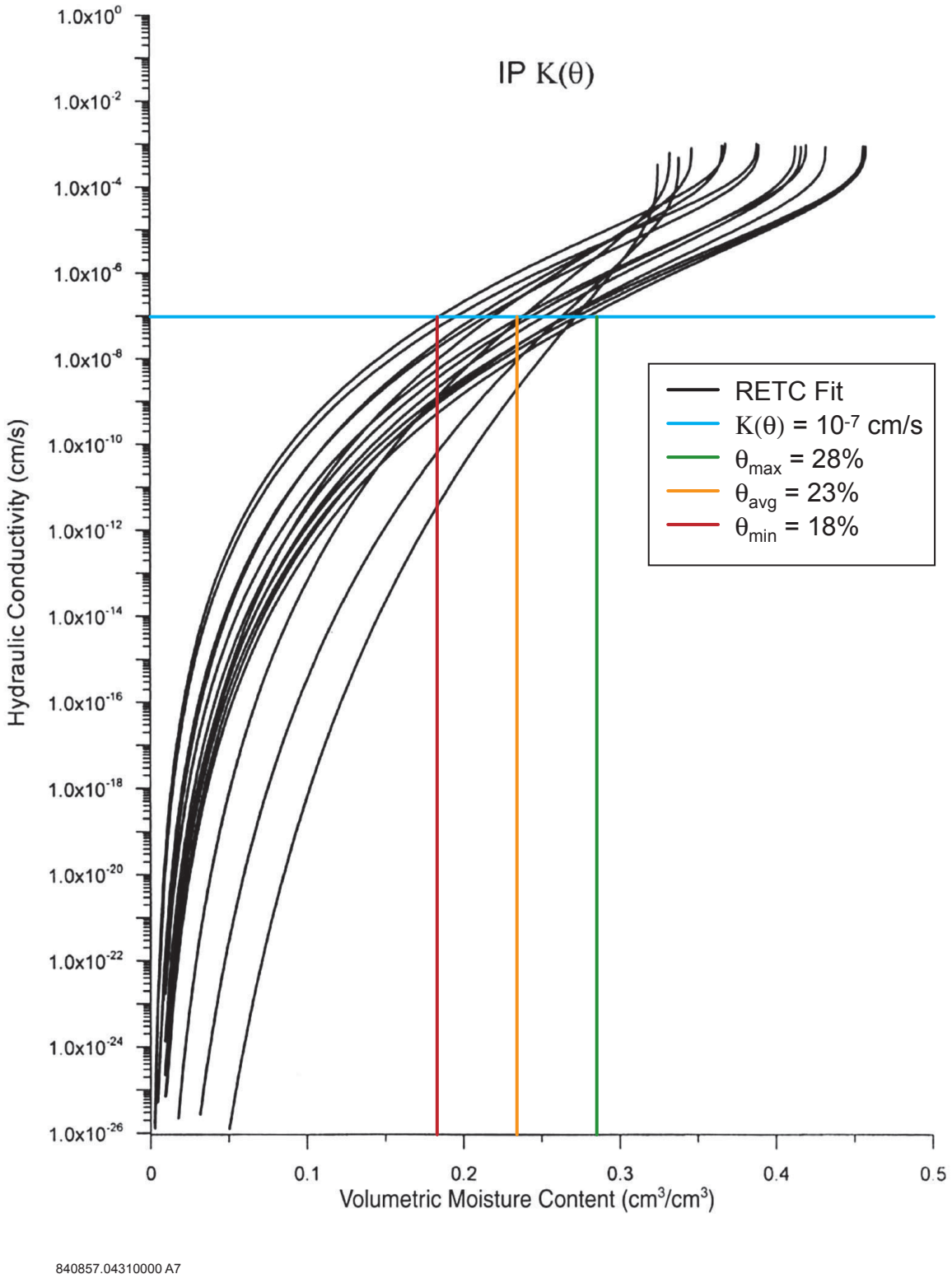

Figure 5.2.3-1
Hydraulic Conductivity as a Function of Volumetric Moisture Content for Different Soil Samples at the IP Site Mixed Waste Landfill

5.2.4.2 Volatile Organic Compounds

Groundwater monitoring for VOCs at the MWL has been conducted since September 1990 and there is no evidence that the MWL has contaminated groundwater. However, earlier studies (Johnson et al. 1995 and Klavetter August 1995), as well as the current probabilistic performance-assessment modeling (Ho et al. January 2007), have shown that a potential exists for VOCs to contaminate groundwater at the MWL.

The potential downward vertical transport of six organic compounds to groundwater by both aqueous-phase transport and vapor-phase transport was evaluated in 1995 (Klavetter August 1995). The study showed that PCE could eventually migrate to groundwater through vapor-phase transport. Although the modeling predicted that the most likely PCE concentrations in groundwater would be considerably lower than the detection limit of 0.5 parts per billion (ppb), sensitivity analyses suggest that PCE concentrations could potentially reach 1 to 5 ppb within 50 years (Klavetter August 1995).

The current probabilistic performance-assessment modeling (Ho et al. January 2007) also simulated the migration of PCE to groundwater and arrived at similar conclusions regarding the potential contamination of groundwater by PCE through vapor-phase transport. Because PCE is modeled in this study as a proxy (due to its mobility) for other VOCs detected in both soil vapor and soil beneath the MWL, a potential exists for other VOCs from the MWL to also migrate to groundwater in the future. For this reason, groundwater will continue to be monitored for VOCs.

Groundwater trigger levels have been developed for all Target Compound List VOCs for which there are primary EPA MCLs or EPA Region 6 Human Health Medium-Specific Screening Levels (EPA December 2006). The groundwater trigger levels for VOCs with MCLs are equal to one-half of the EPA MCLs; the trigger levels for concentrations of VOCs with no corresponding MCLs are the EPA Region 6 Human Health Medium-Specific Screening Levels.

The point of compliance is at each downgradient monitoring well within the MWL groundwater monitoring well network. Should any VOC trigger values be exceeded in MWL groundwater at the point of compliance, the trigger evaluation process (Figure 5.1-1) will be implemented. Additional details regarding long-term groundwater monitoring at the MWL are presented in the Groundwater SAP for the MWL (Appendix D).

5.3 Summary of Triggers

Based upon the results of the probabilistic performance-assessment modeling conducted for the MWL (Ho et al. January 2007) and input from the NMED and public, monitoring triggers have been developed for the air, surface soil, vadose zone, and groundwater at the MWL. Specific triggers include numerical thresholds for the following:

- Radon concentrations in the air
- Tritium, gamma-emitting radionuclides, and metals in surface soil
- Soil moisture in the vadose zone

- VOCs in the vadose zone
- Uranium, VOCs, metals, water-quality indicators, and radionuclide concentrations in groundwater
- Gamma-emitting radionuclides in biota

The triggers were derived from EPA, DOE, and NMED regulatory standards, as well as NMED-approved background concentrations for select radionuclides. If a trigger is exceeded, then the DOE/Sandia will initiate a trigger evaluation process (Figure 5.1-1) that will allow for sufficient data to be collected to assess trends and recommend corrective action, if necessary.

By utilizing these triggers during long-term monitoring at the MWL, the DOE/Sandia will ensure that the MWL remedy continues to protect human health and the environment, while meeting the performance objectives for the cover and the corrective action objectives established in the MWL Corrective Measures Study (CMS) Final Report (SNL/NM May 2003).

6.0 INSTITUTIONAL CONTROLS

6.1 Introduction

This chapter describes the ICs to be implemented and maintained at the MWL during long-term monitoring at the site. Upon completion of environmental remediation activities, measures to restrict the use of contaminated land and other resources are sometimes required. ICs are mechanisms used to restrict inappropriate uses of land, facilities, and environmental media by limiting exposure to residual contaminants left behind following remedy implementation. ICs can take the form of administrative controls, legal controls, physical barriers or markers, and methods to preserve information and data and inform current and future generations of hazards and risks.

ICs may be appropriate to use when complete remediation is neither technically nor economically feasible, remediation risks to worker health and safety are too great, or collateral ecological damage associated with remediation would be too extensive. ICs are generally used to supplement active remediation measures (EPA September 2000) by instituting post-remediation administrative or physical controls.

ICs typically used at DOE sites include the following:

- Government ownership (e.g., federal or state)
- Warning notices (e.g., no trespassing signs, notification signs for hazardous and sensitive areas)
- Entry restrictions (e.g., requirements for security badges, fencing, training for persons entering hazardous or sensitive areas)
- Resource-use management (e.g., land use and real property controls, excavation permits, groundwater use restrictions)
- Site information systems (e.g., information tracking systems on the location and nature of waste sites or geographic based-information archives)

6.2 Institutional Controls at the Mixed Waste Landfill

ICs are a key element of the long-term monitoring and maintenance strategy for the MWL. Various ICs were already in place for the landfill, and others have been implemented since the remedy was fully implemented. The application of multiple ICs at the MWL is consistent with a conservative strategy that uses multiple, independent layers of safety to protect human health and the environment. Thus, if one control temporarily fails, other controls will be in place to mitigate significant consequences of the failure.

The ICs applicable to the MWL are discussed in depth in the following sections.

6.2.1 Government Ownership

Government ownership is a key IC that restricts or prevents unauthorized access to sites with hazardous or radioactive materials. The MWL is located on KAFB in TA-III, one of five TAs at SNL/NM. TA-III is a test area owned by the DOE and includes two rocket-sled tracks, two centrifuges, and a radiant heat facility. Because of the nature of these facilities, TA-III will likely remain under DOE control (and on land owned by the federal government) indefinitely. Figure 6.2.1-1 shows the location of SNL/NM TAs and land uses within KAFB. Future land-use designations are based upon the Kirtland Area Office input for the DOE Future Use Report (DOE et al. September 1995).

In case of the unlikely scenario that the DOE relinquishes ownership of TA-III and the property is transferred to state or local authorities or to private ownership, the site would have to be reevaluated to determine what, if any, measures would be required to make the site acceptable for its expected land use after ownership transfer.

6.2.2 Entry Restrictions

Entry restrictions are another category of ICs imposed at the MWL. Entry restrictions include security requirements and fencing. Access to the MWL is strictly controlled because of its location on both KAFB and in TA-III. Access to KAFB is strictly limited to members of the workforce, construction/maintenance contractors, visitors with badges, and to families of military personnel who live on base. Access is restricted by armed guards at the gates to KAFB. Access to TA-III is restricted to an even higher level of security than access to KAFB and is controlled using an automated vehicle access gate system at the northeastern corner of the TA. DOE-approved badges are required for access to TA-III.

Three tiers of fences limit access to the MWL. Both KAFB and TA-III are fenced along their perimeters, providing physical controls and deterrents against illegal access. A 44-inch-high, barbed-wire fence surrounds the MWL perimeter. The fence incorporates three strands of barbed-wire with tee-posts set into the ground, and steel corner posts set in concrete.

The MWL fence has one 16-foot-long, 42-inch-high gate comprised of tubular steel with galvanized chain links, located near the northeastern corner of the landfill. This gate is locked at all times except as necessary to provide access for surveillance, maintenance, and monitoring activities. Additional details on the MWL fences and gates are presented in Section 02445 of Appendix A (Construction Specifications) in the MWL CMI Plan (SNL/NM November 2005).

6.2.3 Warning Notices

A third category of ICs at the MWL are warning notices, including “no trespassing” signs and radiological postings for the site. To ensure visual notification, the fence line is posted with signs having as a minimum, a legend reading “Caution—Unauthorized Personnel Keep Out” (Title 20, New Mexico Administrative Code, Section 4.1.500, incorporating 40 CFR 264.14[c]) and warning against entering the area without specific permission of the Owner. The signs are

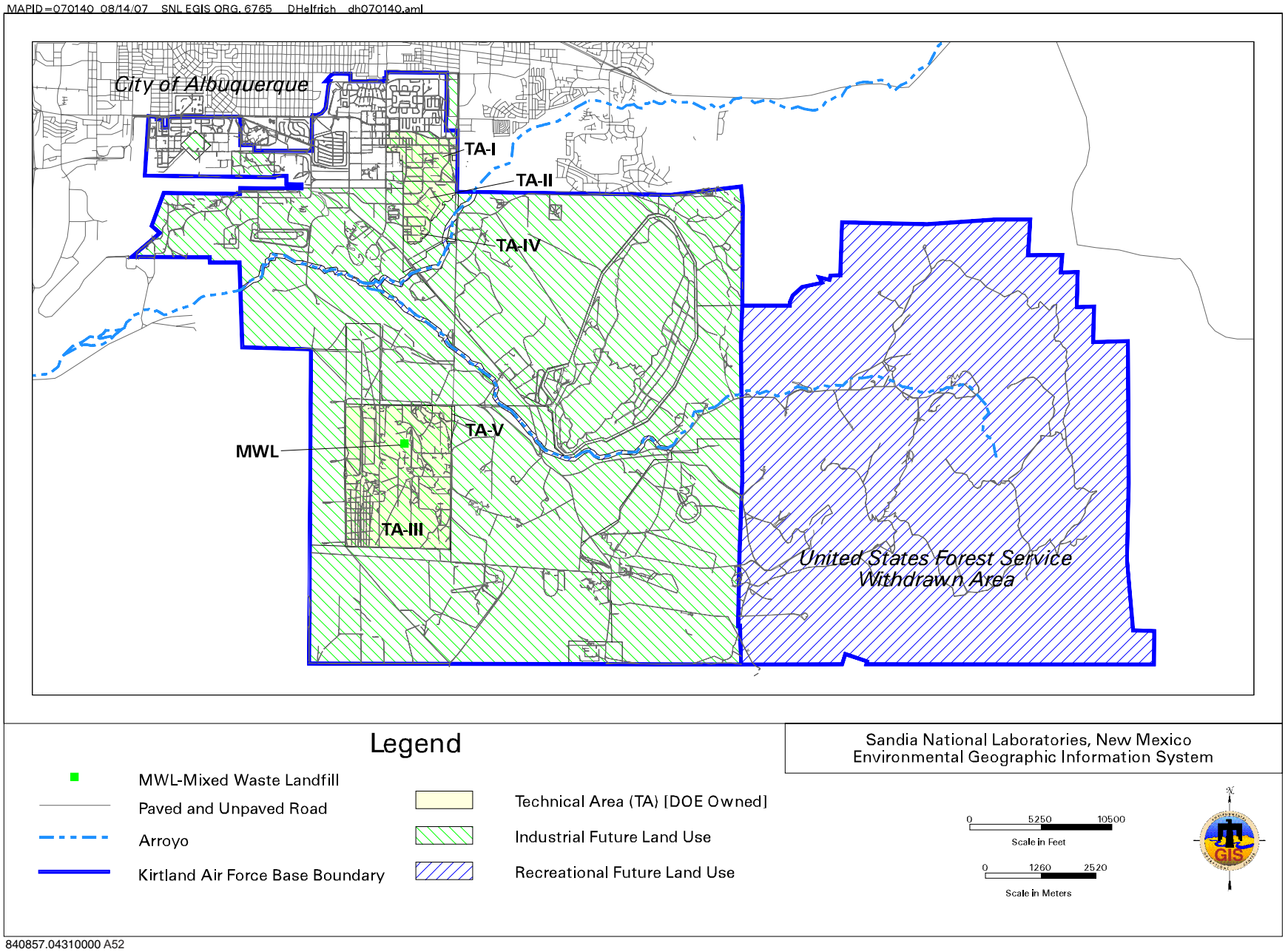

Figure 6.2.1-1 Future Land-Use Designations on Kirtland Air Force Base

legible from a distance of at least 25 feet and will be spaced at intervals of 50 feet. The size of the visual warning and the spacing of the warning signs are large enough and close enough to ensure that one or more of the signs can be seen from any approach prior to an individual actually making contact with the fenceline.

Radiological warning signs are also on the fence. The signs read, "Caution: Underground Radioactive Material, Controlled Area, Authorized Personnel Only." The radiological signs are spaced at intervals of 50 feet along the fence and are legible from a distance of at least 25 feet. Warning notices and radiological postings in Spanish are also installed on the fence.

6.2.4 Active Controls

Another category of ICs are active controls that rely on the presence of humans to fulfill safeguard and maintenance responsibilities. These include the use of security guards to monitor and control site access, monitoring to ensure that contaminant migration is not occurring and the containment design is functioning appropriately, and conducting routine inspections and maintenance at the site. Monitoring activities are discussed in depth in Chapter 3.0 of this document and will include monitoring of air, soil, the vadose zone soil vapor and soil moisture, and groundwater. Inspections and maintenance activities are discussed in Chapter 4.0.

SNL/NM's Protective Force conducts routine, periodic patrols and surveillance of the MWL. Patrols and surveillance consist of drive-by patrolling around the fenced perimeter of the landfill according to a randomly generated schedule. The patrols and surveillance by the Protective Force serve as a deterrent to unauthorized entry into the landfills and as a means of detection should the buried wastes be disturbed. During these patrols, the integrity of the perimeter fence is assessed, and the locked condition of the entrance gate is checked to ensure that gate integrity is maintained and that there is no evidence of tampering. Surveillance also includes visual observations of the entire enclosed area for any signs of human activity. Additionally, surveillance patrols will be conducted around the site perimeter for signs of unauthorized human activities. This surveillance routine will continue as long as waste considered classified remains at the MWL. Mitigating actions will be taken to address any unusual conditions identified during periodic inspection and surveillance by security personnel.

6.2.5 Resource-Use Management

ICs addressing land use and excavation are also in place at SNL/NM and hence, the MWL. Land use within TA-III is managed through the SNL/NM Facilities group, in accordance with all applicable requirements. Land-use controls are mechanisms intended to ensure that land use follows the appropriate planning process and are intended to minimize the potential for unplanned disturbances of sites containing hazardous or radioactive material. Construction activities must be evaluated through a formal National Environmental Policy Act process prior to approval.

Excavation permits are another type of resource-use IC in place at the MWL. Excavation permits are internal work procedures specific to SNL/NM and are required for any excavation activities deeper than 6 inches in depth. Permits are required for digging, saw-cutting, drilling, coring, or trenching into soil, concrete sidewalks, or asphalt to a depth greater than 6 inches. Permits are also required for scraping, blading, or excavating any area previously undisturbed

or that appears to be undisturbed, such as areas covered with native vegetation, and blading or improvements to previously unimproved roads or paths. The use of excavation permits reduces the potential for unplanned disturbances and informs and protects workers regarding potential exposure to hazardous or radioactive waste. Excavation permits also reduce the likelihood of mobilizing contaminants from contaminated areas due to human intrusion.

Radiological Work Permits (RWPs) are another resource-use IC affecting potential work within the MWL perimeter. RWPs are required for conducting work in areas involving potential exposure to radiation or radioactive materials. The permit authorizes work that involves exposure to radiation or radioactive materials and identifies radiological conditions, establishes worker protection and monitoring requirements, and contains specific approvals. RWPs are used to establish radiological controls for 1) work in any radiological area; 2) intrusive work in soil contamination areas, underground radioactive material areas, or fixed contamination areas; and 3) work involving direct contact with radioactive material that could result in contamination to the worker or property.

In 1995, the Future Use Logistics and Support Working Group, which included members of the public, conducted a study recommending future land use for the various TAs at SNL/NM. Based upon the nature of test facilities in TA-III, as well as the limited transportation, emergency access, and utility service, the study recommended an "industrial" classification for future use of TA-III (DOE et al. September 1995). It is expected that an industrial land-use designation will be the long-term land use for TA-III.

Although not required by any permit or regulation, the DOE/Sandia will document land use restrictions for the MWL by:

- Submitting, to the Bernalillo County Clerk, a post-remediation notice including a survey plat with the legal description of the MWL, a description of wastes remaining in place, and a statement prohibiting any future disturbance of the MWL surface or subsurface.

- Submitting, to the Bernalillo County Zoning, Building, and Planning Commission, a survey plat containing the legal description of the MWL and a statement prohibiting any future disturbance of the MWL surface or subsurface.

These submittals may address only the MWL or possibly multiple SWMUs.

6.2.6 Site Information Systems

SNL/NM has a number of information systems in place that help to manage its activities. These include the following:

- SNL/NM Customer-Funded Records Center

- SNL/NM Geographic Information System (GIS) Program

- SNL/NM Facilities databases

- Long-Term Environmental Stewardship (LTES) Website

- Geographical Environmental Management System (GEMS)
- Community Resources Information Office (CRIO)
- The Government Information Department Public Reading Room at the University of New Mexico (UNM) Zimmerman Library
- SNL/NM IC Tracking Database

The Administrative Record is the body of documents and information that was considered, or relied upon, to arrive at a final decision for remedial action or hazardous waste management at the MWL. The documents related to the MWL in the Administrative Record include, but are not limited to, RFI Work Plans, Phase 1 and Phase 2 RFI Reports, Responses to Notices of Deficiencies, the MWL CMS Final Report, the MWL CMI Plan, and other relevant correspondence and documents. The Administrative Record may be reviewed at the Government Information Department at the UNM Zimmerman Library and at the NMED in Santa Fe, New Mexico.

Additional information on the MWL is contained in the SNL/NM Customer-Funded Records Center. The Records Center maintains all records on the MWL and other SWMUs at SNL/NM, including location, waste type, and current status. The Records Center is maintained by Sandia in accordance with DOE Orders on records maintenance. The long-term preservation of waste site information is one of the key responsibilities of the Records Center.

6.3 Application of Institutional Controls

As described above, various systems are in place at SNL/NM to implement and maintain ICs. The SNL/NM LTES Program (SNL/NM September 2006) is responsible for ensuring that ICs are properly implemented at active sites and former ER sites.

The LTES Program will ensure that the MWL is inspected on a regular basis to verify that ICs continue to be implemented at the site. IC inspections at the MWL will be conducted in conjunction with IC inspections at the other sites subject to long-term controls, including the Chemical Waste Landfill and the Corrective Action Management Unit. An internal checklist will be used to assess the ICs, and the results will be summarized in the annual long-term monitoring and maintenance report.

It is anticipated that the SNL/NM IC inspection and site walkover will be conducted annually for the first five years, then biannually for four years, and then progress to once every five years. This frequency will be subject to adjustment as needed.

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7.0 CONTINGENCY PROCEDURES

This section details contingency procedures to be implemented if the MWL vegetative soil cover fails to be protective of human health and the environment. Actual contingency responses will be addressed on a situation-specific basis in cooperation with the NMED.

The MWL Class 3 Permit Modification for the MWL states:

> The [long-term monitoring and maintenance] plan shall also include contingency procedures that must be implemented by the Permittees if the remedy set forth in Section V.2 above [the vegetative soil cover with biointrusion barrier] fails to be protective of human health and the environment.

The MWL LTMMP is designed to collect data far enough in advance to allow for contingency measures to be taken. Contingency measures are designed to accommodate any unanticipated events, should the remedy not be protective of human health and the environment.

Possible MWL failure scenarios and contingencies are listed in Table 7-1. The contingencies identified depend heavily upon the implementation of the Trigger Evaluation Process (Section 5.1). Triggers for long-term monitoring at the MWL are discussed in Chapter 5.0. If the monitoring triggers are exceeded, then the Trigger Evaluation Process (Figure 5.1-1) will be initiated, as described in Section 5.1.

All contingencies are addressed through the Trigger Evaluation Process. Should a specific trigger be exceeded, then the process shown in Figure 5.1-1 will be used to ensure that adequate data are collected to determine whether additional corrective action is warranted. The increased frequency of data collection in the trigger evaluation process (Step 3 in Figure 5.1-1) will ensure that adequate data are collected to eliminate field sampling error, laboratory error, or short-term exceedances that do not reflect long-term trends. Thus, any recommendations for corrective action because of trigger exceedances will be based upon data trends rather than upon single detection values above the trigger level. If data trends in the monitored parameters indicate an established trend above the trigger value, the process requires that a technical letter report be submitted to the NMED recommending whether or not corrective action should be implemented.

The Trigger Evaluation Process discussed in Chapter 5.0 allows specific contingencies to be addressed on a situation-specific basis in full coordination with the NMED. An exceedance of a trigger listed in Table 5.2-1 does not necessarily constitute failure of the remedy but does indicate that additional data evaluation is necessary to determine whether corrective action is required (Figure 5.1-1).

Table 7-1
Possible Failure Scenarios and Contingencies
Mixed Waste Landfill, Sandia National Laboratories/New Mexico

Failure Scenario	Notes	Procedure	Possible Corrective Action
Radon concentrations in air exceed trigger level of 4 pCi/L	Scenario unlikely based upon historical measurements of radon emissions from MWL without cover (Haaker January 1998).	1. Verify exceedance of trigger level. 2. If verified, notify NMED in writing within 15 days. 3. Negotiate sampling frequency with NMED. 4. Increase sampling frequency. 5. Reevaluate data. 6. If data indicate persistent and increasing concentrations of radon, consider corrective action.	1. Assess compliance with NESHAP and DOE Orders. If all regulatory standards are met, no further action is necessary. 2. Consider augmenting cover soil to reduce radon concentrations emitted to atmosphere.
Tritium in surface soil exceeds trigger value of 20,000 pCi/L in soil moisture	Scenario possible.	1. Verify exceedance of trigger level. 2. If verified, notify NMED in writing within 15 days. 3. Negotiate sampling frequency with NMED. 4. Increase sampling frequency. 5. Reevaluate data. 6. If data indicate persistent and increasing concentrations of tritium, consider corrective action.	1. Assess compliance with NESHAP and DOE Orders. If all regulatory standards are met, no further action is necessary. 2. Evaluate risk to human health and the environment. If risk is negligible, no further action is required. 3. If risk is significant, implement appropriate engineering and/or administrative controls to reduce risk.
Radionuclides in surface soil at animal burrows and ant hills exceed NMED-approved maximum background concentrations	See Table 5.2-1 for list of radionuclides and NMED maximum background concentrations.	1. Verify exceedance of trigger level. 2. If verified, notify NMED in writing within 15 days. 3. Negotiate sampling frequency with NMED. 4. Increase sampling frequency. 5. Reevaluate data. 6. If data indicate persistent and increasing concentrations of radionuclides, consider corrective action.	1. Assess compliance with DOE Orders. If all regulatory standards are met, no further action is necessary. 2. Evaluate risk to human health and the environment. If risk is negligible, no further action is required. 3. If risk is significant, consider eliminating ant hills and removing animals creating the burrows. 4. If biotic mobilization of contaminants continues to be a major concern, consider adding additional thickness to MWL cover.

Refer to footnotes at end of table.

Table 7-1 (Continued)
Possible Failure Scenarios and Contingencies
Mixed Waste Landfill, Sandia National Laboratories/New Mexico

Failure Scenario	Notes	Procedure	Possible Corrective Action
RCRA metal concentrations in surface soil near animal burrows and ant hills exceed trigger values (NMED industrial SSLs)	See Table 5.2-1 for list of RCRA metals and corresponding trigger values (NMED industrial SSLs).	1. Verify exceedance of trigger level. 2. If verified, notify NMED in writing within 15 days. 3. Negotiate sampling frequency with NMED. 4. Increase sampling frequency. 5. Reevaluate data. 6. If data indicate persistent and increasing concentrations of RCRA metals, consider corrective action.	1. Assess compliance with SSLs and DOE Orders. If all regulatory standards are met, no further action is necessary. 2. Evaluate risk to human health and the environment. If risk is negligible, no further action is required. 3. Consider eliminating ant hills and removing animals creating the burrows. 4. If biotic mobilization of contaminants continues to be a major concern, consider adding additional thickness to MWL cover.
Gamma-emitting radionuclides detected in vegetation growing on landfill surface	Scenario unlikely due to biointrusion barrier.	1. Verify exceedance of trigger level. 2. If verified, notify NMED in writing within 15 days. 3. Negotiate sampling frequency with NMED. 4. Increase sampling frequency. 5. Reevaluate data. 6. If data indicate persistent and increasing concentrations of radionuclides, consider corrective action.	1. Assess compliance with DOE Orders (including 450.1 and 5400.5). If all regulatory standards are met, no further action is necessary. 2. Evaluate risk to human health and the environment. If risk is negligible, no further action is necessary. 3. If risk is significant, consider design changes to the cover. 4. If biotic mobilization of contaminants continues to be a major concern, consider adding additional thickness to MWL cover.

Refer to footnotes at end of table.

Table 7-1 (Continued)
Possible Failure Scenarios and Contingencies
Mixed Waste Landfill, Sandia National Laboratories/New Mexico

Failure Scenario	Notes	Procedure	Possible Corrective Action
Moisture in vadose zone at linear depths of between 10 to 100 ft exceed trigger levels	Scenario unlikely due to anticipated performance of the cover.	1. Verify exceedance of trigger level. 2. If verified, notify NMED in writing within 15 days. 3. Negotiate sampling frequency with NMED. 4. Increase sampling frequency. 5. Reevaluate data. 6. If data indicate persistent and increasing moisture in vadose zone, consider corrective action.	1. Determine if ponding and preferential flow down the boreholes is responsible for the elevated moisture content. If preferential flow is occurring, regrade surface adjacent to soil-moisture monitoring access tubes to divert surface runoff. 2. Evaluate infiltration through the cover using alternative methods such as double-ring infiltrometers or air-entry permeameters. 3. Assess performance of cover; if cover is not reducing infiltration sufficiently to meet the RCRA-prescribed equivalence criteria of 10^{-7} cm/s, determine reasons for poor performance of the cover. 4. Consider remedial measures to improve cover performance, such as discing native soil layer to increase porosity and vegetation growth characteristics. Replant native vegetation to enhance evapotranspiration.
VOCs in vadose zone exceed trigger levels	Scenario possible, based upon MWL fate and transport model results. See Table 5.2-1 for trigger levels for VOCs.	1. Verify exceedance of trigger level. 2. If verified, notify NMED in writing within 15 days. 3. Negotiate sampling frequency with NMED. 4. Increase sampling frequency. 5. Reevaluate data. 6. If data indicate persistent and increasing concentrations of VOCs in vadose zone, consider corrective action.	1. Refine conceptual site model of contaminant distributions and transport through additional soil-vapor samples. 2. Update fate and transport model with additional data to predict potential impacts. 3. If groundwater contamination appears likely, consider corrective action before contaminants reach groundwater. 4. Corrective action may include soil-vapor extraction to reduce the contaminant source term.

Refer to footnotes at end of table.

Table 7-1 (Concluded)
Possible Failure Scenarios and Contingencies
Mixed Waste Landfill, Sandia National Laboratories/New Mexico

Failure Scenario	Notes	Procedure	Possible Corrective Action
VOC concentrations in groundwater exceed trigger levels	See Table 5.2-1 for trigger levels. Scenario possible based upon MWL Fate and Transport Model (Ho et al. January 2007)	1. Verify exceedance of trigger level. 2. If verified, notify NMED in writing within 15 days. 3. Negotiate sampling frequency with NMED. 4. Increase sampling frequency. 5. Reevaluate data. 6. If data indicate persistent and increasing concentrations of VOCs, consider corrective action.	1. Update fate and transport model with additional data to predict potential impacts. 2. Conduct risk assessment with contaminant data. 3. Consider additional corrective action measures based upon fate and transport model results and risk assessment results. 4. Possible remedial measures include monitored natural attenuation or active pump and treat. 5. Consider installation of “baro-balls” to control VOCs in the vadose zone above the aquifer. 6. Consider controlling VOC migration through the vadose zone using soil-vapor extraction.
Uranium concentrations in groundwater exceed trigger level	Scenario highly unlikely without significant increase in infiltration through the MWL cover	1. Verify exceedance of trigger level. 2. If verified, notify NMED in writing within 15 days. 3. Negotiate revised groundwater sampling frequency with NMED. 4. Resample per the negotiated frequency. 5. Reevaluate groundwater data for uranium. 6. If data indicate persistent and increasing uranium contamination of groundwater, recommend corrective action.	1. Update fate and transport model with additional data to predict potential impacts. 2. Conduct risk assessment with contaminant data. 3. Consider additional corrective action measures based upon fate and transport model results and risk assessment results. 4. Reduce uranium concentrations through monitored natural attenuation. 5. Install pump and treat system to remediate uranium in groundwater to less than the EPA MCL (30 μg/L).

cm/s = Centimeter(s) per second.
DOE = U.S. Department of Energy.
EPA = U.S. Environmental Protection Agency.
ft = Foot (feet).
L = Liter(s).
MCL = Maximum contaminant level.
μg = Microgram(s).
MWL = Mixed Waste Landfill.
NESHAP = National Emissions Standards for Hazardous Air Pollutants.
NMED = New Mexico Environment Department.
pCi = Picocurie(s).
RCRA = Resource Conservation and Recovery Act.
SSL = Soil screening level.
VOC = Volatile organic compound.

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APPENDIX A
Air Sampling and Analysis Plan for the Mixed Waste Landfill

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LIST OF ATTACHMENTS

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A-1 Radtrak® Long-Term Radon Monitoring

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1.0 INTRODUCTION

Requirements for monitoring at the Mixed Waste Landfill (MWL) are defined in the Long-Term Monitoring and Maintenance Plan (LTMMP) provided by the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia). This Air Sampling and Analysis Plan (SAP) was developed in response to a request by the New Mexico Environment Department (NMED) to monitor for potential radon emissions at the MWL, Technical Area III (TA-III), Sandia National Laboratories, New Mexico (SNL/NM) (Figure A-1-1). Previously, radon emissions have not been monitored using the track-etch method proposed in this SAP. However, a study of radon flux from the MWL was conducted in 1997 to measure radon surface flux from the MWL (Haaker 1998). The study, which involved placement of 89 four-inch-diameter activated charcoal radon canisters across the MWL surface, evaluated radon surface fluxes in the vicinity of the MWL and at background locations. Results showed that the measured radon fluxes above the MWL were not significantly different than the background values (Haaker 1998).

1.1 Monitoring Objective

The LTMMP, including this SAP, is designed to ensure the monitoring of specified parameters over a period of time. The monitoring objective of this SAP is to provide radon emission data in order to characterize radon emissions at the MWL. In addition to establishing monitoring and data quality objectives (DQOs), this SAP presents specifications for the use of radon detectors, laboratory analysis, data evaluation, records management, and reporting. This document provides sampling personnel with the necessary information to perform radon sampling in air. The results will be compared to the proposed trigger level of 4 picocuries per liter (pCi/L), as presented in the LTMMP and in the "Probabilistic Fate and Transport Modeling of the Mixed Waste Landfill at Sandia National Laboratories" (Ho et al. January 2007).

1.2 Scope

Monitoring (sampling) of radon emissions at the MWL will be conducted on a routine basis throughout the long-term monitoring and maintenance period for the MWL. Monitoring will be conducted quarterly for 2 years to establish baseline conditions, then semiannually for the next 2 years, followed by annually. Each sampling event requires the placement of a radon detector at designated locations for each exposure period. Radon detectors will be collected at the end of the sampling period and analyzed based upon the frequency schedule described below. The locations of the proposed radon sampling sites are shown in Figure A-1.2-1.

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Legend

Road

Technical Area

Mixed Waste Landfill

Figure A-1-1
Location of the Mixed Waste Landfill within Technical Area III

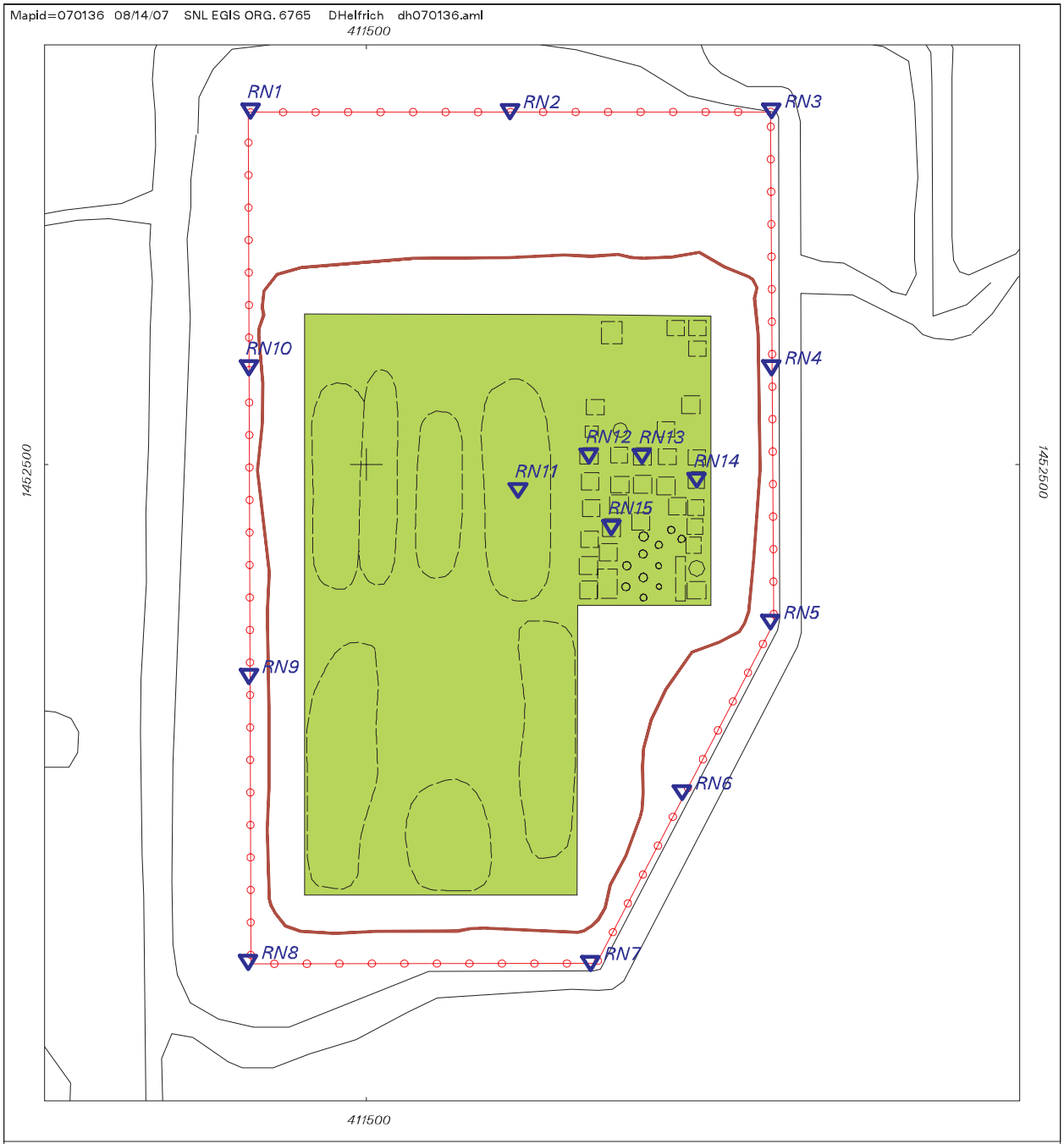
0 1000 2000
Scale in Feet

0 240 480
Scale in Meters

N

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04310000 A45.ai



Legend

- Radon Sampling location and name
- Fence
- Trench and Pit
- Toe of Landfill Cover
- Road
- MWL Extent

Figure A-1.2-1
Radon Sampling Locations at the Mixed Waste Landfill

0 60 120
Scale in Feet

0 14.4 28.8
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04310000 A40

2.0 BACKGROUND INFORMATION

The MWL fate and transport model predicts no potential for release of radon-222 into the atmosphere in excess of regulatory standards, as long as the sealed sources containing radium-226 within the MWL inventory remain intact (Ho et al. 2007). However, the MWL fate and transport model also predicts that if the sealed sources containing radium-226 degrade over time, there is some potential for radon to be emitted to the atmosphere in concentrations above regulatory standards.

Because there is a potential for radon to be emitted from the MWL wastes in excess of regulatory standards, DOE and Sandia will conduct radon monitoring at the landfill surface to verify that the sealed sources remain intact, and that the disposal cell continues to be protective of human health and the environment.

As described in the "Responses to the NMED Notice of Disapproval" (SNL/NM January 2007), radon will be monitored above ground surface along the MWL perimeter using track-etch radon detectors. Additional radon sampling locations are planned at locations overlying select pits and trenches in which radium-226 was disposed, and which have a potential for generating radon in the future. The track-etch technique is superior for analysis of radon flux (unit concentration per unit area per unit time), and will provide more useful information than time-discrete samples collected from soil-vapor samples. Radon has not been detected above background (natural environmental) levels in soils at the MWL. Any significant releases of radon in the near future are unlikely due to the nature of the sealed sources containing radium-226, from which the radon would emanate.

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3.0 DATA QUALITY OBJECTIVES

The primary DQO is to produce representative, accurate, and defensible analytical results to support the monitoring objective (i.e., provide radon emission data). This SAP is designed to ensure that radon measurement procedures are consistent and can be used to establish radon emission trends. This DQO will be accomplished through the implementation of standard operating procedures and analytical procedures/methods through the use of quality assurance (QA) measures, quality control (QC) samples, and data evaluation protocols. Guidance on sampling protocols was also taken from the U.S. Environmental Protection Agency (EPA) (EPA July 1992).

3.1 Measurement of Radon in Air

Radon concentrations will be measured by Radtrak® radon detectors manufactured by Landauer® Incorporated (Attachment A-1). Radtrak® is an alpha-track radon gas detector designed to monitor radon exposure for three months to one year to obtain a long-term average concentration over time. Services provided by Landauer® include the detector, comprehensive analysis (calibration, laboratory background determination, and laboratory QA/QC tests), reporting of exposure results, and long-term storage of the processed detector for a period of at least 25 years. The detectors can be packaged for indoor or outdoor area monitoring or personnel monitoring.

Landauer® has been involved with the development of radiation monitoring services for nuclear research centers and laboratories, hospitals, medical and dental offices, universities, and other industries where radiation might be present. The highly accurate Radtrak® radon detector uses the exclusive Track-Etch® process. Radtrak® radon detectors are used by the EPA, the National Institutes of Health, the American Lung Association, and many other government and professional organizations.

3.2 Detector Locations and Sampling Frequency

Radon levels around the perimeter of the MWL will be measured using Radtrak® radon detectors (referred to as the detectors). A total of 10 detectors will be placed at corners and midpoints of the perimeter fence. Five detectors will be placed within the boundaries of the completed cover at locations overlying pits and trenches containing the highest activities of radium-226 in their disposal inventory (Figure A-1.2-1). Two detectors will be placed in areas determined to represent background conditions. A field control sample (serving as a QC sample) will be prepared during each sampling event.

Table A-3.2-1 gives the sampling (detector exchange) frequency for the 5 years following the completion of the MWL cover. Detector exchange will consist of removing the exposed detector and replacing it at the same location with an unexposed detector. The exposed detector will be sent to the Landauer® laboratory (referred to as the laboratory) for analyses.

Table A-3.2-1
Sampling Frequency

Time Period	Sample Frequency[a]	Sample Locations	Quality Control Samples	Number Samples Per Year
Year 1	4 events (quarterly basis)	10 perimeter 2 background 5 on site	4 trip blanks (1 per event)	72
Year 2	4 events (quarterly basis)	10 perimeter 2 background 5 on site	4 trip blanks (1 per event)	72
Year 3	2 events (semi-annual basis)	10 perimeter 2 background 5 on site	2 trip blanks (1 per event)	36
Year 4	2 events (semi-annual basis)	10 perimeter 2 background 5 on site	2 trip blanks (1 per event)	36
Year 5 and subsequent years	1 event (annual basis thereafter)	10 perimeter 2 background 5 on site	1 trip blank	18

[a]Refers to the frequency in which the detectors are exchanged.

3.3 Data Accuracy

Proper sampling procedures and use of QC samples will help reduce random and systematic sampling error or bias. Accurate estimates of radon concentration can be made reliably through the use of a qualified laboratory, appropriate methodologies, and effective QA/QC procedures. These measures along with consistent implementation of the LTMMP and this SAP will satisfy the DQO for accuracy.

3.4 Data Consistency and Comparability

Data consistency and comparability will be achieved through implementation of this SAP, which defines field and laboratory procedures designed for this purpose. Consistency in methods and procedures will be maintained in the following areas to ensure radon emission data are consistent and that the data sets are comparable.

- Field sample collection and management
- Use of an off-site contract laboratory (manufacturer laboratory)

After radon emission results are received from the laboratory, the SNL/NM will review the laboratory report for completeness and conformance to the monitoring and DQOs. If problems are noted that require corrective action during these reviews, the laboratory will be contacted for further information.

Each set of time period (quarter, semi-annual, annual) results of data will be compared to the previous set, as well as the field background. This evaluation process will aid in characterization and allow analysis of trends, but will also help identify outliers or other potential indicators of error and inconsistency.

3.5 Quality Control

The QC measures ensure that data are scientifically sound and of known precision and accuracy. QC samples will be collected to help reduce random and systematic sampling error or bias. Section 3.5.3 presents the samples needed to meet the QC requirements for radon emission monitoring at the MWL.

3.5.1 Calibration Measures

Calibration measurements are the responsibility of the laboratory supplying the detectors. Calibration measurements determine the response or reading of an instrument relative to a series of known values; results are used to develop correction or calibration factors. These factors are determined for a range of concentrations and exposure times, and for a range of other exposure and/or analysis conditions pertinent to the detector.

3.5.2 Laboratory Background Measures

Laboratory background measurements are made in the laboratory by analyzing unexposed detectors (laboratory blanks). The results are subtracted from the actual field measurements before calculating the reported concentration. Laboratory background levels may be due to electronic noise of the analysis system, leakage of radon into the detector, detector response to gamma radiation, or other causes. The laboratory is responsible for routinely measuring the background of a statistically significant number of unexposed detectors from each batch or lot to establish the laboratory background for the batch and the entire measurement system.

3.5.3 Field Control Measures

Two types of field control measures will be employed for quality control; a field control sample (field/trip blank) and a field background sample (natural environmental). These samples are specified in Table A-3.2-1.

A field control sample (field/trip blank) will be prepared during each sampling event. An unexposed detector will be set aside from each detector shipment, kept sealed and in a low radon environment, labeled in the same manner as the field samples to preclude special processing, and returned to the analysis laboratory along with each shipment. These trip blanks measure the background exposure that may accumulate during shipment and storage.

A field (natural environmental) background sample will be collected during each sampling event at areas outside of the MWL, but within TA-III. This will allow the measurement of background radiation that is always present due to cosmic rays and natural radiation. This field background value will be compared to (subtracted from) the sample detectors that are placed on and around the MWL.

4.0 SAMPLING ACTIVITIES

This section describes the field and laboratory measures to be taken in providing radon measurements in air.

4.1 Field Activities

Field activities include the preparation, deployment, collection, and shipping of the detectors and the methods and procedures governing these activities. Adherence to this protocol will help ensure uniformity among measurements, and allow comparison of the results. Activities that will be conducted in preparation for or during radon emission monitoring include the following:

- Health and Safety
- Pre-Field Preparations
- Detector Deployment and Collection
- Sample Labeling
- Sample Custody Documentation
- Sample Handling and Shipment
- Waste Management

The SNL/NM Administrative Operating Procedure (AOPs) and Field Operating Procedure (FOPs) for these activities are listed in Table A-4.1-1 as well as Sample Management Office (SMO) Laboratory Operating Procedures (LOPs) and guidance. All personnel directly involved in radon emission monitoring field activities will review and abide by these procedures.

Table A-4.1-1
Reference Documentation
MWL Radon Monitoring

Document[a]	Title
FOP 94-01 (SNL/NM December 2006)	Safety Meetings, Inspections, and Pre-Entry Briefings
FOP 94-25 (SNL/NM November 2004)	Documentation of Field Activities
FOP 94-34 (SNL/NM May 1995)	Field Sample Management and Custody
AOP 95-16 (SNL/NM February 2007a)	Sample Management and Custody
LOP 94-03 (SNL/NM February 2007b)	Sample Handling, Packaging, and Shipping, SMO

[a]The most current version will be used.
AOP = Administrative operating procedure.
FOP = Field operating procedure.
LOP = Laboratory operating procedure.
MWL = Mixed Waste Landfill.
SMO = Sample Management Office.

4.1.1 Health and Safety

Field operations will be conducted in an approach that prioritizes the health and safety of field personnel above all other objectives. Every team member has the authority and responsibility to stop operations if an unsafe condition develops or is observed. All sampling personnel will perform field activities in accordance with the applicable Health and Safety Plan.

4.1.2 Pre-Field Preparations

Sampling locations will be identified, marked, and numbered. Only the number of detectors needed for each sampling event should be ordered as close as possible to the deployment time in order to minimize chances of background exposure. All information regarding detectors, dates, and locations will be maintained in a log book.

4.1.3 Detector Deployment and Collection

The detector and the radon-proof container will be inspected to make sure that they are intact and have not been physically damaged in shipment or handling. The sampling period begins when the protective cover or bag is removed and will be noted in the log book along with the detector number and sample location. The edge of the bag must be cut carefully, or the cover removed, so that it can be reused to reseal the detector at the end of the exposure period.

At the end of the sampling period (Table A-3.2-1), each detector will be inspected for damage or deviation from the conditions noted at the time of deployment. The time and date of removal and any observable changes to the detector will be noted in the log book. The detector should then be resealed following the instructions provided by the supplier. After retrieval, the detectors should be stored in a low radon environment and returned as soon as possible to the laboratory for processing.

4.1.4 Sample Labeling

Each detector is identified by a unique serial number laser engraved on the inside of the detector (by the manufacturer), printed and bar coded on the outside of the detector, and on the film-foil bag. A unique SNL/NM SMO issued sample identification number will be assigned to each detector. The sample numbers are preprinted on self-adhesive labels in numerical order and are obtained from SMO. After recovery from the field, the sample number will be affixed to or noted on the sample label and/or the analysis request/chain of custody (AR/COC) form.

A SNL/NM sample label will be completed with indelible ink and affixed to each sample container. Each completed sample label should include the following information:

- SNL/NM SMO sample number
- Sample matrix type
- Sample location
- Analysis required
- Date and time of sample collection

- Types of preservatives used, if any
- Name of the sampling personnel

A field log will be maintained documenting the collection of all samples.

4.1.5 Sample Custody Documentation

To ensure the integrity of samples from the time of collection through the reporting of analytical results, sample collection, handling, and custody will be documented. The continuous record of documented sample possession is referred to as the chain-of-custody. Primary elements in the documentation of samples are: sample identification number, sample labels, custody tape, and the AR/COC form. Standardized forms will be used to document sample information. Sample custody and documentation procedures for sampling activities are outlined in AOP 95-16 (SNL/NM February 2007a) and LOP 94-03 (SNL/NM February 2007b).

4.1.6 Sample Handling and Shipment

The exposed detectors will be packaged in either the original bag or in new bags to prevent further exposure. No preservation is needed. Detector numbers will be recorded on an AR/COC form that will accompany the detectors to the laboratory.

Samples will be shipped to the analytical laboratory in accordance with SMO procedures detailed in LOP 94-03. Prior to shipment, the sample collection documentation will be verified. Any error will be noted and corrected as required by SNL/NM SMO protocols.

4.1.7 Waste Management

There will not be any waste generated during these activities.

4.2 Technical Specifications and Concerns

Technical specifications of the detectors include the following:

- The radiosensitive element is a CR-39 (allyl diglycol carbonate) based, passive alpha-track detector.
- The CR-39 is enclosed in a plastic housing composed of electrically conducting material with filtered openings to permit diffusion of radon gas only.
- Minimum level of detection is 30 pCi/L days (0.33 pCi/L based upon 90 days).
- Detectors should not be in locations that exceed a temperature of 160 degrees Fahrenheit (70 degrees Celsius).

- The detectors are packaged in film-foil bags that meet Military Specification MIL-B-131, Class 1 to prevent exposure prior to and following use.

- A metallic label is provided for each detector to seal the filtered openings following the exposure period to minimize subsequent exposure to radon during the return shipment to the laboratory.

- Each detector is identified by a unique serial number laser engraved on the CR-39, printed and bar coded on the outside of the detector, and on the film-foil bag.

- For outdoor monitoring, the detector is fastened to the bottom of a clear plastic cup. The cup is then installed in a protective canister will be attached to a post at approximately 5 feet above ground level.

4.3 Analytical Methods

The detectors measure the average radon concentration at the location of the detector during the sampling period. The alpha-track detector consists of a plastic housing and a radiosensitive element that records submicroscopic damage tracks as the alpha particle emissions (alpha track) from the natural decay of radon strike the detector. At the end of the sampling period, the detectors are returned the laboratory. The detectors are placed in a caustic solution that accentuates the damage tracks so they can be counted using an automated counting system. The number of tracks per unit area is correlated to the radon concentration in air, using a conversion factor derived from data generated at the calibration facility. The number of tracks per unit of analyzed detector area produced per unit of time is proportional to the radon concentration. The detectors function as true integrators and measure the average concentration over the exposure period.

4.4 Records Management and Reporting

Records associated with the radon emission sampling activities include the MWL LTMMP, this SAP, applicable AOPs, FOPs, and LOPs, AR/COC forms, personnel training, field documentation, laboratory analytical results, and technical data evaluations. These records will be maintained at the SNL/NM Customer Funded Records and comply with the record-keeping provisions of 20.4.1.500 New Mexico Administrative Code, incorporating Title 40 Code of Federal Regulations Section 264.74, concerning the availability, retention, and disposition of records.

Reports will be prepared and submitted to the NMED according to the schedule defined in the LTMMP.

5.0 REFERENCES

Haaker, R., 1998. "Radon flux testing at the Mixed Waste and the adjacent Classified Waste Landfills, Technical Area III, SNL/NM," memo to Hans Oldewage, Sandia National Laboratories, Albuquerque, NM, January 19, 1998.

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Sandia National Laboratories/New Mexico (SNL/NM), February 2007b. "Sample Handling, Packaging, and Shipping," Sample Management Office (SMO) LOP 94-03, Sandia National Laboratories, Albuquerque, New Mexico.

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ATTACHMENT A-1
Radtrak® Long-Term Radon Monitoring

LANDAUER®

Radtrak® Long-Term Radon Monitoring

Radtrak is an alpha-track radon gas detector designed to monitor radon exposure for three months to one year to obtain a long-term average concentration over time. Landauer service includes the Radtrak detector, comprehensive analysis, and a confidential report of the findings. Radtrak can be packaged for indoor or outdoor area monitoring or personnel monitoring.

Landauer is the leader and pioneer in radon gas detection and monitoring service. Since 1954, our scientists have been involved with the development of radiation monitoring services for nuclear research centers and laboratories, hospitals, medical and dental offices, universities, and other industries where radiation might be present. This experience and technology have been incorporated into Landauer's highly accurate Radtrak radon detector using our exclusive Track-Etch® process. Radtrak radon detectors are used by the Environmental Protection Agency, the National Institutes of Health, the American Lung Association, and many other government and professional organizations.

Radtrak measures the average radon concentration at the location of the detector during the monitoring period. The alpha-track detector has, inside the plastic housing, a radiosensitive element that records alpha particle emissions (alpha tracks) from the natural radioactive decay of radon.

When the detector is returned to Landauer's laboratory, the alpha tracks are counted using computer-assisted image analysis equipment. The number of alpha tracks along with the deployment time period provides the basis for calculating the average radon concentration. The report with the radon gas measurement, reported in picocuries per liter of air (pCi/l), is mailed within seven to ten days after receipt of detector.

Thoron Proof Filter

Upon request, a detector can be fitted with a thoron proof filter that provides measurement of Rn 222 only.

Technical Specifications

- The radiosensitive element is a CR-39 (allyl diglycol carbonate) based, passive alpha-track detector.
- The CR-39 is enclosed in a plastic housing composed of electrically conducting material with filtered openings to permit diffusion of radon gas only.
- Minimum level of detection is 30 pCi/l days i.e., 0.33 pCi/l based on 90 days.
- Detectors, before, during or after exposure, should not be in locations that exceed a temperature of 160°F (70°C).
- Radtrak detectors are packaged in film-foil bags that meet Military specification MIL-B-131, Class 1 to prevent exposure prior to use.
- A metallic label is provided for each detector to seal the filtered openings following the exposure period to minimize subsequent exposure to radon during the return shipment to Landauer's laboratory.
- Each detector is identified by a unique serial number laser engraved on the CR-39, printed and bar coded on the outside of Radtrak, and the film-foil bag.

Indoor Use

Monitoring indoors requires placing the detector in an upright position on a flat surface, or it may be hung from a joist or ceiling with the detector's hanger strip included with the shipment. The U.S. Environmental Protection Agency recommends the detector be placed in the lowest lived-in level of the home. It should be placed in a room that is used regularly but not a kitchen or bathroom. States or other organizations may have differing recommendations. Contact your state agency if you have a question regarding placement.

Outdoor Use

For monitoring outdoors, the detector is fastened to the bottom of a clear plastic cup. The cup is then installed inside a protective canister that has been attached to a post or other location. The protective canisters are sold separately.

Personnel Monitoring

The personnel monitor comes with a clip that easily attaches to the detector and securely fastens to clothing.

For more information on radon, refer to the U.S. Environmental Protection Agency's publication "A Citizen's Guide to Radon" at http://www.epa.gov/iaq/radon/pubs/citguide.html or contact your state department of health.

APPENDIX B
Soil-Vapor Sampling and Analysis Plan for the Mixed Waste Landfill

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B-1 Schematic of a Typical FLUTe™ Well Installation Beneath the MWL

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1.0 INTRODUCTION

Requirements for monitoring at the Mixed Waste Landfill (MWL) are defined in the Long-Term Monitoring and Maintenance Plan (LTMMP) provided by the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia). This Soil-Vapor Sampling and Analysis Plan (SAP) was developed in response to a request by the New Mexico Environment Department (NMED) to monitor the vadose zone for volatile organic compounds (VOCs) at the MWL, Technical Area III, Sandia National Laboratories, New Mexico (SNL/NM) (Figure B-1-1) (NMED November 2006).

1.1 Sampling Objective

The LTMMP, including this SAP, is designed to ensure the monitoring of specified parameters over a period of time. The monitoring objective of this SAP is to provide for VOC soil-vapor sampling in the vadose zone at the MWL. In addition to establishing monitoring and data quality objectives (DQOs), this SAP presents specifications for the monitoring systems, analytical laboratory analysis, data validation and evaluation, records management, and reporting. This document provides sampling personnel with the necessary information to perform vadose zone sampling. The results will be compared to the proposed trigger level presented in Chapter 5.0 of the LTMMP and in the "Probabilistic Fate and Transport Modeling of the Mixed Waste Landfill at Sandia National Laboratories" (Ho et al. January 2007).

1.2 Scope

Sampling of soil vapor in the vadose zone at the MWL will be conducted on a routine basis throughout the long-term monitoring and maintenance period for the MWL. Sampling will be conducted quarterly for 2 years to establish baseline conditions, then semiannually for the next 2 years, and annually thereafter.

Each sampling event will require the collection of soil-vapor samples from the soil-vapor monitoring wells and off-site laboratory analysis for VOCs.

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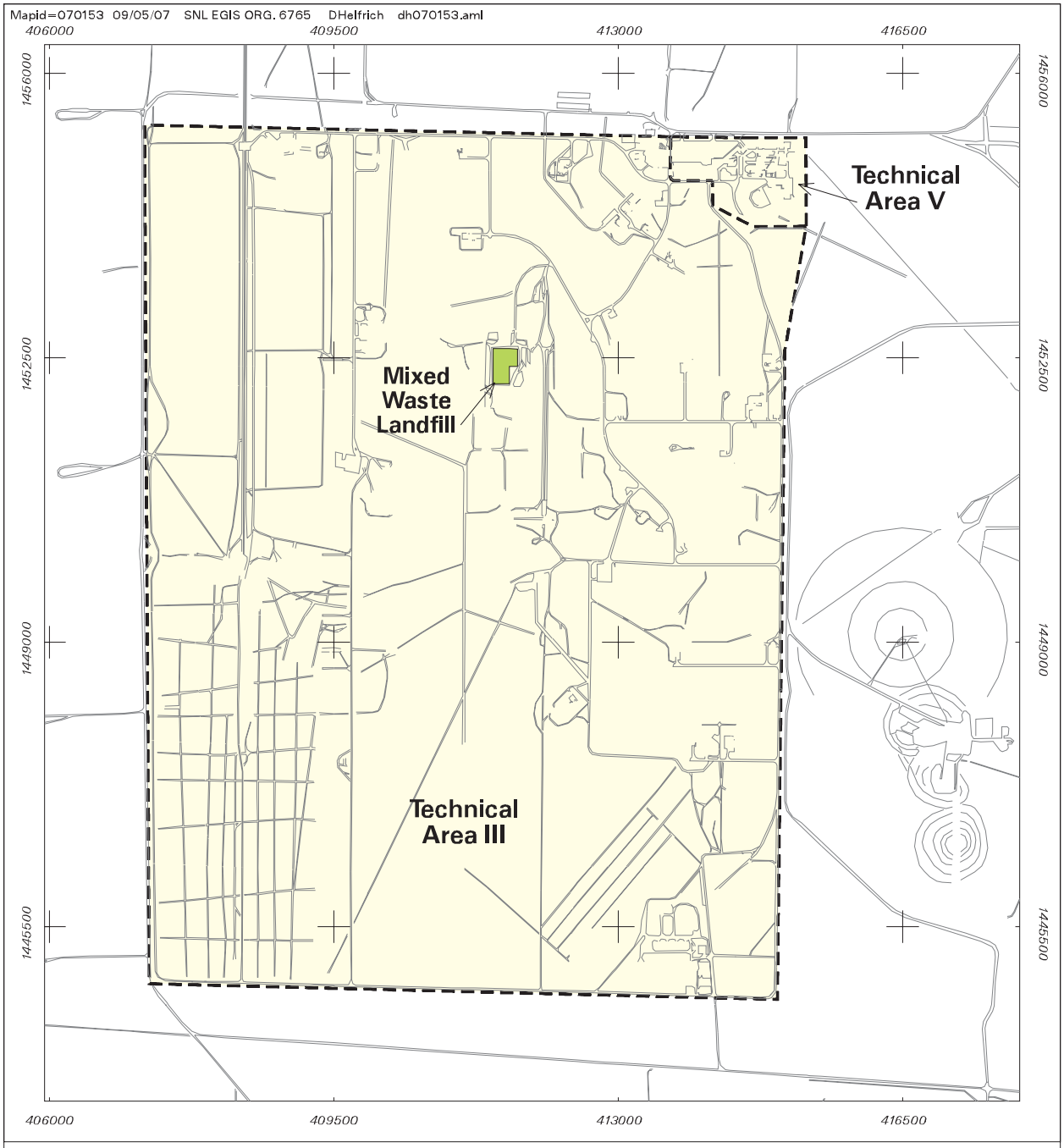

Legend

Road

Technical Area

Mixed Waste Landfill

Figure B-1-1
Location of the Mixed Waste Landfill within Technical Area III

0 1000 2000
Scale in Feet

0 240 480
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

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2.0 BACKGROUND INFORMATION AND HISTORICAL INVESTIGATIONS

2.1 Background Information

The MWL Corrective Measures Implementation Work Plan was written and submitted to the NMED in November 2005 (SNL/NM November 2005). NMED reviewed the document, and responded with a "Notice of Disapproval" (NOD) letter dated November 20, 2006 (NMED November 2006). This letter described a number of deficiencies related to the MWL cover, construction plans, performance and fate and transport modeling, and monitoring triggers. The letter also included a requirement for soil-vapor sampling in the vadose zone, as follows:

> "The NMED expects the vadose zone to be monitored for volatile organic compounds, tritium, and radon, in addition to soil moisture. The NMED may also require soil-gas monitoring to be conducted at depths other than at 173 feet, as implied by the Permittees in the second paragraph of Section 7.1. Monitoring details will need to be included in the long-term monitoring and maintenance plan, due within 180 days following approval of the CMI Report." (NMED November 2006).

In the "Responses to the NMED Notice of Disapproval" (SNL/NM December 2006), DOE/Sandia proposed a robust soil-vapor monitoring system for long-term monitoring at the MWL. The soil-vapor monitoring wells will serve as an early-warning system to protect groundwater from potential migration of contaminants. Additional information regarding the proposed monitoring, including the parameters and depths to be monitored, were included in the DOE/Sandia responses to the second set of comments within this NOD (Part 2).

In the "Responses to the NMED Notice of Disapproval, Comment Set 2" (SNL/NM January 2007), DOE/Sandia responded to the following statement from the NOD (NMED November 2006):

> "Develop triggers for tritium, radon, PCE and total VOCs as soil vapor. The NMED expects soil-gas in the vadose zone to be monitored for these constituents."

In order to monitor soil vapor for contaminants, DOE/Sandia proposed installation of a monitoring system for sampling soil vapor within the vadose zone at the MWL. The proposed vadose zone monitoring system would allow early detection of contaminants migrating through the vadose zone, before they impact groundwater quality. Soil-vapor samples would be analyzed for VOCs. Sampling for tritium and radon would be conducted on the ground surface, rather than in the vadose zone, as described in Section 3.2 and 3.3 of the LTMMP.

2.2 Historical Soil-Vapor Investigations

During the Phase 2 Resource Conservation and Recovery Act (RCRA) Facility Investigation in the mid 1990s, extensive soil-vapor data were collected to determine the nature and extent of VOC contamination in near-surface soils at the site (SNL/NM September 1996) with most of the samples collected from depths of 10 feet and 30 feet below ground surface (bgs). Although low concentrations of VOCs have been detected in the vadose zone at the MWL, they have not

impacted groundwater quality based upon sixteen years of groundwater monitoring data collected since 1990.

Analytical results for the 1994 soil-vapor samples are presented and discussed in the “Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation, Sandia National Laboratories, New Mexico” (SNL/NM September 1996). Eight individual VOCs were detected in the 10 and 30-foot samples, with total VOC concentrations ranging from 0.03 to 30.7 parts per million (ppm) in the 10-feet bgs samples, and from 0.107 to 27.7 ppm in the 30-feet bgs samples. These VOCs included dichloro-difluoromethane, trichloro-fluoromethane, 1,1,2-trichloro-1,2,2-trifluoroethane, trichloroethene, 111-trichloroethane, tetrachloroethane, methylene chloride, and chloroform.

3.0 DATA QUALITY OBJECTIVES

The main DQO is to produce representative, accurate, and defensible analytical results to support the sampling objective (i.e., provide VOC soil-vapor data from the vadose zone). This SAP is designed to ensure that sampling procedures are consistent and can be used to establish VOC concentration trends. This DQO will be accomplished through the implementation of standard operating procedures and analytical procedures/methods through the use of quality assurance (QA) measures, quality control (QC) samples, and data evaluation protocols.

3.1 Monitoring System

The vadose zone monitoring system will provide updated data regarding VOC profiles with depth, and will consist of three Flexible Liner Underground Technologies (FLUTe™) soil-vapor monitoring wells (hereinafter referred to as FLUTe™ wells). The FLUTe™ wells are constructed in vertical boreholes located immediately outside the perimeter of the MWL cover with the locations near areas where the highest concentrations of VOCs were detected during earlier studies at the MWL (Figure B-3.1-1). Soil-vapor sampling ports are installed in each FLUTe™ well at targeted depths of 50 feet, 100 feet, 200 feet, 300 feet, and 400 feet bgs. (Attachment B-1 presents a schematic of a typical FLUTe^{TM} well installation beneath the MWL.)

Soil-vapor data collected from the FLUTe™ wells will be used to assess current VOC distributions with depth, and to monitor VOC concentrations over time, allowing early identification of any potential threats to groundwater. The VOC data from the FLUTe™ wells will also be used to update the MWL fate and transport model every five years, as required in the NMED Final Order (NMED August 2005).

Selection of sampling location and depth, total number of samples per sampling event, and sampling frequency help ensure that the data are representative of conditions in the vadose zone.

Table B-3.1-1 gives the sampling frequency for the 5 years following the completion of the MWL cover.

3.2 Data Accuracy

Proper sampling procedures and use of QC samples such as environmental sample duplicates (Section 3.5) will help reduce random and systematic sampling error or bias. Accurate estimates of VOC concentration can be made reliably through the use of a qualified laboratory, appropriate methodologies, and effective QA/QC procedures. These measures, along with consistent implementation of the LTMMP and this SAP, will satisfy the DQO for accuracy.

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Legend

- Soil-Moisture Monitoring Access Tube (showing horizontal extent of tube)
- FLUTe™ Well
- Fence
- Toe of Landfill Cover
- Road
- MWL Extent

Figure B-3.1-1
FLUTe™ Well Locations and Soil-Moisture Monitoring Access Tubes at the Mixed Waste Landfill

0 60 120
Scale in Feet

0 14.4 28.8
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

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Table B-3.1-1
Soil-Vapor Sampling Frequency

Time Period	Sample Frequency	Boreholes	Sample Depths (bgs)	Number Samples Per Year
Year 1 Year 2	Quarterly (4 events)	3	50	60
			100	
			200	
			300	
			400	
Year 3 Year 4	Semi-annually (2 events)	3	50	30
			100	
			200	
			300	
			400	
Year 5 and Subsequent Years	Annually	3	50	15
			100	
			200	
			300	
			400	

bgs = Below ground surface.

Accuracy is the agreement between a measured value and an accepted reference value. When applied to a set of observed values, accuracy is a combination of a random component and a systematic bias. Accuracy will be maintained and evaluated through referenced calibration standards, laboratory control samples, matrix spike samples, and surrogate spike samples. The bias component will be evaluated and expressed as a percent recovery (%R). Acceptance criteria are defined in the SNL/NM Statement of Work (SOW) for Analytical Laboratories (SNL/NM March 2003), and verified as part of the data validation process.

$$\%R = \frac{(measure\ sample\ concentration)}{true\ concentration} x100\%$$

3.3 Precision

Precision is the agreement among a set of replicate measurements. Precision data will be derived from environmental and laboratory duplicate samples. Precision will be reported as the relative percent difference (RPD) which is calculated as follows:

$$RPD = \frac{|R_1 - R_2|}{[(R_1 + R_2)/2]} \times 100$$

RPD = Relative percent difference is calculated with the following equation and rounded to nearest whole number where:

R_1 = analysis result

R_2 = duplicate analysis result

The acceptable range for RPD is less than or equal to 20 percent.

3.4 Data Consistency and Comparability

Data consistency and comparability will be achieved through implementation of this SAP, which defines field and laboratory procedures designed for this purpose. Consistency in methods and procedures will be maintained in the following areas to ensure VOC data are consistent and that the data sets are comparable.

- Field sample collection and management
- Use of an off-site contract laboratory
- Use of an identified VOC soil-vapor analytical method
- VOC soil-vapor analytical data review and validation

After VOC soil-vapor analytical results are received from the laboratory, the SNL/NM Sample Management Office (SMO) will review the laboratory report for completeness and conformance to the performance criteria, and arrange for data validation. If problems are noted that require corrective action during these verification and validation reviews, corrective action will be implemented as defined in the SOW (SNL/NM March 2003). The scope of the data verification and validation process addresses field sample management and custody requirements, as well as adherence to QA/QC requirements by the off-site laboratory performing the analyses.

Each new set of VOC soil-vapor data will be compared to historical soil-vapor data collected. This evaluation process can identify term plume trends, but will also help identify outliers or other potential indicators of error and inconsistency.

3.5 Quality Control

Quality control measures ensure that data are scientifically sound and of known precision and accuracy. QC samples will be collected to help reduce random and systematic sampling error or bias. Table B-3.5-1 presents the samples needed to meet the QC requirements for soil-vapor sampling at the MWL.

Table B-3.5-1
Quality Control Samples

Sample Type	Frequency	Acceptance Criteria	Matrix
Duplicate Environmental Soil-Vapor Samples	1 with each sample batch sent to the laboratory or 1 per 20 samples.	RPD less than or equal to 20 percent (guidance only, RPDs for low concentrations of constituents may exceed 20 percent).	Vapor

RPD = Relative percent difference.

4.0 SAMPLING ACTIVITIES

This section describes the field and laboratory measures to be taken in providing VOC soil-vapor data from the vadose zone.

4.1 Field Activities

Field activities include the preparation, purging and VOC monitoring, sample collection, sample shipping, and the methods and procedures governing these activities. Adherence to this protocol will help ensure uniformity among measurements, and allow comparison of the results. Activities that will be conducted in preparation for or during soil-vapor sampling include the following:

- Health and Safety
- Pre-Field Preparations
- Purging and Field Estimation of Total Concentration of VOCs
- Sample Acquisition
- Sample Documentation and Custody
- Handling, Labeling, and Shipment
- Waste Management

The SNL/NM Administrative Operating Procedure (AOPs) and Field Operating Procedure (FOPs) for these activities are listed in Table B-4.1-1 as well as SMO procedures and guidance. All personnel directly involved in VOC soil-vapor sampling activities will review and abide by these procedures. The most current versions of these documents will be used.

4.1.1 Health and Safety

Field operations will be conducted in an approach that prioritizes the health and safety of field personnel above all other objectives. Every team member has the authority and responsibility to stop operations if an unsafe condition develops or is observed. All sampling personnel will perform field activities in accordance with the applicable Health and Safety Plan.

4.1.2 Pre-Field Preparations

Pre-field preparations include a vacuum check of the Summa canister as described in Activity Specific Standard Operating Procedure (ASSOP) pending (SNL/NM 2007a, pending) and calibration of the PID according to FOP 94-28 (SNL/NM March 1997).

Table B-4.1-1
Reference Documentation
MWL Soil-Vapor Monitoring

Document[a]	Title
FOP 94-01 (SNL/NM December 2006b)	Safety Meetings, Inspections, and Pre-Entry Briefings
FOP 94-22 (SNL/NM March 1994)	Deep Soil Sampling (modified for the FLUTe™ well sampling system)
FOP 94-25 (SNL/NM November 2004)	Documentation of Field Activities
FOP 94-28 (SNL/NM March 1997)	Health and Safety Monitoring of Organic Vapors (FID and PID)
AOP 95-16 (SNL/NM February 2007a)	Sample Management and Custody
AOP 00-03 (SNL/NM December 1999)	Data Validation Procedure for Chemical and Radiochemical Data
LOP 94-03 (SNL/NM February 2007b)	Sample Handling, Packaging, and Shipping, SMO
ASSOP pending (SNL/NM 2007a, pending)	Activity Specific Standard Operating Procedure for Soil-Vapor Sampling at the Mixed Waste Landfill
SMO 05-03 (SNL/NM 2007b, pending)	Procedure for Completing the Contract Verification Review
NA (SNL/NM March 2003)	SNL/NM Statement of Work for Analytical Laboratories
NA (SNL/NM December 2003)	Quality Assurance Project Plan for the Sample Management Office

[a]The most current version will be used.
AOP = Administrative operating procedure.
ASSOP = Activity-specific standard operating procedure.
FID = Flame Ionization Detector.
FOP = Field operating procedure.
LOP = Laboratory operation procedure.
MWL = Mixed Waste Landfill.
NA = Not applicable.
PID = Photoionization Detector.
SMO = Sample Management Office.
SNL/NM = Sandia National Laboratories/New Mexico.

4.1.3 Purging and Field Estimation of Total Concentration of VOCs

At the FLUTe™ wellhead, a vacuum pump connected to the sample tubing via a Swagelok® or equivalent fitting will be used to purge stagnant and/or pre-existing soil vapor from the monitoring ports and sample tubing. The stream of soil vapor extracted from the sampling port will be screened with the calibrated PID and readings will be monitored during purging and recorded in the field logbook.

Purging requirements for the individual sample depths are defined in the ASSOP pending (SNL/NM 2007a, pending). Table B-4.1-2 provides estimated purging volumes and the purging times. Equations for the calculations are provided in Appendix A of the ASSOP.

4.1.4 Sample Acquisition

Samples are to be collected using the sampling manifold provided by the FLUTe™ well manufacturer and specified in ASSOP 01-07. The manifold allows access to each sampling depth through a sampling port.

Table B-4.1-2
Estimated Purge Volumes and Time

Sample ports at each Flute™ Well (ft bgs)	Total of 3 Purge Volumes (ft^3)	Purge Time (seconds)
50	0.051	5
100	0.102	8
200	0.205	12
300	0.307	17
400	0.409	22

bgs = Below ground surface.
FLUTe™ = Flexible Liner Underground Technologies.
ft = Foot (feet).
ft^3 = Cubic feet.

4.1.5 Sample Documentation and Custody

To ensure the integrity of samples from the time of collection through the reporting of analytical results, sample collection, handling, and custody will be documented. The continuous record of documented sample possession is referred to as the chain-of-custody. Primary elements in the documentation of samples are: sample identification number, sample labels, custody tape, and the analysis request/chain of custody (AR/COC) form. Standardized forms will be used to document sample information. Sample custody and documentation procedures for sampling activities are outlined in AOP 95-16 (SNL/NM February 2007a) and LOP 94-03 (SNL/NM February 2007b). These procedures will be followed throughout each soil-vapor sampling event.

4.1.6 Handling, Labeling, and Shipment

The Summa® canisters are provided with a permanent number identifying each canister. The number is to be recorded in the logbook as well as on the AR/COC form. Do not attach the SNL/NM sample identification labels to the canisters (as requested by the laboratory); place labels on the cardboard box provided for shipping.

A SNL/NM sample label should be completed with indelible ink and affixed to each sample shipping container prior to or during sampling. Each completed sample label should include the following information:

- SNLNM SMO sample number (with sample fraction designation)
- Sample matrix type
- Sample location
- Analysis required
- Date and time of sample collection
- Types of preservatives used, if any
- Name of the sampling personnel

Canisters in the shipping boxes are returned to the SMO office for shipment to the laboratory.

4.1.7 Waste Management

There are no hazardous wastes generated from these soil-vapor sampling activities.

4.2 Analytical Methods

VOCs will be analyzed by U.S. Environmental Protection Agency (EPA) Compendium for Methods for the Determination of Toxic Organic (TO) Compounds in Ambient Air (EPA January 1999) compendium method TO-14A. The off-site laboratory is responsible for implementing the requirements of the method, including analytical methodology, target analytes for quantification, and internal QA/QC procedures. The target analytes are listed in Table B-4.2-1.

Table B-4.2-1
EPA Compendium Method TO-14 Analyte List[a]

Compound	Compound
Acetone	1,2-Dichloropropane
Benzene	cis-1,3-Dichloropropene
Benzyl chloride	trans-1,3-Dichloropropene
Bromodichloromethane	Ethylbenzene
Bromoform	4-Ethyltoluene
Bromomethane	Hexachlorobutadiene
2-Butanone	2-Hexanone
Carbon disulfide	Methylene chloride
Carbon tetrachloride	4-Methyl-2-pentanone
Chlorobenzene	Styrene
Chloroethane	1,1,2,2-Tetrachloroethane
Chloroform	Tetrachloroethene
Chloromethane	Toluene
Dibromochloromethane	1,1,2-Trichloro-1,2,2-trifluoroethane
1,2-Dibromoethane	1,2,4-Trichlorobenzene
1,2-Dichloro-1,1,2,2-tetrafluoroethane	1,1,1-Trichloroethane
1,2-Dichlorobenzene	1,1,2-Trichloroethane
1,3-Dichlorobenzene	Trichloroethene
1,4-Dichlorobenzene	Trichlorofluoromethane
Dichlorodifluoromethane	1,2,4-Trimethylbenzene
1,1-Dichloroethane	1,3,5-Trimethylbenzene
1,2-Dichloroethane	Vinyl acetate
1,1-Dichloroethene	Vinyl chloride
cis-1,2-Dichloroethene	m-, p-Xylene
trans-1,2-Dichloroethene	o-Xylene

[a]EPA January 1999.
EPA = U.S. Environmental Protection Agency.
TO = Toxic Organic.

5.0 DATA VALIDATION, REVIEW, AND REPORTING

Data validation and review of analytical and field documentation will be performed for completeness and conformance to the procedures established for the various activities. Field and analytical QC data will be reviewed for conformance to QC acceptance criteria. The entire data package will be reviewed for representativeness of quality and comparability to determine whether the specified DQOs have been met.

5.1 Field Measurement Data and Documentation Review

Completed field documentation will be reviewed and verified for accuracy, completeness, and conformance with established procedures. The review will occur at the end of each day in the field to allow verification, correction, and retrieval of missing information as appropriate.

5.2 Laboratory Data Verification and Validation

The SNL/NM SMO will review the laboratory report. The data package shall be reviewed for completeness and conformance to the performance criteria of the contract with the laboratory according to SMO 05-03 (SNL/NM December 2003).

Upon receipt of the analytical results from the Analytical Laboratory, the SNL/NM SMO will arrange for the validation of the data. The purpose of the validation is to determine the usability and establish the defensibility of the numerical results in support of the environmental and waste management activities at SNL/NM. Data validation is based upon review of laboratory-supplied QC data, the specific QC criteria identified in the procedures for the EPA-approved analytical methods, and the DQOs identified in this SAP. Data validation will be conducted according to the requirements of AOP 00-03 (SNL/NM December 2003). All associated data validation reports will be provided along with the results for each monitoring event.

5.3 Reporting

A Periodic Monitoring Report shall be prepared as defined in the Compliance Order on Consent (NMED April 2004). All monitoring data will be compiled into an annual report. This report shall include the following (as a minimum):

- Title page and signature block
- Executive summary
- Table of contents
- Introduction
- Scope of activities
- Regulatory criteria
- Monitoring results
- Conclusions
- Tables

- Figures
- Appendices

The report will also include a description of sampling activities, a summary of field measurement data, a summary of laboratory analytical and measurement data, a discussion of QC analyses and data reviews, a description of project variances, and data validation summaries. Copies and monitoring records will be maintained in the SNL/NM Customer Funded Records Center. In addition, any changes to the LTMMP monitoring program or this SAP that would require notification of the NMED and regulatory approval (such as a change in the monitoring well network, sampling frequency, or analyte list) will be presented in the annual report.

5.4 Records Management

Records associated with the soil-vapor sampling effort including field documentation, laboratory analytical results, data validation reports, and LTMMP reports/technical data evaluations will be maintained at the SNL/NM Customer Funded Records Center and comply with the record-keeping provisions of 20.4.1.500 New Mexico Administrative Code, incorporating Title 40, Code of Federal Regulations, Section 264.74, concerning the availability, retention, and disposition of records.

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ATTACHMENT B-1
Schematic of a Typical FLUTe™ Well Installation Beneath the MWL

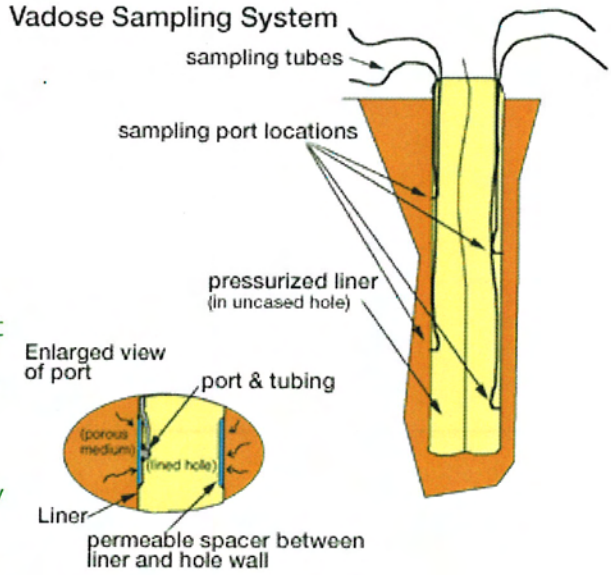
VADOSE FLUTe™

This is the oldest of the FLUTe systems. It has been in use since 1990. The Vadose FLUTe system has the following characteristics:

- Easily installed
- Seals the entire hole with a pressurized liner
- Draws the pore gas directly from the formation
- Easily removed
- Installed in holes drilled in many different ways.

The Vadose FLUTe liner is made of a rugged Nylon fabric with an impermeable polyurethane coating. The tubing in the liner is gathered in sleeves welded to the inside surface of the liner. Exterior permeable spacers over each port are welded to the liner to allow sampling from an area, rather than from a spot on the hole wall.

The Vadose FLUTe liner is normally installed by eversion (everting liner mechanism) from a pressure canister like that shown in the photo. However, many of these systems have been installed in unstable media through driven casing and filled with sand as the casing is withdrawn. A special procedure allows the sand fill to be matched inch by inch with the casing withdrawal. The sand filled liner can not be removed except by drilling out the hole. These liners are easily installed in any direction, even vertically upward.



The interval to be sampled is defined by the spacer length on the outside of the sealing liner (see drawing above). The pore gas is drawn into the port, through the interior tube (on the inside of the liner), to the surface. Five to fifteen ports per liner are typical. The wellhead is usually built to the needs of the particular site.

In those situations where the liner is pressurized with air, a small solar panel and pump are provided to maintain the air pressure indefinitely. The air filled system is easily removed by the reverse of the installation procedure.

Vadose FLUTe liner sizes have ranged from 2-18" diameter and up to 800 feet in length. Some vadose liners have been in use for 10 years for tritium monitoring.

Prices are available at Vadose Prices. Ancillary equipment needs range from renting an air pressure canister to a "Slider", depending upon the installation procedure to be used. Installation procedures are available at Vadose Procedures. Landfill monitoring is an especially useful application of this system.

APPENDIX C
Soil-Moisture Monitoring Plan for the Mixed Waste Landfill

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1.0 INTRODUCTION

Requirements for monitoring at the Mixed Waste Landfill (MWL) are defined in the Long-Term Monitoring and Maintenance Plan (LTMMP) provided by the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia). This Soil-Moisture Monitoring Plan (MP) was developed for use during long-term monitoring of the vadose zone for soil moisture at the MWL, Technical Area III, Sandia National Laboratories, New Mexico (SNL/NM) (Figure C-1-1).

1.1 Objective

The LTMMP, including this MP, is designed to ensure the integrity and performance of the final landfill cover. The objective of this MP is to provide for soil-moisture monitoring of the vadose zone at the MWL over a period of time. In addition to establishing monitoring and data quality objectives (DQOs), this MP presents specifications for the use and handling of the CPN503 DR Hydroprobe® Moisture Depth Gauge (neutron probe), data evaluation, records management, and reporting. This document provides monitoring personnel with the necessary information to perform vadose zone soil moisture monitoring. The results will be compared to the proposed trigger level presented in Chapter 5.0 of the LTMMP and in the "Probabilistic Fate and Transport Modeling of the Mixed Waste Landfill at Sandia National Laboratories" (Ho et al. January 2007).

1.2 Scope

Monitoring for soil moisture in the vadose zone will be conducted following the installation of the final landfill cover to assess the hydrologic performance of the MWL cover. Quarterly monitoring is planned for the first two years after completion of the cover, followed by semiannual monitoring for two more years, and then annual monitoring thereafter. Each monitoring event requires the deployment of the neutron probe in the current monitoring system consisting of three angled access tubes. The locations of the access tubes are shown in Figure C-1.2-1. A schematic of the MWL soil-moisture monitoring access tubes is shown in Figure C-1.2-2.

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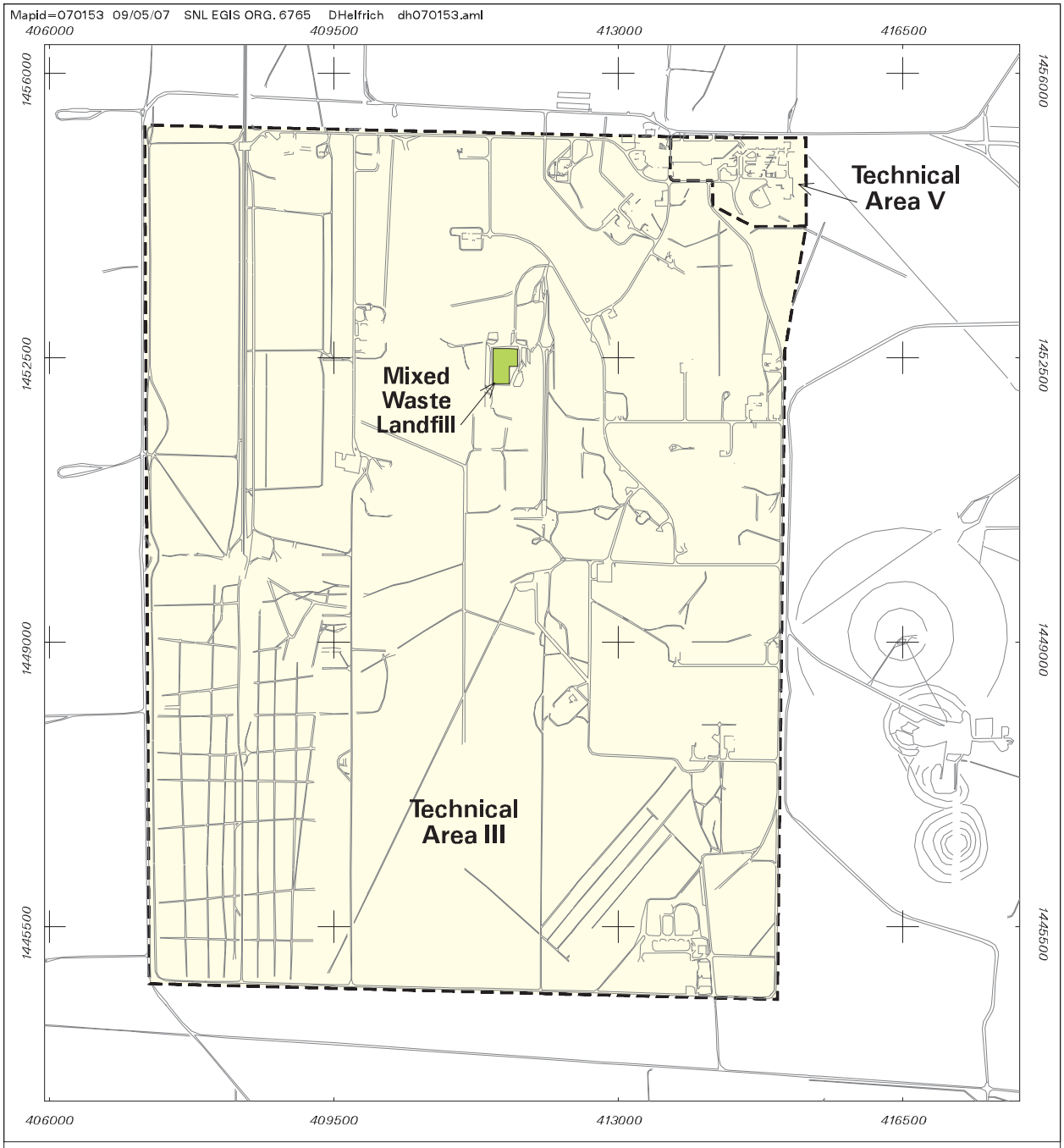

Legend

Road

Technical Area

Mixed Waste Landfill

Figure C-1-1
Location of the Mixed Waste Landfill within Technical Area III

0 1000 2000
Scale in Feet

0 240 480
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04310000 A22.ai

Legend

- Soil-Moisture Monitoring Access Tube (showing horizontal extent of tube)
- FLUTe™ Well
- Fence
- Toe of Landfill Cover
- Road
- MWL Extent

Figure C-1.2-1
FLUTe™ Well Locations and Soil-Moisture Monitoring Access Tubes at the Mixed Waste Landfill

0 60 120
Scale in Feet

0 14.4 28.8
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04310000 A42

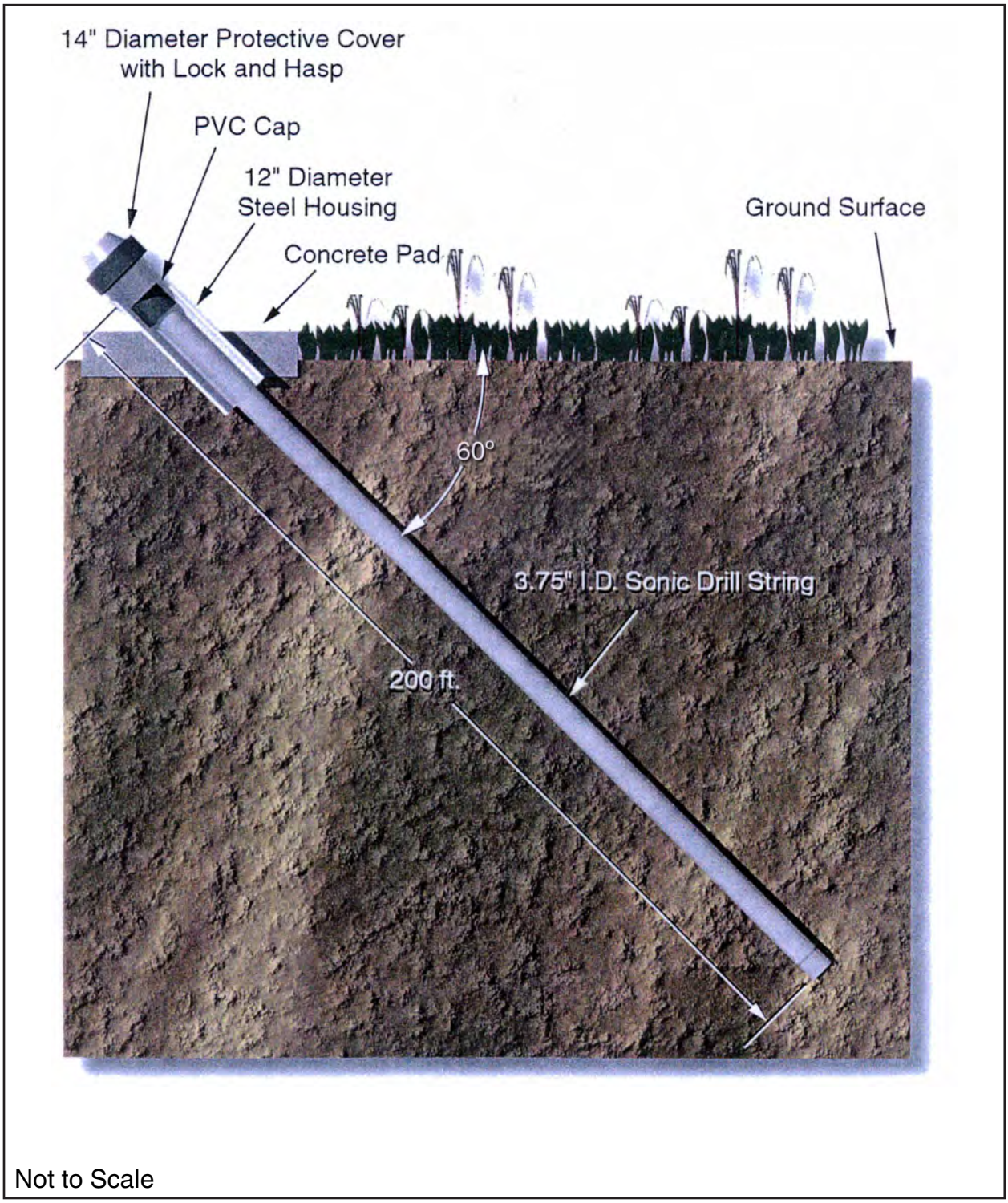

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Figure C-1.2-2
Schematic of Soil-Moisture Monitoring Access Tube,
Mixed Waste Landfill

2.0 BACKGROUND INFORMATION

The MWL Corrective Measures Implementation Work Plan was written and submitted to the New Mexico Environment Department (NMED) in November 2005 (SNL/NM November 2005). NMED reviewed the document, and responded with a "Notice of Disapproval" (NOD) letter dated November 20, 2006 (NMED November 2006). This letter described a number of deficiencies related to the MWL cover, construction plans, performance and fate and transport modeling, and monitoring triggers. The letter also included a requirement for soil-moisture monitoring in the vadose zone, as follows:

> "The NMED expects the vadose zone to be monitored for volatile organic compounds, tritium, and radon, in addition to soil moisture." (NMED November 2006).

In the "Responses to the NMED Notice of Disapproval" (SNL/NM December 2006), DOE/Sandia proposed soil-moisture monitoring via the current monitoring system. The soil-moisture monitoring will serve as an early-warning system for the potential migration of contaminants. Additional information regarding the proposed monitoring, including the trigger levels and depths to be monitored, were included in the DOE/Sandia responses to the second set of comments within the NOD (Part 2) (SNL/NM January 2007).

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3.0 DATA QUALITY OBJECTIVES

The primary DQO is to produce representative, accurate, and defensible results to support the monitoring objective (i.e., provide soil-moisture data from the vadose zone). This MP is designed to ensure that procedures are consistent and can be used to detect soil moisture beneath the landfill cover. This DQO will be accomplished through the implementation of standard operating procedures and the use of quality assurance and quality control (QA/QC) measures and data evaluation protocols.

3.1 Monitoring System

The soil-moisture monitoring system was installed in 2003, and is comprised of three boreholes drilled on a 30-degree angle from vertical to a depth of 200 linear feet and a vertical depth of 173 feet below ground surface. Each borehole was cased with drill string used to advance the borehole. The drill string is approximately 4.5 inches in diameter and is made of steel. The borehole is open to the soil in the bottom (no end cap). These are referred to as the access tubes.

During long term monitoring at the MWL, moisture readings will be taken within each access tube at intervals given in Table C-3.1-1.

Table C-3.1-1
Soil-Moisture Monitoring Frequency

Time Period	Monitoring Frequency	Access Tubes	Depths (ft bgs)
Year 1 Year 2	Quarterly (4 events)	3	4-25, at 1 ft intervals 25-200, 5 ft intervals
Year 3 Year 4	Semi-annually (2 events)	3	4-25, at 1 ft intervals 25-200, 5 ft intervals
Year 5 and subsequent years	Annually	3	4-25, at 1 ft intervals 25-200, 5 ft intervals

bgs = Below ground surface.
ft = Foot (feet).

3.2 Neutron Probe

The primary moisture sensor will be a CPN 503DR neutron moisture probe, or an equivalent soil moisture probe. The CPN 503DR is a geophysical means of measuring soil moisture content. The probe uses a 50.0 millicurie americium-241:beryllium neutron source for moisture content measurements. The probe is self-contained and includes the radioactive sources, and detectors. Briefly, a neutron probe uses the absorption of emitted neutrons to calculate soil moisture content. The assumption is made that the hydrogen in soil moisture is the dominant absorber of the emitted neutrons. In the MWL soil, the calibration and QA/QC procedures to be used for the neutron probe associated with this monitoring system have not been confirmed; therefore, the following calibration and QA/QC checks are required.

3.2.1 Calibration

Calibration of the CPN 503DR neutron probe is performed in a controlled environment that duplicates as close as possible the in situ characteristics of the field monitoring location.

The probe is inserted into the access tube and count readings are taken as the soil moisture content in the repacked native soil is varied. The resulting count/soil moisture content relationship is used to develop a correlation curve for the instrument, which associates a neutron count to a known soil moisture content. Technically, this process is a correlation, not a calibration, because the probe electronics are not actually being adjusted or tuned to a known moisture content. Rather a mathematical formula is developed that correlates a neutron count to a known moisture content.

The CPN 503DR neutron probe was field-calibrated in August 2001 at the Infiltration Pilot Test Site, located approximately 500 feet west of the MWL (SNL/NM September 2001). A calibration study was conducted during which the relationship between neutron count readings measured with the CPN 503DR neutron probe and volumetric water content was determined. The results of this study determined that the relationship between volumetric water content and the neutron count ration can be expressed as follows:

$$\theta = 17.784\ R - 2.0801$$

Where

θ = the volumetric water content, and
R = count ratio (neutron probe counts divided by the standard count)

3.2.2 Quality Assurance and Quality Control

The CPN 503DR neutron probe is operated in accordance with the Activity Specific Standard Operating Procedure (ASSOP) (SNL/NM 2007, pending). A standard count will be taken once daily (during the monitoring event) prior to the moisture logging to ensure the highest measurement of accuracy. The standard count measures the proper function of the gauge electronics and also compensates for the source decay. This measurement shall be performed daily when used as described in ASSOP (SNL/NM 2007, pending).

Each new set of soil-moisture data will be compared to historical data collected. This evaluation process can aid in identifying trends, but will also help identify outliers or other potential indicators of error and inconsistency.

4.0 MONITORING ACTIVITIES

Monitoring activities include preparation for monitoring and monitoring methods and procedures governing these activities. Adherence to this protocol will help ensure uniformity among measurements, and allow comparison of the results. Activities that will be conducted in preparation for or during monitoring include the following:

- Health and safety plan review
- Pre-monitoring activities
- Correlation of the neutron probe
- Visual inspection of access tube entry point

The SNL/NM managing documents and Field Operating Procedure (FOPs) for these activities are listed in Table C-4-1. All personnel directly involved in field activities will review and abide by these procedures.

Table C-4-1
Reference Documentation
MWL Vadose Zone Soil-Moisture Monitoring

Document[a]	Title
FOP 94-01 (SNL/NM December 2006b)	Safety Meetings, Inspections, and Pre-Entry Briefings
FOP 94-25 (SNL/NM November 2004)	Documentation of Field Activities
ASSOP pending (SNL/NM 2007, pending)	Activity Specific Standard Operating Procedure for Use of the CPN 503DR Hydroprobe® Moisture Depth Gauge and Neutron Logging Activities at the Mixed Waste Landfill
HASP PLA 06-05, Revision 00 (SNL/NM May 2006)	Site Health and Safety Plan Environmental Restoration Project Vadose Zone Monitoring at the MWL
PHS SNL06A00497-002 (SNL/NM June 2007)	Primary Hazard Screening Vadose Zone Monitoring at the Mixed Waste Landfill

[a]The most current version will be used.
ASSOP = Activity-specific standard operating procedure.
FOP = Field operating procedure.
HASP = Health and Safety Plan.
MWL = Mixed Waste Landfill.
PHS = Primary Hazard Screening

4.1 Health and Safety

Field operations will be conducted in an approach that prioritizes the health and safety of field personnel above all other objectives. Every team member has the authority and responsibility to stop operations if an unsafe condition develops or is observed. All personnel will perform field activities in accordance with the applicable Health and Safety Plan.

4.2 Data Acquisition

A standard count will be taken and the results recorded in the field logbook. After assembly of the probe and necessary cables, the probe will be lowered to each predetermined location (Table C-3.1-1) in the access tube. At each monitoring location, the neutron counts will be logged and recorded in the field logbook.

The data will be downloaded from the probe (control box) and saved onto a laptop computer. The data files can be accessed in Microsoft Excel.

4.3 Waste Management

There are no hazardous wastes generated from these monitoring activities.

5.0 DATA REVIEW AND REPORTING

Review of data and field documentation will be performed for completeness and conformance to the procedures established for this activity. The data will be reviewed for representativeness of quality and comparability to determine whether the specified DQOs have been met.

5.1 Data Review

Completed field documentation will be reviewed and verified for accuracy, completeness, and conformance with established procedures. The review will occur at the end of each day in the field to allow verification, correction, and retrieval of missing information as appropriate.

5.2 Reporting

Reports will be prepared and submitted to the NMED according to the schedule defined in the LTMMP.

5.3 Records Management

Records associated with the soil-moisture monitoring including field documentation, logging results, reports, and LTMMP reports/technical data evaluations will be maintained at the SNL/NM Customer Funded Records Center and comply with the record-keeping provisions of 20.4.1.500 New Mexico Administrative Code, incorporating Title 40 Code of Federal Regulations Section 264.74, concerning the availability, retention, and disposition of records.

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APPENDIX D
Groundwater Sampling and Analysis Plan for the Mixed Waste Landfill

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1.0 INTRODUCTION

Requirements for monitoring and sampling at the Mixed Waste Landfill (MWL) are defined in the Long-Term Monitoring and Maintenance Plan (LTMMP) provided by the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia). The MWL is located in Technical Area III of Sandia National Laboratories/New Mexico (SNL/NM) (Figure D-1-1).

This Groundwater Sampling and Analysis Plan (SAP) was developed in response to the New Mexico Environment Department (NMED) Compliance Order on Consent (Consent Order) (NMED April 2004). The Consent Order states that groundwater beneath the MWL is to be monitored via annual sampling.

At the writing of this document, several modifications to the groundwater monitoring well network have been proposed. As important details (construction diagrams and locations) of the proposed wells could not be provided in the LTMMP, the DOE/Sandia fully discuss the existing well network with reference to the proposed changes. Efforts have been made to include all proposed wells in the discussion, as these are critical to the long-term monitoring of the groundwater. Because the proposed wells have not yet been installed, the circumstances of their installation may change.

1.1 Sampling Objective

The LTMMP, including this SAP, is designed to ensure the monitoring of specified parameters over a period of time. The sampling objective of this SAP is to provide defensible data for groundwater monitoring (via the collection of groundwater samples) at the MWL. In addition to establishing sampling and data quality objectives (DQOs), this SAP presents specifications for the purging methods, analytical laboratory analysis, data validation and evaluation, records management, and reporting. This document provides sampling personnel with the necessary information to perform groundwater sampling. The results will be compared with the proposed trigger levels presented in Chapter 5.0 of the LTMMP and in the "Probabilistic Fate and Transport Modeling of the Mixed Waste Landfill at Sandia National Laboratories" (Ho et al. January 2007).

1.2 Regulatory Criteria

Historically, the NMED Hazardous Waste Bureau has provided regulatory oversight of the MWL as Solid Waste Management Unit (SWMU) 76 under the Hazardous and Solid Waste Amendments (HSWA) module of the facility Resource Conservation and Recovery Act permit. The NMED confirmed that the MWL is properly designated as a SWMU (Dinwiddie June 1998), and as such, must comply with the corrective action program defined in Title 20, New Mexico Administrative Code (NMAC), Section 4.1.500, incorporating Title 40, Code of Federal Regulations (CFR), Section 264.101. Requirements for corrective action at the MWL, including groundwater monitoring requirements, are established through the corrective measures process.

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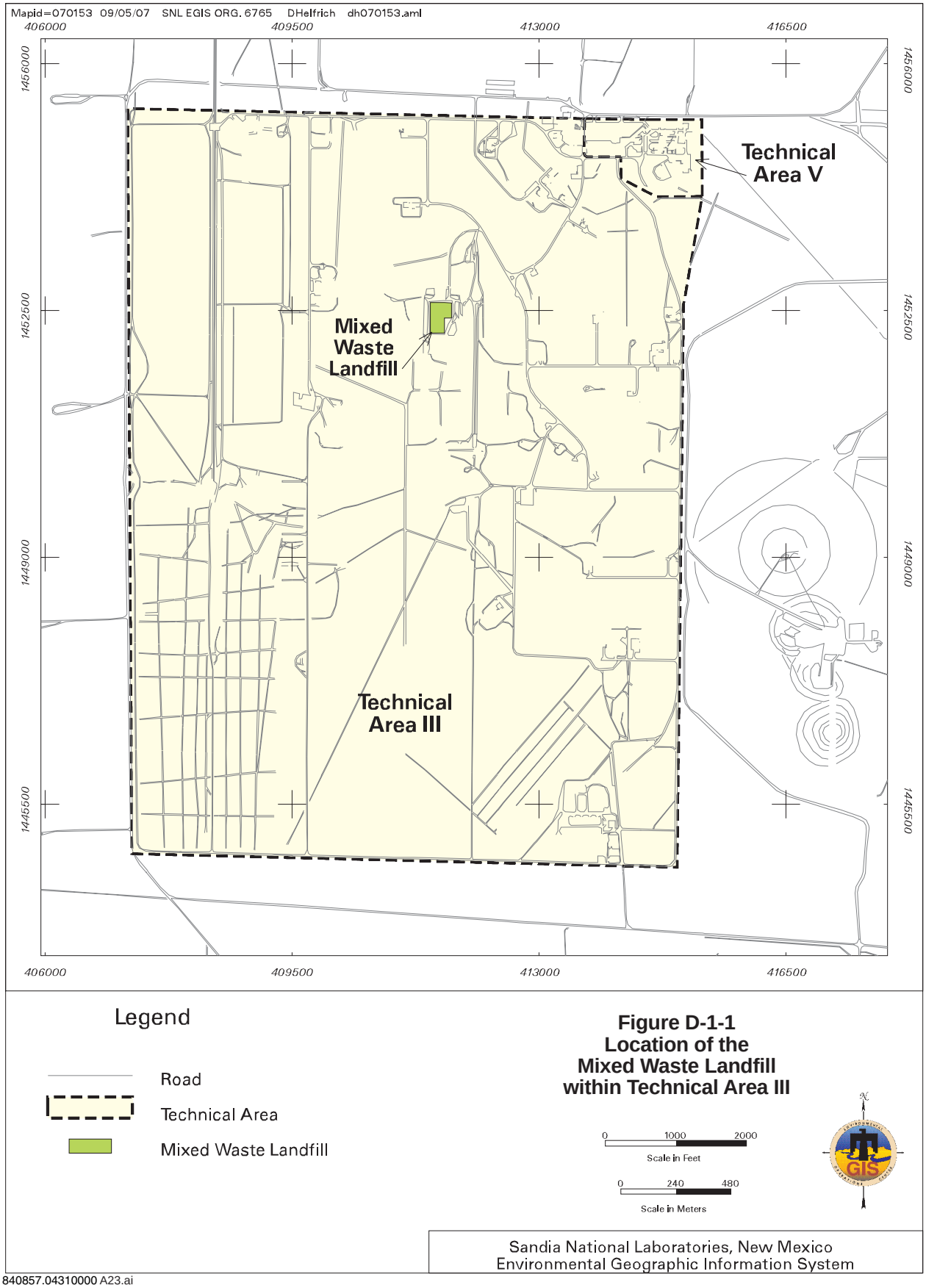

Figure D-1-1
Location of the Mixed Waste Landfill within Technical Area III

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

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The issuance of the Consent Order (NMED April 2004) transferred regulatory authority for groundwater sampling at the MWL from the HSWA module to the Consent Order. The Consent Order specifies that a SAP for groundwater monitoring shall, at a minimum, include the elements of discussion listed in Table D-1.2-1. The sections in this SAP where these elements are discussed are also provided in Table D-1.2-1.

Table D-1.2-1
MWL Groundwater SAP Crosswalk Reference

Required Elements as listed in the Consent Order (NMED April 2004)	Sections in this SAP
Water level measurements	4.2
Sampling equipment / pump type	4.5
Purge requirements	4.5
Filtration	4.7
Preservation and holding time	5.0 (Table D-5-1)
Containers	5.0 (Table D-5-1)
Sequence of sample fractions	4.7
Field QC samples	5.2.1
Laboratory QC samples	5.2.2
Labeling containers	4.4
Analytical requests	4.10
Chain of custody	4.10
Handling/shipping	4.10/4.11
Field parameters (pH, temperature, specific conductance, turbidity, dissolved oxygen)	4.6
Decontamination procedures	4.8
Report format	6.3
Schedules and frequency of sampling	3.6
Report due date	6.3
Instrument calibration methods	4.3
Health and safety	4.1

NMED = New Mexico Environment Department.
QC = Quality control.
SAP = Sampling and Analysis Plan.

1.3 Scope

Groundwater will be sampled annually from monitoring wells designated for long-term monitoring at the MWL. Each sampling event requires the collection of groundwater from each well and the off-site laboratory analysis for selected chemical parameters. The locations of the current and proposed groundwater monitoring wells are shown in Figure D-1.3-1.

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Legend

- Existing Monitoring Well Proposed for Plug and Abandonment
- Angled Monitoring Well (showing horizontal extent)
- Replacement Monitoring Well (location shown schematically)
- Existing Monitoring Well
- Road
- Fence
- Toe of Landfill Cover
- MWL Extent

Figure D-1.3-1
Mixed Waste Landfill
Groundwater Monitoring Wells

0 100 200
Scale in Feet

0 24 48
Scale in Meters

N

GIS

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

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2.0 BACKGROUND INFORMATION

The MWL monitoring well network (Figure D-1.3-1) currently (as of September 2007) consists of seven wells completed within interfingering, fine-grained, alluvial fan deposits and coarse-grained Ancestral Rio Grande deposits (Goering et al. 2002). This network includes one background well (MWL-BW1), one on-site well (MWL-MW4), and five downgradient or cross-gradient wells (MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW5, and MWL-MW6). All seven wells are constructed of 5-inch, Schedule 80 polyvinyl chloride (PVC) casing. Wells MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3 have screens composed of slotted Type 304 stainless steel. Wells MWL-MW4, MWL-MW5, and MWL-MW6 have screens composed of slotted Schedule 80 PVC.

Monitoring well MWL-MW4 was installed in 1993 directly beneath a disposal trench in which 204,000 gallons of coolant wastewater from the SNL/NM Engineering Reactor Facility were disposed of in 1967 (Peace et al. September 2002). MWL-MW4 was completed at an angle of 6 degrees from vertical and is screened at two discrete intervals 20 feet apart to evaluate vertical anisotropy, vertical potentiometric gradients, and changes in aquifer parameters with depth. The approximate horizontal extent of MWL-MW4 is shown in Figure D-1.3-1. An inflatable packer separates the screened intervals and pressure is maintained in the packer to prevent the mixing of water from the two screened sections of the aquifer.

The monitoring well network is being updated in preparation for long-term monitoring at the MWL. The four oldest wells, MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3, were installed in 1988 and 1989, and although they have provided excellent quality data over the years, they are becoming increasingly problematic.

Two of these wells, MWL-BW1 and MWL-MW3, are dry or nearly dry due to declining water levels in the regional aquifer. Groundwater levels beneath the MWL declined at an average rate of 0.5 feet/year (yr) between April 2001 and October 2006. As of April 2007, approximately 1 foot of water remained above the well screen in MWL-BW1, and approximately 3 feet of water remained above the well screen in MWL-MW3 (Table D-1.3-1). The NMED has requested that these wells be plugged and abandoned and replaced (NMED March 2007 and July 2007). A Monitoring Well Plug and Abandonment (P&A) Plan and Replacement Well Construction Plan for MWL-BW1 was submitted to the NMED on April 17, 2007 (SNL/NM April 2007). However, the NMED submitted a Notice of Disapproval regarding this plan in June 2007 (NMED June 2007), and the DOE/Sandia submitted a revised P&A and Replacement Well Construction Plan for MWL-BW1 in July 2007 (SNL/NM July 2007a).

On July 2, 2007, the NMED requested replacement of monitoring wells MWL-MW1 and MWL-MW3 due to low water levels in MWL-MW3 and to problems with corrosion of the stainless-steel screens in these wells (NMED July 2007). The DOE/Sandia submitted a P&A and Replacement Well Construction Plan for both of these wells in July 2007 (SNL/NM July 2007b). In addition, the DOE/Sandia plan to replace MWL-MW2 in the near future because of corrosion of its stainless-steel screen.

The proposed replacement wells for MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3 are shown in Figure D-1.3-1 as MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9. The well MWL-BW2 will serve as an upgradient background well, and MWL-MW7, MWL-MW8, and

MWL-MW9 will serve as point-of-compliance wells located at the downgradient toe of the landfill cover (Table D-2-1).

Table D-2-1
MWL Long-Term Groundwater Monitoring Well Network

Monitoring Well	Location	Installation Year
MWL-BW2	Background	2007 (planned)
MWL-MW5	Downgradient	2001
MWL-MW6	Downgradient	2001
MWL-MW7	Downgradient	2007 (planned)
MWL-MW8	Downgradient	2007 (planned)
MWL-MW9	Downgradient	2007 (planned)

MWL = Mixed Waste Landfill.

The DOE/Sandia intends to leave MWL-MW4 in place but not include it in annual sampling because it is not a point-of-compliance well. The packer pressure will be maintained and the well will be available for discretionary sampling.

Therefore, the groundwater monitoring well network proposed to be in place for long-term monitoring includes six wells (existing wells MWL-MW5 and MWL-MW6 and proposed wells MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9).

Sampling has been conducted on a regular basis since 1990 for a variety of analytes. These have included volatile organic compounds (VOCs), semivolatile organic compounds, target analyte list (TAL) metals, total uranium, nitrate plus nitrite, bromide, fluoride, chloride, and sulfate. Radionuclides analyzed include gross alpha/beta radioactivity, tritium, isotopic uranium, and gamma-emitting radionuclides.

3.0 DATA QUALITY OBJECTIVES AND QUALITY CONTROL

The primary DQO is to produce representative, accurate, and defensible analytical results to support the monitoring objective (i.e., provide groundwater data). This SAP is designed to ensure that sampling procedures are consistent and can be used to characterize the groundwater and to ensure that SNL/NM is complying with DOE Orders and guidance, federal, state, and local regulations pertaining to groundwater quality, and that triggers for groundwater quality (listed in Chapter 5.0 of the LTMMP) are not exceeded. This DQO will be accomplished through the implementation of standard operating procedures and analytical procedures/methods through the use of quality assurance measures, quality control (QC) samples, and data evaluation protocols.

DQOs specified as accuracy, precision, data representativeness, completeness, and comparability are imposed on the sample collection and analysis process to verify data quality. DQO measurement data are defined in the following sections.

3.1 Accuracy

Accuracy is the agreement between a measured value and an accepted reference value. When applied to a set of observed values, accuracy is a combination of a random component and a systematic bias. Accuracy will be maintained and evaluated through referenced calibration standards, laboratory control samples (LCS), matrix spike (MS) samples, and surrogate spike samples. The bias component will be evaluated and expressed as a percent recovery (% R). Acceptance criteria are defined in the SNL/NM Statement of Work (SOW) for Analytical Laboratories (SNL/NM March 2003) and verified as part of the data validation process.

$$\%R = \frac{(measure\,sample\,concentration)}{true\,concentration}\,x100\%$$

3.2 Precision

Precision is the agreement among a set of replicate measurements. Precision data will be derived from environmental and laboratory duplicate samples. Precision will be reported as the relative percent difference (RPD) which is calculated as follows:

$$RPD = \frac{|R_1 - R_2|}{[(R_1 + R_2)/2]} \times 100$$

RPD = Relative percent difference is calculated with the following equation and rounded to the nearest whole number where:

R_1 = analysis result

R_2 = duplicate analysis result

The acceptable range for RPD is less than or equal to 20 percent.

3.3 Completeness

Completeness is defined as a measure of the amount of usable data resulting from a data collection activity given the sample design and analysis. Examples of events that reduce the amount of usable data include improperly collected and preserved samples, missed holding times, sample container breakage, and operating outside prescribed QC limits. The completeness objective is 100 percent for compliance data. If the completeness objective is not met and sufficient sample material remains for reanalysis, then the laboratory will repeat the analysis.

$$\%Completeness = \frac{number\ of\ accepted\ data\ points}{total\ number\ of\ samples\ collected} x100\%$$

3.4 Data Representativeness

Data representativeness is the degree to which sample analyses accurately and precisely represent the media they are intended to represent. Data representativeness will be achieved by implementing appropriate sample collection procedures and the use of standard analytical methods. Groundwater sampling procedures will ensure that samples are representative of formation water. The analytical methods selected will accurately and precisely represent the true concentration value of the analytes of interest.

3.5 Comparability

Comparability is the extent to which one data set or value can be related to another or to specific regulatory criteria. Comparability between data sets is achieved through the collection and analysis of samples using consistent methods and QC criteria. Aqueous samples will be reported in units of milligrams (mg)/liter (L) or micrograms (μg)/L, whichever unit is most appropriate to the analytical method.

3.6 Sampling Frequency

Table D-3.6-1 gives the sampling frequency for the five years following the completion of the MWL cover.

Table D-3.6-1
MWL Groundwater Monitoring Wells Sampling Frequency

Well Number	Sampling Frequency	Screened Lithology
MWL-BW2	Quarterly for 2 years, then annually	Alluvial fan deposits
MWL-MW5	Annually	Alluvial fan/Ancestral Rio Grande deposits
MWL-MW6	Annually	Ancestral Rio Grande deposits
MWL-MW7	Quarterly for 2 years, then annually	Alluvial fan deposits
MWL-MW8	Quarterly for 2 years, then annually	Alluvial fan deposits
MWL-MW9	Quarterly for 2 years, then annually	Alluvial fan deposits

MWL = Mixed Waste Landfill.

3.7 Quality Control

QC measures ensure that data are scientifically sound and of known precision and accuracy. QC samples will be collected to help reduce random and systematic sampling error or bias. Section 5.2 presents the samples necessary to meet the QC requirements for groundwater sampling at the MWL.

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4.0 FIELD ACTIVITIES

Groundwater sampling and associated field activities will be conducted in accordance with this SAP and SNL/NM Administrative Operating Procedure (AOPs) and Field Operating Procedure (FOPs) listed in Table D-4-1 as well as Sample Management Office (SMO) procedures and guidance. All personnel directly involved in groundwater sampling field activities will review and abide by these procedures. The most current versions of these documents will be used. Adherence to the methods and procedures governing these activities will help ensure uniformity and allow comparison of the results. Activities that will be conducted in preparation for, or during, groundwater sampling include the following:

- Health and Safety
- Water Level Measurements
- Monitoring Equipment Calibration
- Sample Container Labeling
- Well Purging
- Water Quality Measurements
- Sample Acquisition
- Equipment Decontamination
- Waste Management
- Sample Documentation and Custody
- Sample Shipment

Table D-4-1 summarizes documents that are associated with this SAP, which can be obtained from the SNL/NM Customer-Funded Records Center.

4.1 Health and Safety

Field operations will be conducted in a manner that prioritizes the health and safety of field personnel above all other objectives. Every team member has the authority and responsibility to stop operations if an unsafe condition develops or is observed. All groundwater personnel will perform field activities in accordance with the applicable Groundwater Sampling Health and Safety Plan.

4.2 Water Level Measurements

Water level information is used to determine the volume of water in each well and to update the potentiometric surface map. Measurements are referenced to a surveyed mark of known elevation at the top of the well casing. The static water level is measured in each well prior to purging or obtaining a sample, and measurements are taken to the nearest 0.01 foot using a water level indicator. Instructions for water level measurements are provided in FOP 05-01 (SNL/NM August 2005a).

Table D-4-1
MWL LTMMP Groundwater Sampling Reference Documentation

Document[a]	Document Title
AOP 00-03 (SNL/NM July 2007c)	Data Validation Procedure for Chemical and Radiochemical Data
AOP 95-16 (SNL/NM February 2007a)	Administrative Operating Procedure for Sample Management and Custody
FOP 94-01 (SNL/NM December 2006)	Safety Meetings, Inspections, and Pre-Entry Briefings
FOP 94-25 (SNL/NM November 2004)	Documentation of Field Activities
FOP 05-01 (SNL/NM August 2005a)	LTES Groundwater Monitoring Well Sampling and Field Analytical Measurements
FOP 05-02 (SNL/NM August 2005b)	LTES Groundwater Monitoring Equipment Field Check For Water Quality Measurements
FOP 05-03 (SNL/NM August 2005c)	LTES Groundwater Sampling Equipment Decontamination
FOP 05-04 (SNL/NM August 2005d)	LTES Groundwater Monitoring Well Waste Management
LOP 94-03 (SNL/NM February 2007b)	Sample Handling, Packaging, and Shipping
SMO 05-03 (SNL/NM 2007, pending)	Procedure for Completing the Contract Verification Review
NA (SNL/NM March 2003)	SNL/NM Statement of Work for Analytical Laboratories
NA (SNL/NM February 2007c)	Quality Assurance Project Plan (QAPP) for the Sample Management Office

[a]The most current version will be used.
AOP = Administrative Operating Procedure.
MWL = Mixed Waste Landfill.
FOP = Field Operating Procedure.
LOP = Laboratory Operating Procedure.
LTES = Long-Term Environmental Stewardship.
LTMMP = Long-Term Monitoring and Maintenance Plan.
NA = Not applicable.
SMO = Sample Management Office.
SNL/NM = Sandia National Laboratories/New Mexico.

4.3 Monitoring Equipment Calibration

Monitoring instruments used to measure groundwater field parameters shall be calibrated or function-checked prior to sampling activities. Calibration and field-check instructions are presented in FOP 05-02 (SNL/NM August 2005b).

4.4 Sample Container Labeling

A unique SNL/NM SMO-issued sample identification number is assigned to each sample. The sample numbers are preprinted on self-adhesive labels in numerical order and are obtained from the SMO. The sample number should be affixed to, or noted on, the sample label and/or the analysis request/chain of custody (AR/COC) form.

An SNL/NM sample label should be completed with indelible ink and affixed to each sample container prior to, or during, sampling. Each completed sample label should include the following information:

- SNL/NM SMO sample number (with sample fraction designation)
- Sample matrix type
- Sample location
- Analysis required
- Date and time of sample collection
- Types of preservatives used, if any
- Name of the sample collector

4.5 Well Purging

MWL LTMMP groundwater monitoring will be performed using low-flow sampling methods with an appropriate submersible pump system. The DOE/Sandia will purge monitoring wells using low-flow techniques as outlined in the position paper, "Use of Low-Flow and Other Non-Traditional Sampling Techniques for RCRA Compliant Groundwater Monitoring" (NMED October 2001).

It is assumed in this SAP that low-flow sampling methods will have been approved by the NMED on a well-by-well basis. Each monitoring well in the MWL groundwater monitoring system proposed for low-flow sampling methods will have the following information available that documents proper well construction:

- Well installation details (construction diagrams including the length of the screened interval, lithologic logs, and geophysical logs)

- Well construction diagrams depicting details of the sealed intervals to demonstrate adherence to NMED and U.S. Environmental Protection Agency (EPA) guidance that prohibits surface water infiltration into the screened intervals and communication between saturated zones and/or surface infiltration

Drawdown will be measured and recorded during purging. The purging rate will not exceed the recharge rate.

4.6 Water Quality Measurements

Water quality measurements will be collected during monitoring well purging in accordance with FOP 05-01 (SNL/NM August 2005a). Measurements include groundwater potential of hydrogen (pH), specific conductivity (SC), temperature, and turbidity. Additional field measurements may include dissolved oxygen (DO), oxidation-reduction potential (ORP), and an alkalinity titration. Water quality parameters are defined as follows:

DO Content—The amount of oxygen dissolved in water in percent saturation or in mg/L.

SC—The ability of a cubic centimeter of water to conduct electricity. It varies directly with the amount of ionized minerals in the water and is measured in micro-mhos per centimeter at 25 degrees Celsius (ºC).

pH—A measure of the acidity or alkalinity of a solution. Numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity.

ORP—Potential for an oxidation (loss of electrons to another atom or molecule) or reduction (gain of electrons from another atom or molecule) reaction in millivolts.

Temperature—The temperature of the water in °C.

Turbidity (nephelometric)—The cloudiness in water due to suspended and colloidal organic and inorganic material. Water turbidity is measured in nephelometric turbidity units (NTUs).

Alkalinity—The buffering system or titratable base in water, expressed as calcium carbonate ($CaCO_3$) in mg/L.

Measurements will be made every 5 minutes during purging until stabilization is achieved. The well is considered to be stable when the indicator parameters have stabilized over three consecutive readings spaced a minimum of 5 minutes apart and when the indicator parameters SC, temperature, DO, and turbidity are ± 10 percent, and pH is ± 0.5 units. Alkalinity will only be measured once following stabilization of the other parameters.

4.7 Sample Acquisition

Sample acquisition procedures will take into consideration specific monitoring well characteristics and conditions. Detailed instructions are provided in FOP 05-01 (SNL/NM August 2005a).

MWL LTMMP groundwater monitoring will be performed using low-flow sampling methods as defined in Section 4.5 and until stability is achieved as defined in Section 4.6.

Samples will be collected in laboratory-supplied sample containers. Groundwater samples will be collected from each well in the order of VOCs, metals, nitrate plus nitrite, major anions, gamma spectroscopy, and tritium. All samples collected requiring filtration will be filtered in the field using in-line filters of 0.45-micron or less. To ensure the integrity of samples from the time of collection through analysis results reporting, sample collection, handling, and custody will be documented. Sample container types, preservatives, and holding times are detailed in Section 5.0.

4.8 Equipment Decontamination

All equipment that comes into contact with the sample, the interior of the well, or groundwater will be decontaminated prior to entering the well to prevent cross-contamination. Equipment and materials (including chemicals and protective clothing), decontamination procedures, and waste management are defined in the FOP 05-03 (SNL/NM August 2005c).

4.9 Waste Management

All waste generated during groundwater sampling activities will be managed in accordance with federal, state, and city regulations, and applicable SNL/NM requirements. All purge and decontamination water will be managed as nonregulated waste based upon historical sampling results. Analytical data collected from annual sampling events will be compared to discharge/disposal criteria. Based upon past experience, the anticipated disposal path for purge water and decontamination water will be discharge to the sanitary sewer. If the City of Albuquerque discharge standards are not met, purge and decontamination water will be managed through the SNL/NM Hazardous Waste Management Facility. Personal protective equipment that comes into contact with groundwater will be managed as nonregulated waste disposed of through the SNL/NM Solid Waste Transfer Facility. Waste management activities associated with groundwater monitoring will be performed in accordance with FOP 05-04 (SNL/NM August 2005d).

4.10 Sample Documentation and Custody

To ensure the integrity of samples from the time of collection through the reporting of analytical results, sample collection, handling, and custody will be documented. The continuous record of documented sample possession is referred to as the chain-of-custody. The primary elements in the documentation of samples consist of sample identification number, sample labels, custody tape, and the AR/COC form. Standardized forms will be used to document sample information. Sample custody and documentation procedures for sampling activities are outlined in AOP 95-16 (SNL/NM February 2007a) and Laboratory Operating Procedure (LOP) 94-03 (SNL/NM February 2007b). These procedures will be followed throughout each groundwater sampling event.

4.11 Sample Shipment

Samples will be shipped to the analytical laboratory in accordance with SMO procedures detailed in LOP 94-03 (SNL/NM February 2007b). Prior to shipment, the sample collection documentation will be verified. Any error will be noted and corrected as required by SNL/NM SMO protocols.

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5.0 ANALYTICAL PROCEDURES

The analytical laboratory will analyze samples using EPA-approved analytical methods and specified performance criteria in accordance with the SNL/NM SOW for Analytical Laboratories (SNL/NM March 2003). The analytical laboratory will provide appropriate sample containers prepared with the required sample preservative. The analytical laboratory will prepare and submit to the SNL/NM SMO an analysis data report as described in the SOW for Analytical Laboratories. Table D-5-1 summarizes typical analytical requirements and EPA Methods (EPA November 1986) applicable to groundwater monitoring at the MWL. Sampling for parameters for which triggers have been approved (Chapter 5.0 of the LTMMP) is considered mandatory; sampling for the remaining parameters is optional, and may be conducted for characterization of major ion chemistry and groundwater characteristics.

5.1 Analytical Laboratory

The analytical laboratory is responsible for performing analyses in accordance with this SAP, the SNL/NM SOW for Analytical Laboratories, and regulatory requirements. The laboratory will maintain documentation of sample handling and custody, analytical data, and internal QC data. The laboratory will analyze QC samples in accordance with this SAP, the SNL/NM SOW for Analytical Laboratories, and its own internal QC program for indicators of analytical accuracy and precision. The SNL/NM SMO will direct the laboratory activity, including investigation and corrective action, if necessary, for data generated outside laboratory acceptance limits.

In addition, two types of analytical laboratory audits may be performed as part of the sampling program and are defined as system audits and performance audits. A system audit determines whether appropriate project systems (i.e., equipment, procedures) are in place. Performance audits indicate whether the project systems are functioning properly and are capable of meeting project DQOs. These audits will be completed as required by SNL/NM SMO procedures and protocols.

5.2 Quality Control Samples

QC samples will be analyzed in conjunction with the groundwater samples to ensure that the data generated meet the DQOs of this SAP. QC for the entire activity will be achieved through adherence to requirements and procedures listed and described in Section 3.0 of this SAP. Mandatory QC samples are identified in the following sections.

5.2.1 Field Quality Control Samples

Control of field operations requires the collection and analysis of field QC samples, in addition to conformance to standardized sampling procedures as defined in SNL/NM FOPs. Field QC samples are used to document data quality and identify sampling inconsistencies resulting from variability in sample collection, storage, transportation, and equipment decontamination. Field

Table D-5-1
MWL Groundwater Monitoring Parameters, Test Methods, and Selection Criteria

Parameter	Required or Optional?	EPA Method[a]	Container/Preservative/ Holding Time	Selection Criteria
Volatile Organic Compounds	Required	SW846-8260	40-mL glass vial/ HCL/14 days	Screening for VOCs
Total Uranium	Required	SW846-6020	500-mL HDPE/ HNO_3/6 months	Screening for uranium
Gamma Spectroscopy (short list)	Required	EPA 901.1 or Equivalent	1-L HDPE/HNO_3/6 months	Screening for radionuclides
Gross Alpha/Beta	Required	EPA 900.0 or Equivalent	1-L HDPE/HNO_3/6 months	Screening for radionuclides
Tritium	Required	EPA 906.0 or Equivalent	250-mL amber glass/ 4ºC/6 months	Screening for tritium
Perchlorate[b]	Required for the first 4 quarters for new wells	EPA 314.0	250-mL HDPE/4ºC/28 days	Required by Compliance Order on Consent
Total TAL[c] Metals	Optional	SW846-6020/7470	500-mL HDPE/ HNO_3/6 months[d]	Major Ion Chemistry; screening for RCRA metals
Filtered TAL[c] Metals (filtered in the field)	Optional	SW846-6020/7470	500-mL HDPE/ HNO_3/6 months[d]	Major Ion Chemistry; screening for RCRA metals
Nitrate plus Nitrite	Optional	EPA 353.2	250-mL HDPE/ H_2SO_4/28 days	Major ion chemistry
Major Anions	Optional	SW846-9056	250-mL HDPE/4ºC/28 days	Major ion chemistry
Total Alkalinity	Optional	EPA 310.1	250-mL HDPE/4ºC/14 days	Major ion chemistry
Total Dissolved Solids	Optional	EPA 160.1	1-L HDPE/4ºC/7 days	General groundwater chemistry
Field Alkalinity	Optional	HACH 8203	NA	Major ion chemistry

[a]U.S. Environmental Protection Agency, 1986 (and updates), "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd Edition, U.S. Environmental Protection Agency, Washington, D.C.
[b]Perchlorate screening is required by the Consent Order (NMED April 2004) for all newly-installed groundwater monitoring wells for four consecutive quarters, unless perchlorate is detected. If detected, a sampling frequency will be negotiated with the NMED.
[c]TAL metals = Aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, cyanide, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium and zinc.
[d]Mercury has a holding time of 28 days.

EPA = U.S. Environmental Protection Agency.
HACH = Hach Company.
HCL = Hydrochloric acid.
HDPE = High-density polyethylene.
HNO_3 = Nitric acid.
H_2SO_4 = Sulfuric acid.
L = Liter(s).
mL = Milliliter(s).
MWL = Mixed Waste Landfill.
NA = Not applicable
NMED = New Mexico Environment Department.
ºC = Degrees Celsius
RCRA = Resource Conservation and Recovery Act.
SW = Solid waste.
TAL = Target Analyte List.
VOC = Volatile organic compound.

QC samples submitted to the analytical laboratory will be handled and analyzed in the identical manner as environmental samples. Field QC samples to be collected include duplicate environmental samples and trip blanks (TBs). Table D-5.2-1 provides a description of the field QC samples.

Table D-5.2-1
MWL Groundwater Monitoring Field Quality Control Samples

Sample Type	Purpose of Sample	Frequency	Acceptance Criteria	Matrix
Duplicate Samples	To evaluate the overall precision of the sampling and analysis system.	1 with each sample batch sent to the laboratory or 1 per 20 samples.	RPD less than or equal to 20 percent (guidance only, RPDs for low concentrations constituents may exceed 20 percent).	Aqueous
Trip Blanks	To evaluate VOC contamination originating from sample, transport, shipping, and site conditions.	1 per cooler containing VOC samples.	If contaminants are detected, the data should be evaluated in order to determine probable source and impact on sample results.	Aqueous

RPD = Relative percent difference.
VOC = Volatile organic compound.

Duplicate environmental samples are collected in the field and analyzed to establish and document the precision of the sampling and analysis process. The duplicate samples will be collected immediately after the original environmental sample in order to reduce variability caused by time and/or sampling mechanics and are typically collected at a frequency of 5 percent (minimum of one per MWL sampling event).

TB samples are used to assess the potential for VOC contamination originating from sample, transport, shipping, and site conditions. The TBs are analyzed for VOCs only. Each batch of VOC groundwater samples, identified with a specific AR/COC, will be accompanied by a TB during shipping. The laboratory prepares the TB by filling a VOC vial with deionized water and using the same sample preservation method designated for VOC environmental samples. Each vial is sealed with custody tape and dated when it is prepared. The TBs accompany the empty sample containers when they are shipped to the field supervisor prior to the start of sample collection. The TBs are taken into the field during sample collection and are included in the shipment of environmental samples to the laboratory. The TBs must remain sealed during this entire cycle and may be opened only for analysis upon return to the analytical laboratory.

5.2.2 Laboratory Quality Control Samples

The analytical laboratory must have established procedures that demonstrate the analytical process is always controlled during each sample analysis step. The procedures include LCSs, method blank samples, and MS samples. Laboratories must operate in conformance with SNL/NM FOPs, SNL/NM AOPs, and the SNL/NM SOW for Analytical Laboratories.

An LCS consists of a control matrix (e.g., deionized water) spiked with analytes representative of the target analytes. LCSs are prepared and analyzed for each analytical procedure performed. LCSs are analyzed with each analytical batch containing environmental samples to verify the precision and bias of the analytical process. The results of the LCS analyses are compared to the control limits established to assess the usability of the data.

Method blank samples are used to check for contamination in the laboratory during sample preparation and analysis. Method blank samples are concurrently prepared and analyzed with each analytical batch. Method blanks are reported in the same units as corresponding environmental samples, and the results are included with each analytical report.

Surrogate spike analysis will be performed for all samples analyzed by Gas Chromatography/ Mass Spectroscopy. The surrogate compounds added to the sample will be those specified in the applicable EPA analytical method procedure (EPA November 1986). Recovery values for surrogate compounds that are outside specified control limits require corrective action, which is detailed in the SNL/NM SOW for Analytical Laboratories.

The analytical process shall be systematically evaluated for the effects of indigenous constituents present in the environmental sample matrix. MS/matrix spike duplicate (MSD) analyses shall be performed in accordance with the specified analytical procedures. An MSD will be prepared for organic sample fractions to evaluate the precision of the analytical process. For inorganic analytes, the precision of the analytical process shall be evaluated by preparing a laboratory replicate analyzed in accordance with the specified analytical procedures.

6.0 DATA VALIDATION, REVIEW, AND REPORTING

Data validation and review of analytical and field documentation will be performed for completeness and conformance to the procedures established for the various activities. Field and analytical QC data will be reviewed for conformance to QC acceptance criteria. The entire data package will be reviewed for representativeness of quality and comparability to determine whether the specified DQOs have been met.

6.1 Field Measurement Data and Documentation Review

Completed field documentation will be reviewed and verified for accuracy, completeness, and conformance with established procedures. The review will occur at the end of each day in the field to allow verification, correction, and retrieval of missing information as appropriate. Field documentation found to be incomplete or questionable will be remeasured and/or corrected prior to finalizing the field reports.

6.2 Laboratory Data Verification and Validation

The SNL/NM SMO will review the laboratory report. The data package shall be reviewed for completeness and conformance to the performance criteria of the contract with the laboratory according to the procedure SMO 05-03 (SNL/NM 2007, pending).

Upon receipt of the analytical results from the Analytical Laboratory, the SNL/NM SMO will arrange for the validation of the data. The purpose of the validation is to determine the usability and establish the defensibility of the numerical results in support of the environmental and waste management activities at SNL/NM. Data qualification is based upon review of laboratory-supplied QC data, the specific QC criteria identified in the procedures for the EPA-approved analytical methods, and the DQOs identified in this SAP. Data validation will be conducted according to the requirements of AOP 00-03 (SNL/NM July 2007c). All associated data validation reports will be provided along with the results for each monitoring event.

6.3 Reporting

A Periodic Monitoring Report shall be prepared as defined in the Consent Order (NMED April 2004). All groundwater monitoring data will be compiled into an annual report. This report shall include the following (as a minimum):

- Title page and signature block
- Executive summary
- Table of contents
- Introduction
- Scope of activities
- Regulatory criteria
- Monitoring results
- Conclusions

- Tables
- Figures
- Appendices

The report may also include a description of sampling activities, a summary of field measurement data, a summary of laboratory analytical and measurement data, a discussion of QC analyses and data reviews, a description of project variances, and data validation summaries. Reports and copies of groundwater monitoring records will be maintained in the SNL/NM Customer-Funded Records Center. In addition, any changes to the LTMMP groundwater monitoring program or this SAP that would require regulatory approval (such as a change in the monitoring well network, sampling frequency, or analyte list) will be presented in the annual report.

6.4 Records Management

Records associated with the groundwater sampling effort, including field documentation, laboratory analytical results, data validation reports, and LTMMP reports/technical data evaluations, will be maintained at the SNL/NM Customer-Funded Records Center and comply with the record-keeping provisions of 20.4.1.500 NMAC, incorporating 40 CFR 264.74, concerning the availability, retention, and disposition of records.

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APPENDIX E
Biota Sampling and Analysis Plan for the Mixed Waste Landfill

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1.0 INTRODUCTION

Requirements for monitoring at the Mixed Waste Landfill (MWL) are defined in the Long-Term Monitoring and Maintenance Plan (LTMMP). This Biota Sampling and Analysis Plan (SAP) was developed in response to a request by the New Mexico Environment Department (NMED) to monitor for potential biotic mobilization of contaminants at the MWL, Technical Area III, Sandia National Laboratories, New Mexico (SNL/NM) (Figure E-1-1) (NMED November 2006).

Biotic mobilization of contaminants can be defined as the migration of contaminants by burrowing insects and animals (ants and rodents), and uptake by vegetation. The collection of soil samples from ant hills and/or animal burrows, and vegetation samples can determine if contaminant mobilization has occurred via these mechanisms.

1.1 Monitoring Objective

The LTMMP, including this SAP, is designed to ensure the monitoring of specified parameters over a period of time. The monitoring objective of this SAP is to provide analytical data in order to characterize biotic mobilization of contaminants at the MWL. In addition to establishing monitoring and data quality objectives (DQOs), this SAP presents specifications for the locations of sample collection points, sample collection procedures, laboratory analysis, data evaluation, records management, and reporting. This document provides sampling personnel with the necessary information to perform sampling of soil from burrows or nests, and vegetation. The results will be compared to the proposed trigger levels presented in the LTMMP and in the "Probabilistic Fate and Transport Modeling of the Mixed Waste Landfill at Sandia National Laboratories" (Ho et al. January 2007).

1.2 Scope

Following the installation of the final landfill cover, a visual survey will be conducted quarterly to determine the presence of burrowing insects and/or animals and the types of vegetation present on the landfill cover. The locations will be recorded in the geographic information system (GIS) database. Sampling of soil from burrows or nests and vegetation will be conducted in the fifth year following the installation of the final landfill cover (and following years as deemed necessary). Each sampling event requires the identification of burrows and/or nests and the species of vegetation located on the landfill cover. Soil and vegetation samples will be collected from the identified locations and submitted for laboratory analysis of metals and radionuclides by gamma spectroscopy. Vegetation samples will be submitted for laboratory analysis of radionuclides by gamma spectroscopy.

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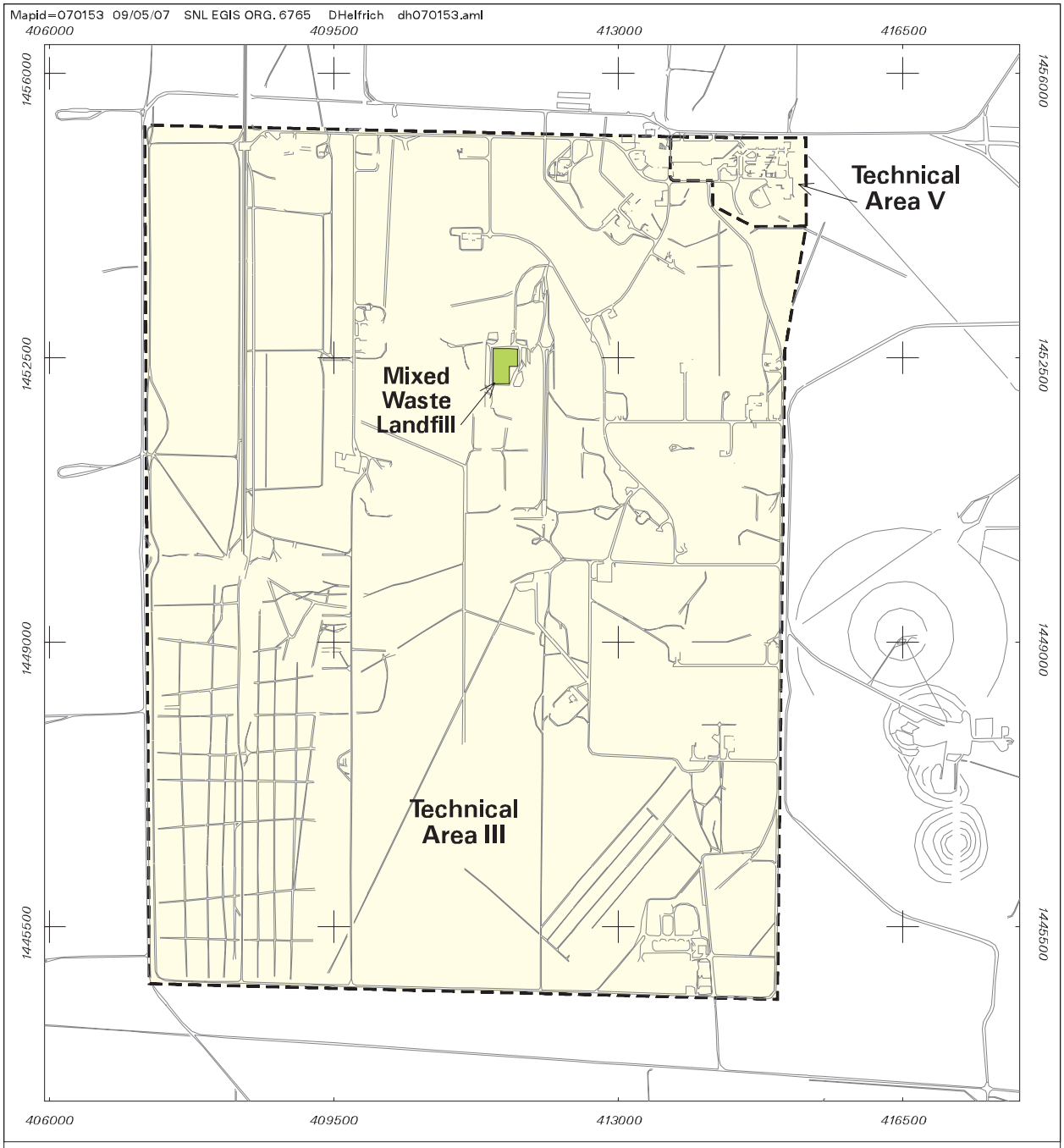

Legend

Road

Technical Area

Mixed Waste Landfill

Figure E-1-1
Location of the Mixed Waste Landfill within Technical Area III

0 1000 2000
Scale in Feet

0 240 480
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04310000 A24.ai

2.0 BACKGROUND INFORMATION

The MWL Corrective Measures Implementation Work Plan was written and submitted to the NMED in November 2005 (SNL/NM November 2005). NMED reviewed the document, and responded with a "Notice of Disapproval" letter dated November 20, 2006 (NMED November 2006). This letter described a number of deficiencies related to the MWL cover, construction plans, performance and fate and transport modeling, and monitoring triggers. The letter also included a requirement for additional sampling at the landfill, as follows:

> "The NMED expects surface soil surrounding animal burrows (including ant nests) to be monitored for radionuclides and metals. Develop triggers that are protective of both human health and the environment for radionuclides and metals in soil" (NMED November 2006).

In the "Responses to the NMED Notice of Disapproval" (SNL/NM January 2007) the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia) stated the following:

> "During long-term monitoring at the MWL, DOE/Sandia will monitor animal burrows and ant nests (ant hills).
>
> Current plans are to survey locations of animal burrows and ant hills by GPS [global positioning system] on an annual basis, and to collect surface soil samples from animal burrows and ant hills every five years to ensure that contaminants have not been mobilized by biota. The soil samples will be analyzed for Resource Conservation and Recovery Act (RCRA) metals, gamma-emitting radionuclides, and gross alpha and gross beta activity.
>
> Triggers proposed for RCRA metals concentrations in the surface soil samples are the NMED Industrial/Occupational Soil Screening Levels (NMED 2006). Triggers proposed for gamma-emitting radionuclides are the NMED Hazardous Waste Bureau (HWB) Approved Background Values (Dinwiddie 1997)."
>
> Please note that the Consent Order (NMED April 2004) includes the corrective action requirements for the MWL but contains no requirements for radionuclides or the radioactive portion of mixed waste. Thus, any triggers proposed for radionuclides are provided voluntarily, pursuant to the Consent Order. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements of the Consent Order. Additional information on radionuclides and the scope of the Consent Order is available in Section III.A of the Consent Order (NMED April 2004).

Although measurement of gross alpha and beta activity in soil samples from animal burrows and ant hills was originally proposed by DOE/SNL in the "Responses to the NMED Notice of Disapproval" (SNL/NM January 2007), it is not proposed in this document. The analysis of gross alpha and beta activity of soils is neither a typical, nor useful assay for soils, as naturally-occurring radioactive decay chains such as uranium-238 and thorium-232 both have alpha and beta decay radionuclides in their series, which greatly limit any ability to make meaningful interpretation of the results. For this reason, soils from ant nests and animal burrows will not be analyzed for gross alpha and beta activity. However, the soils will still be analyzed for gamma-emitting radionuclides to verify that radionuclides are not being mobilized by ants or burrowing animals. This is consistent with the routine analysis of soils conducted in the Sandia Terrestrial Surveillance Program.

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3.0 DATA QUALITY OBJECTIVES

The main DQO is to produce representative, accurate, and defensible analytical results to support the monitoring objective (i.e., provide analytical data for biotic mobilization of contaminants). This SAP is designed to ensure that procedures are consistent and can be used to establish any contaminant mobilization trends. This DQO will be accomplished through the implementation of standard operating procedures and analytical procedures/methods through the use of quality assurance measures, quality control (QC) samples, and data evaluation protocols.

3.1 Sample Locations and Sampling Frequency

The sampling locations will be identified by visually examining the surface of the landfill cover. The number of available sampling locations is variable, depending on the presence and distribution of the insects, animals, and vegetation. Up to six animal burrows, six ant hills, and six similar plants will be sampled.

The visual survey for burrows and nests, and vegetation will take place quarterly and will be recorded in the GIS database. Soil and vegetation samples will be collected on the second year following the completion of the final landfill cover. Soil and vegetation samples will be collected every two years thereafter. Animal burrows and/or ant hills will be sampled if they have developed on the MWL cover.

3.2 Data Accuracy

Proper sampling procedures and use of QC samples such as environmental sample duplicates will help reduce random and systematic sampling error or bias. Contaminant measurements can be made reliably through the use of a qualified laboratory, appropriate methodologies, and effective QA/QC procedures. These measures along with consistent implementation of the LTMMP and this SAP will satisfy the DQO for accuracy.

Accuracy is the agreement between a measured value and an accepted reference value. When applied to a set of observed values, accuracy is a combination of a random component and a systematic bias. Accuracy will be maintained and evaluated through referenced calibration standards, laboratory control samples (LCS), matrix spike (MS) samples, and surrogate spike samples. The bias component will be evaluated and expressed as a percent recovery (% R). Acceptance criteria are defined in the SNL/NM Statement of Work (SOW) for Analytical Laboratories (SNL/NM March 2003) and verified as part of the data validation process.

$$\%R = \frac{(measure\,sample\,concentration)}{true\,concentration}\,x100\%$$

3.3 Precision

Precision is the agreement among a set of replicate measurements. Precision data will be derived from environmental and laboratory duplicate samples. Precision will be reported as the relative percent difference (RPD) which is calculated as follows:

$$RPD = \frac{|R_1 - R_2|}{[(R_1 + R_2)/2]} \times 100$$

RPD = Relative percent difference is calculated with the following equation and rounded to nearest whole number where:

R_1 = analysis result

R_2 = duplicate analysis result

The acceptable range for RPD is less than or equal to 20 percent.

3.4 Data Consistency and Comparability

Data consistency and comparability will be achieved through implementation of this SAP, which defines field and laboratory procedures designed for this purpose. Consistency in methods and procedures will be maintained in the following areas to ensure biotic mobilization data are consistent and that the data sets are comparable.

- Field sample collection and management
- Use of an off-site contract laboratory

After analytical results are received from the laboratory, DOE/Sandia will review the laboratory report for completeness and conformance to the sampling and data quality objectives. If problems are noted that require corrective action during these reviews, the laboratory will be contacted for further information.

Results will be compared to the trigger levels and to established soil background levels. This evaluation process will aid in characterization and allow analysis of trends, but will also help identify outliers or other potential indicators of error and inconsistency.

3.5 Quality Control

Quality control measures ensure that data are scientifically sound and of known precision and accuracy. QC samples will be collected to help reduce random and systematic sampling error or bias. Section 5.2 presents the samples needed to meet the QC requirements for biotic mobilization sampling at the MWL.

4.0 SAMPLING ACTIVITIES

This section describes the field and laboratory measures to be taken in providing biotic mobilization data.

4.1 Field Activities

Field activities include the preparation, identification, collection, and shipping of the samples and the methods and procedures governing these activities. Adherence to this protocol will help ensure uniformity, and allow comparison of the results. Activities that will be conducted in preparation for or during sampling include the following:

- Pre-field work planning
- Health and safety considerations
- Visual inspection of landfill surface for the presence of burrows and/or nests and vegetation
- Enter locations into GIS database
- Sample acquisition
- Sample documentation, handling, and shipping
- Waste management

The SNL/NM Administrative Operating Procedure (AOPs) and Field Operating Procedure (FOPs) for these activities are listed in Table E-4.1-1 as well as Sample Management Office (SMO) procedures and guidance. All personnel directly involved in survey and sampling field activities will review and abide by these procedures. The most current versions of these documents will be used.

4.2 Health and Safety

Field operations will be conducted in an approach that prioritizes the health and safety of field personnel above all other objectives. Every team member has the authority and responsibility to stop operations if an unsafe condition develops or is observed. All sampling personnel will perform field activities in accordance with the applicable Health and Safety Plan.

4.3 Surface Survey

The annual visual inspection of the surface of the landfill will be performed in order to identify the presence of burrowing animals and/or ant hills, and vegetation. All information regarding dates, locations, and species type (if available) will be maintained in a log book. Locations will be recorded in the GIS database.

Table E-4.1-1
Reference Documentation
MWL Biotic Mobilization Sampling

Document[a]	Document Title
AOP 00-03 (SNL/NM July 2007)	Data Validation Procedure for Chemical and Radiochemical Data
AOP 95-16 (SNL/NM February 2007)	Sample Management and Custody
FOP 94-01 (SNL/NM December 2006b)	Safety Meetings, Inspections and Pre-Entry Briefings
FOP 94-25 (SNL/NM November 2004)	Documentation of Field Activities
FOP 95-03 (SNL/NM March 2006)	Terrestrial Surveillance Program
NA (SNL/NM December 2003)	Quality Assurance Project Plan for the Sample Management Office

[a]The most current version will be used.
AOP = Administrative Operating Procedure.
MWL = Mixed Waste Landfill.
FOP = Field Operating Procedure.
NA = Not applicable.
SNL/NM = Sandia National Laboratories/New Mexico.

4.4 Sample Acquisition and Labeling

Samples will be collected from the designated locations using FOP 95-03 (SNL/NM March 2006). Soil will be placed in appropriate containers obtained from the laboratory and labeled with sample identification information.

A unique SNL/NM SMO issued sample identification number is assigned to each sample. The sample numbers are preprinted on self-adhesive labels in numerical order and are obtained from SMO. The sample number should be affixed to or noted on the sample label and/or the analysis request/chain of custody (AR/COC) form.

A SNL/NM sample label should be completed with indelible ink and affixed to each sample container prior to or during sampling. Each completed sample label should include the following information:

- SNLNM SMO sample number (with sample fraction designation)
- Sample matrix type
- Sample location
- Analysis required
- Date and time of sample collection
- Types of preservatives used, if any
- Name of the sampling personnel

A field log will be maintained documenting the collection of all samples.

An aliquot of soil will be collected for analysis of RCRA metals and radionuclides by gamma spectroscopy. See Section 5.0 below for sample container information.

4.5 Equipment Decontamination

All equipment that comes into contact with the sample will be decontaminated prior to and following the collection of the sample to prevent cross-contamination. Equipment and materials (including chemicals and protective clothing), decontamination procedures, and waste management are defined in the FOP 95-03 (SNL/NM March 2006).

4.6 Sample Custody Documentation

To ensure the integrity of samples from the time of collection through the reporting of analytical results, sample collection, handling, and custody will be documented. The continuous record of documented sample possession is referred to as the chain-of-custody. Primary elements in the documentation of samples are: sample identification number, sample labels, custody tape, and the AR/COC form. Standardized forms will be used to document sample information. Sample custody and documentation procedures for sampling activities are outlined in AOP 95-16 (SNL/NM February 2007).

4.7 Sample Shipment

Samples will be shipped to the analytical laboratory in accordance with FOP 95-03. Prior to shipment, the sample collection documentation will be verified. Any error will be noted and corrected as required by SNL/NM SMO protocols.

4.8 Waste Management

Waste generated during sampling activities may include used personal protective equipment and decontamination water. All waste generated will be managed in accordance with federal, state, and city regulations, and applicable SNL/NM requirements. Analytical data collected from the sampling event will be used to characterize any waste generated. Waste management activities associated with the sampling event will be performed in accordance with the requirements of the Waste Management specialist at the time.

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5.0 ANALYTICAL METHODS

The analytical laboratory will analyze samples using U.S. Environmental Protection Agency (EPA)-approved analytical methods and specified performance criteria in accordance with the SNL/NM SOW for Analytical Laboratories (SNL/NM March 2003). The analytical laboratory will provide appropriate sample containers prepared with the required sample preservative (if applicable). The analytical laboratory will prepare and submit to SNL/NM SMO an analysis data report as described in the SOW for Analytical Laboratories. Table E-5-1 summarizes analytical requirements and EPA Methods (EPA November 1986) applicable to biota monitoring at the MWL.

Table E-5-1
Laboratory Analytical Methods
MWL Biotic Mobilization Sampling

Parameter	EPA Method[a]	Container Type/Size x Number/Preservative
RCRA[b] Metals	SW846-6020/7470	1-gallon Ziplock bag
Gamma Spectroscopy (short list)	EPA 901.1 or Equivalent	1-gallon Ziplock bag

[a]U.S. Environmental Protection Agency, 1986 (and updates), "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd Edition, U.S. Environmental Protection Agency, Washington, D.C.
[b]RCRA metals = arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver.
EPA = U.S. Environmental Protection Agency.
MWL = Mixed Waste Landfill.
RCRA = Resource Conservation and Recovery Act.
SW = Solid waste.

5.1 Analytical Laboratory

The analytical laboratory is responsible for performing analyses in accordance with this SAP, SNL/NM SOW for Analytical Laboratories, and regulatory requirements. The laboratory will maintain documentation of sample handling and custody, analytical data, and internal QC data. The laboratory will analyze QC samples in accordance with this SAP, the SNL/NM SOW for Analytical Laboratories, and its own internal QC program for indicators of analytical accuracy and precision. The SNL/NM SMO will direct the laboratory activity, including investigation and corrective action, if necessary, for data generated outside laboratory acceptance limits.

In addition, two types of analytical laboratory audits may be performed as part of the sampling program and are defined as system audits and performance audits. A system audit determines whether appropriate project systems (i.e., equipment, procedures) are in place. Performance audits indicate whether the projects systems are functioning properly and are capable of meeting project DQOs. These audits will be completed as required by SNL/NM SMO procedures and protocols.

5.2 Quality Control Samples

QC samples will be analyzed in conjunction with the soil samples to ensure that the data generated meet the DQOs of this SAP. QC for the entire activity will be achieved through adherence to requirements and procedures listed and described in Section 2.0 of this SAP. Mandatory QC samples are identified in the following sections.

5.2.1 Field Quality Control Samples

Control of field operations requires the collection and analysis of field QC samples, in addition to conformance to standardized sampling procedures as defined in SNL/NM FOPs. Field QC samples are used to document data quality and identify sampling inconsistencies resulting from variability in sample collection, storage, transportation, and equipment decontamination. Field QC samples submitted to the analytical laboratory will be handled and analyzed in the identical manner as environmental samples. Field QC samples to be collected include equipment blanks and duplicate environmental samples. Table E-5.2-1 provides a description of the field QC samples.

Table E-5.2-1
Field Quality Control Samples

Sample Type	Purpose of Sample	Frequency	Acceptance Criteria	Matrix
Duplicate Samples	To evaluate the overall precision of the sampling and analysis system.	1 with each sample batch sent to the laboratory or 1 per 20 samples.	RPD less than or equal to 20 percent (guidance only, RPDs for low concentrations constituents may exceed 20 percent).	Soil
Equipment Blanks	To evaluate decontamination procedures and cross sample contamination by sampling equipment.	1 with each sample batch sent to the laboratory or 1 per 20 samples.	If contaminants are detected, the data should be evaluated in order to determine probable source and impact on sample results.	Aqueous

RPD = Relative percent difference.

Equipment blank (EB) samples demonstrate the effectiveness of equipment decontamination and monitor the cleanliness of the sampling system. After sampling equipment decontamination has been completed, an EB sample is collected prior to the collection of an environmental sample. EB samples will be collected at a frequency of 5 percent (minimum of one per MWL sampling event) and analyzed for the specified analytical parameters.

Duplicate environmental samples are collected in the field and analyzed to establish and document the precision of the sampling and analysis process. The duplicate samples will be collected immediately after the original environmental sample in order to reduce variability caused by time and/or sampling mechanics and are typically collected at a frequency of 5 percent (minimum of one per MWL sampling event).

5.2.2 Laboratory Quality Control Samples

The analytical laboratory must have established procedures that demonstrate the analytical process is always in control during each sample analysis step. The procedures include LCSs, method blank samples, and MS samples. Laboratories must operate in conformance with SNL/NM FOPs, SNL/NM AOPs, and the SNL/NM SOW for Analytical Laboratories.

An LCS consists of a control matrix (e.g., deionized water) spiked with analytes representative of the target analytes. LCSs are prepared and analyzed for each analytical procedure performed. LCSs are analyzed with each analytical batch containing environmental samples to verify the precision and bias of the analytical process. The results of the LCS analyses are compared to the control limits established to assess the usability of the data.

Method blank samples are used to check for contamination in the laboratory during sample preparation and analysis. Method blank samples are concurrently prepared and analyzed with each analytical batch. Method blanks are reported in the same units as corresponding environmental samples, and the results are included with each analytical report.

Surrogate spike analysis will be performed for all samples analyzed by Gas Chromatography/ Mass Spectroscopy. The surrogate compounds added to the sample will be those specified in the applicable EPA analytical method procedure (EPA November 1986). Recovery values for surrogate compounds that are outside specified control limits require corrective action, which is detailed in the SNL/NM SOW for Analytical Laboratories.

The analytical process shall be systematically evaluated for the effects of indigenous constituents present in the environmental sample matrix. For inorganic analytes, the precision of the analytical process shall be evaluated by preparing a laboratory replicate analyzed in accordance with the specified analytical procedures.

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6.0 DATA VALIDATION, REVIEW, AND REPORTING

Data validation and review of analytical and field documentation will be performed for completeness and conformance to the procedures established for the various activities. Field and analytical QC data will be reviewed for conformance to QC acceptance criteria. The entire data package will be reviewed for representativeness of quality and comparability to determine whether the specified DQOs have been met.

6.1 Field Measurement Data and Documentation Review

Completed field documentation will be reviewed and verified for accuracy, completeness, and conformance with established procedures. The review will occur at the end of each day in the field to allow verification, correction, and retrieval of missing information as appropriate.

6.2 Laboratory Data Verification and Validation

The SNL/NM SMO will review the laboratory report. The data package shall be reviewed for completeness and conformance to the performance criteria of the contract with the laboratory according to the SMO 05-03 (SNL/NM 2007, pending).

Upon receipt of the analytical results from the laboratory, the SNL/NM SMO will arrange for the validation of the data. The purpose of the validation is to determine the usability and establish the defensibility of the numerical results in support of the environmental and waste management activities at SNL/NM. Data qualification is based upon review of laboratory-supplied QC data, the specific QC criteria identified in the procedures for the EPA-approved analytical methods, and the DQOs identified in this SAP. Data validation will be conducted according to the requirements of AOP 00-03 (SNL/NM July 2007). All associated data validation reports will be provided along with the results for each monitoring event.

6.3 Reporting

A report of the biotic mobilization results will be submitted based upon the schedule presented in the LTMMP. The report may include a description of sampling locations and activities, a summary of laboratory analytical and measurement data, a discussion of QC analyses and data reviews, a description of project variances, and data validation summaries.

6.4 Records Management

Records associated with the biotic mobilization sampling effort including field documentation, laboratory analytical results, data validation reports, and LTMMP reports/technical data evaluations will be maintained at the SNL/NM Customer Funded Records Center and comply with the record-keeping provisions of 20.4.1.500 New Mexico Administrative Code, incorporating Title 40 Code of Federal Regulations Section 264.74, concerning the availability, retention, and disposition of records.

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7.0 REFERENCES

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APPENDIX F
Mixed Waste Landfill Well Database Summary Sheets

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA III
ER ADS #:	1289	**Well Completion Date:**	01-JUL-1989
Well Name:	MWL-BW1	**Completion Zone:**	SAND AND GRAVEL
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE
Date Drilling Started:	24-JUN-1989	**Well Comment:**	WATER LEVEL MEASURED ON 5/14/90
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	MUD ROTARY		
Borehole Depth:	519		
Casing Depth:	477.17		

Survey Data

Survey Date: 12-APR-1990

Surveyed By: SANTIAGO ROMERO AND ASSOCIATES

State Plane Coordinates

(X) Easting: 411756.001

(Y) Northing: 1451698.73

Surveyed Elevations (FAMSL)

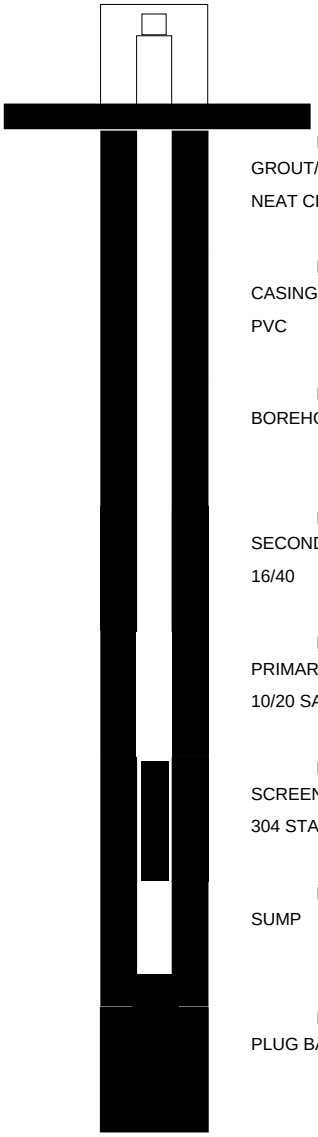
Protective Casing:	5385.05
Top of Inner Well Casing:	5384.51
Concrete Pad:	5383.35
Ground Surface:	5382.7

Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4923.3	
Initial Depth To Water: (FBGS)	461.21	
Last measured water level was measured on	4918.54	**FASL**
	06-AUG-1996	

Date Updated: 14-MAR-00

Date Printed: 20-JUN-2006



Completion Data Measured Depths (FBGS)

Casing Stickup: 1.16

Interval	Start	Stop
GROUT/BACKFILL	0'	433'
NEAT CEMENT		

Interval	Start	Stop
CASING	0'	477.17'
PVC	**I.D.**	5"

Interval	Start	Stop
BOREHOLE	0'	519'
	O.D.	12.25"

Interval	Start	Stop
SECONDARY PACK	441'	443'
16/40		

Interval	Start	Stop
PRIMARY PACK	443'	478'
10/20 SAND		

Interval	Start	Stop
SCREEN	452.17'	472.17'
304 STAINLESS STEEL		
	Slot Size	.01"

Interval	Start	Stop
SUMP	472.17'	477.17'

Interval	Start	Stop
PLUG BACK	477.17'	519'

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA III
ER ADS #:	1289	**Well Completion Date:**	01-JUL-1989
Well Name:	MWL-BW1	**Completion Zone:**	SAND AND GRAVEL
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE
Date Drilling Started:	24-JUN-1989	**Well Comment:**	WATER LEVEL MEASURED ON 5/14/90
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	MUD ROTARY		
Borehole Depth:	519		
Casing Depth:	477.17		

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	MIXED WASTE LANDFILL
ER ADS #:	1289	**Well Completion Date:**	01-OCT-1988
Well Name:	MWL-MW1	**Completion Zone:**	SILTY SAND
Owner Name:	SNL	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	28-SEP-1988	**Well Comment:**	BOREHOLE DIAM IS 14" TO 200' - 10" TO 478.67 - WATER LEV ELEV 8/16/90
Drilling Contractor:	WATER DEVELOPMENT		
Drilling Method:	AIR ROTARY		
Borehole Depth:	478.67		
Casing Depth:	478		

Survey Data

Survey Date: 01-JAN-1990

Surveyed By: SANTIAGO ROMERO AND ASSOCIATES

State Plane Coordinates

(X) Easting: 411661.747

(Y) Northing: 1452661.099

Surveyed Elevations (FAMSL)

Protective Casing:	5382.2
Top of Inner Well Casing:	5381.54
Concrete Pad:	5379.56
Ground Surface:	5379.12

Calculated Depths and Elevations

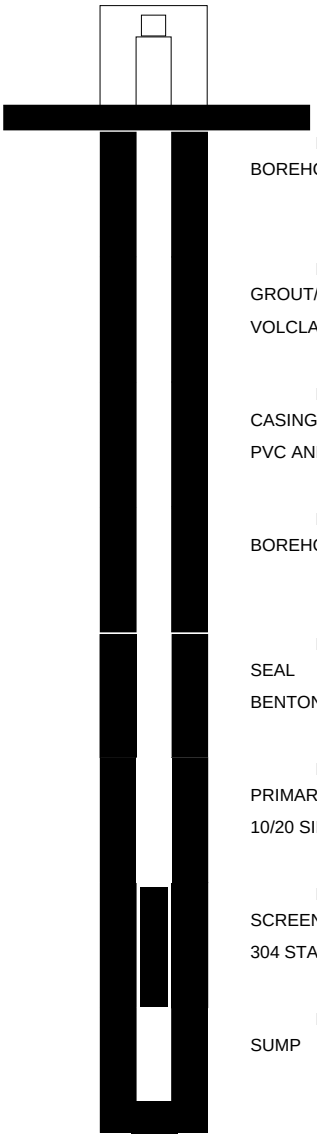
Initial Water Elevation: (FAMSL)	4923.36
Initial Depth To Water: (FBGS)	458.18

Last measured water level was 4918.82 **FASL**

measured on 06-AUG-1996

Date Updated: 14-MAR-00

Date Printed: 20-JUN-2006



Completion Data Measured Depths (FBGS)

Casing Stickup: 1.98

Interval	Start	Stop	
BOREHOLE	0'	200'	
		O.D.	14"
GROUT/BACKFILL	0'	434.9'	
VOLCLAY			
CASING	0'	478'	
PVC AND STEEL	**I.D.**	5"	
BOREHOLE	200'	478.67'	
		O.D.	10"
SEAL	434.9'	445.5'	
BENTONITE PELLETS			
PRIMARY PACK	445.5'	478.67'	
10/20 SILICA SAND			
SCREEN	456'	476'	
304 STAINLESS STEEL			
		Slot Size	.01"
SUMP	476'	478'	

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	MIXED WASTE LANDFILL
ER ADS #:	1289	**Well Completion Date:**	01-OCT-1988
Well Name:	MWL-MW1	**Completion Zone:**	SILTY SAND
Owner Name:	SNL	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	28-SEP-1988	**Well Comment:**	BOREHOLE DIAM IS 14" TO 200' - 10" TO 478.67 - WATER LEV ELEV 8/16/90
Drilling Contractor:	WATER DEVELOPMENT		
Drilling Method:	AIR ROTARY		
Borehole Depth:	478.67		
Casing Depth:	478		

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA III
ER ADS #:	1289	**Well Completion Date:**	01-AUG-1989
Well Name:	MWL-MW2	**Completion Zone:**	SAND
Owner Name:	SNL	**Formation of Completion:**	SANTA FE
Date Drilling Started:	21-JUL-1989	**Well Comment:**	WATER LEVEL MEASURED ON 5/14/90
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	MUD ROTARY		
Borehole Depth:	521		
Casing Depth:	477		

Survey Data

Survey Date: 12-APR-1990

Surveyed By: SANTIAGO ROMERO AND ASSOCIATES

State Plane Coordinates

(X) Easting: 411451.366

(Y) Northing: 1452692.592

Surveyed Elevations (FAMSL)

Protective Casing:	5378.18
Top of Inner Well Casing:	5377.26
Concrete Pad:	5376.49
Ground Surface:	5375.71

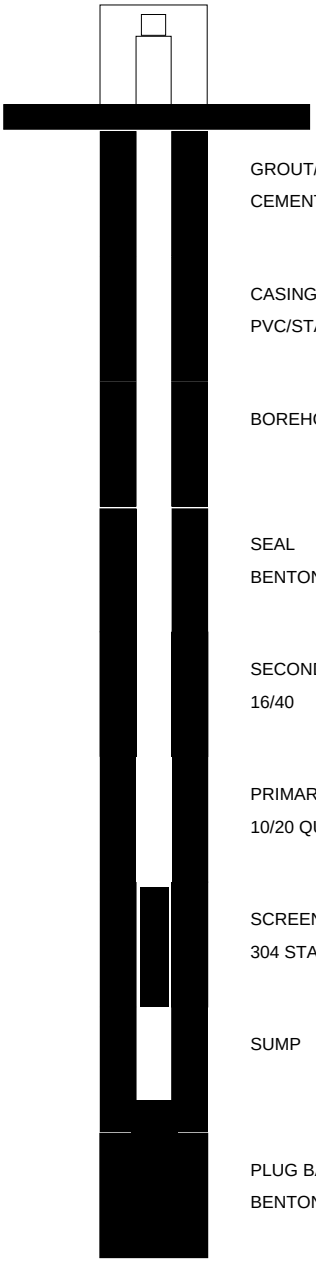
Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4923.27
Initial Depth To Water: (FBGS)	453.99

Last measured water level was measured on 4918.78 **FASL** 06-AUG-1996

Date Updated: 14-MAR-00

Date Printed: 20-JUN-2006



Completion Data Measured Depths (FBGS)

Casing Stickup: .77

Interval	Start	Stop
GROUT/BACKFILL	0'	430'
CEMENT/BENTONITE		

Interval	Start	Stop
CASING	0'	477'
PVC/STAINLESS STEEL	**I.D.** 5"	

Interval	Start	Stop
BOREHOLE	0'	521'
	O.D. 12.25"	

Interval	Start	Stop
SEAL	430'	442'
BENTONITE		

Interval	Start	Stop
SECONDARY PACK	442'	444'
16/40		

Interval	Start	Stop
PRIMARY PACK	444'	477'
10/20 QUARTZ SAND		

Interval	Start	Stop
SCREEN	452'	472'
304 STAINLESS STEEL		
	Slot Size .01"	

Interval	Start	Stop
SUMP	472'	477'

Interval	Start	Stop
PLUG BACK	477'	521'
BENTONITE		

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA III
ER ADS #:	1289	**Well Completion Date:**	01-AUG-1989
Well Name:	MWL-MW2	**Completion Zone:**	SAND
Owner Name:	SNL	**Formation of Completion:**	SANTA FE
Date Drilling Started:	21-JUL-1989	**Well Comment:**	WATER LEVEL MEASURED ON 5/14/90
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	MUD ROTARY		
Borehole Depth:	521		
Casing Depth:	477		

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA-III
ER ADS #:	1289	**Well Completion Date:**	22-AUG-1989
Well Name:	MWL-MW3	**Completion Zone:**	SAND
Owner Name:	SNL	**Formation of Completion:**	SANTA FE
Date Drilling Started:	20-AUG-1989	**Well Comment:**	BOREHOLE TD AT 501', BACKFILL WITH .4 BENTONITE/CEMENT PLUG TO 478' ABOUT 1' OF 16/40 FN SIL SAND AT TOP OF FILTER PACK
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	MUD ROTARY		
Borehole Depth:	501		
Casing Depth:	476.3		

Survey Data

Survey Date: 16-AUG-1990

Surveyed By: SANTIAGO ROMERO AND ASSOCIATES

State Plane Coordinates

(X) Easting: 411407.995

(Y) Northing: 1452476.617

Surveyed Elevations (FAMSL)

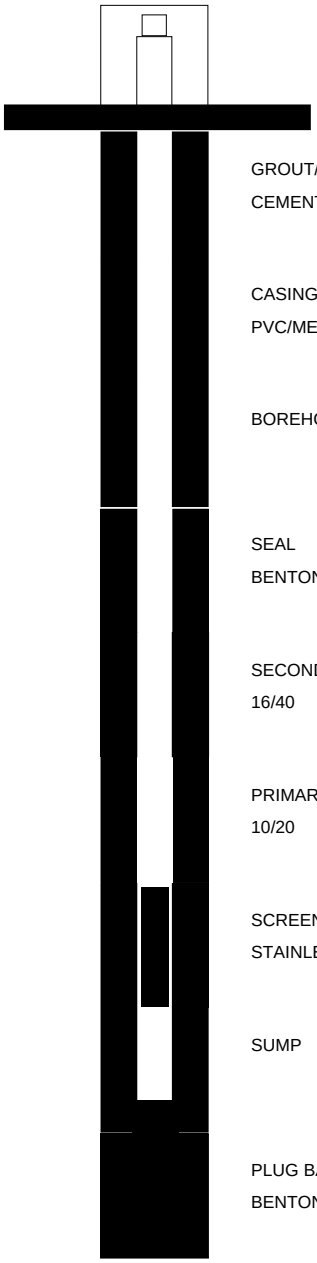
Protective Casing:	5381.78
Top of Inner Well Casing:	5381.32
Concrete Pad:	5379.41
Ground Surface:	5378.97

Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4921.1	
Initial Depth To Water: (FBGS)	460.22	
Last measured water level was measured on 06-AUG-1996	4917.35	**FASL**

Date Updated: 14-MAR-00

Date Printed: 20-JUN-2006



Completion Data Measured Depths (FBGS)

Casing Stickup: 1.91

Interval	Start	Stop
GROUT/BACKFILL	0'	429'
CEMENT/BENTONITE		

Interval	Start	Stop
CASING	0'	478.8'
PVC/METAL	**O.D.**	5"

Interval	Start	Stop
BOREHOLE	0'	501'
	O.D.	12.25"

Interval	Start	Stop
SEAL	429'	444'
BENTONITE		

Interval	Start	Stop
SECONDARY PACK	444'	446'
16/40		

Interval	Start	Stop
PRIMARY PACK	446'	476'
10/20		

Interval	Start	Stop
SCREEN	451.3'	471.3'
STAINLESS STEEL		
	Slot Size	.01"

Interval	Start	Stop
SUMP	471.3'	476.3'

Interval	Start	Stop
PLUG BACK	476.3'	501'
BENTONITE		

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA-III
ER ADS #:	1289	**Well Completion Date:**	22-AUG-1989
Well Name:	MWL-MW3	**Completion Zone:**	SAND
Owner Name:	SNL	**Formation of Completion:**	SANTA FE
Date Drilling Started:	20-AUG-1989	**Well Comment:**	BOREHOLE TD AT 501', BACKFILL WITH .4 BENTONITE/CEMENT PLUG TO 478' ABOUT 1' OF 16/40 FN SIL SAND AT TOP OF FILTER PACK
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	MUD ROTARY		
Borehole Depth:	501		
Casing Depth:	476.3		

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA III
ER ADS #:	1289	**Well Completion Date:**	10-FEB-1993
Well Name:	MWL-MW4	**Completion Zone:**	FINE MEDIUM SAND/GRAVELLY SAND
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	16-DEC-1992	**Well Comment:**	2 SCREENED INTERVALS
Drilling Contractor:	WATER DEVELOPMENT CORPOF		
Drilling Method:	SONIC/DRY		
Borehole Depth:	552.5		
Casing Depth:	548		

Survey Data

Survey Date: 15-MAY-1994

Surveyed By: GREINER,INC.

State Plane Coordinates

(X) Easting: 411608.044

(Y) Northing: 1452565.255

Surveyed Elevations (FAMSL)

Protective Casing: 5384.05

Top of Inner Well Casing: 5383.46

Concrete Pad: 5381.35

Ground Surface: 5381.61

Calculated Depths and Elevations

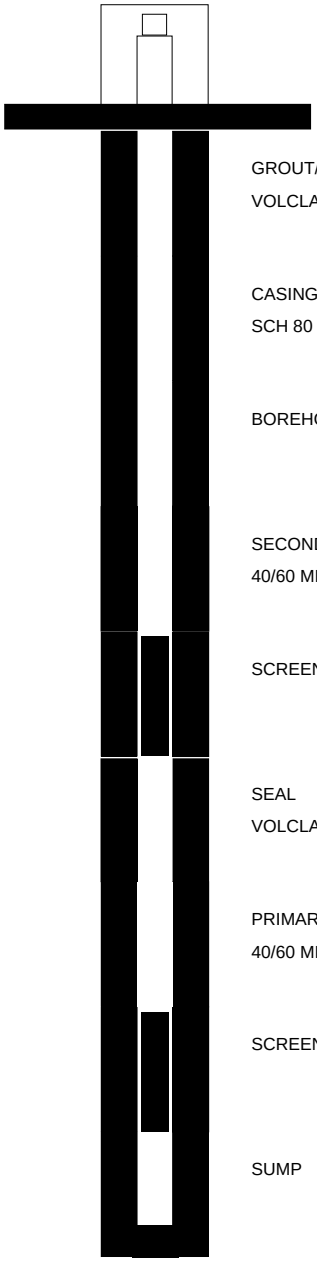
Initial Water Elevation: (FAMSL) 4896.46

Initial Depth To Water: (FBGS) 487

Last measured water level was measured on **FASL**

Date Updated: 14-MAR-00

Date Printed: 20-JUN-2006



Completion Data Measured Depths (FBGS)

Casing Stickup: 2.11

Interval	Start	Stop	
GROUT/BACKFILL	0'	473'	
VOLCLAY			
CASING	0'	548'	
SCH 80 PVC	**I.D.** 4.768"	**O.D.** 5.563"	
BOREHOLE	0'	552.5'	
		O.D. 11"	
SECONDARY PACK	473'	508'	
40/60 MESH			
SCREEN	482.5'	502.5'	
	Slot Size .01"		
SEAL	503'	520'	
VOLCLAY/BENTONITE			
PRIMARY PACK	520'	552.5'	
40/60 MESH			
SCREEN	522.5'	542.5'	
	Slot Size .01"		
SUMP	542.5'	548'	

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA III
ER ADS #:	1289	**Well Completion Date:**	10-FEB-1993
Well Name:	MWL-MW4	**Completion Zone:**	FINE MEDIUM SAND/GRAVELLY SAND
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	16-DEC-1992	**Well Comment:**	2 SCREENED INTERVALS
Drilling Contractor:	WATER DEVELOPMENT CORPOF		
Drilling Method:	SONIC/DRY		
Borehole Depth:	552.5		
Casing Depth:	548		

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TAIII
ER ADS #:	1289	**Well Completion Date:**	19-NOV-2000
Well Name:	MWL-MW5	**Completion Zone:**	SILTY SAND
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	03-OCT-2000	**Well Comment:**	
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	ARCH		
Borehole Depth:	550		
Casing Depth:	521.5		

Survey Data

Survey Date: 26-JAN-2001

Surveyed By: ALBUQUERQUE SURVEYING CO.

State Plane Coordinates

(X) Easting: 411261.94

(Y) Northing: 1452294.82

Surveyed Elevations (FAMSL)

Protective Casing: 5380.53

Top of Inner Well Casing: 5379.89

Concrete Pad: 5377.97

Ground Surface: 5377.65

Calculated Depths and Elevations

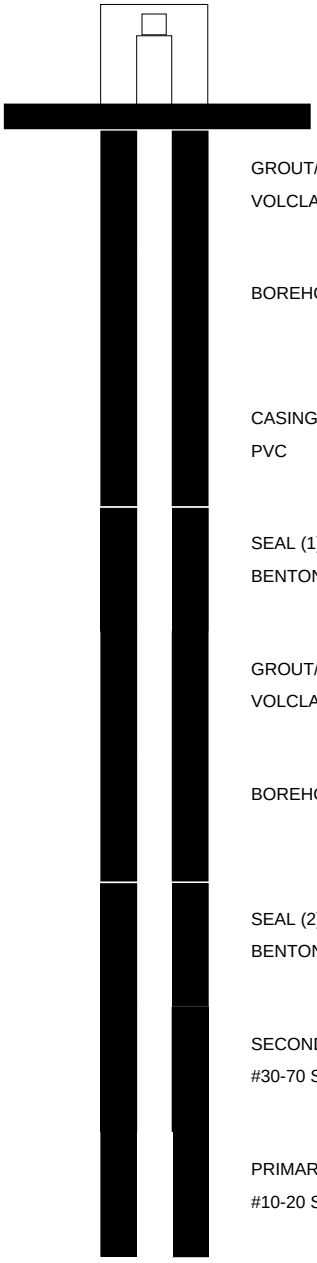
Initial Water Elevation: (FAMSL) 4893.3

Initial Depth To Water: (FBGS) 486.59

Last measured water level was measured on **FASL**

Date Updated: 18-APR-01

Date Printed: 20-JUN-2006



Completion Data Measured Depths (FBGS)

Casing Stickup: 2.24

Interval	Start	Stop
GROUT/BACKFILL (1)	0'	171'
VOLCLAY		

Interval	Start	Stop
BOREHOLE (1)	0'	300'
O.D.		11.75"

Interval	Start	Stop
CASING	0'	521.5'
PVC		

Interval	Start	Stop
SEAL (1)	171'	192'
BENTONITE PELLETS		

Interval	Start	Stop
GROUT/BACKFILL (2)	192'	465'
VOLCLAY		

Interval	Start	Stop
BOREHOLE (2)	300'	550'
O.D.		9.625"

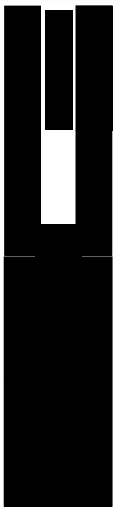
Interval	Start	Stop
SEAL (2)	465'	487'
BENTONITE PELLETS		

Interval	Start	Stop
SECONDARY PACK	487'	489'
#30-70 SAND		

Interval	Start	Stop
PRIMARY PACK	489'	521'
#10-20 SAND		

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TAIII
ER ADS #:	1289	**Well Completion Date:**	19-NOV-2000
Well Name:	MWL-MW5	**Completion Zone:**	SILTY SAND
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	03-OCT-2000	**Well Comment:**	
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	ARCH		
Borehole Depth:	550		
Casing Depth:	521.5		



	Interval	Start	Stop
SCREEN		496.5'	516.5'
5" PVC			
	Slot Size	.02"	
	Interval	**Start**	**Stop**
SUMP		516.5'	521.5'
	Interval	**Start**	**Stop**
PLUG BACK (1)		521.5'	527'
BENTONITE PELLETS			
	Interval	**Start**	**Stop**
PLUG BACK (2)		527'	546'
#10-20 SAND			

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA III
ER ADS #:	1289	**Well Completion Date:**	19-OCT-2000
Well Name:	MWL-MW6	**Completion Zone:**	SAND
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	07-SEP-2000	**Well Comment:**	
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	ARCH		
Borehole Depth:	550		
Casing Depth:	505.5		

Survey Data

Survey Date: 26-JAN-2001

Surveyed By: ALBUQUERQUE SURVEYING CO.

State Plane Coordinates

(X) Easting: 410925.5

(Y) Northing: 1452656.51

Surveyed Elevations (FAMSL)

Protective Casing: 5372.87

Top of Inner Well Casing: 5372.64

Concrete Pad: 5370.21

Ground Surface: 5369.96

Calculated Depths and Elevations

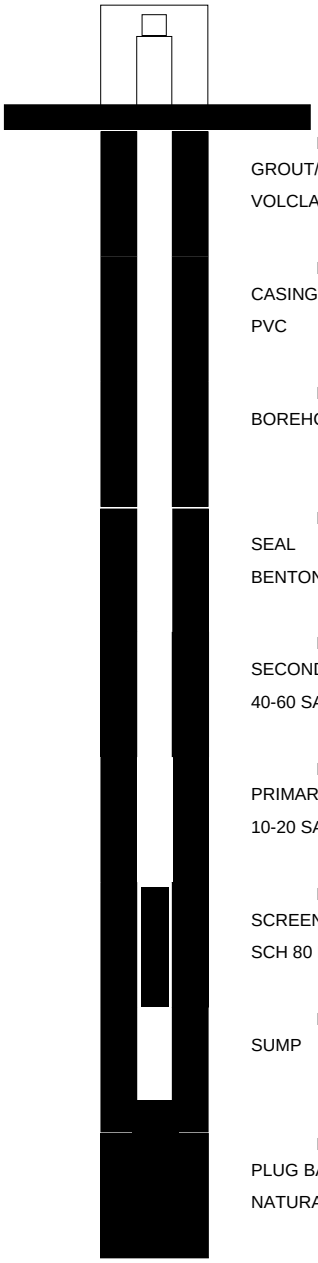
Initial Water Elevation: (FAMSL) 4888.8

Initial Depth To Water: (FBGS) 483.84

Last measured water level was measured on **FASL**

Date Updated: 18-APR-01

Date Printed: 20-JUN-2006



Completion Data Measured Depths (FBGS)

Casing Stickup: 2.68

Interval	Start	Stop	
GROUT/BACKFILL	0'	478'	
VOLCLAY			
Interval	**Start**	**Stop**	
CASING	0'	505.5'	
PVC		**O.D.**	5"
Interval	**Start**	**Stop**	
BOREHOLE	0'	550'	
		O.D.	9.625"
Interval	**Start**	**Stop**	
SEAL	478'	493'	
BENTONITE PELLETS			
Interval	**Start**	**Stop**	
SECONDARY PACK	493'	499'	
40-60 SAND			
Interval	**Start**	**Stop**	
PRIMARY PACK	499'	537'	
10-20 SAND			
Interval	**Start**	**Stop**	
SCREEN	505.5'	525.5'	
SCH 80 PVC		**Slot Size**	.02"
Interval	**Start**	**Stop**	
SUMP	525.5'	530.5'	
Interval	**Start**	**Stop**	
PLUG BACK	537'	550'	
NATURAL BACKFILL			

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA III
ER ADS #:	1289	**Well Completion Date:**	19-OCT-2000
Well Name:	MWL-MW6	**Completion Zone:**	SAND
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	07-SEP-2000	**Well Comment:**	
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	ARCH		
Borehole Depth:	550		
Casing Depth:	505.5		

APPENDIX G
Mixed Waste Landfill Long-Term Monitoring Inspection Forms

Biology Checklist for MWL Cover

Mixed Waste Landfill
Post-Closure Inspection Form
Biology Inspection Checklist for the MWL Cover

Mandatory requirement:

The inspector has read the MWL Long-Term Monitoring Plan and activity-related procedures in the last 12 months, and completed all required training: (*Inspector must initial box before proceeding with the inspection.)* ☐

Date read _____

Approximate vegetative coverage (actively photosynthesizing): _____%

Approximate percent native vegetation of the total vegetative cover: _____%

Listed below are the main plant species identified growing on the MWL cover and the approximate percent cover for each species.

Scientific Name	Common Name (optional)	% [a]

[a]Total cover photosynthesizing

Mixed Waste Landfill
Biology Inspection Checklist for the MWL Cover (Continued)

Are there any contiguous areas of no vegetation greater than 200 square feet? (approximately 14 x14 ft.): _____

If "Yes," mark such areas on a map and attach to this checklist, and provide the MWL project lead with recommendations to improve such area(s) with native vegetation via soil augmentation, scarification, and/or reseeding.

Are there any very deeply rooted (roots greater than 8 feet deep at maturity) plant species present on the cover? _____

If "Yes," mark such areas on a map and attach to this checklist, and remove plant(s) from the cover.

Notes: _____

_____

_____

_____

Inspection for animal burrow intrusion into MWL cover

Are any burrows present on the cover? _____

Does any burrow(s) appear to be active? _____

Does any active burrow(s) appear to be that of a species that is able to burrow 6 feet deep or greater? _____

If any of the active burrows appear to be that of a species that is able to burrow 6 feet or greater, mark such burrow(s) on a map and attach at the end of this checklist, and provide the MWL project lead with recommendations to take actions as necessary to prevent damage to the cover.

Notes: _____

_____

Biological Aspects Map – [note: sketch map to locate specific features will be attached]

Survey Biologist Name: _____ Date: _____

Original to: Sandia National Laboratories Customer-Funded Records Center

Mixed Waste Landfill
Inspection Checklist

Mixed Waste Landfill
Long-Term Monitoring
Inspection Checklist

1. Date of Inspection _____
2. Time of Inspection _____
3. Name of Inspector _____

Mandatory requirement:

The inspector has read the MWL Long-Term Monitoring Plan and activity-related procedures in the last 12 months, and completed all required training: (*Inspector must initial box before proceeding with the inspection.)* ☐

Date read _____

Provide explanatory notes for each parameter not inspected or each action required. Include any remedial steps required.

I. COVER SYSTEM [Quarterly]			
Inspection Parameters	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Visible settlement of the soil cover in excess of 6 inches.			
B. Erosion of the soil cover in excess of 6 inches deep.			
C. Evidence of water ponding.			
D. Animal intrusion burrows in excess of 4 inches in diameter.			
E. Evidence of growth of very deeply rooted (rooted greater than 8 feet deep at maturity) plant species.			
F. Contiguous areas of no vegetation greater than 200 ft^2.			
II. SURFACE-WATER (STORM-WATER) DIVERSION STRUCTURES [Quarterly]			
Inspection Parameters	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Channel or sidewall erosion in excess of 6 inches deep.			
B. Channel sediment accumulation in excess of 6 inches deep.			
C. Debris that blocks more than 1/3 of the channel width.			

Mixed Waste Landfill
Inspection Checklist (Continued)

III. FENCE [Quarterly]			
Inspection Parameters	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Accumulation of wind-blown plants and debris.			
B. Fence wires and posts in need of repair/maintenance.			
C. Gates in need of oiling/repair/maintenance.			
D. Locks in need of cleaning or replacement.			
E. Warning signs in need of repair or replacement.			
F. Survey monuments in vicinity of MWL visible.			

IV. SOIL-VAPOR AND GROUNDWATER MONITORING WELLS [Semi-Annually]			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Concrete pads, bollards, and protective casings in need of repair/maintenance.			
B. Well cover caps and Swagelok® dust caps in need of repair/maintenance.			
C. Soil-vapor monitoring ports, pumps and tubing in need of repair/maintenance.			
D. Monitoring wells and soil-vapor sample port locations properly labeled.			
E. Locks in need of cleaning or replacement.			
V. PREVIOUS DEFICIENCIES [Quarterly]			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Uncorrected/undocumented previous deficiencies.			

Mixed Waste Landfill
Inspection Checklist (Continued)

NOTES

Note Number	Description

Mixed Waste Landfill
Inspection Checklist (Continued)

Action (Note Number) _____ assigned to _____Date action completed_____

Action (Note Number) _____ assigned to _____Date action completed_____

Action (Note Number) _____ assigned to _____Date action completed_____

Action (Note Number) _____ assigned to _____Date action completed_____

Action (Note Number) _____ assigned to _____Date action completed_____

Additional Comments:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Inspector's Signature _____

Original to: Mixed Waste Landfill Operating Record

Copy to: Sandia National Laboratories Customer-Funded Records Center

Volume V

TAB 2

Notice of Public Comment Period for Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan, September 2007

From: NMED/Kieling
To: SNL/Wagner

Back of Tab 2

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

CINDY PADILLA
Deputy Secretary

October 31, 2007

SUBJECT: NOTICE OF PUBLIC COMMENT PERIOD FOR SANDIA NATIONAL LABORATORIES MIXED WASTE LANDFILL LONG-TERM MONITORING AND MAINTENANCE PLAN

Dear Interested Person:

Enclosed is a **Public Notice** regarding the U. S. Department of Energy (DOE)/Sandia Corporation's (Permittees) Long-term Monitoring and Maintenance (LTM) Plan for the Sandia National Laboratories (SNL) Mixed Waste Landfill. The LTM Plan is a requirement of Section V.6 of the SNL Resource Conservation and Recovery Act Permit.

The DOE is owner, and with Sandia Corporation, co-operator of SNL. The Permittees are located at the following addresses: SNL, 1515 Eubank SE, Albuquerque, NM, 87123; and NNSA/DOE, Sandia Site Office, KAFB-East, Pennsylvania & H Street, Albuquerque, NM 87116.

The enclosed Public Notice provides locations where the LTM Plan may be reviewed by any members of the public. Comments will be received through **5:00 p.m. MST, December 31, 2007**. Any person seeking additional information may contact:

Mr. William Moats
New Mexico Environment Department
Hazardous Waste Bureau
5500 San Antonio, NE
Albuquerque, NM 87109

E-mail: William.Moats@state.nm.us
Telephone: (505) 222-9551
Fax: (505) 222-9510

Sincerely,

John E. Kieling
Program Manager
Permits Management Program
Hazardous Waste Bureau

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

CINDY PADILLA
Deputy Secretary

PUBLIC NOTICE NO. 07-17

NEW MEXICO ENVIRONMENT DEPARTMENT
HAZARDOUS WASTE BUREAU
SANTA FE, NEW MEXICO
October 31, 2007

NOTICE OF PUBLIC COMMENT PERIOD FOR SANDIA NATIONAL LABORATORIES MIXED WASTE LANDFILL LONG-TERM MONITORING AND MAINTENANCE PLAN

The federal Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §§ 6901 to 6992(k), provides for the regulation of hazardous waste. Congress waived the immunity of the United States for actions brought under state hazardous and solid waste laws as well as under RCRA. Pursuant to Section 3006 of RCRA, 42 U.S.C § 6926, the U.S. Environmental Protection Agency (EPA) delegated to the New Mexico Environment Department (NMED), on April 16, 1985 by delegation numbers 8-31 and 8-32, the authority to enforce the New Mexico Hazardous Waste Act (HWA) and its implementing regulations, the New Mexico Hazardous Waste Management Regulations (HWMR), 20.4.1 NMAC, in lieu of EPA enforcement through RCRA. NMED has maintained its delegation from EPA over hazardous waste management in New Mexico and from time to time has amended its state program to conform to statutory or regulatory changes in RCRA. The HWMR require corrective action at solid waste management units (SWMUs) where releases of hazardous waste or hazardous constituents have or may have occurred.

The U. S. Department of Energy, owner and operator, and Sandia Corporation, co-operator, (hereinafter referred to as the Permittees) have been issued a RCRA Permit for the Sandia National Laboratories (SNL) Facility, located in Bernalillo County, New Mexico, EPA ID# NM5890110518. The Permittees must comply with the HWA, the HWMR, and the SNL RCRA Permit, and must conduct corrective action as required under the SNL Order on Consent (April 29, 2004) to protect human health and the environment.

On May 26, 2005, the NMED Secretary approved a final permit and ordered a final remedy for SNL's Mixed Waste Landfill (MWL). The Secretary also directed that the public be given the opportunity to comment on all major documents regarding the MWL prior to any final action being taken by the NMED. The permit and final order requires the Permittees to submit to the NMED for approval a Long-term Monitoring and Maintenance (LTM) Plan. The LTM Plan was submitted to the NMED on September 25, 2007. Pursuant to the Secretary's order, the NMED is seeking public comment on the LTM Plan prior to making a final decision on whether to approve the plan.

LOCATION OF THE SNL FACILTY AND THE MWL

The Permittees are located at the following addresses: SNL, 1515 Eubank SE, Albuquerque, NM, 87123; and NNSA/DOE, Sandia Site Office, KAFB-East, Pennsylvania & H Street, Albuquerque, NM 87116.

The Permittee's primary contact for this action is Mr. John Gould, NNSA/Sandia Site Office, DOE, at P.O. Box 5400, Albuquerque, NM 87185.

SNL is located within the boundaries of Kirtland Air Force Base (KAFB), south of Albuquerque in Bernalillo County, New Mexico. KAFB occupies 52,233 acres. SNL research and administration facilities occupy 2,842 acres and are divided into five Technical Areas (TAs), (designated 1 through 5) and several test areas. TA-1, TA-2, and TA-4 are separate research facilities in the north-central portion of KAFB. TA-3 and TA-5 are contiguous research facilities forming a 4.5-square-mile rectangular area in the southwestern portion of KAFB.

The Mixed Waste Landfill (MWL) is located approximately 5 miles southeast of the Albuquerque International Sunport. The landfill occupies 2.6 acres in the north-central portion of TA-3.

FACILITY OPERATIONS

SNL, in operation since 1945, is engaged in research and development of conventional and nuclear weapons, alternative energy sources, and a wide variety of national security related research and development activities. As a result of these activities, SNL has generated hazardous, radioactive, mixed (those wastes containing both hazardous and radioactive components), and solid wastes. From 1945 to 1988 most of these wastes were disposed of at SNL at numerous locations, which have been classified by the NMED as Solid Waste Management Units (SWMUs) or Areas of Concern (AOCs). The SWMUs and AOCs include unpermitted landfills, septic-system drainfields and seepage pits, outfalls, waste piles, and test areas. Past waste management activities at SNL have caused the release of hazardous and radioactive contaminants into the environment. The Mixed Waste Landfill is classified as SWMU 76.

DESCRIPTION AND HISTORY OF THE MIXED WASTE LANDFILL

The MWL was opened as the "TA-3 low-level radioactive waste dump" in March 1959. The MWL accepted low-level radioactive waste and mixed waste from SNL research facilities and off-site generators from March 1959 to December 1988. Approximately 100,000 cubic feet of radioactive waste containing 6,300 curies (Ci) of activity (at the time of disposal) were disposed of at the MWL in unlined trenches and pits.

Investigations at the landfill indicate that tritium is the primary contaminant that has been released from the landfill. Results of a risk assessment prepared by the Permittees indicate that releases of contaminants from the MWL pose little risk to human health or the environment under an industrial land use scenario. Tritium activities at the MWL will decrease steadily with time due to its relatively short half-life of 12.3 years. Because of tritium's short half-life and in consideration of current activity levels, the NMED does not believe that tritium releases at the MWL pose a threat to groundwater, human health, or the environment.

REGULATORY BACKGROUND

NMED issued a RCRA Permit for storage of hazardous waste at SNL on August 6, 1992. On February 6, 2002, the Permittees applied to the NMED to renew their RCRA permit (the old Permit remains in effect until a final decision is made on the renewal request; a draft permit was issued by the NMED on August 20, 2007). On October 11, 2001, the NMED directed the Permittees to conduct a Corrective Measures

Study (CMS) for the MWL because of concerns raised by the public. The CMS Work Plan was approved with conditions by the NMED on October 10, 2002.

After approval of the CMS Work Plan, the CMS was conducted by the Permittees to identify, develop, and evaluate corrective measures alternatives and to recommend a final remedy to be taken at the MWL. The results of the CMS were documented in a CMS Report following completion of the study; the report was transmitted to the NMED on May 21, 2003. The CMS Report was deemed complete by the NMED on January 5, 2004.

On January 23, 2004, the Permittees proposed a Class 3 modification of the SNL RCRA Permit, requesting that the NMED select a final remedy for the MWL. As part of a 60-day public notice and comment period initiated by the Permittees, a public meeting was held on February 26, 2004 in Albuquerque, New Mexico. Following completion of the Permittees public comment period, the NMED issued a public notice and began an additional public comment period starting August 11, 2004.

A public hearing on the selection of a final remedy for the MWL was held by the NMED on December 2-3 and 8-9, 2004; the NMED public comment period was held from August 11, 2004 to December 2, 2004, and extended until December 9, 2004. Based on the administrative record and the Hearing Officer's Report, on May 26, 2005, the NMED Secretary approved a final permit and ordered a final remedy for SNL's Mixed Waste Landfill, selecting a vegetative soil cover with bio-intrusion barrier as the final remedy.

The Permittees were required under their RCRA Permit to submit to NMED a Corrective Measures Implementation (CMI) Work Plan within 180 days after approval of the final remedy. The CMI Work Plan was submitted by the Permittees on November 3, 2005. The SNL Permit also requires the Permittees to submit to the NMED for approval a Long-term Monitoring and Maintenance (LTM) Plan, the subject of this public notice. The Permittees have chosen to submit the LTM Plan earlier than required by their RCRA Permit. The LTM Plan was submitted on September 25, 2007. The LTM plan must describe the types and frequencies of monitoring and maintenance that will be conducted at the MWL to ensure protection of human health and the environment. The LTM Plan must also include all necessary physical and institutional controls to be implemented in the future at the MWL, and must include contingency procedures to be implemented if the final remedy selected for the landfill fails to be protective of human health and the environment.

PUBLIC REVIEW OF THE LTM PLAN

The LTM Plan may be reviewed by any member of the public at the following locations during the public comment period:

NMED – Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
(505) 476-6000
Contact: Pam Allen
Monday - Friday from 8:00 a.m. to 5:00 p.m.

NMED-District 1 Albuquerque Office
5500 San Antonio NE
Albuquerque, New Mexico 87109
(505) 222-9500
Contact: William Moats
Monday - Friday from 8:00 a.m. to 5:00 p.m.

The LTM Plan is also available electronically on the NMED web site at: www.nmenv.state.nm.us/HWB/snlperm.html under Mixed Waste Landfill under Long-Term Monitoring and Maintenance Plan. To obtain a copy of the LTM Plan or a portion thereof, please contact Ms. Pam Allen at (505) 476-6000, or at the address given above. NMED will provide copies, or portions thereof, of the administrative record at a cost to the requestor.

NMED issues this public notice on **October 31, 2007,** to announce the beginning of a 60-day comment period that will end at **5:00 p.m. MST, December 31, 2007**. Any person who wishes to comment should submit written or electronic mail (e-mail) comment(s) with the commenter's name and address to the respective address below. Only comments and/or requests received on or before **5:00 p.m. MST, December 31, 2007** will be considered.

John E. Kieling, Program Manager
Hazardous Waste Bureau - New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303
Ref: Sandia National Laboratories – MWL LTM Plan
E-mail: john.kieling@state.nm.us

To be considered relevant to this matter, written comments must be based on the LTM Plan.

The NMED must ensure that the approved LTM Plan will be consistent with the New Mexico Hazardous Waste Management Regulations. Written comments submitted will become part of the administrative record, will be considered in formulating a final decision, and may cause the LTM Plan to be modified. NMED will respond in writing to all significant public comment. The response will specify which provisions, if any, of the LTM Plan have been changed in the final decision, and the reasons for the change. This response will also be posted on the NMED website in addition to NMED notifying all persons providing written comments.

After consideration of the written public comments received, NMED will approve, or approve with modifications the LTM Plan. If NMED modifies the plan, the Permittees shall be provided by certified mail a copy of the modified plan and a detailed written statement of reasons for the modifications. The NMED will make the final decision publicly available. The NMED's decision shall constitute a final agency decision. All persons on the mailing list, or that provided written comments, or who requested notification in writing, will be notified of the final decision by mail.

The final decision will become effective immediately upon service of the decision to the Permittees, unless a later date is specified.

ARRANGEMENTS FOR PERSONS WITH DISABILITIES

Any person with a disability requiring assistance or auxiliary aid to participate in this process should contact Judy Bentley by 10 days prior to the end of the public comment period at the following address: New Mexico Environment Department, Room N-4030, P.O. Box 26110, 1190 St. Francis Drive, Santa Fe, New Mexico 87502-6110, (505) 827-9872. TDD or TDY users please access Ms. Bentley's number via the New Mexico Relay Network at 1-800-659-8331.

Volume V

TAB 3

Extension of the Public Comment Period on the Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, September 2007

From: NMED/Kieling
To: SNL/Wagner

Back of Tab 3

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

December 17, 2007

SUBJECT: EXTENSION OF THE PUBLIC COMMENT PERIOD ON THE LONG-TERM MONITORING AND MAINTENNCE PLAN FOR THE MIXED WASTE LANDFILL AT SANDIA NATIONAL LABORATORIES

Dear Interested Person:

Attached is a public notice extending the period for submission of public comments on the Long-term Monitoring and Maintenance Plan (LTM Plan) for the Mixed Waste Landfill at the Sandia National Laboratories (SNL). On October 31, 2007, the New Mexico Environment Department (NMED) issued an initial public notice to submit public comment by December 31, 2007. Since issuance of that initial notice, NMED has received requests to extend the public comment period.

The public comment period shall be extended for an additional thirty (30) day period. NMED will now receive public comment through **5:00 p.m. MST, January 31, 2007**.

Any person seeking additional information regarding this notice may contact either:

Mr. John E. Kieling
NMED – Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505
Email: john.kieling@state.nm.us
Telephone: (505) 476-6000
Fax: (505) 476-6030

Mr. William Moats
NMED – Hazardous Waste Bureau
5500 San Antonio NE
Albuquerque, New Mexico 87109
Email: william.moats@state.nm.us
Telephone: (505) 222-9551
Fax: (505) 222-9510

Sincerely,

John E. Kieling
Program Manager
Permits Management Program
Hazardous Waste Bureau

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

PUBLIC NOTICE NO. 07-24

NEW MEXICO ENVIRONMENT DEPARTMENT
HAZARDOUS WASTE BUREAU
SANTA FE, NEW MEXICO
December 17, 2007

EXTENSION OF PUBLIC COMMENT PERIOD
FOR SANDIA NATIONAL LABORATORIES MIXED WASTE LANDFILL
LONG-TERM MONITORING AND MAINTENANCE PLAN

This is a notice extending the period for submission of public comment on the Long-term Monitoring and Maintenance Plan (LTM Plan) for the Mixed Waste Landfill at the Sandia National Laboratories (SNL). On October 31, 2007, the New Mexico Environment Department (NMED) issued an initial public notice to submit public comment by December 31, 2007. Since issuance of that initial notice, NMED has received requests to extend the public comment period.

The public comment period shall be extended for an additional thirty (30) day period. NMED will now receive public comment through **5:00 p.m. MST, January 31, 2007**.

PUBLIC REVIEW OF THE LTM PLAN

The LTM Plan may be reviewed by any member of the public at the following locations during the public comment period with prior appointment:

NMED – Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
(505) 476-6000
Contact: Pam Allen
Monday - Friday from 8:00 a.m. to 5:00 p.m.

NMED-District 1 Albuquerque Office
5500 San Antonio NE
Albuquerque, New Mexico 87109
(505) 222-9500
Contact: William Moats
Monday - Friday from 8:00 a.m. to 5:00 p.m.

The LTM Plan is also available electronically on the NMED web site at: www.nmenv.state.nm.us/HWB/snlperm.html under Mixed Waste Landfill under Long-Term Monitoring and Maintenance Plan. To obtain a copy of the LTM Plan or a portion thereof, please contact Ms. Pam

Allen at (505) 476-6000, or at the address given above. NMED will provide copies, or portions thereof, of the administrative record at a cost to the requestor.

NMED issues this public notice on **December 17, 2007**, to announce the extension of the comment period that will end at **5:00 p.m. MST, January 31, 2008**. Any person who wishes to comment on the LTM Plan should submit written or electronic mail (e-mail) comment(s) with the commenter's name and address to the respective address below. Only comments received before **5:00 p.m. MST** on **January 31, 2008** will be considered.

John E. Kieling, Program Manager
Hazardous Waste Bureau - New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303
Ref: Sandia National Laboratories – MWL LTM Plan
E-mail: john.kieling@state.nm.us

To be considered relevant to this matter, written comments must be based on the LTM Plan.

The NMED must ensure that the approved LTM Plan will be consistent with the New Mexico Hazardous Waste Act and Hazardous Waste Management Regulations. Written comments submitted will become part of the administrative record, will be considered in formulating a final decision, and may cause the LTM Plan to be modified. NMED will respond in writing to all significant public comment. The response will specify which provisions, if any, of the LTM Plan have been changed in the final decision, and the reasons for the change. This response will also be posted on the NMED website in addition to NMED notifying all persons providing written comments.

After consideration of the written public comments received, NMED will approve, or approve with modifications the LTM Plan. If NMED modifies the plan, the Permittees shall be provided by certified mail a copy of the modified plan and a detailed written statement of reasons for the modifications. The NMED will make the final decision publicly available. The NMED's decision shall constitute a final agency decision. All persons on the mailing list, or that provided written comments, or who requested notification in writing, will be notified of the final decision by mail.

The final decision will become effective immediately upon service of the decision to the Permittees, unless a later date is specified.

ARRANGEMENTS FOR PERSONS WITH DISABILITIES

Any person with a disability requiring assistance or auxiliary aid to participate in this process should contact Judy Bentley by 10 days prior to the end of the public comment period at the following address: New Mexico Environment Department, Room N-4030, P.O. Box 26110, 1190 St. Francis Drive, Santa Fe, New Mexico 87502-6110, (505) 827-9872. TDD or TDY users please access Ms. Bentley's number via the New Mexico Relay Network at 1-800-659-8331.

Volume V

TAB 4

Withdrawal of the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan Submitted in September 2007

From: SNL/Wagner
To: NMED/Kieling

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National Nuclear Security Administration
Sandia Site Office
P. O. Box 5400
Albuquerque, NM 87185
DEC 07 2011

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

Mr. John E. Kieling
Acting Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Bldg. 1
Santa Fe, NM 87505

Subject: Withdrawal of the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan Submitted to the New Mexico Environment Department in September 2007

Dear Mr. Kieling:

On behalf of the United States Department of Energy/National Nuclear Security Administration (DOE/NNSA), and Sandia Corporation (Sandia), DOE/NNSA is notifying New Mexico Environment Department (NMED) that the September 2007 Mixed Waste Landfill (MWL) Long-Term Monitoring and Maintenance Plan (LTMMP) is hereby withdrawn. This withdrawal is based upon your letter dated October 14, 2011 *Notice of Approval: Mixed Waste Landfill Corrective Measures Implementation Report, January 2010, Sandia National Laboratories, EPA ID NM5890110518, HWB-SNL-10-005* requiring the submission of an LTMMP within 180 days of the date of the letter. Therefore, a MWL LTMMP will be submitted to the NMED according to this schedule. The document will include information regarding the groundwater monitoring well network (new wells installed in 2008) and evapotranspirative (ET) cover (i.e., ET Cover, installation completed in 2009). In addition, the document will incorporate information regarding the installation of two soil-vapor monitoring wells through the ET Cover during construction and ET Cover maintenance performed since installation of the ET Cover, including all supplemental watering activities.

Should you have any questions regarding this report please feel free to contact me at (505) 845-6036 or Daniel Pellegrino of my staff at (505) 845-5398.

Sincerely,

Kimberly A Davis for

Patty Wagner
Manager

Enclosure

cc w/enclosure
See Page 2

cc:
William Moats, NMED-HWB (via Certified Mail)
Laurie King, EPA, Region 6 (via Certified Mail)
Thomas Skibitski, NMED-OB, MS-1396
Zimmerman Library, UNM
SNL ES&H Records Center, SNL/NM, MS-0718
Robert Fleming, NA-173, HQ/GTN
Joanna Serra, NA-173, HQ/FORS
Amy Blumberg, SNL/NM, MS-0141
David Miller, SNL/NM, MS-0718
John Cochran, SNL/NM, MS-0719
Mike Mitchell, SNL/NM, MS-0718
Carolyn Daniel, SNL/NM, MS-0718
Andrew Orrell, SNL/NM, MS-0771
Kimberly Davis, SSO/MO, MS-0184
Shirley Mondy, SSO/MO, MS-0184
Daniel Pellegrino, SSO/ESH, MS-0184
11-0345-402125

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Withdrawal of the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan submitted to the New Mexico Environment Department in September 2007**

Document author: **Michael Mitchell, Department 06234**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 11/21/11
Date

S. Andrew Orrell, Director
Nuclear Energy & Fuel Cycle Programs
Center 6200
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ for 12/7/11
Date

Ms. Patty Wagner, Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Volume V

TAB 5

Withdrawal of Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan, September 2007

From: NMED/Kieling
To: SNL/Wagner

Back of Tab 5

National Nuclear Security Administration
Sandia Site Office
P. O. Box 5400
Albuquerque, NM 87185
DEC 07 2011

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

Mr. John E. Kieling
Acting Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Bldg. 1
Santa Fe, NM 87505

Subject: Withdrawal of the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan Submitted to the New Mexico Environment Department in September 2007

Dear Mr. Kieling:

On behalf of the United States Department of Energy/National Nuclear Security Administration (DOE/NNSA), and Sandia Corporation (Sandia), DOE/NNSA is notifying New Mexico Environment Department (NMED) that the September 2007 Mixed Waste Landfill (MWL) Long-Term Monitoring and Maintenance Plan (LTMMP) is hereby withdrawn. This withdrawal is based upon your letter dated October 14, 2011 *Notice of Approval: Mixed Waste Landfill Corrective Measures Implementation Report, January 2010, Sandia National Laboratories, EPA ID NM5890110518, HWB-SNL-10-005* requiring the submission of an LTMMP within 180 days of the date of the letter. Therefore, a MWL LTMMP will be submitted to the NMED according to this schedule. The document will include information regarding the groundwater monitoring well network (new wells installed in 2008) and evapotranspirative (ET) cover (i.e., ET Cover, installation completed in 2009). In addition, the document will incorporate information regarding the installation of two soil-vapor monitoring wells through the ET Cover during construction and ET Cover maintenance performed since installation of the ET Cover, including all supplemental watering activities.

Should you have any questions regarding this report please feel free to contact me at (505) 845-6036 or Daniel Pellegrino of my staff at (505) 845-5398.

Sincerely,

Kimberly A Davis for

Patty Wagner
Manager

Enclosure

cc w/enclosure
See Page 2

cc:
William Moats, NMED-HWB (via Certified Mail)
Laurie King, EPA, Region 6 (via Certified Mail)
Thomas Skibitski, NMED-OB, MS-1396
Zimmerman Library, UNM
SNL ES&H Records Center, SNL/NM, MS-0718
Robert Fleming, NA-173, HQ/GTN
Joanna Serra, NA-173, HQ/FORS
Amy Blumberg, SNL/NM, MS-0141
David Miller, SNL/NM, MS-0718
John Cochran, SNL/NM, MS-0719
Mike Mitchell, SNL/NM, MS-0718
Carolyn Daniel, SNL/NM, MS-0718
Andrew Orrell, SNL/NM, MS-0771
Kimberly Davis, SSO/MO, MS-0184
Shirley Mondy, SSO/MO, MS-0184
Daniel Pellegrino, SSO/ESH, MS-0184
11-0345-402125

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Withdrawal of the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan submitted to the New Mexico Environment Department in September 2007**

Document author: **Michael Mitchell, Department 06234**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 11/21/11
Date

S. Andrew Orrell, Director
Nuclear Energy & Fuel Cycle Programs
Center 6200
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ for 12/7/11
Date

Ms. Patty Wagner, Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Volume V

TAB 6

Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, March 2012

From: SNL/Sena
To: NMED/Kieling

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National Nuclear Security Administration
Sandia Site Office
P. O. Box 5400
Albuquerque, NM 87185

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

MAR 23 2012

Mr. John E. Kieling
Acting Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Bldg. 1
Santa Fe, NM 87505

SUBJECT: Department of Energy/National Nuclear Security Administration Sandia Site Office Submittal of the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan to the New Mexico Environment Department

Dear Mr. Kieling:

On behalf of the United States Department of Energy/National Nuclear Security Administration (DOE/NNSA), and Sandia Corporation (Sandia), DOE/NNSA is submitting the Mixed Waste Landfill (MWL) Long-Term Monitoring and Maintenance Plan (LTMMP) to the New Mexico Environment Department (NMED). Your letter dated October 14, 2011, *Notice of Approval: Mixed Waste Landfill Corrective Measures Implementation Report, January 2010, Sandia National Laboratories, EPA ID NM5890110518, HWB-SNL-10-005,* requires the submission of a MWL LTMMP within 180 days of the date of the letter.

The revised MWL LTMMP is being submitted to NMED in compliance with this schedule and includes updated information regarding the groundwater monitoring well network (new wells installed in 2008) and evapotranspirative cover (i.e., ET Cover; installation completed in 2009). In addition, the document incorporates information regarding the installation of two soil-vapor monitoring wells through the ET Cover during construction and ET Cover maintenance performed since installation of the ET Cover, including all supplemental watering activities performed to date. Questions regarding the trigger evaluation process and all final trigger levels for the multi-media monitoring program detailed in MWL LTMMP were resolved during discussions with you and your staff over the past several months.

If you have questions please contact me at (505) 845-6036 or Daniel Pellegrino, Assistant Manager for Environment, Safety and Health, at (505) 845-5398.

Sincerely,

Richard F. Sena
Acting Manager

Enclosure

cc:
See Page 2
cc w/enclosure:

12-119-425336

cc w/enclosure:
Thomas Skibitski, NMED-OB, MS-1396
William Moats, NMED-HWB (**via Certified Mail**)
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505
Laurie King, EPA, Region 6 (**via Certified Mail**)
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Dallas, TX 75202
Zimmerman Library, UNM
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1 University of New Mexico
Albuquerque, NM 87101-0001
SNL ES&H Records Center, SNL/NM, MS-0718

cc w/o enclosure:
Amy Blumberg, SNL/NM, MS-0141
Andrew Orrell, SNL/NM, MS-0771
David Miller, SNL/NM, MS-0718
John Cochran, SNL/NM, MS-0719
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Carolyn Daniel, SNL/NM, MS-0718
Robert Fleming, HQ/GTN, NA-173
Joanna Serra, HQ/GTN, NA-173
Jo Loftis, SSO/MO, MS-184
Shirley Mondy, SSO/MO, MS-0184
Michael McFadden, SSO/FP, MS-0184
Daniel Pellegrino, SSO/ESH, MS-0184
Joe Estrada, SSO/FP, MS-0184
David Rast, SSO/ESH, MS-0184
John Weckerle, SSO/ESH, MS-0184
12-119-425336

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan**

Document author: **Mike Mitchell, Department 06234**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 3/8/2012
Date

S. Andrew Orrell, Director
Nuclear Energy & Fuel Cycle Programs
Center 6200
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ 3/23/12
Date

Mr. Richard Sena, Acting Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Sandia National Laboratories

Sandia National Laboratories/New Mexico Environmental Restoration Operations

LONG-TERM MONITORING AND MAINTENANCE PLAN FOR THE MIXED WASTE LANDFILL

MARCH 2012

United States Department of Energy
Sandia Site Office

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

EXECUTIVE SUMMARY

The Mixed Waste Landfill (MWL) is an inactive site, designated as a Solid Waste Management Unit, at Sandia National Laboratories, New Mexico (SNL/NM). The SNL/NM facility is owned by the U.S. Department of Energy (DOE). SNL/NM is managed and operated by Sandia Corporation (Sandia). The DOE and Sandia are hereinafter referred to as DOE/Sandia throughout this document. The MWL is located in Technical Area III of SNL/NM, which is within the boundaries of the federally-owned Kirtland Air Force Base, south of the City of Albuquerque. The MWL is undergoing corrective action in accordance with the following regulatory criteria:

- New Mexico Administrative Code, Title 20, Chapter 4, Part 1, Section 600 incorporating Title 40 of the Code of Federal Regulations, Part 264
- Module IV of Resource Conservation and Recovery Act Permit No. NM5890110518 (U.S. Environmental Protection Agency [EPA] August 1993), as revised and updated
- New Mexico Environment Department (NMED) Class 3 Permit Modification for the MWL (NMED August 2005)
- New Mexico Secretary of the Environment Final Order No. HWB 04-11(M) in the matter of request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill No. HWB 04-11(M) (Final Order) (Curry May 2005)
- NMED Compliance Order on Consent (Consent Order) (NMED April 2004)

In the Final Order on the MWL, NMED selected a vegetative soil cover with a biointrusion barrier as the final remedy, hereinafter referred to as the MWL evapotranspirative (ET) Cover, and requested the identification of specific monitoring trigger levels to be implemented as part of a Long-Term Monitoring and Maintenance Plan (LTMMP). Deployment of the MWL final remedy was completed in September 2009, and the MWL Corrective Measures Implementation (CMI) Report (SNL/NM January 2010, Revision 1) was approved by NMED on October 14, 2011 (Bearzi October 2011).

This LTMMP defines monitoring, inspection/maintenance/repair, reporting, and physical and institutional control (IC) requirements for the MWL. DOE/Sandia will implement the LTMMP to determine whether the MWL ET Cover is performing as designed and confirm that site conditions remain protective of human health and the environment. The MWL monitoring program is based upon the results of the site investigation process (SNL/NM September 1990 and September 1996), probabilistic performance-assessment modeling presented in the MWL CMI Plan (Ho et al. January 2007), and input from NMED and the public. The program addresses air, surface soil, vadose zone, groundwater, and biota. The following parameters will be monitored:

- Radon concentrations in the air
- Tritium, gamma-emitting radionuclides, and metal concentrations in surface soil
- Soil moisture in the vadose zone
- Volatile organic compound (VOC) concentrations in the vadose zone soil vapor

- VOCs, specific metals, and radionuclide concentrations in groundwater
- Gamma-emitting radionuclides in biota

The monitoring and sampling activities, data quality objectives, frequencies, and analytical methods are presented for each parameter in the sampling and analysis plans provided in the appendices. Although monitoring is planned for radionuclides in various media at the MWL, the information related to radionuclides is provided voluntarily to NMED by DOE/Sandia.

Monitoring trigger levels have been established as the criteria against which the monitoring results will be compared. In the event that a trigger level is exceeded, an evaluation process has been established that ensures the collection of sufficient data to assess trends and determine whether further investigation is warranted. Specific trigger levels include numerical thresholds derived from EPA, DOE, and NMED regulatory standards.

Routine surveillance and maintenance of the ET Cover, monitoring networks, and physical controls (i.e., fences, signs, gates, locks, and survey monuments) will also be performed to ensure the integrity of the ET Cover, monitoring networks, and site physical controls. Surveillance will be conducted to evaluate the following:

- Physical condition of the site and ET Cover (vegetation survey, signs of erosion, settlement, water ponding, intrusion by animals, contiguous areas lacking vegetation)
- Surface-water diversion structures
- Groundwater monitoring wells, soil-vapor sampling wells, and neutron access tubes
- Security fence, signs, gates and locks, and survey monuments

Maintenance will be performed to prevent deterioration or failure of the ET Cover or associated networks and features and, if needed, repairs will be implemented to restore conditions to the original specifications.

ICs are a key element of the long-term monitoring and maintenance strategy for the MWL. Categories of ICs in place at the MWL include:

- Government ownership
- Entry restrictions
- Warning notices
- Active controls
- Resource-use management
- Site information systems

The application of multiple ICs at the MWL is consistent with a conservative strategy that incorporates multiple, independent layers of controls to protect human health and the environment. In the event of the temporary failure of a control, others are in place to mitigate significant consequences of the failure.

Contingency procedures are addressed through the trigger evaluation process, which will be used to evaluate any monitoring results that exceed the specified trigger levels. Potential failure

scenarios are presented, along with possible corrective action responses. Any such response will be assessed on a situation-specific basis in accordance with NMED requirements.

The purpose of the long-term monitoring and maintenance program is to ensure that the MWL, with the ET Cover deployed, remains protective of human health and the environment. The comprehensive, multi-media long-term monitoring program, combined with media-specific trigger levels and evaluation process, provides for early detection of potentially changing conditions and reflects the priority placed on protecting groundwater. The long-term maintenance program ensures that the ET Cover and monitoring systems will be regularly inspected and repaired as needed so they operate according to design specifications. Reports that document monitoring and maintenance activities and evaluate the effectiveness of the ET Cover over time will be submitted to NMED annually and allow for continued public involvement.

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ACRONYMS AND ABBREVIATIONS

µg	microgram(s)
bgs	below ground surface
CAC	corrective action complete
CAMU	Corrective Action Management Unit
CFR	Code of Federal Regulations
Ci	curie(s)
cm	centimeter(s)
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
CWL	Chemical Waste Landfill
CY	calendar year
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ET	evapotranspirative
FLUTe™	Flexible Liner Underground Technologies
ft/day	feet per day
ft/yr	feet per year
g	gram(s)
GPS	global positioning system
HWB	Hazardous Waste Bureau
IC	institutional control
KAFB	Kirtland Air Force Base
L	liter(s)
LTMMP	Long-Term Monitoring and Maintenance Plan
m^2	square meter
MCL	maximum contaminant level
MDL	method detection limit
mm	millimeter(s)
MP	Monitoring Plan
MWL	Mixed Waste Landfill
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NOD	Notice of Disapproval
P&A	plug and abandonment
PCE	tetrachloroethane
pCi	picocurie(s)
ppmv	part(s) per million by volume
PQL	practical quantitation limit
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
s	second
Sandia	Sandia Corporation
SAP	Sampling and Analysis Plan
SNL/NM	Sandia National Laboratories, New Mexico
SWMU	Solid Waste Management Unit

ACRONYMS AND ABBREVIATIONS (Concluded)

TA	Technical Area
TCE	trichloroethene
UNM	University of New Mexico
VOC	volatile organic compound
yr	year

1.0 INTRODUCTION

The Mixed Waste Landfill (MWL) at Sandia National Laboratories, New Mexico (SNL/NM) is a Solid Waste Management Unit (SWMU) undergoing corrective action in accordance with the following regulatory criteria:

- New Mexico Administrative Code (NMAC), Title 20, Chapter 4, Part 1, Section 600 (20.4.1.600 NMAC) incorporating Title 40 of the Code of Federal Regulations (CFR), Part 264 (40 CFR 264.101)

- Module IV of Resource Conservation and Recovery Act (RCRA) Permit No. NM5890110518 (U.S. Environmental Protection Agency [EPA] August 1993), as revised and updated

- New Mexico Environment Department (NMED) Class 3 Permit Modification for the MWL (NMED August 2005)

- New Mexico Secretary of the Environment's Final Order in the matter of request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill No. HWB 04-11(M) (Final Order) (Curry May 2005)

- Compliance Order on Consent (Consent Order) (NMED April 2004)

On May 26, 2005, NMED issued the Final Order on the MWL selecting a vegetative soil cover with biointrusion barrier as the final remedy for the MWL, hereinafter referred to as the MWL evapotranspirative (ET) Cover. NMED Final Order and the Class 3 Permit Modification require a Long-Term Monitoring and Maintenance Plan (LTMMP) to address monitoring, maintenance, physical and institutional controls (ICs), and reporting at the MWL following remedy implementation. Deployment of the MWL final remedy was completed in September 2009. The MWL Corrective Measures Implementation (CMI) Report (SNL/NM January 2010, Revision 1) documenting ET Cover construction in accordance with the MWL CMI Plan (SNL/NM November 2005) was approved by NMED on October 14, 2011 (Bearzi October 2011).

1.1 Purpose

This LTMMP describes how the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia), hereinafter referred to as DOE/Sandia, will meet the long-term monitoring and maintenance requirements for the MWL. This plan satisfies the requirement for an LTMMP in the Final Order and the Class 3 Permit Modification. This LTMMP describes the necessary physical controls and ICs to be implemented, the maintenance and monitoring activities for the site and ET Cover, the frequencies at which such activities will be conducted, and the associated reporting. These activities will be performed, documented, and reported in accordance with this LTMMP to ensure that the MWL ET Cover performs as designed and site conditions remain protective of human health and the environment. The Five-Year Reevaluation Report required by NMED Final Order and the Class 3 Permit Modification is also addressed.

1.2 Regulatory Background

The NMED Final Order and Class 3 Permit Modification were issued in May and August 2005, respectively. On November 3, 2005, DOE/Sandia submitted a CMI Plan (SNL/NM November 2005) incorporating the final remedy selected by NMED. The CMI Plan presented the design for a 3-foot-thick, vegetated soil cover, underlain by a 1-foot-thick biointrusion barrier and a subgrade layer that varies from 2 to 40 inches in thickness. The CMI Plan also included detailed engineering design drawings and construction specifications, a construction quality assurance plan, and the results of a fate and transport model with proposed triggers to be implemented during the long-term monitoring period.

In November 2006, NMED issued a Notice of Disapproval (NOD) for the MWL CMI Plan (Bearzi November 2006). The NOD contained two sets of comments, requesting 1) clarification regarding the MWL cover design and fate and transport model, and 2) additional triggers for long-term monitoring. The DOE/Sandia responses to the NOD (Wagner December 2006 and January 2007) included clarifications regarding the MWL cover design, the fate and transport model, and a revised list of monitoring triggers for long-term monitoring. NMED issued a second NOD (Bearzi October 2008a) that clarified resolution of issues related to the initial NOD. The DOE/Sandia response (Davis November 2008) and revised CMI Plan were subsequently approved with conditions by NMED (Bearzi December 2008). ET Cover construction began approximately five months later, in May 2009, and was completed in September 2009.

The MWL CMI Report documenting cover construction in accordance with the CMI Plan was submitted to NMED in January 2010 (SNL/NM January 2010, Revision 1). NMED held a public meeting on the CMI Report on December 14, 2010, and issued an NOD in May 2011 (Bearzi May 2011) with eight comments. DOE/Sandia submitted comment responses (Wagner August 2011), and the CMI Report was approved by NMED on October 14, 2011 (Bearzi October 2011). All conditions related to NMED approval of the CMI Plan are addressed in the CMI Report and in this revised LTMMP.

The Final Order and Class 3 Permit Modification require DOE/Sandia to submit an LTMMP to NMED within 180 days after NMED approval of the CMI Report. In 2007, while NMED comments on the CMI Plan were being addressed, DOE/Sandia developed and submitted a MWL LTMMP (SNL/NM September 2007) at the request of NMED. NMED held a public comment period from October 31, 2007, through January 31, 2008, and posted the 2007 LTMMP on NMED web site. However, by the December 2010 public meeting for the CMI Report, NMED had determined that a revised LTMMP would be required due to significant changes at the MWL (e.g., a new groundwater monitoring network that was installed in 2008 and the ET Cover that was constructed in 2009). NMED required submittal of the revised LTMMP within 180 days of NMED approval of the CMI Report (Kieling October 2011). In December 2011 DOE/Sandia withdrew the 2007 MWL LTMMP (Wagner December 2011); the withdrawal was formally accepted by NMED (Kieling December 2011).

The trigger evaluation process and final trigger levels for long-term monitoring are presented in Chapter 5.0 of this document. Triggers for long-term monitoring have been developed for both hazardous and radiological constituents; however, the triggers and monitoring for radionuclides are provided to NMED voluntarily by DOE/Sandia. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements of the Consent Order. Additional information on radionuclides and the scope of the Consent Order is available in Section III.A of the Consent Order (NMED April 2004).

1.3 Legal and Regulatory Requirements

The MWL is designated as a SWMU, subject to corrective action under 20.4.1.600 NMAC incorporating 40 CFR 264.101. The NMED Hazardous Waste Bureau (HWB) is the lead regulatory agency and oversees corrective action at the MWL under the corrective action provisions of the Consent Order (NMED April 2004) issued pursuant to the New Mexico Hazardous Waste Act.

A requirement to develop an LTMMP was presented in the NMED Final Order on the MWL (Curry May 2005) and the Class 3 Permit Modification (NMED August 2005). Although the Consent Order (NMED April 2004) governs the remedy selection process for the MWL, it does not contain any requirements related to long-term monitoring, other than requirements for monitoring well replacement. Rather, the Consent Order defers to Module IV of SNL/NM RCRA Permit NM589011051 (as revised by the August 2005 Class 3 Permit Modification for the MWL) for implementation of long-term controls for SWMUs. Following NMED approval of this LTMMP, DOE/Sandia will request a Class 3 Permit Modification for corrective action complete (CAC) at the MWL.

The 2005 Class 3 Permit Modification provides the framework for the LTMMP and states the following in Section V(6):

> A long-term monitoring and maintenance plan, which includes all necessary physical and institutional controls to be implemented in the future shall be submitted by the Permittees to the Administrative Authority for approval within 180 days after the Administrative Authority's approval of the CMI Report. The Administrative Authority may require monitoring, maintenance, and physical and institutional controls different than those specified in the Corrective Measures Study report referenced in V.1 of this section. The plan shall also include contingency procedures that must be implemented by the Permittees if the remedy set forth in Section V.2 above fails to be protective of human health and the environment.

The 2005 Class 3 Permit Modification also requires DOE/Sandia to prepare a report every five years, reevaluating the feasibility of excavating the MWL contents and analyzing the continued effectiveness of the MWL remedy. NMED determined the first five-year period will begin upon NMED approval of this LTMMP (Kieling October 2011). Additional information regarding the Five-Year Reevaluation reporting requirements is provided in Section 4.8.2.

1.4 Implementation Requirements

This section describes the roles of DOE/Sandia relative to implementing this LTMMP; regulatory requirements for maintaining, inspecting, and monitoring the MWL; future land use requirements; and the process to change or amend this LTMMP.

1.4.1 Roles of DOE/Sandia

SNL/NM is owned by DOE and managed and operated by Sandia, a wholly owned subsidiary of Lockheed Martin Corporation. Sandia has a Management and Operating Contract with DOE for SNL/NM. DOE is the facility owner and Sandia is the facility operator for hazardous waste management and corrective action, in accordance with 20.4.1.900 NMAC incorporating

40 CFR 270. DOE/Sandia are jointly responsible for preparation, revision, and implementation of the LTMMP.

The monitoring and maintenance activities and requirements are based on an annual reporting period. DOE/Sandia are responsible for preparation and submittal to NMED of an annual long-term monitoring and maintenance report for each annual reporting period, as detailed in Section 4.8.1. In addition, DOE/Sandia are responsible for the preparation and submittal of a Five-Year Reevaluation Report as described in the Final Order and Section 4.8.2.

1.4.2 Regulatory Requirements for Solid Waste Management Units

DOE/Sandia will maintain the final remedy at the MWL as described in Chapters 3 and 4 of this LTMMP and summarized as follows:

- Maintain the integrity and effectiveness of the ET Cover, including making repairs, as necessary, to correct the effects of settling, subsidence, erosion, or other events
- Operate and maintain the monitoring systems described in Sections 3.4 and 3.5 of this LTMMP, and comply with all other applicable requirements as detailed in Chapters 3.0 and 4.0
- Prevent run-on and runoff from eroding or otherwise damaging the ET Cover
- Protect and maintain survey monuments

1.4.3 Security Requirements

DOE/Sandia will comply with all security requirements as specified in Section 4.5 of this LTMMP.

1.4.4 Inspection and Monitoring

DOE/Sandia will inspect the ET Cover, monitoring networks, sampling/monitoring equipment, and physical controls at the MWL in accordance with the Inspection and Maintenance/Repair Schedule described in Section 4.6 of this LTMMP using the Inspection Checklists/Forms in this LTMMP.

DOE/Sandia shall perform all monitoring following the procedures and requirements described in Chapter 3.0 and the Sampling and Analysis Plans (SAPs) of this LTMMP.

1.4.5 Future Land Use Requirements

DOE/Sandia will not allow any use of the MWL that will disturb the integrity of the ET Cover or the function of the unit's monitoring systems during the long-term monitoring period.

1.4.6 LTMMP Revision

After this LTMMP takes effect, DOE/Sandia will request permit modification(s) to authorize change(s) as needed in response to MWL events and conditions, including changes in monitoring and maintenance requirements. Requests will be made in accordance with applicable requirements of 20.4.1.901 NMAC incorporating 40 CFR 270.42, and will include a copy of the proposed amended portions of this LTMMP for approval by NMED.

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2.0 FINAL SITE CONDITIONS

This chapter presents general information on the MWL, including current site conditions with the ET Cover and 2008 groundwater monitoring network in place. The current site conditions and conceptual site model provide the context for long-term monitoring and maintenance activities and are based upon more than 20 years of groundwater monitoring, extensive site investigations, and corrective action implementation.

2.1 Location, Conditions, and Description of the MWL

This section presents a brief history of the disposal activities at the MWL and summarizes the results of the two RCRA facility investigations (RFIs) conducted at the site. Groundwater flow conditions and the MWL monitoring well network are also discussed, and surface features are summarized. The toluene investigation (conducted in 2009 through 2010) and the CMI Report documenting ET Cover construction in accordance with the CMI Plan are also summarized. Additional MWL characterization data and ET Cover deployment information are available in the following documents:

- Report of the Phase 1 RFI of the Mixed Waste Landfill (SNL/NM September 1990)
- Report of the Mixed Waste Landfill Phase 2 RFI (SNL/NM September 1996)
- Mixed Waste Landfill Groundwater Report, 1990 through 2001 (Goering et al. December 2002)
- Mixed Waste Landfill Annual Groundwater Monitoring Report, Calendar Year 2009 (SNL/NM June 2010)
- Mixed Waste Landfill Toluene Investigation Report (SNL/NM October 2010)
- Mixed Waste Landfill CMI Report (SNL/NM January 2010, Revision 1)

2.1.1 Location and Description

SNL/NM is located within the boundaries of Kirtland Air Force Base (KAFB), immediately south of the City of Albuquerque in Bernalillo County, New Mexico (Figure 2.1.1-1). The MWL is located 4 miles south of SNL/NM's central facilities and 5 miles southeast of Albuquerque International Sunport. The MWL is located in the north-central portion of Technical Area (TA)-III at SNL/NM (Figure 2.1.1-2).

The MWL disposal area comprises 2.6 acres and accepted containerized and uncontainerized low-level radioactive waste and minor amounts of mixed waste from SNL/NM research facilities and off-site DOE and U.S. Department of Defense generators from March 1959 to December 1988.

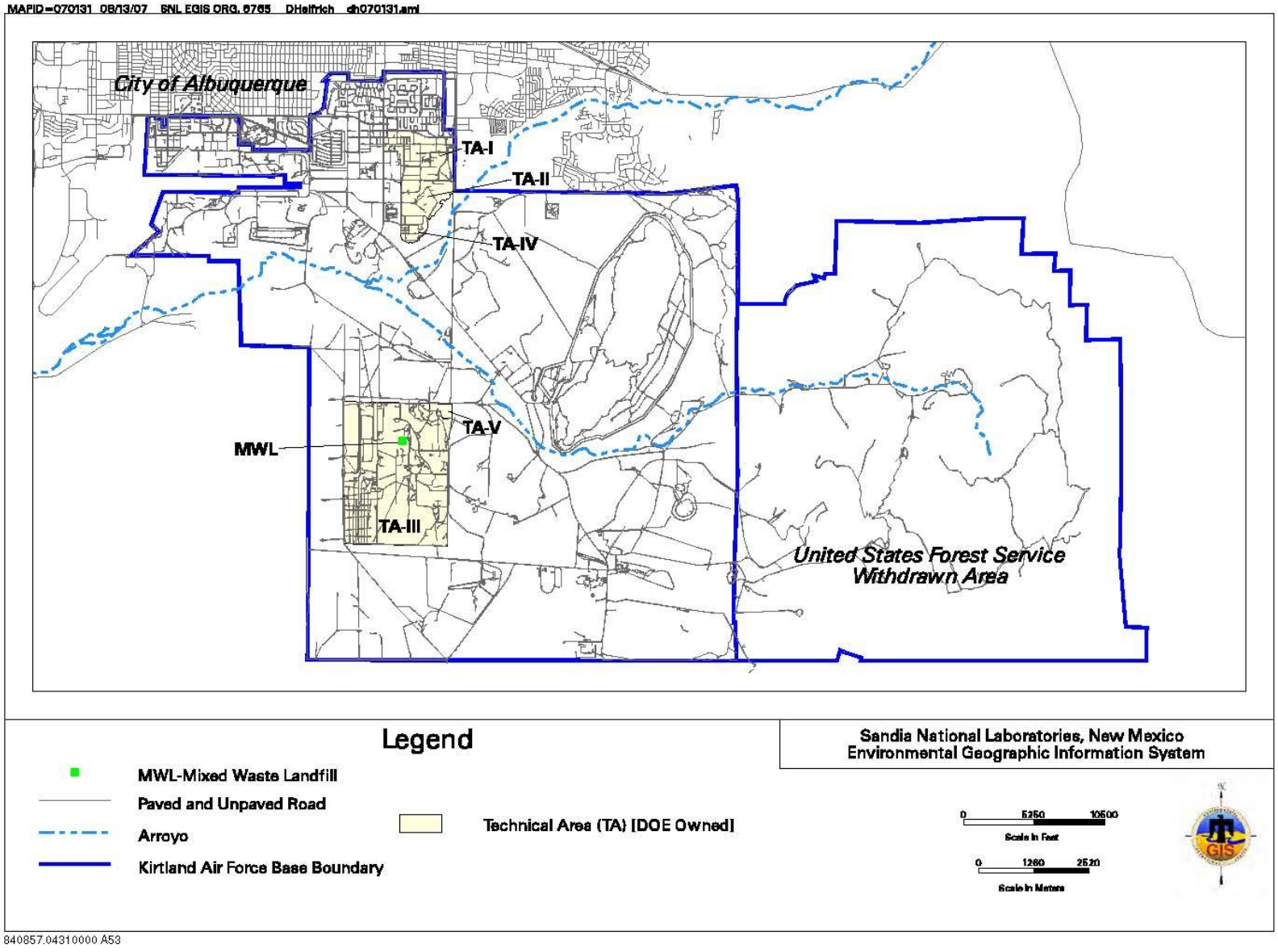

Figure 2.1.1-1
Location of Sandia National Laboratories and Kirtland Air Force Base

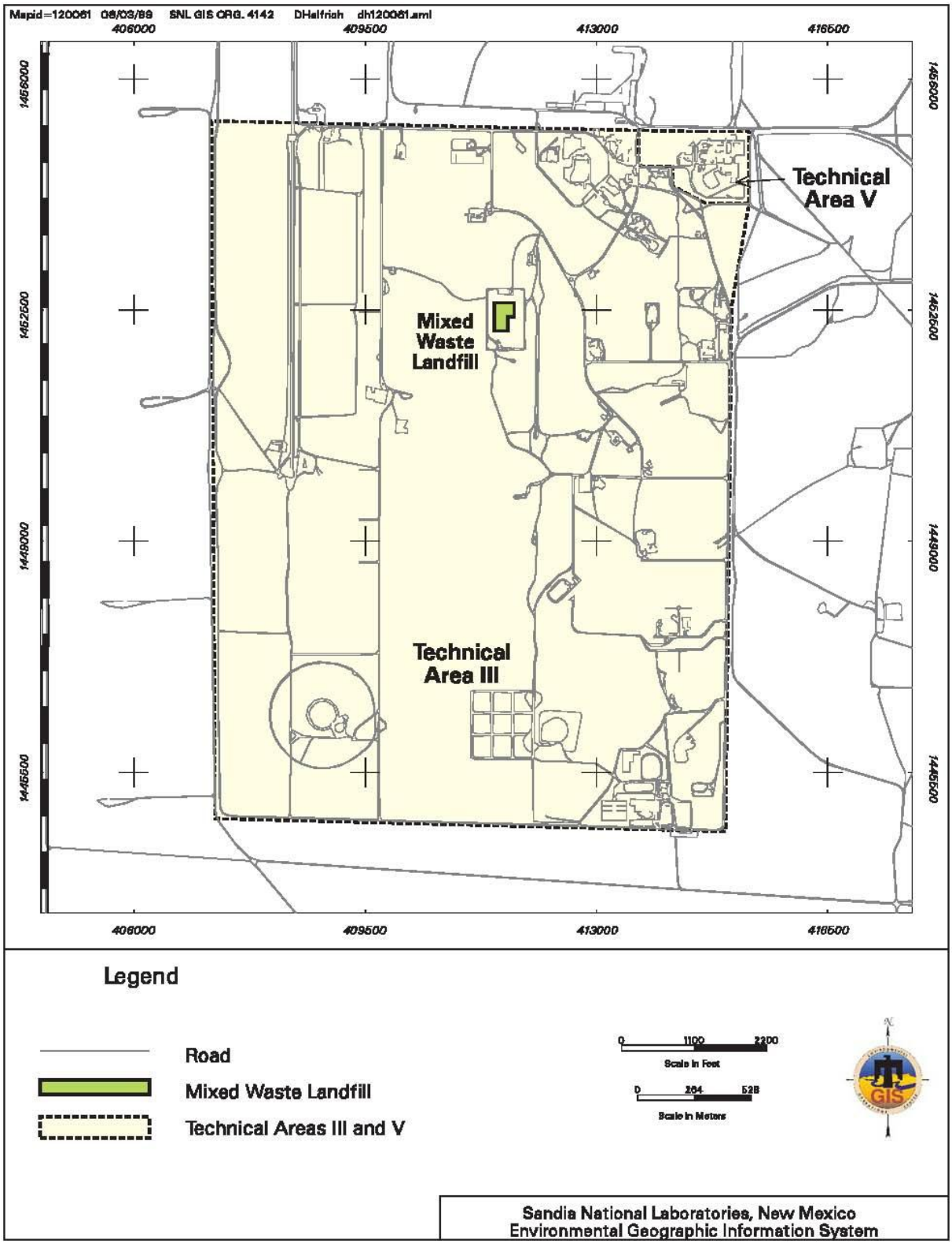

Figure 2.1.1-2
Location of the Mixed Waste Landfill within Technical Area III

Approximately 100,000 cubic feet (3,700 cubic yards) of low-level radioactive waste (excluding packaging, containers, demolition and construction debris, and contaminated soil) containing an estimated 6,300 curies (Ci) of activity (at the time of disposal) were disposed of at the MWL. Disposal cells (i.e., pits and trenches) at the MWL are unlined and were backfilled and compacted to grade with stockpiled soil.

Two distinct disposal areas are present at the MWL: the classified area (occupying 0.6 acres) and the unclassified area (occupying 2.0 acres) (Figure 2.1.1-3). Wastes in the classified area were disposed of in a series of vertical, cylindrical pits. Historical records indicate that early pits were 3 to 5 feet in diameter and 15 feet deep; later pits were 10 feet in diameter and 25 feet deep. Once pits were filled with waste, they were backfilled with soil and capped with concrete. Wastes in the unclassified area were disposed of in a series of parallel, north-south–trending trenches. Records indicate that trenches were 15 to 25 feet wide, 150 to 180 feet long, and 15 to 20 feet deep. Trenches were backfilled with soil on a quarterly basis and, once filled with waste, were capped with the original soil that had been excavated and locally stockpiled.

Containment and disposal of routine waste commonly occurred using tied, double-polyethylene bags, sealed A/N cans (military ordnance metal containers of various sizes), fiberboard drums, wooden crates, cardboard boxes, and 55-gallon steel and polyethylene drums. Larger items, such as glove boxes, spent fuel shipping casks, and contaminated soil, were disposed of in bulk without containment. Disposal of free liquids was not allowed at the MWL, except for the 1967 disposal of 204,000 gallons of reactor coolant water in Trench D. Liquids such as acids, bases, and solvents were solidified with commercially available agents before containerization and disposal. A detailed MWL waste inventory, by pit and trench, is provided in the Environmental Restoration (ER) Operations (formerly ER Project) “Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Dated September 1996” (SNL/NM June 1998).

A Phase 1 RFI was conducted in 1989 and 1990 to determine whether a release of RCRA contaminants had occurred at the MWL (SNL/NM September 1990). A Phase 2 RFI was conducted from 1992 to 1995 to determine the contaminant source, define the nature and extent of contamination, identify potential contaminant transport pathways, evaluate potential risks posed by the levels of contamination identified, and provide remedial action alternatives for the MWL (SNL/NM September 1996).

Both investigations revealed that tritium has migrated from the pits and trenches of the MWL. Tritium was detected during the Phase 2 RFI in surface and near-surface soil in and around the classified area of the MWL at levels ranging from 1,100 picocuries (pCi) per gram (g) in surface soil to 206 pCi/g in subsurface soil. The highest tritium levels were within 30 feet below ground surface (bgs) in soil adjacent to and directly beneath the classified area disposal pits. At distances greater than 30 feet bgs, tritium levels decreased rapidly in soil. Tritium was detected to a maximum depth of 120 feet bgs beneath the MWL. Tritium also occurs as a diffuse air emission from the MWL. A study conducted in 2003 estimated the annual tritium flux from soil to air to be 0.09 Ci per year (yr) (URS Corporation February 2004).

2.1.2 Groundwater

Groundwater occurs approximately 500 feet bgs within the Santa Fe Group deposits (basin fill) in either fine-grained alluvial fan deposits or coarse-grained Ancestral Rio Grande deposits. The

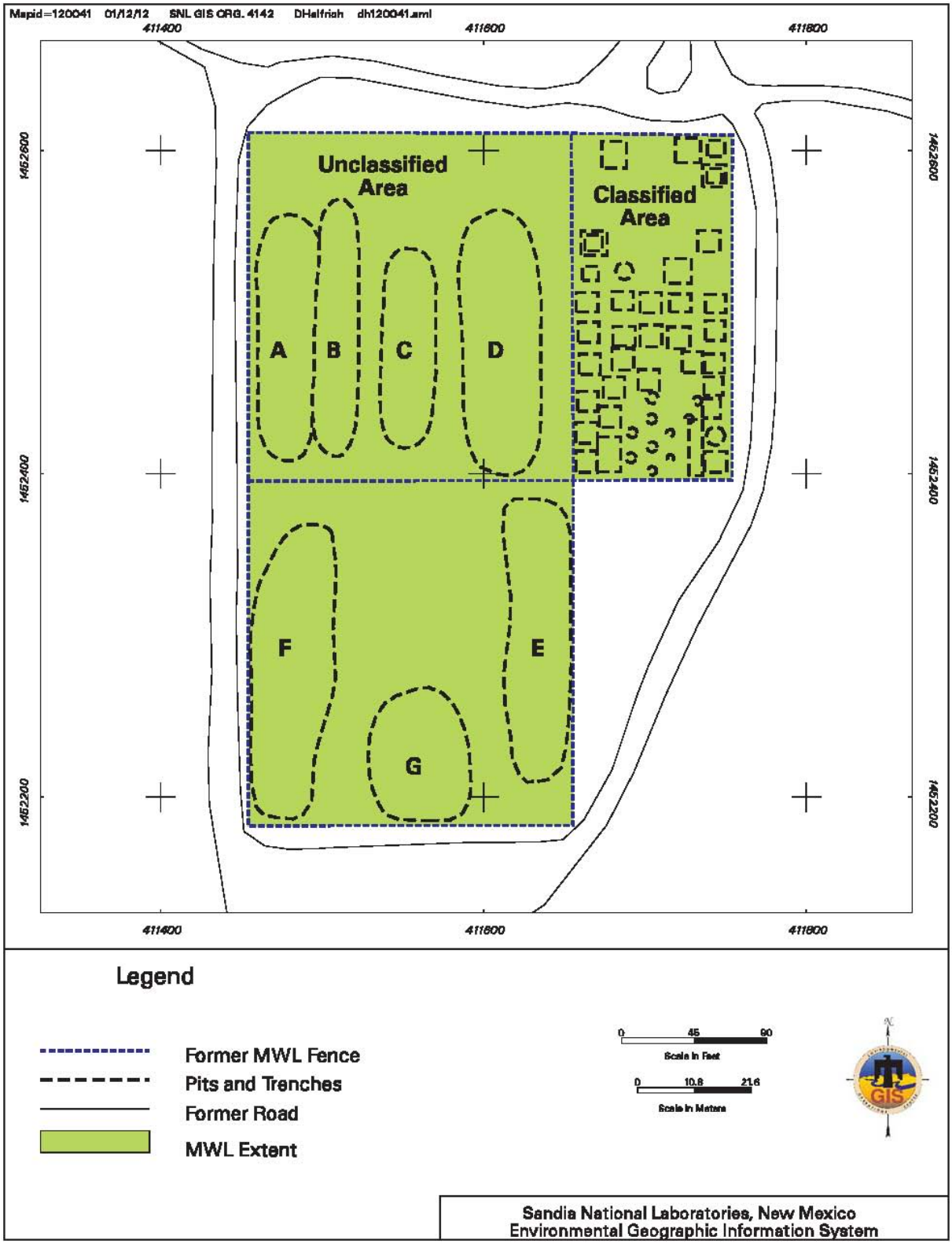

Figure 2.1.1-3
Map of the Mixed Waste Landfill Disposal Areas

upper surface of the regional aquifer occurs in the alluvial fan deposits, which are finer-grained and overlie the coarser-grained Ancestral Rio Grande deposits. A detailed analysis of the regional aquifer is presented the "MWL Groundwater Report, 1990 through 2001" (Goering et al. December 2002); a brief summary is provided as follows.

Hydraulic conductivities average 1.64×10^{-2} feet per day (ft/day) in the alluvial fan deposits and 1.81 ft/day in the Ancestral Rio Grande deposits. Groundwater flows westward at an average velocity of 0.17 feet per year (ft/yr) in the alluvial fan deposits and 18.5 ft/yr in the Ancestral Rio Grande deposits. Although the upper surface of the regional aquifer is within alluvial fan deposits, the majority of the groundwater occurs in the underlying, coarser grained, and more productive Ancestral Rio Grande deposits. Figure 2.1.2-1 shows the potentiometric surface of the regional aquifer west of the Sandia fault complex. Figure 2.1.2-2 shows the localized potentiometric surface of aquifer at the MWL. Groundwater levels beneath the MWL declined at an average rate of approximately 0.5 ft/yr as a result of ongoing large-scale removal of water by the City of Albuquerque and KAFB from production wells through 2007. The nearest production well, KAFB-4, is located 3 miles north of the MWL. From 1990 through 2001 the average rate of decline based on all wells at the MWL was 0.77 ft/yr, and total water level decline was approximately 7 feet. A strong vertical downward gradient exists in the regional aquifer beneath the MWL due to regional pumping and the declining aquifer surface.

Due to the declining water level, the original groundwater monitoring well network (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) installed in 1988 and 1989 was replaced, and four new wells were installed in 2008 (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9). The completion intervals of the four 2008 wells are deeper, with the well screens across the uppermost part of the regional aquifer. The aquifer hydraulic conductivity values based upon slug test results performed in the 2008 wells, range from 1.95×10^{-1} to 1.48×10^{-2} ft/day, with an average of 8.58×10^{-2} ft/day. The hydraulic conductivity for the 2008 wells is generally higher than that for the original MWL groundwater monitoring wells, indicating an increase in hydraulic conductivity with depth and proximity to the highly conductive Ancestral Rio Grande deposits.

Water levels were lower than expected in the 2008 monitoring wells relative to the water levels in the older wells. The lower groundwater elevations in MWL-MW7 through MWL-MW9 appear to be related to the following two major factors:

- Variation in hydraulic conductivity in the upper part of the regional groundwater system (showing increasing hydraulic conductivity with depth)
- Ongoing large-scale removal of water by the City of Albuquerque and KAFB, which has created a strong downward vertical gradient at the MWL

The completion intervals of the new wells are deeper and within a higher hydraulic conductivity layer than the shallower wells they replaced (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3). Thus, the vertical gradient and drawdown of the regional aquifer have greater impact in the new wells, resulting in a lower groundwater elevation relative to the previous monitoring well network.

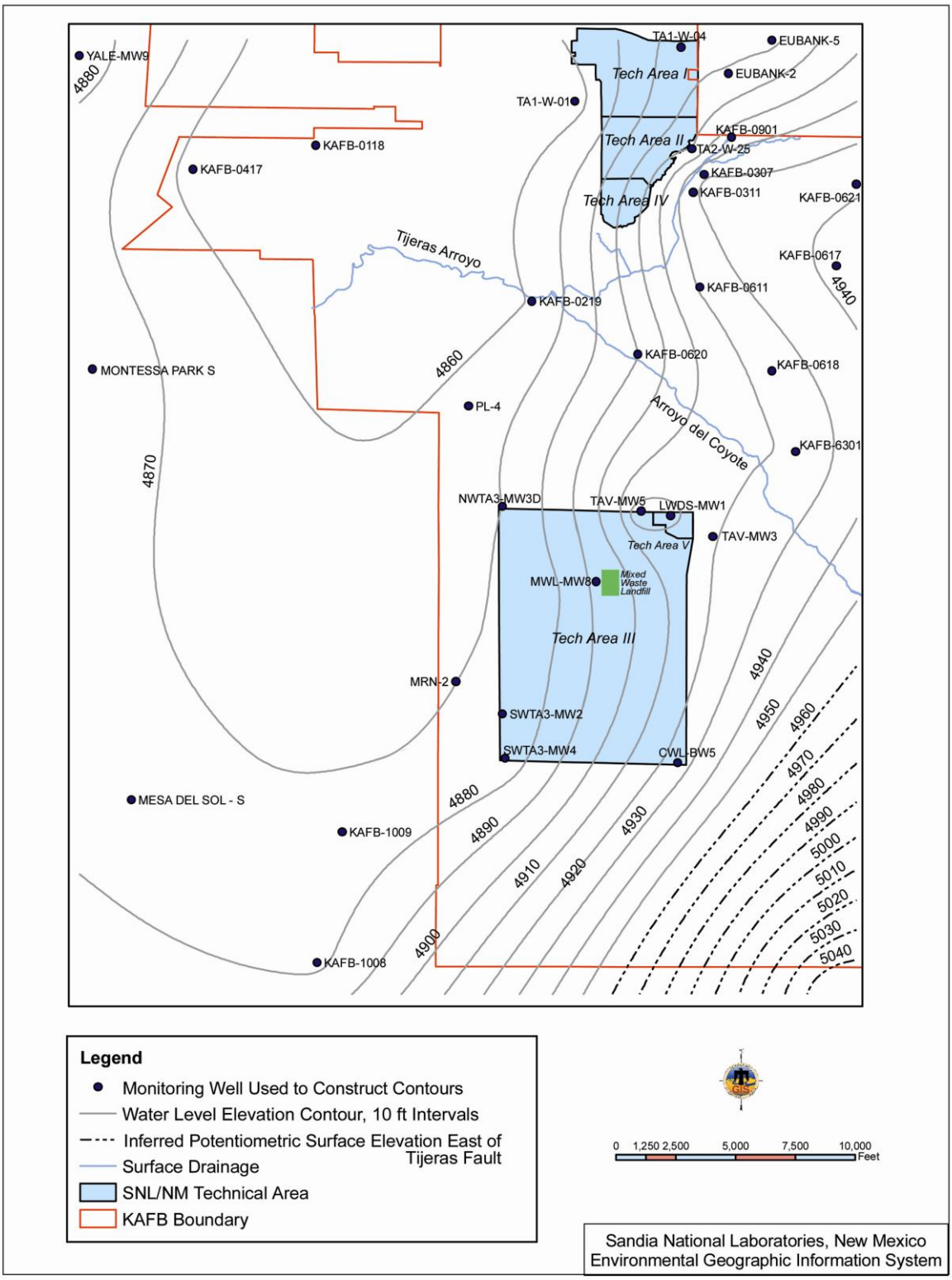

Figure modified from the *Annual Groundwater Monitoring Report, Calendar Year 2010* (SNL/NM September 2011)

Figure 2.1.2-1
Potentiometric Surface of the Regional Aquifer near the Mixed Waste Landfill, October 2010

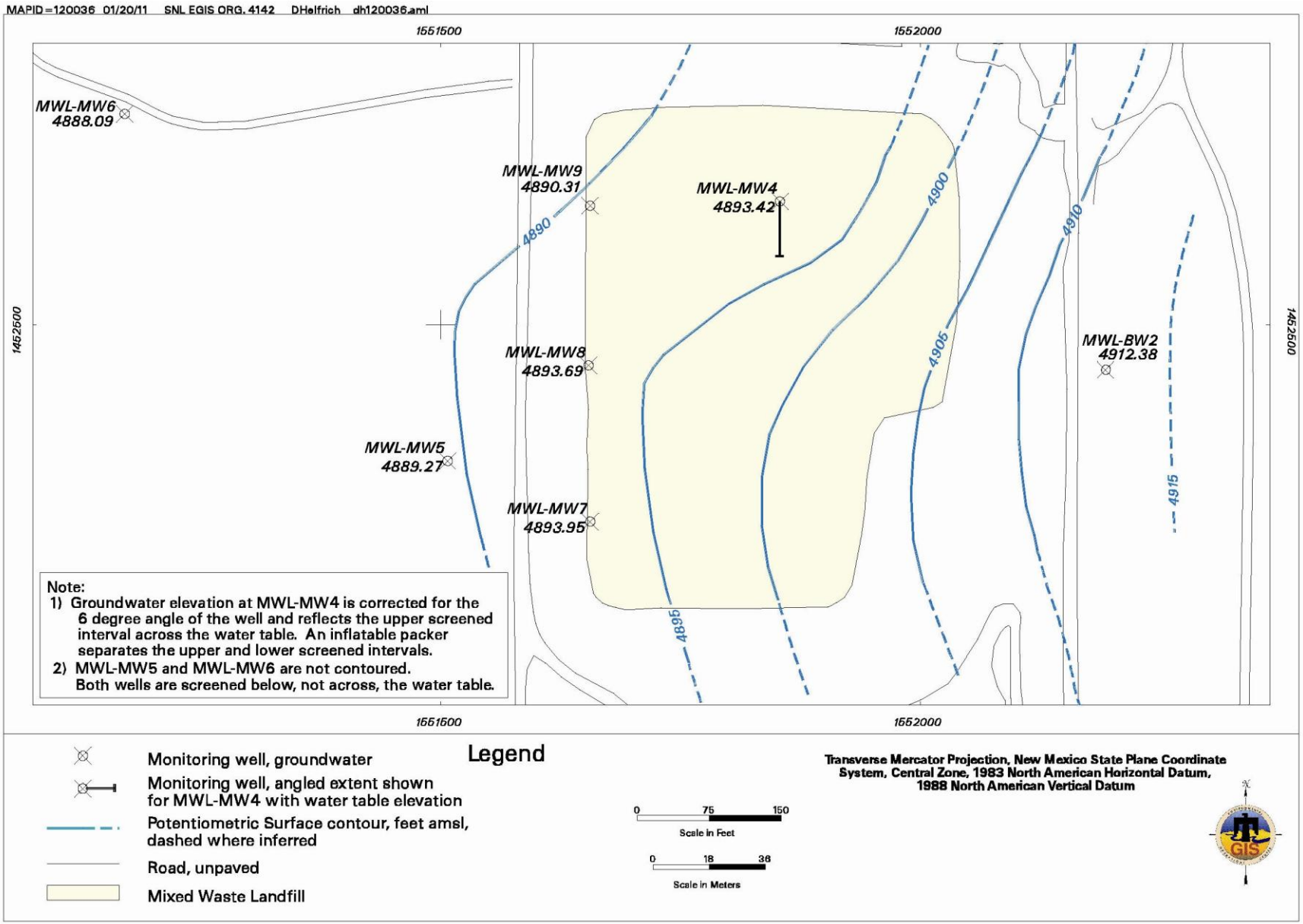

Figure 2.1.2-2
Localized Potentiometric Surface of Basin Fill Aquifer at the Mixed Waste Landfill, October 2011

A more detailed explanation of the lower water levels in the 2008 monitoring wells, the hydraulic conductivity of the uppermost part of the regional aquifer, and an update to the MWL hydrogeologic conceptual model presented in the "Mixed Waste Landfill Groundwater Report, 1990 through 2001" (Goering et al. December 2002) is included in the NMED-approved "Mixed Waste Landfill Annual Groundwater Monitoring Report, Calendar Year 2009" (SNL/NM June 2010).

2.1.3 Surface Features

No permanent aboveground structures are located at the MWL. All disposal pits and trenches were excavated below grade. No perennial streams are present in the immediate area of the MWL. Surface runoff is regionally controlled and generally to the west. The MWL ET Cover slopes gently and sheds surface-water runoff to the site perimeter. An engineered drainage swale located immediately east, north, and south of the ET Cover diverts surface run-on and runoff around the ET Cover to the west. Figure 2.1.3-1 presents the current topography of the ET Cover and immediate vicinity of the MWL, as well as the location of the engineered drainage swale along the eastern, northern, and southern perimeter of the ET Cover.

2.2 Description of the Engineered Cover

The MWL ET Cover was constructed from May through September 2009 and consists of four main layers: compacted subgrade, biointrusion barrier, compacted native soil, and topsoil. The Subgrade varies in thickness from 0 to 3.3 feet, and the combined average thickness of the overlying ET Cover layers (Biointrusion, Native Soil, and Topsoil Layers) is 5.37 feet. The overall footprint of the ET Cover is 4.1 acres including side slopes. The ET Cover was constructed with approximately 33,000 cubic yards of soil fill and 6,800 cubic yards of rock (in-place, compacted volumes) that meet the CMI Plan specifications (SNL/NM November 2005) based upon 113 laboratory tests (Standard Proctor, Gradation, Classification, and Saturated Hydraulic Conductivity), 271 field tests (in-place density and moisture), and visual inspections. All MWL ET Cover construction activities were observed, inspected, and documented by an independent third-party construction quality assurance contractor. The ET Cover construction is detailed in the MWL CMI Report (SNL/NM January 2010, Revision 1). A schematic cross-section of the cover is shown in Figure 2.2-1.

The Topsoil Layer was seeded with native grasses to mitigate surface erosion and promote evapotranspiration. The native grass species were selected based upon biological assessments of TA-III (Sullivan and Knight 1992, Peace et al. November 2004), and consist of black grama, spike dropseed, galleta grass, and ring muhly. This plant community was designed to approximate the dominant and subdominant species in TA-III and is expected to develop into a climax community indistinguishable from the surrounding TA-III natural community.

During MWL ET Cover construction in early August 2009, two single-port soil-vapor monitoring wells (MWL-SV01 and MWL-SV02) were installed as required by NMED (Bearzi December 2008). The location, depth, and construction of the two monitoring wells were selected and

Figure 2.1.3-1
Mixed Waste Landfill Final ET Cover Grading Plan

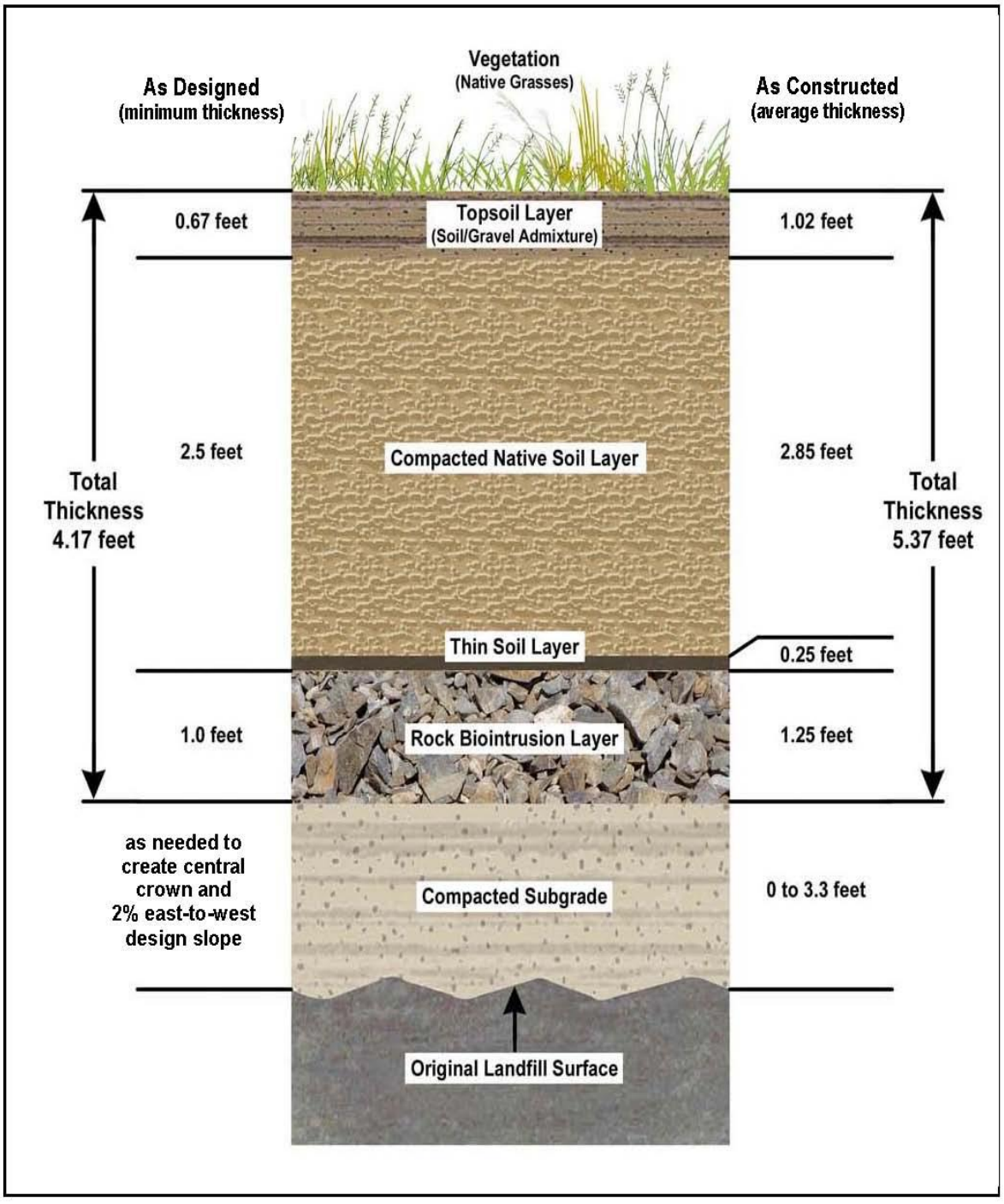

Figure 2.2-1
Schematic Profile of the Mixed Waste Landfill ET Cover Layers

approved by NMED prior to installation as documented in the Installation Report presented in Appendix A. These wells were installed during the construction of the ET Cover but prior to placement of the Topsoil Layer to minimize the impact of drilling and installation activities on the ET Cover.

Additional details for the MWL ET Cover construction are presented in the NMED-approved MWL CMI Report (SNL/NM January 2010, Revision 1). The CMI Report includes a summary of the MWL cover construction activities, as-built drawings and specifications, a photographic log, and the construction quality assurance report.

Since completion of the MWL ET Cover, supplemental watering and cover maintenance activities have been performed to promote the growth and establishment of seeded native grasses, control and remove undesirable invasive annual species (i.e., weeds), and complete minor cover repairs. Supplemental watering and cover maintenance activities performed from 2009 through 2011 are summarized in Appendix B.

2.3 Storm-Water Diversion Structures

Surface drainage features designed to control surface-water run-on and runoff are shown in the MWL Final Grading Plan (Figure No. 2, 2009 Alternative Cover As-Built Drawings, Construction Quality Assurance Report, Appendix A of the CMI Report [SNL/NM January 2010, Revision 1]).

The primary storm-water diversion structure incorporated into the MWL remedy is a continuous drainage swale along the eastern, northern, and southern perimeter of the ET Cover, shown in Figure 2.1.3-1. This feature diverts storm-water run-on around the northern and southern ends of the ET Cover where the water then travels west, preventing erosion of the cover. The aboveground profile; vegetated, gently sloping cover surface topography (2-percent grade from east to west); broad central crown; 6:1 side slopes; and eastern boundary drainage swale prevent storm-water run-on to the ET Cover. Surface water originating from the ET Cover is controlled by the gentle, vegetated slopes (cover surface and side slopes) and diverted towards the perimeter swale (eastern, northern, and southern sides) or western perimeter of the ET Cover, away from the MWL.

3.0 MONITORING ACTIVITIES AND FREQUENCIES

This section describes all monitoring activities to be conducted at the MWL as part of the LTMMP. The activities include monitoring of air, surface soil, vadose zone, groundwater, and biota. Monitoring methods, frequencies, analytical parameters, and EPA Test Methods (EPA November 1986) are also presented.

3.1 Introduction

The primary objective of the monitoring activities at the MWL is to ensure that the final remedy and site conditions are protective of human health and the environment. Long-term monitoring of the air, surface soil, vadose zone, groundwater, and biota will be conducted at the MWL for the foreseeable future. Air will be monitored for radon; surface soil will be monitored for tritium, metals, and gamma-emitting radionuclides; the vadose zone will be monitored for volatile organic compounds (VOCs) and moisture; groundwater will be monitored for VOCs, specific metals, and radionuclides (tritium, gamma-emitting radionuclides, and gross alpha/beta activity); and vegetation will be monitored for gamma-emitting radionuclides.

Although monitoring is planned for radionuclides in various media at the MWL, the information related to radionuclides is provided voluntarily by DOE/Sandia. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements imposed by NMED, as specified in Section III.A of the Consent Order (NMED April 2004).

A summary of the long-term monitoring program, including information on the frequency, parameters, and monitoring methods, is presented in Table 3.1-1. The media-specific monitoring activities and more detailed information on analytical methods are presented in Sections 3.2 through 3.6. The SAPs and Monitoring Plans (MPs) for each type of monitoring are provided in Appendices C through G.

Changes to sampling parameters, monitoring frequencies, or other aspects of the long-term monitoring program may be warranted as trends are established and additional data needs are identified. If changes to the monitoring program are warranted, DOE/Sandia will submit a permit modification request in writing to NMED. More information regarding revising this LTMMP is provided in Section 1.4.6.

3.2 Air Monitoring

Air monitoring for radon shall be conducted at the MWL along the perimeter and at select locations on the ET Cover. This section discusses the rationale and approach for radon air monitoring, and why air monitoring for tritium and other radionuclides will not be performed.

Table 3.1-1
Summary of Long-Term Monitoring Parameters, Frequencies, and Methods
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Sampling Media	Monitoring Parameters[a]/ Constituents of Concern	Monitoring Frequency[a]	Number of Samples Per Event	Locations	Monitoring Method	Comments
Air	Radon	Year 1 – Quarterly Year 2 – Quarterly Year 3 – Semiannual Year 4 – Semiannual Year 5 and subsequent years – Annual	17	10 detectors placed at corners and midpoints of perimeter fence 5 detectors placed on completed cover 2 detectors at background locations (TBD)	Track-etch detectors (at breathing level); sampling and analysis per Appendix C	Samples are time-weighted average and will be collected over a 3-month period.
Surface Soil	Tritium	Annual	4	One sample collected from each corner of the MWL ET Cover.	Grab samples of soil collected; moisture extracted and analyzed for tritium using liquid scintillation	Samples will continue to be collected from the original MWL ground surface at the four corners of the ET Cover.
Vadose Zone	VOCs in soil vapor	Year 1 – Semiannual Year 2 – Semiannual Year 3 – Semiannual Year 4 and subsequent years – Annual	17	Samples collected from 3 perimeter multi-port FLUTe™ or equivalent wells (5 sampling ports per well) and 2 single-port soil-vapor monitoring points installed through the ET Cover	Sampling and analysis per Appendix D (Compendium Method TO-15 or equivalent). Table 3.4.1-1 presents list of analytes	The 3 multiport FLUTe™ wells or equivalent are proposed and located at the MWL perimeter. Sampling ports planned for depths of 50, 100, 200, 300, and 400 ft bgs. The 2 single-port soil-vapor monitoring points have a sampling port approximately 35 ft below the original ground surface.
Vadose Zone	Moisture content underneath the ET Cover	Year 1 – Semiannual Year 2 – Semiannual Year 3 and subsequent years – Annual	171	3 soil-moisture monitoring access tubes Measurements obtained at 1-ft increments from 4 ft to 25 ft bgs, then 5-ft increments to total depth of the access tube (200 linear ft)	Soil-moisture monitoring per Appendix E	Moisture content in vadose zone beneath the cover is measured using a neutron probe to evaluate moisture infiltration through the ET Cover.

Refer to footnotes at end of table.

Table 3.1-1 (Concluded)
Summary of Long-Term Monitoring Parameters, Frequencies, and Methods
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Sampling Media	Monitoring Parameters[a]/ Constituents of Concern	Monitoring Frequency[a]	Number of Samples Per Event	Locations	Monitoring Method	Comments
Groundwater	VOCs, metals, tritium, radon, gamma-emitting radionuclides (short list), and gross alpha/beta activity	Semiannual	4	MWL compliance groundwater monitoring well network: MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9	Sampling and Analysis per Appendix F. Table 3.5.4-1 lists specific analytes and EPA Methods[b]	Monitoring wells MWL–MW4, MWL-MW5, and MWL-MW6 will be retained for information only.
Biota – Surface Soil	RCRA Metals plus Cu, Ni, V, Zn, Co, and Be; and gamma-emitting radionuclides (short list)	Annual	Up to 4 (2 each, if they exist)	Variable - ant hills and animal burrows on the MWL ET Cover located during ET Cover inspections, if present	Grab sampling and analysis of surface soil at animal burrow and/or ant hill feature per Appendix G	Soil sampling will be performed in August or September to evaluate potential for mobilization of contaminants by biota. If no features are identified, no samples will be collected.
Biota – Cover Vegetation	Gamma-emitting radionuclides (short list) in vegetation	Annual	Up to 2 if they exist	Variable - potentially deep-rooted vegetation overlying former disposal areas located during ET Cover inspections, if present	Grab sampling and analysis of vegetation, including the plant and root system per Appendix G	Vegetation sampling will be performed in August or September to evaluate potential for mobilization of contaminants by plants. If no potentially deep-rooted plants are present, no samples will be collected.

[a]Monitoring parameters and frequency will be reevaluated every five years in the Five-Year Reevaluation Report.
[b]EPA November 1986.
bgs = Below ground surface.
EPA = U.S. Environmental Protection Agency.
ET = Evapotranspirative.
FLUTe™ = Flexible Liner Underground Technologies.
ft = Foot (feet).
MWL = Mixed Waste Landfill.
RCRA = Resource Conservation and Recovery Act.
TBD = To be determined.
TO-15 = EPA Method TO-15 (EPA January 1999).
VOC = Volatile organic compound.

3.2.1 Radon

The MWL fate and transport model predicts no potential for release of radon-222 into the atmosphere in excess of regulatory standards, as long as the sealed sources containing radium-226 within the MWL inventory remain intact (Ho et al. January 2007). This modeling prediction is consistent with the results from two studies conducted in 1997 and 2008 to measure radon surface flux from the MWL (Haaker January 1998, ERG April 2008). Both studies, which involved placement of 4-inch-diameter activated charcoal radon canisters across the MWL surface, evaluated radon surface fluxes in the vicinity of the MWL and at background locations. The results showed that the radon fluxes above the MWL are not significantly different from background values. A comparison of the 1997 and 2008 results shows that radon emissions for the MWL and background areas have not changed significantly from 1997 to 2008 (SNL/NM August 2008). The median radon flux in the vicinity of the MWL was 0.33 pCi per square meter (m^2) per second (s), while the median background flux was 0.35 pCi/m^2/s in 1997 (Haaker January 1998). In April 2008 the average flux recorded for the MWL was 0.33 pCi/m^2/s, which is below the background mean of 0.60 pCi/m^2/s. The maximum measured fluxes for the MWL were 1.02 pCi/m^2/s in 1997 and 0.43 pCi/m^2/s in 2008.

The MWL fate and transport model also predicts that if the sealed sources containing radium-226 degrade over time, a potential exists for radon to be emitted to the atmosphere at concentrations that exceed regulatory standards. For this reason, radon monitoring will be conducted to determine whether significant quantities of radon are being emitted from the MWL surface. Commercially available track-etch detectors will be utilized to measure the radon concentrations in air. Radtrak® radon gas track-etch detectors, or equivalent, will be used and are designed to monitor radon exposure over long exposure periods, on the order of three to six months, to obtain long-term average concentrations. These detectors will provide an integrated average concentration of radon in air over long exposure periods. The alternative monitoring detectors, charcoal canisters, are useful for only short exposure periods, on the order of a few days.

Radon monitoring locations within the MWL boundary were selected based upon the MWL inventory (SNL/NM June 1998), and Table 3.2.1-1 list pits and trenches containing radium-226. Figure 3.2.1-1 shows the relative locations of these pits and trenches within the MWL. As Table 3.2.1-1 indicates, four of the MWL pits contain millicurie quantities of radium-226 (a potential source for radon at the MWL). Because these pits contain the highest concentrations of radium-226, radon emissions from these pits would have the greatest potential to exceed the regulatory standard, should the sealed sources degrade over time. For this reason, these pits will be monitored for radon emissions.

The fifth radon sampling point within the MWL boundary will be located over Trench D, where a damaged radium-226 source was disposed. The exact location of the source in Trench D is unknown. The detector will be placed above the middle of the trench.

Figure 3.2.1-2 shows the radon sampling locations. All detectors will be placed on posts approximately 3 to 5 feet above the ground surface. Ten detectors (RN1 through RN10) will be placed on the MWL perimeter fence, five detectors (RN11 through RN15) will be placed at locations within the MWL boundary above pits and trenches with radium-226 sealed sources, and two detectors (RN16 and RN17) will be placed at locations within TA-III away from the MWL to characterize background radon concentrations.

Table 3.2.1-1
Pits and Trenches Containing Radium-226 at the Mixed Waste Landfill
Sandia National Laboratories, New Mexico

Location	Ra-226 Quantity (mCi)	MWL Inventory Listing[a]
Trench D	Unknown	Damaged Ra-226 source in plastic holder
Pit 33	250	Ten 25-mCi Ra-226 sources encapsulated in concrete-filled 55-gallon drums
Pit 31	4.01	One 10-µCi Ra-226 ionostat; one 4-mCi Ra-226/Be source
Pit 16	3.12	Two nonfunctional 1.5-mCi Ra-226 ionization alphatron gauges encapsulated in a concrete-filled A/N can; twenty 5-µCi Ra-226/Be sources in lead container encapsulated in concrete-filled, A/N can; two 10-µCi Ra-226/Be sources in lead container encapsulated in a concrete-filled, 5-gallon A/N can
Pit 24	1.5	Three 500-µCi Ra-226 sources
Pit 32	<1.0	Ra-226, Na-22, Ba-133, Co-60, Co-57, Mo-54, and mixed isotopes (1.0 mCi) in lead pig
Pit 26	0.86	Four 10-µCi Ra-226/Be sources in a lead container encapsulated in concrete-filled, 55-gallon drum; five sealed 160-µCi Ra-226 sources; two sealed 10-µCi Ra-226 check sources; eighteen 1.8-µCi Ra-226 ionization alphatron gauges encapsulated in concrete-filled, 32-gallon A/N can
Pit 17	0.5	One 0.5-mCi Ra-226/Be source
Pit 13	0.1103	One 98-µCi Ra-226 source, one 1.3-µCi Ra-226 source, two 5-µCi Ra-226 sources, and one 1-µCi Ra-226 source encapsulated in concrete-filled A/N can
Pit 15	0.107	One 102.1-µCi Ra-226/Be source and one 5.5-µCi source encapsulated in a concrete-filled, 55-gallon drum; fume hood filters; and filter housings
Trench C	0.1	One 0.1-mCi Ra-226/Be source encapsulated in concrete-filled A/N can
Pit 18	0.07	Seven 10-µCi Ra-226/Be sources in a lead container encapsulated in concrete-filled, 55-gallon drum
Pit 25	0.0516	One 11.6-µCi Ra-226 dew pointer in brass cylinder; four 10-µCi Ra-226/Be sources in a lead container encapsulated in concrete-filled, 55-gallon drum

[a]SNL/NM June 1998.
µCi = Microcurie(s).
mCi = Millicurie(s).
MWL = Mixed Waste Landfill.

Figure 3.2.1-1
Pits and Trenches Containing Radium-226 at the Mixed Waste Landfill

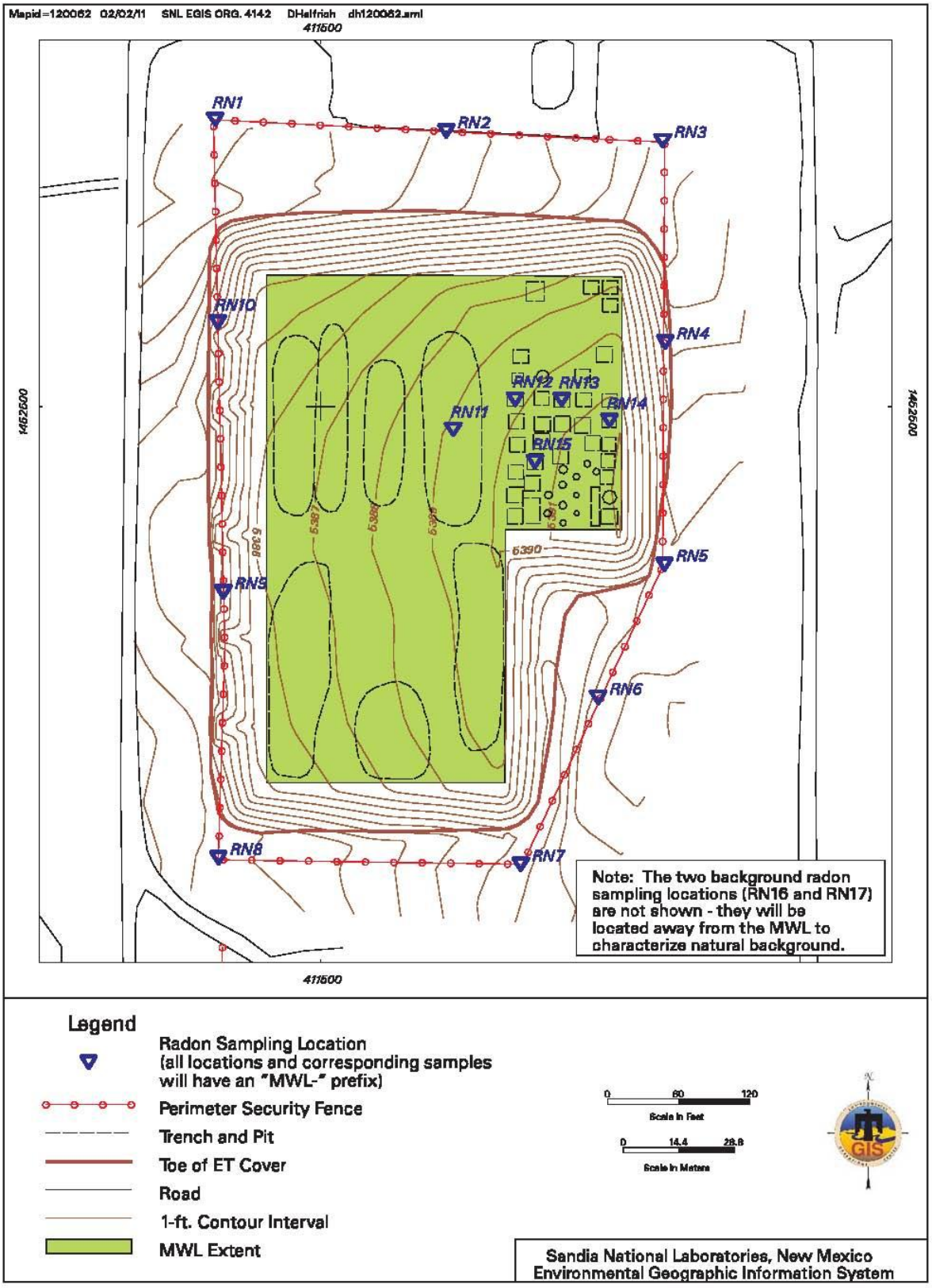

Figure 3.2.1-2
Radon Sampling Locations at the Mixed Waste Landfill

The Radtrak® radon gas alpha-track detector has a radiosensitive element that records alpha particle emissions (alpha tracks) from the natural radioactive decay of radon. After exposure, the detectors are returned to the manufacturer for analysis, and the alpha tracks are counted using computer-assisted image analysis equipment. The number of alpha tracks along with the deployment time period provides the basis for calculating the average radon concentration. The resulting data are reported in pCi of radon per liter (L) of air.

Radon monitoring will be conducted quarterly for the first two years to establish initial concentration data, semiannually for the following two years, and annually thereafter. Results will be compiled and compared with the trigger level in the annual MWL long-term monitoring and maintenance report. The trigger level and evaluation process for radon in air are discussed in Section 5.2.1, and additional details for the radon monitoring are presented in Appendix C, "Air Sampling and Analysis Plan for the Mixed Waste Landfill."

3.2.2 Tritium and Other Radionuclides

Air monitoring for tritium and radionuclides other than radon will not be conducted due to the significant decline in tritium emissions from the MWL over the last decade, as well as the lack of a reasonable transport scenario to the atmosphere for other radionuclides. Although the MWL is a diffuse source for tritium to the environment, studies conducted during 1992, 1993, and 2003 reveal that tritium concentrations released to the atmosphere are at low levels and do not pose a threat to human health or the environment (Radian Corporation September 1992, November 1992, and 1994; URS Corporation February 2004). These studies indicate that, as expected, tritium concentrations released from the MWL to the atmosphere declined significantly during the 10-year period from 1993 to 2003. The estimated tritium emitted from the MWL to the atmosphere in 1993 was 0.486 Ci/yr, while the estimated tritium emitted from the MWL in 2003 was 0.090 Ci/yr. This significant reduction reflects the natural radioactive decay of tritium and its relatively short half-life of 12.3 years. Because tritium levels in the MWL inventory will continue to decline due to radioactive decay, concentrations released to the atmosphere will also continue to decline.

The maximum predicted dose to an exposed site worker and an off-site worker was orders of magnitude below regulatory limits in 1993 (Phase 2 RFI; SNL/NM September 1996) and even lower in 2003. Because it is highly unlikely that tritium could be released from the MWL to the atmosphere above regulatory limits, long-term monitoring of tritium in air at the MWL will not be conducted.

Similarly, there is no reasonable scenario for the transport of other radionuclides from the MWL to the air pathway. Tritium is the primary radionuclide disposed of at the MWL with the potential to move through vapor transport upward into the atmosphere. The remaining radionuclides within the MWL inventory are relatively immobile and are buried under 3 feet or more of backfill, up to 3.3 feet of subgrade soil, and on average another 5.37 feet of rock and soil (Biointrusion, Native Soil, and Topsoil Layers). Because no reasonable scenario exists for the potential transport of radionuclide contaminants upward through the ET Cover and into the atmosphere, no air monitoring for other radionuclides will be performed at the MWL.

3.3 Tritium Surface Soil Monitoring

Surface soil monitoring will be performed for tritium, which is the primary constituent of concern based upon the MWL Phase 2 RFI (SNL/NM September 1996) and the most mobile radionuclide disposed of at the MWL. Surface soil samples for metals and radionuclides will be collected at animal burrows and/or ant hills to address potential mobilization of contaminants by biota and are discussed in Section 3.6.

The SNL/NM Terrestrial Surveillance Program has monitored concentrations of tritium and gamma-emitting radionuclides in surface soil at the MWL on an annual basis since 1985. As part of the SNL/NM Terrestrial Surveillance Program, soil samples are collected annually at the four corners of the MWL (outside the former perimeter fence) and analyzed for tritium and gamma-emitting radionuclides using liquid scintillation and gamma spectroscopy, respectively. As the ET Cover Subgrade Layer (2006) and later the ET Cover (2009) were completed, the soil sampling locations were moved laterally to the corners of the toe of the slope so the samples could be collected from the original ground surface. Starting in 2010, the tritium surface soil samples have been collected at the four corners of the ET Cover side slopes; these locations will continue to be used for long-term tritium monitoring (Figure 3.3-1). Tritium is routinely detected in soil samples, with the highest concentrations most often detected at the northeastern corner of the MWL at location TS-2NE. These concentrations have been diminishing with time due to natural radioactive decay of tritium. During the 2008 MWL soil-vapor investigation, tritium soil samples were collected from the subsurface in the immediate vicinity of the disposal areas. These samples had significantly higher tritium activities than the surface samples collected by the Terrestrial Surveillance Program (SNL/NM August 2008). The conservative risk assessment performed as part of the 2008 investigation used the maximum activity of tritium detected and assumed it was on the surface of the MWL. The risk assessment calculations show that tritium activities at the MWL do not pose a threat to human health or the environment (SNL/NM August 2008).

DOE/Sandia will continue to sample surface soil at the four corners of the MWL (Figure 3.3-1) on an annual basis to allow long-term data trending in accordance with the MWL Tritium and Biota SAP presented in Appendix G. The locations represent the closest available points to the original MWL corners where the original land surface can be sampled without disturbing the ET Cover. Tritium is very mobile and should a significant release of tritium from the subsurface occur, increased tritium would be detected in soil samples during the annual sampling events. Results will be compiled and compared with the trigger level in the annual MWL long-term monitoring and maintenance report. The trigger level and evaluation process for tritium in surface soil are discussed in Section 5.2.2.

3.4 Vadose Zone Soil-Vapor and Soil-Moisture Monitoring

The vadose zone beneath the MWL extends nearly 500 feet from ground surface to groundwater. Because VOCs released from the MWL have the potential to migrate via the soil-vapor phase to groundwater (Ho et al. January 2007), a monitoring system is planned for the vadose zone at the MWL to serve as an early detection system for protecting groundwater. This system will provide timely evidence of potential threats to groundwater and will allow corrective action to be initiated before groundwater contamination occurs.

Long-term monitoring of the vadose zone is planned for both soil vapor (VOCs) and moisture content to provide assurance that the MWL site conditions remain protective of human health

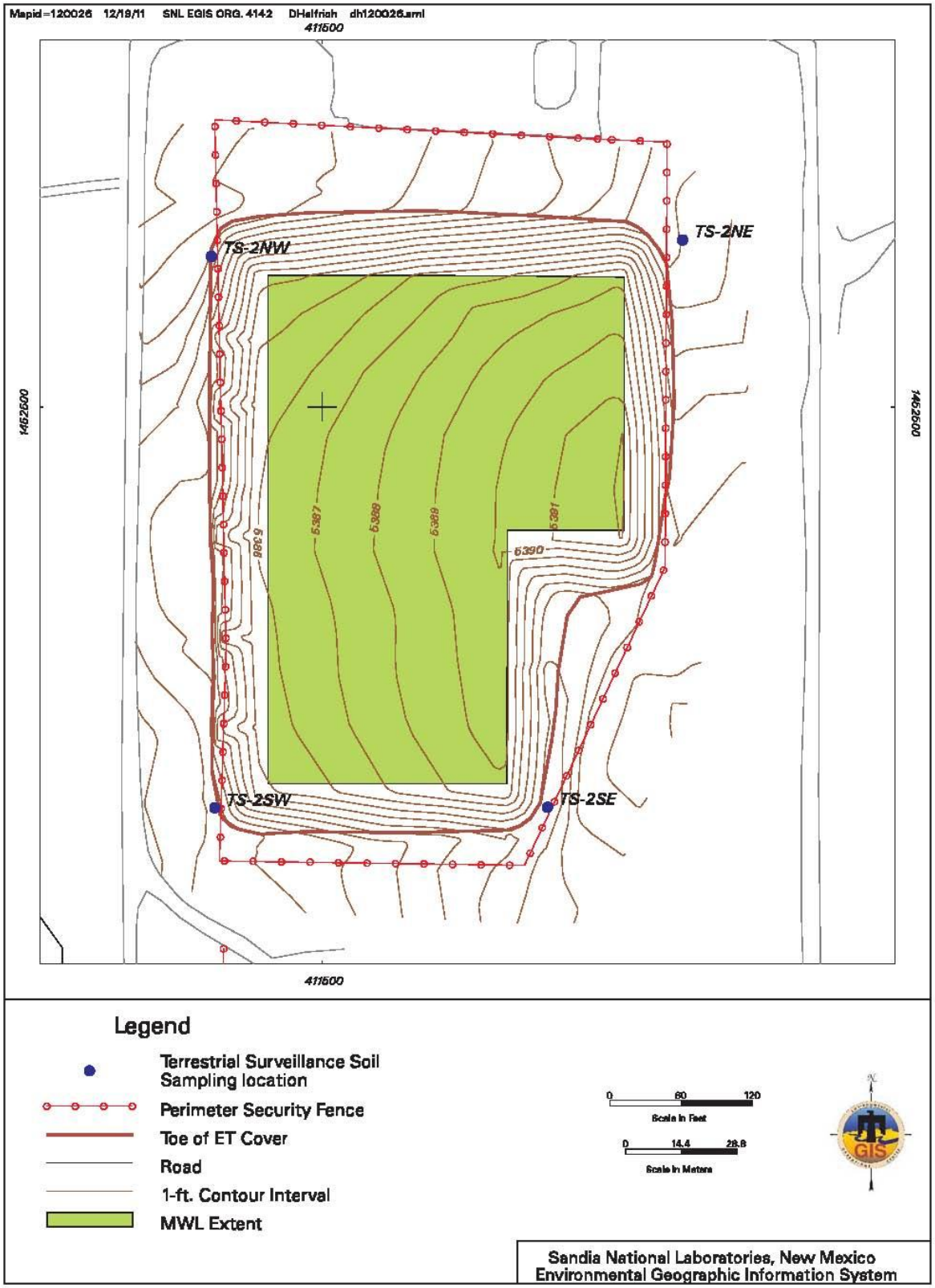

Figure 3.3-1
Soil Sampling Locations for Tritium at the Mixed Waste Landfill

and the environment. The details of the monitoring systems for VOCs and moisture content are presented in the following sections.

3.4.1 Vadose Zone Soil-Vapor Monitoring for VOCs

VOCs are the most mobile of the hazardous constituents detected in the soil beneath the MWL. During the MWL Phase 2 RFI, two passive and three active soil-gas surveys at the MWL showed the presence of low concentrations of VOCs in soil gas (soil vapor) (SNL/NM September 1996). Low concentrations of VOCs were also detected in subsurface soil samples collected from boreholes drilled during the MWL Phase 2 RFI (SNL/NM September 1996). More recently (2008) a second soil-vapor survey was conducted to determine whether the survey data collected during the 1990s were still representative of site conditions. The 2008 soil-vapor survey results show that, in general, vadose zone VOC concentrations have decreased since 1994 (SNL/NM August 2008).

VOC concentrations in the vadose zone will be monitored using two existing single-port soil-vapor monitoring wells installed through the MWL ET Cover and three proposed Flexible Liner Underground Technologies (FLUTe™) or equivalent multi-port soil-vapor monitoring wells (hereinafter referred to as FLUTe™ or equivalent wells). The three multi-port FLUTe™ or equivalent wells will provide VOC concentration data at various depths beneath the MWL, whereas the single-port soil-vapor monitoring wells will monitor VOC concentrations immediately beneath the disposal areas. Together these five soil-vapor monitoring wells will provide a robust monitoring system to characterize VOC soil-vapor concentrations throughout the thick vadose zone beneath the MWL and provide an early detection system for the protection of groundwater from the downward movement of the most mobile contaminants.

In early August 2009, during MWL ET Cover construction, two single-port soil-vapor monitoring wells (MWL-SV01 and MWL-SV02) were installed as required by NMED (Bearzi December 2008). The location, depth, and construction of the two monitoring wells were selected and approved by NMED prior to installation as documented in the Installation Report presented in Appendix A. The wells were installed with a Geoprobe Systems® direct-push drilling rig and include polyethylene tubing connected to a single, 6-inch-long by ½-inch-diameter, stainless steel screen (i.e., sampling port). The locations of MWL-SV01 and MWL-SV02 were selected based upon the highest VOC soil-vapor detections identified during the 1994 and 2008 subsurface soil-vapor surveys. The depth of the sampling ports is approximately 35 feet below the original surface of the MWL and 10 feet below the bottoms of the waste trenches and pits. These wells were installed immediately after placement of the topsoil layer, but prior to tilling, seeding, and mulching this layer, to minimize the impact of drilling and installation activities on the ET Cover.

The FLUTe™ or equivalent wells will be constructed in vertical boreholes located immediately outside the perimeter of the ET Cover near locations where the highest concentrations of VOCs have been detected during earlier studies at the MWL. Soil-vapor sampling ports are planned to be installed in each FLUTe™ or equivalent well at depths of 50, 100, 200, 300, and 400 feet bgs. Figure 3.4.1-1 shows the existing locations of the two single-port soil-vapor monitoring wells (MWL-SV01 and MWL-SV02) and the proposed locations of the three FLUTe™ or equivalent wells (MWL-SV03, MWL-SV04, and MWL-SV05).

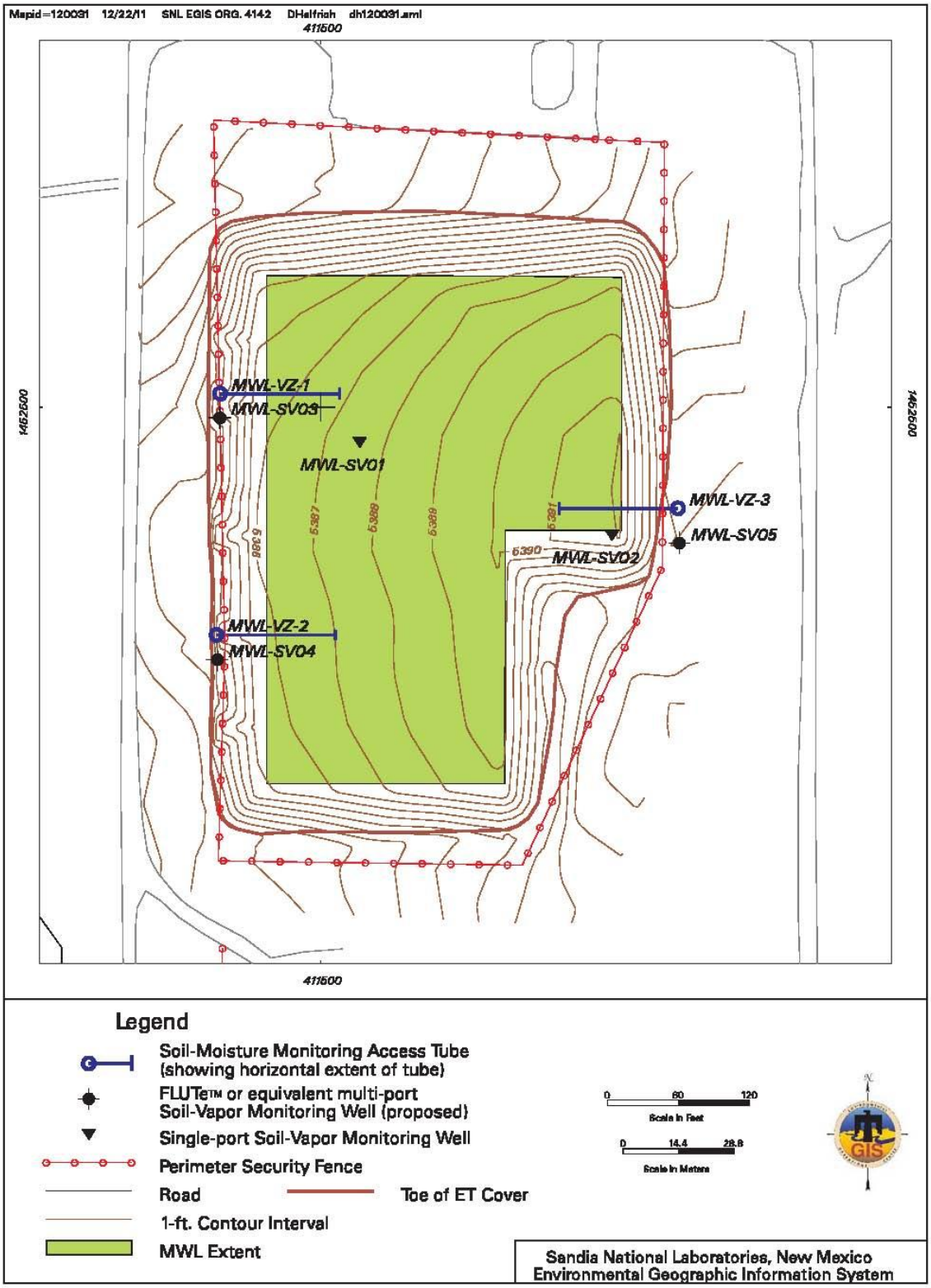

Figure 3.4.1-1
Soil-Vapor Monitoring Well and Soil-Moisture Monitoring Access Tube Locations at the Mixed Waste Landfill

Data collected from the soil-vapor monitoring well network will be used to assess VOC distributions with depth and to monitor VOC concentrations over time. Soil-vapor samples will be collected and analyzed for the VOCs listed in Table 3.4.1-1 according to EPA Compendium Method TO-15 or equivalent (EPA January 1999) semiannually for the first three years and

Table 3.4.1-1
Mixed Waste Landfill Soil-Vapor Monitoring Analyte List[a]

Compound	Compound
Acetone	1,2-Dichloropropane
Benzene	cis-1,3-Dichloropropene
Benzyl chloride	trans-1,3-Dichloropropene
Bromodichloromethane	Ethyl benzene
Bromoform	4-Ethyltoluene
Bromomethane	Hexachlorobutadiene
2-Butanone	2-Hexanone
Carbon disulfide	Methylene chloride
Carbon tetrachloride	4-Methyl-2-pentanone
Chlorobenzene	Styrene
Chloroethane	1,1,2,2-Tetrachloroethane
Chloroform	Tetrachloroethene
Chloromethane	Toluene
Dibromochloromethane	1,1,2-Trichloro-1,2,2-trifluoroethane
1,2-Dibromoethane	1,2,4-Trichlorobenzene
1,2-Dichloro-1,1,2,2-tetrafluoroethane	1,1,1-Trichloroethane
1,2-Dichlorobenzene	1,1,2-Trichloroethane
1,3-Dichlorobenzene	Trichloroethene
1,4-Dichlorobenzene	Trichlorofluoromethane
Dichlorodifluoromethane	1,2,4-Trimethylbenzene
1,1-Dichloroethane	1,3,5-Trimethylbenzene
1,2-Dichloroethane	Vinyl acetate
1,1-Dichloroethene	Vinyl chloride
cis-1,2-Dichloroethene	m-, p-Xylene
trans-1,2-Dichloroethene	o-Xylene

[a]EPA Method TO-14 analyte list that was used for the 1994 and 2008 Soil-Vapor Surveys (SNL/NM August 2008).
EPA = U.S. Environmental Protection Agency.

annually thereafter. This approach allows for early identification of potential threats to groundwater from the most mobile MWL constituents of concern (i.e., VOCs).

The results will be compiled and compared with the trigger levels in the annual MWL long-term monitoring and maintenance report. The annual report will also present summary data tables listing trichloroethene (TCE), tetrachloroethene (PCE), and total VOC results, organized by well and port, and laboratory data sheets providing all TO-15 or equivalent results. After the first three years of semiannual monitoring are completed, concentration versus time graphs will be presented. The trigger levels and evaluation process for VOCs in the vadose zone are discussed in Section 5.2.3. The Soil-Vapor SAP for the MWL is presented in Appendix D.

3.4.2 Soil-Moisture Monitoring

A soil-moisture monitoring system has been installed beneath the MWL and consists of three soil moisture access tubes drilled at a 30-degree angle (from vertical) directly below waste disposal cells. Using this system, infiltration through the cover shall be monitored in the vadose zone beneath the MWL. The monitoring system functions as an early detection system, providing infiltration and cover performance information.

In August 2003, three angled, 4.5-inch-outside-diameter, 3.75-inch-inside-diameter steel access tubes were installed in the shallow vadose zone directly beneath the MWL, two angled eastward and one angled westward (Figure 3.4.1-1). The access tubes (MWL-VZ-1 through MWL-VZ-3) are located at the outer edge of the ET Cover to provide optimal coverage beneath the MWL without compromising the integrity of the cover. The tubes are spaced at equal increments in a north-south direction, with the east access tube (MWL-VZ-3) halfway between the two west access tubes (MWL-VZ-1 and MWL-VZ-2). The tubes were installed using the Resonant Sonic drilling technique. Resonant Sonic is the preferred drilling technique for this application because it fluidizes and displaces the surrounding soil as the drill string advances, creating a very tight fit between the drill string and the formation.

Each access tube is completed at the toe of the ET Cover side slopes. Each borehole was drilled 200 linear feet at 30 degrees to a true vertical depth of 173 feet (Figure 3.4.2-1). Each tube remains open to the vadose zone at the bottom, and a protective cover constructed of steel pipe extends approximately 2 feet bgs and 3 feet aboveground. Each protective cover is fitted with a locking cap. A 3- by-3-foot concrete pad has been constructed around each protective cover to prevent preferential flow down the annulus, and protective bollards have been placed at the outer corners of each concrete pad.

Moisture content with depth shall be monitored using a neutron probe, a technique developed in the 1950s that provides an efficient and reliable method for monitoring soil moisture. The neutron probe consists of a source of fast (energized) neutrons, a detector of slow (thermalized) neutrons, and an electronic gauge to monitor the flux of slow neutrons scattered by the soil. The probe is lowered into the access tube, and the emitted neutrons interact with soil water surrounding the tube and are detected by the instrument. Because energized neutrons can easily travel through steel, the steel access tube is essentially invisible to the neutrons, allowing direct measurement of moisture in the surrounding soil.

Moisture content shall be measured semiannually for the first two years and annually thereafter using neutron logging. The data will be compared to baseline moisture content data collected prior to deployment of the ET Cover. This method allows cover performance to be assessed without compromising the integrity of the ET Cover. A significant increase in moisture content beneath the MWL may indicate that the ET Cover is not performing as originally designed and that infiltration through the cover is greater than originally predicted. Moisture content data will be evaluated to ensure that the performance objective of infiltration through the ET Cover is less than the EPA-prescribed technical equivalence criteria of 10^{-7} centimeters (cm)/s (equivalent to 31.5 millimeters [mm]/yr). Results will be presented in soil moisture versus depth graphs and compared with the trigger level in the annual MWL long-term monitoring and maintenance report. The trigger level and evaluation process for soil moisture in the shallow vadose zone are discussed in Section 5.2.3.2, and Appendix E presents the MWL Soil-Moisture MP.

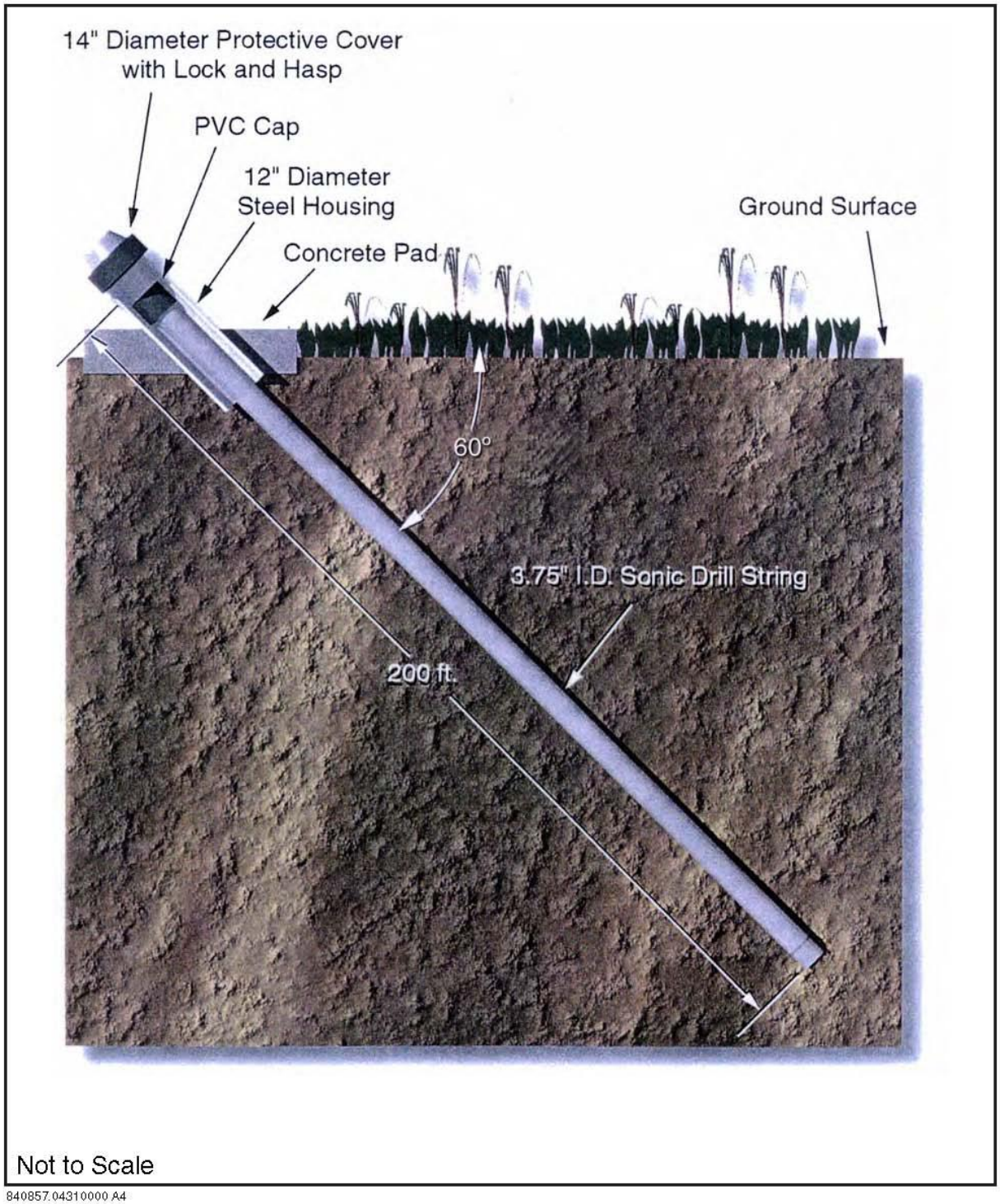

Figure 3.4.2-1
Soil-Moisture Monitoring Access Tube, Mixed Waste Landfill

3.5 Groundwater Monitoring

Since 1990, groundwater in the area of the MWL has been extensively characterized for major ion chemistry, VOCs, semivolatile organic compounds, nitrate, metals, radionuclides, and perchlorate. Data collected indicate that groundwater has not been contaminated by releases from the MWL (Goering et al. December 2002; SNL/NM November 2001, January 2002, April 2002, July 2002, October 2002, April 2003, September 2003, April 2004; Lyon and Goering April 2005; SNL/NM November 2006, January 2008, May 2009, June 2010, and September 2011). The following sections present information on the MWL groundwater monitoring network, plug and abandonment (P&A), well replacement, and monitoring parameters and frequency.

3.5.1 MWL Monitoring Well Network

The MWL groundwater monitoring well network was modified in 2008 (SNL/NM May 2009). Due to declining water levels, four monitoring wells (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) were plugged and abandoned, and four new monitoring wells (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) were installed. The monitoring wells and installation reports were approved by NMED (Bearzi October 2008b and January 2009). The MWL monitoring well network (Figure 3.5.1-1) consists of seven wells completed within interfingering, fine-grained alluvial fan deposits and coarse-grained Ancestral Rio Grande deposits (Goering et al. December 2002, SNL/NM June 2010). This network includes one background well (MWL-BW2), one on-site well (MWL-MW4), and five downgradient wells (MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9). All seven wells are constructed of 5-inch, Schedule 80 polyvinyl chloride (PVC) casing and slotted well screens. Table 3.5.1-1 presents well construction information and recent water levels measured in existing monitoring wells. Well database summary sheets showing monitoring well completion diagrams are presented in Appendix H.

Monitoring well MWL-MW4 was installed in 1993 directly beneath a disposal trench and completed at an angle of 6 degrees from vertical, with two discrete well screen intervals 20 feet apart to evaluate various aquifer parameters with depth. An inflatable packer separates the screened intervals, and pressure is maintained in the packer to prevent the mixing of water from the two screened sections of the aquifer. Monitoring wells MWL-MW5 and MWL-MW6 were installed in 2000 with their respective screen intervals in the Ancestral Rio Grande sediments, below the top of the regional aquifer water table. While these three wells will be retained for information purposes (water levels, water quality parameters, other data as needed), they are not part of the MWL compliance network for long-term groundwater monitoring required analytes.

The long-term groundwater monitoring compliance network consists of the four wells installed in 2008 screened across the uppermost part of the regional aquifer: MWL-BW2 (upgradient background well) and MWL-MW7, MWL-MW8, and MWL-MW9 (downgradient wells). The point-of-compliance is defined as the three downgradient wells (MWL-MW7, MWL-MW8, and MWL-MW9) located along the western MWL boundary at the toe of the ET Cover.

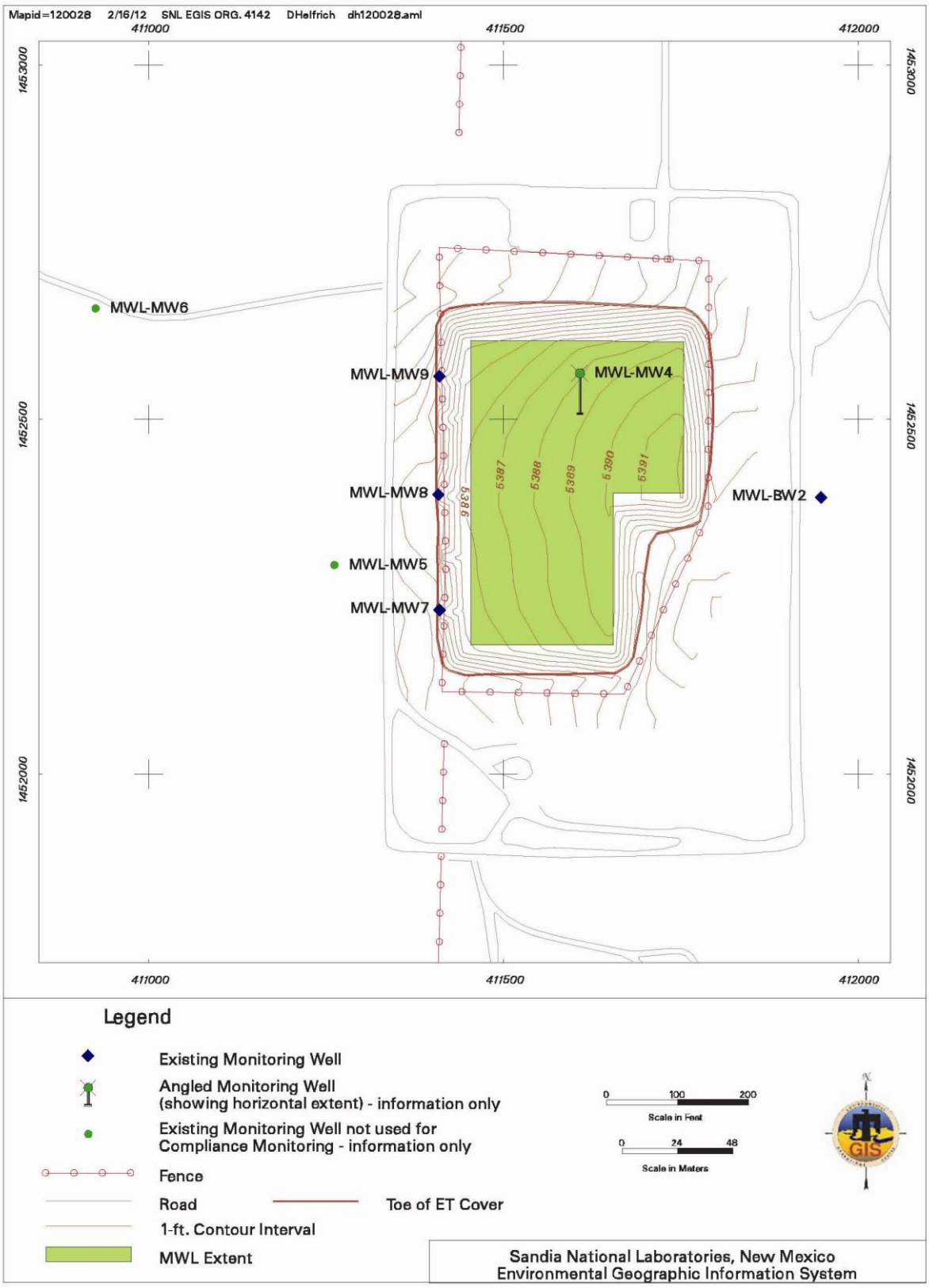

Figure 3.5.1-1
Mixed Waste Landfill Groundwater Monitoring Wells

Table 3.5.1-1
Monitoring Well Construction Details and Recent Water Levels
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Monitoring Well	Top of Inner Casing[a] (FAMSL)	Ground Surface Elevation (FAMSL)	Well Depth (FBGS)	Top of Well Screen (FBGS)	Bottom of Well Screen (FBGS)	Bottom of Well Screen (FAMSL)	October 2011 Measured Depth to Water (FBGS)	October 2011 Water Level (FAMSL)	Screened Lithology	Comments
Compliance Wells										
MWL-BW2	5391.02	5388.70	502.0	467.0	497.0	4891.70	478.64	4912.38	Alluvial Fan	Screen intervals are across the upper surface of the regional aquifer.
MWL-MW7	5383.30	5380.90	498.80	464.7	494.0	4886.90	489.35	4893.95	Alluvial Fan	
MWL-MW8	5384.67	5382.40	500.00	465.0	495.0	4887.40	490.98	4893.69	Alluvial Fan	
MWL-MW9	5381.91	5379.30	500.00	465.0	495.0	4884.30	491.60	4890.31	Alluvial Fan	
Information Only Wells										
MWL-MW4[b] (upper)	5391.70	5390.20	511.09[c]	488.4	508.4	4879.11	501.02	4893.42[d]	Alluvial Fan	Well contains two screens 20 feet apart, hydraulically separated by a pneumatic packer.
MWL-MW4[b] (lower)	5391.70	5390.20	553.9	528.4	548.4	4841.80	NM	NM	Alluvial Fan/ Ancestral Rio Grande	
MWL-MW5	5382.56	5380.40	521.50	496.5	516.5	4863.90	493.29	4889.27	Alluvial Fan/ Ancestral Rio Grande	Screen intervals are below the top of the regional aquifer.
MWL-MW6	5375.31	5372.70	530.50	505.5	525.5	4847.20	487.22	4888.09	Ancestral Rio Grande	

[a]Top of inner casing is the measurement point for the well.
[b]Well MWL-MW4 is screened at two intervals and is angled 6 degrees from vertical. All measurements and elevations not corrected for the 6 degree angle of the borehole except the October 2011 groundwater elevation.
[c]Well depth based on approximate depth (feet below ground surface) to top of the inflatable packer separating the upper and lower screen intervals.
[d]Groundwater elevation for MWL-MW4 is adjusted/corrected for the 6 degree angle of the monitoring well/borehole.
BW = Background well.
FAMSL = Feet above mean sea level.
FBGS = Feet below ground surface.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
NM = Not measured.

3.5.2 Monitoring Well Plugging and Abandonment Guidance

Requirements for monitoring well replacement are presented in the Consent Order (NMED April 2004). MWL monitoring wells will be plugged and abandoned when they are no longer required in the monitoring network, no longer provide representative groundwater samples because of declining water levels or insufficient productivity, or become damaged beyond repair. The goal of well abandonment is to seal the well in such a manner that it cannot act as a conduit for the migration of contaminants from the ground surface to the saturated zone. Well P&A plans will be prepared for any wells that meet these criteria and will be submitted to the NMED for approval as a permit modification. No groundwater monitoring wells at the MWL will be abandoned without prior written approval of the NMED.

3.5.3 Monitoring Well Replacement

Additional wells may be necessary to replace wells that require P&A due to the expected continual decline of regional groundwater levels. Additional monitoring wells will be constructed to the specifications provided in Sections VIII.A and VIII.B of the Consent Order (NMED April 2004).

Replacement wells for long-term monitoring at the MWL will have 30-foot-long PVC screens to maximize the monitoring life of the wells. Replacement wells will comply with the requirements of the Consent Order (NMED April 2004) as well as the guidelines established in EPA guidance, including, but not limited to, the following:

- "RCRA Groundwater Monitoring: Draft Technical Guidance," EPA/530-R-93-001 (EPA November 1992)
- "RCRA Groundwater Monitoring Technical Enforcement Guidance Document," OSWER-9950.1 (EPA September 1986)
- "Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells," EPA 600/4-89/034 (Aller et al. 1991)

3.5.4 Groundwater Monitoring Parameters, Frequency, and Reporting

The long-term groundwater monitoring compliance network comprised of the four wells installed in 2008 (Section 3.5.1) will be sampled semiannually according to the MWL Groundwater SAP presented in Appendix F. The groundwater monitoring analytical requirements and EPA Test Methods (EPA November 1986) are summarized in Table 3.5.4-1. Sampling for the other parameters may be conducted on an as-needed basis to characterize major ion chemistry and determine groundwater characteristics. The Groundwater SAP provides guidance, methods, and analytical protocols for collecting and analyzing groundwater samples during the long-term monitoring period consistent with historical monitoring at the MWL.

Table 3.5.4-1
Groundwater Monitoring Parameters, Test Methods, and Selection Criteria
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Parameter	EPA Method[a]	Monitoring Method
Volatile Organic Compounds	SW846-8260 or Equivalent	Sampling and Analysis per Appendix F
Metals: total uranium, total chromium, cadmium, and nickel	SW846-6020 or Equivalent	
Tritium	EPA 906.0 or Equivalent	
Radon	SM 7500 series	
Gamma Spectroscopy (short list)	EPA 901.1 or Equivalent	
Gross Alpha/Beta Activity	EPA 900.0 or Equivalent	

[a]EPA November 1986.
EPA = U.S. Environmental Protection Agency.
SM = Standard Methods
SW = Solid Waste.

Results will be compiled, presented, and compared with historical results and trigger levels in the annual MWL long-term monitoring and maintenance report. Time versus concentration graphs for specific constituents will be included to show data trends if appropriate. The trigger levels and evaluation process for groundwater are discussed in Section 5.2.4.

In addition to semiannual sampling and analysis, the groundwater surface (i.e., potentiometric surface) elevation, hydraulic gradient, flow direction, and flow rate will be determined annually and included in the annual MWL long-term monitoring and maintenance report.

3.6 Biota Monitoring

Biotic mobilization of contaminants is a potential transport mechanism that will be evaluated as part of the MWL long-term monitoring program. The 1.25-foot-thick Biointrusion Layer of the MWL ET Cover considerably reduces this potential. The intent of the biointrusion rock barrier is to prevent any intrusion by burrowing animals, and it should also restrict plant root growth as long as the underlying materials are relatively dry (Anderson and Forman September 2002). The potential for biotic mobilization of contaminants is also reduced by the compacted Subgrade Layer (2 to 40 inches in thickness) underlying the biointrusion barrier and the overall thickness of the ET Cover (5.37-foot average thickness; Figure 2.2-1).

Biota monitoring will include two sampling and analysis approaches. Sampling of surface soil from animal burrows and ant hills addresses the potential transport of less mobile contaminants (i.e., metals and radionuclides) by biota. Deep-rooted vegetation growing on the MWL also has the potential to uptake contaminants from the subsurface and bring them to the surface. This potential is largely eliminated by the thickness of the ET Cover and the fact that deep-rooted plant species will not be allowed to grow to maturity on the ET Cover as specified by the inspection and maintenance protocol for the ET Cover vegetation (Section 4.2). Both monitoring approaches are described in the following sections, the analytical methods are detailed in Table 3.6-1, and the SAP is presented in Appendix G.

Table 3.6-1
Biota Monitoring Parameters, Test Methods, and Selection Criteria
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Parameter	EPA Method[a]	Monitoring Method
Surface Soil Samples from Animal Burrows and/or Ant Hills		
RCRA metals[b] plus copper, nickel, vanadium, zinc, cobalt, and beryllium	SW846-6020/7470 or Equivalent	Sampling and Analysis per Appendix G
Gamma Spectroscopy (short list)	EPA 901.1 or Equivalent	
Vegetation samples		
Gamma Spectroscopy (short list)	EPA 901.1 or Equivalent	Sampling and Analysis per Appendix G

[a]EPA November 1986.
[b]RCRA metals consist of arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.
EPA = U.S. Environmental Protection Agency.
RCRA = Resource Conservation and Recovery Act.
SW = Solid Waste.

3.6.1 Surface Soil

Features such as animal burrows and ant hills will be noted and described as part of the ET Cover inspection process presented in Section 4.2. If these features are noted during routine inspections, surface soil samples will be collected to evaluate the potential for contaminant mobilization by ant and/or animal activities. Up to two ant hills and two animal burrows will be located, surveyed with a global positioning system (GPS) unit, and sampled annually if they are present. If ant hills and animal burrows are not identified on the ET Cover, this will be documented and no sampling will occur. Grab samples of surface soil will be collected from the burrow entrance and/or ant hill and analyzed for metals and gamma-emitting radionuclides (short list) (Table 3.6-1). Samples will be collected in August or September, near the end of the growing season when biota activity should be high.

Sampling locations will be presented on a site map, and the results will be presented and compared with both NMED-approved background levels for metals and radionuclides (Dinwiddie September 1997) and trigger levels (metals only) in the annual MWL long-term monitoring and maintenance report. The trigger levels and evaluation process for metals in surface soil are discussed in Section 5.2.2.

3.6.2 Vegetation

Although the potential for biotic mobilization of contaminants by deep-rooted vegetation is very low, two samples of vegetation will be collected annually near the end of the active growing season (August or September) if any plants with root systems capable of extending below the ET Cover are present. The assessment of whether any existing plants have roots potentially extending beneath the ET Cover will be performed by the staff biologist during cover inspections. If any potentially deep-rooted plants are identified over the former disposal areas, up to two plants will be sampled annually in either August or September. The grab sample(s) will include portions of the entire plant including the root system, if possible, and will be analyzed for gamma-emitting radionuclides (Table 3.6-1). Sampled locations will be surveyed with a GPS unit.

Sampling locations will be presented on a site map, and the results will be presented and evaluated in the annual MWL long-term monitoring and maintenance report. No trigger levels are established for radionuclides in vegetation.

4.0 INSPECTION/MAINTENANCE/REPAIR ACTIVITIES AND FREQUENCIES

Surveillance and maintenance will be conducted on the following systems associated with the MWL and documented on the long-term monitoring inspection checklists/forms listed as follows:

- ET Cover Vegetation and Surface – documented on the *Biology and Cover Inspection Checklist/Form*, respectively
- Surface-Water Diversion Structures – documented on the *Cover Inspection Checklist/Form*
- Groundwater, Soil-Vapor, and Soil-Moisture Monitoring Networks and Sampling Equipment – documented on Monitoring Network/Equipment-Specific Inspection Checklists/Forms (three separate forms for each monitoring network)
- Perimeter security fence, security signs, gates, locks, and survey monuments – documented on the *Cover Inspection Checklist/Form*

Inspection, maintenance, and repair of these systems shall be conducted on a regularly scheduled basis to ensure the integrity and proper functioning of the ET Cover, the monitoring networks, the surface-water diversion structures, the perimeter fence, security signs, gates, locks (i.e., access controls), and survey monuments. Repair work will be initiated as needed based upon the results of the inspections. All inspection checklists/forms are presented in Appendix I. Inspection, maintenance, repair, and associated documentation requirements are presented in the following sections.

4.1 Criteria for Successful Revegetation

In addition to routine inspection and maintenance, the ET Cover vegetation will be monitored to ensure the revegetation effort is successful. Establishing a self-sustaining native community of plants on the ET Cover is a critical element in the long-term performance of the cover.

The following information summarizes a climax plant community typical of the undisturbed ecosystem of TA-III (Peace et al. November 2004).

- Total percent foliar coverage equals 22.5 percent (i.e., 22.5 percent of the land surface is covered with living plants versus 77.5 percent bare surface area).
- Of the 22.5 percent of total foliar coverage, 19.2 percent is comprised of native perennial species and 3.3 percent is comprised of annual species, which includes native annual species and nonnative, transitory (or invasive) plant species.
- Considering only the total percentage of foliar coverage, 85.3 percent consists of native perennial species, and 14.7 percent comprises annual species (the majority of the annual species are nonnative, transitory species).

Based upon this information, the following criteria were established for achieving successful revegetation for the MWL ET Cover:

- Total percent foliar coverage equals 20 percent (i.e., 20 percent of the land surface is covered with living plants versus 80 percent bare surface area).
- Of the 20 percent total foliar coverage, 50 percent or greater comprises native perennial species and less than 50 percent comprises annual species.
- No contiguous bare spots greater than 200 square feet (approximately 14 by 14 feet) are present.

If these criteria are met, it will be concluded that the native plant community is successfully reestablished. Successful revegetation is projected to take three to five years after the initial seeding completed in September 2009. The cover monitoring, inspection, and maintenance/repair activities described in Section 4.2 will document the cover revegetation effort and determine whether or not the criteria are met. Local climate trends will have a major impact on plant growth and health and will be documented, evaluated, and summarized together with vegetation survey results in the annual MWL long-term monitoring and maintenance report.

4.2 Final Cover System Inspection/Maintenance/Repair

This section describes the inspection, maintenance, and repair process for the ET Cover vegetation and the ET Cover surface. Both of these ET Cover inspection components include maintenance and repair requirements. ET Cover inspections are documented as described in Sections 4.2.1, 4.2.2, and 4.2.3 and summarized as follows:

- Vegetation Inspection, including maintenance and repair activities are documented on the *Biology Inspection Checklist/Form*
- Cover Inspection, including maintenance and repair activities are documented on the *Cover Inspection Checklist/Form*

The results of these inspections and the associated checklists/forms will be included in the annual MWL long-term monitoring and maintenance report.

4.2.1 Vegetation Inspection

Cover vegetation monitoring shall be accomplished using a two-phase approach. The first phase will concentrate on establishing the vegetation on the cover from seed to a mature plant community. This phase is anticipated to take from three to five years, depending on many factors. Normal succession processes should occur and continue once native flora comprises 50 percent or greater of the established foliar coverage, and the total foliar coverage is 20 percent of the ET Cover surface. During this period, a staff biologist will inspect and document the inventory of the main flora populating the cover on a quarterly basis (i.e., Biology Inspection); inspect the cover for contiguous areas lacking vegetation in excess of 200 square feet, animal burrows, and ant hills; and recommend cover repairs as described in Section 4.2.3

and deemed appropriate to establish a long-term, sustainable, native plant community. Deep-rooted plants, such as four-wing saltbush and other shrubs and trees, will be removed if they are present on the cover. Although these inspections will occur quarterly until successful revegetation criteria are met, the most meaningful inspections relative to determining the foliar coverage of living plants will be the ones performed during the growing season (March through September) and, in particular, the inspection performed at the end of the growing season (August or September).

During this initial phase of quarterly monitoring, the staff biologist will be responsible for noting deep-rooted plants and interpreting signs of animal intrusion. Biota sampling presented in Section 3.6 will be implemented based upon these inspections. Biota sampling locations will be marked in the field, surveyed with a GPS unit, and shown on a site map. At the end of the fourth quarter of each annual monitoring period, the staff biologist will compile the results of the quarterly inspections in a summary report that will be included in the annual MWL long-term monitoring and maintenance report submitted to NMED.

Once native flora has been established and is self-sustaining, the second phase of monitoring will begin. Cover vegetation will be monitored by the staff biologist on an annual basis near the end of the growing season (August or September) to gauge the overall health of the cover vegetation. Based upon these observations, the staff biologist will submit in writing any recommendations for cover repairs as described in Section 4.2.3 and deemed necessary to maintain established vegetation. The presence of deep-rooted plants growing on the cover will be noted along with signs of animal intrusion, and potentially deep-rooted plants will be removed by field technicians (Section 4.2.3) within 60 days.

Barren areas greater than 200 square feet will not require immediate repair after ET Cover vegetation has been determined to meet the criteria for successful revegetation if these areas are the result of relatively short-term climate stresses (e.g., severe short-term drought) and are consistent with the surrounding undisturbed ecosystem of TA-III. Appropriate action will be determined by the staff biologist. No action will be required if it is determined that the area(s) will naturally fill in over time. However, these areas will be noted and tracked during inspections and reviewed annually by the staff biologist and project leader to determine whether action is required based upon comparison to surrounding vegetation. Related documentation will be included in the annual MWL long-term monitoring and maintenance report.

4.2.2 Cover Inspection

A field technician will perform cover inspections on a quarterly basis. Settlement of the cover surface in excess of 6 inches, erosion of the cover soil in excess of 6 inches deep, areas of ponding water on the ET Cover surface in excess of 100 square feet, animal burrows in excess of 4 inches in diameter, ant hills, contiguous areas lacking vegetation in excess of 200 square feet, and any other conditions that may impact the cover integrity or be of interest relative to site monitoring will be noted on the *Cover Inspection Checklist/Form*. Documentation of animal burrows in excess of 4 inches in diameter and contiguous areas lacking vegetation in excess of 200 square feet will be noted quarterly on the *Biology Inspection Checklist/Form* instead of the *Cover Inspection Checklist/Form* until successful revegetation criteria have been met. These features will be noted on both the quarterly *Cover Inspection* and annual *Biology Inspection Checklists/Forms* once the Biology Inspection frequency changes to annual.

4.2.3 Cover Maintenance/Repair

Field technicians will perform soil augmentations, surface scarification, reseeding, or other vegetation maintenance/repair (such as removal of deep-rooted plants) as necessary based upon inspection results. Damage to cover vegetation that exceeds the criteria listed in Section 4.2.2 will be repaired within 60 days of notation on the *Cover Inspection Checklist/Form* to a condition that meets or exceeds the original design. Repairs to the cover will be done using materials consistent with the cover installation specifications, according to soil classification and gradation specifications in the MWL CMI Plan (SNL/NM November 2005). Repair specifications include, but are not limited to, the following:

- Perform soil augmentations, surface scarification, reseeding, or other corrective actions for areas lacking vegetation in excess of 200 square feet and reestablishing the topsoil layer to provide a suitable seedbed.

- Backfill and reseed settlement and/or erosion areas exceeding a depth of 6 inches, areas of ponding water in excess of 100 square feet, and animal burrows in excess of 4 inches in diameter using either stockpiled clean soil from the cover installation (i.e., previously sampled and confirmed to meet CMI Plan specifications) or clean fill with properties meeting the MWL CMI Plan specifications. Compaction will typically not be required for repairs of the ET Cover surface to promote seedling growth and root establishment. However, in the cases of settlement or erosion areas exceeding 6 inches deep, the project leader will determine whether compaction is appropriate.

- Conduct supplemental watering to promote seedling growth in reseeded areas. If extreme climate conditions (e.g., extreme drought) could significantly jeopardize the ET Cover vegetation in the judgment of the staff biologist, additional supplemental watering may be performed across the entire ET Cover.

Supplemental watering has been an important, effective measure in the initial effort to establish a long-term sustainable native plant community on the ET Cover (Appendix B). Supplemental watering will be performed only during the long-term monitoring period if determined to be necessary by the staff biologist. Monitoring and documentation requirements and limits proposed by DOE/Sandia in 2011 (Wagner March 2011) and approved by NMED (Bearzi April 2011) shall apply to any supplemental watering performed and are summarized as follows:

- The amount of water used and the duration of each watering event will be tracked as a precipitation event, along with all natural precipitation in the vicinity of the MWL (natural precipitation will be monitored at a nearby SNL/NM meteorological monitoring station).

- Supplemental watering will be performed in a flexible manner to augment natural precipitation. Care will be taken to minimize the volume of water applied.

- No more than 3 inches of supplemental water will be applied over a 30-day period, and no more than 0.5 inches will be applied during any one daily supplemental watering event.

- The total water (natural plus supplemental) applied to any portion of the MWL ET Cover over the calendar year (CY) should not exceed 16.5 inches and will be documented in the annual MWL long-term monitoring and maintenance report submitted to NMED.

4.3 Storm-Water Diversion Structure Inspection/Maintenance/Repair

This section describes the quarterly inspection, maintenance, and repair process for the storm-water diversion structures associated with the MWL ET Cover. The inspection results and any associated maintenance and repair activities will be documented on the *Cover Inspection Checklist/Form* and included in the annual MWL long-term monitoring and maintenance report.

4.3.1 Inspection

The function of storm-water diversion structures associated with the cover is to prevent storm-water run-on from eroding the cover and to reduce the amount of water that could potentially infiltrate the cover. The storm-water diversion structures will be inspected by a field technician on a quarterly basis to verify structural integrity and ensure adequate performance. Inspections will document erosion of the channels or sidewalls in excess of 6 inches deep and accumulations of silt greater than 6 inches deep or debris that blocks more than one-third of the channel width.

4.3.2 Maintenance/Repair

Based upon the results from the storm-water diversion structure inspections, any areas that exceed the inspection criteria specified in Section 4.3.1 will be repaired within 60 days of notation on the *Cover Inspection Checklist/Form* to a condition that meets or exceeds the original design. Reseeding of the surface drainage features may also be performed to facilitate revegetation and erosion resistance, if necessary.

4.4 Groundwater and Vadose Zone Monitoring Network Inspection/Maintenance/Repair

This section describes the inspection, maintenance, and repair process for groundwater and vadose zone monitoring networks. These include groundwater monitoring wells, soil-vapor monitoring wells, soil-moisture monitoring access tubes, and associated sampling/monitoring equipment. These inspections will occur at the same frequency as the associated monitoring (Table 3.1-1). The inspections and any associated maintenance and repair activities will be documented on monitoring network-specific inspection checklists/forms and included in the annual MWL long-term monitoring and maintenance report. There is a separate inspection checklist/form for each of the three monitoring networks and associated sampling/monitoring equipment.

4.4.1 Inspection

The groundwater monitoring wells, soil-vapor monitoring wells, and soil-moisture monitoring access tubes will be inspected at the same frequency as the associated monitoring (Table 3.1-1). The inspection will note the condition of the components including protective casings and stanchions or bollards, wellhead covers/caps, locks, well casing, soil-vapor sampling ports (i.e., permanent tubing), and well identification markings. Groundwater and soil-vapor pumps and sample tubing will also be inspected prior to each sampling event. The neutron probe and cable system used for soil-moisture monitoring will be inspected as part of each soil-moisture monitoring event. Field operating procedures associated with each of the monitoring activities include operational checks for all related equipment.

4.4.2 Maintenance/Repair

The groundwater monitoring wells, soil-vapor monitoring wells, and soil-moisture monitoring access tubes components shall be maintained/repaired/replaced within 60 days of discovery of any needed repairs. Pump replacement and maintenance and tubing replacement will be performed on an as-needed basis based upon pump performance, inspections, and review of analytical sampling results. The neutron probe and cable system used for soil-moisture monitoring will be repaired and/or replaced as necessary. Maintenance activities will also include ensuring that all system components are protected from the weather to the extent possible.

4.5 Security Fence Inspection/Maintenance/Repair

This section describes the inspection, maintenance, and repair process for the perimeter security fence, gates, locks, warning signs, and survey monuments. The inspection results and any associated maintenance and repair activities will be documented on the *Cover Inspection Checklist/Form* and included in the annual MWL long-term monitoring and maintenance report.

4.5.1 Inspection

The fence, gates, locks, warning signs, and survey monuments will be routinely inspected. The inspections will document the condition of the fence, including fence wires, posts, gates, gate locks, and warning signs. In addition, excessive accumulations of wind-blown plants and debris that would obscure warning signs, block access to the MWL, or interfere with any monitoring events will be documented.

4.5.2 Maintenance/Repair

The fence, gates, warning signs, and survey monuments will be maintained and/or repaired within 60 days of discovery of a problem by routine inspections. Activities may include, but are not limited to, removing excessive accumulations of wind-blown plants and debris, repairing broken wire sections and posts, repairing and oiling gates, cleaning or replacing locks, repairing or replacing warning signs, and removing excess soil and/or vegetation covering survey monuments.

4.6 Inspection Schedule, Corrective Actions, and Recorded Results

A schedule for implementing inspections and prescribed maintenance and repairs of the ET Cover; storm-water diversion structures; monitoring networks; and perimeter security fence, gates, locks, warning signs, and survey monuments is provided in Table 4.6-1.

Completed inspection checklist/forms and a summary of results will be included in the annual MWL long-term monitoring and maintenance report.

Repairs and maintenance will be undertaken to ensure the integrity of the ET Cover, monitoring networks, and site features; protect human health and the environment; and mitigate any potential hazards. If an inspection of the MWL reveals that a problem has developed, the necessary repairs, maintenance, or replacement will be completed within 60 days of notation on the inspection checklist/form, unless circumstances beyond the control of DOE/Sandia cause further delay. The one exception to this 60-day time limit involves ET Cover vegetation repairs; implementation of reseeding can be delayed until an appropriate time during the growing season.

DOE/Sandia will limit any such delays to as short a time period as reasonably possible. If an unexpected event or issue outside of DOE/Sandia control causes the repairs to take longer than 60 days to complete, then NMED will be consulted to discuss the impacts to the schedule. If a hazard appears imminent or a hazardous situation already exists, remedial action will be initiated immediately. Any remedial action taken pursuant to an inspection will be noted on the inspection checklist/form.

4.7 Personnel Training

An MWL-specific personnel training program for inspection, monitoring, maintenance, and repair of the MWL during the long-term monitoring period is not required. However, all personnel working at the MWL shall be qualified to perform their assigned tasks, shall be trained to the appropriate level of their assigned activities, shall have prior experience or conduct work under the supervision of a person with prior experience, and shall have read and understood this LTMMP as it applies to the specific tasks being performed. All activities will be performed in accordance with the requirements of this LTMMP.

4.8 Record Keeping and Reporting

The Corrective Action Management Unit (CAMU) Administrative Trailer, located south of the MWL in TA-III, will be the field office for MWL long-term monitoring and maintenance activities. The following active records shall be maintained at the CAMU Administrative Trailer and the SNL/NM Records Center:

- Current and complete copy of the MWL LTMMP, including all appendices
- Current written versions of operating procedures (administrative, standard, and laboratory) and related guidance referenced in the LTMMP

Table 4.6-1
Long-Term Monitoring, Inspection, and Maintenance Schedule
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

MWL System to be Inspected	Inspection Parameters	Inspection Frequency	Maintenance Implementation	Maintenance/ Repair Frequency[a]
ET Cover Surface	Vegetation Inventory	Quarterly until vegetation is established, annually thereafter by a staff biologist[b]	Soil augmentations and/or reseeding	Within 60 days of discovery of needed repairs. Reseeding repairs may be delayed to await appropriate growing season.
	Contiguous areas of no vegetation >200 ft^2		Revegetate barren areas that exceed prescribed limits	
	Animal intrusion burrows in excess of 4 inches in diameter		Repair cover system damage that exceeds prescribed limits	
ET Cover Surface	Settlement of cover surface in excess of 6 inches	Quarterly by a field technician	Repair cover system damage that exceeds prescribed limits	Within 60 days of discovery of needed repairs. Reseeding repairs may be delayed to await appropriate growing season.
	Erosion of cover soil in excess of 6 inches deep			
	Ponding of water on the ET Cover surface in excess of 100 ft^2			
	Animal intrusion burrows in excess of 4 inches in diameter			
	Contiguous areas of no vegetation >200 ft^2 [c]		Revegetate barren areas that exceed prescribed limits[c]	Within 60 days of discovery of needed repairs.
Surface-Water Drainage Features	Channel or sidewall erosion in excess of 6 inches deep	Quarterly by a field technician	Repair erosion that exceeds prescribed limits	Within 60 days of discovery of needed repairs.
	Accumulations of sediment in excess of 6 inches deep or debris that blocks more than 1/3 of the channel width		Remove sediment and debris accumulations that exceed prescribed limits	
Soil-Vapor Monitoring Wells, Soil-Moisture Monitoring Access Tubes, and Groundwater Monitoring Wells	Concrete pads, stanchions, and protective casings	Groundwater and Vadose Zone Network Components: Field technician to inspect at same frequency/time that monitoring occurs	Maintain, clean, repair, replace, re-label, as appropriate	Within 60 days of discovery of needed repairs.
	Well cover caps and Swagelok® (or equivalent) dust caps			
	Monitoring wells and soil-vapor sampling port labels			
	Locks			
	Sampling pumps and tubing			
	Neutron probe and cable system			

Refer to footnotes at end of table.

Table 4.6-1 (Concluded)
Long-Term Monitoring, Inspection, and Maintenance Schedule
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

MWL System to be Inspected	Inspection Parameters	Inspection Frequency	Maintenance Implementation	Maintenance/ Repair Frequency[a]
Fence	Presence of wind-blown plants and debris	Quarterly by a field technician	Remove wind-blown plants and debris	Within 60 days of discovery of needed repairs.
	Condition of fence wires, posts, gates, gate locks, warning signs, and survey monuments in the local area		Repair broken wire sections and posts, repair/oil gates, clean/replace locks, repair/replace warning signs, clear dirt/debris from monuments	

[a]Maintenance/repairs will be performed as necessary, based upon the results of inspections.
[b]As explained in Section 4.2.1, the transition from quarterly to annual inspections by a staff biologist is based upon meeting successful revegetation criteria as determined by the staff biologist.
[c]Barren areas exceeding >200 ft^2 will not require corrective action after ET Cover vegetation is determined to have met successful revegetation criteria if they are the result of relatively short-term climate stresses (e.g., severe short-term drought), and the staff biologist determines they will naturally fill in over time. However, these areas will be noted and tracked during inspections and reviewed annually by the staff biologist to determine whether action is required based upon comparison to surrounding vegetation.
ET = Evapotranspirative.
ft^2 = Square feet.
MWL = Mixed Waste Landfill.

- A written Operating Record that includes the following:
  - All completed inspection forms
  - Annual MWL long-term monitoring and maintenance reports for the past three years
  - All waste management documentation for the last three years
- Site-specific health and safety plan (current version)

Additionally, the following MWL records shall be maintained at the SNL/NM Records Center:

- All correspondence and other documents from NMED and any other governmental agencies related to long-term monitoring and maintenance
- All training records for current employees and training records for any former employee for a minimum of three years from the last date the employee worked at the MWL
- All completed annual MWL long-term monitoring and maintenance reports
- All groundwater, soil-vapor, soil moisture, surface soil (tritium and biota monitoring), and vegetation monitoring results and records, including full laboratory data packages/reports
- All records of actions taken to prevent or mitigate releases of hazardous waste or hazardous constituents to the environment

DOE/Sandia will comply with the record-keeping provisions of 20.4.1.500 NMAC incorporating 40 CFR 264.74, concerning the availability, retention, and disposition of records.

4.8.1 Annual Long-Term Monitoring and Maintenance Report

During the long-term monitoring and maintenance period, DOE/Sandia will submit an MWL long-term monitoring and maintenance report to NMED on an annual basis. The report will present data and include the following components for the preceding annual reporting period:

- Summary of inspection, maintenance, and repair activities, and an explanation of whether implemented repairs were effective and met the original specifications
- Results for air, surface soil (tritium and biota monitoring), vadose zone soil vapor and soil moisture, groundwater, and vegetation monitoring and an evaluation of the results
- Where applicable, a comparison of results with monitoring triggers, indicating whether trigger levels were exceeded for any constituent

- Summary of any problems that either endangered or presented significant potential to endanger human health and the environment for the reporting period and what was done to mitigate such problems

- Review of the regulatory standards and screening levels that were used to develop the media-specific trigger levels presented in Section 5.2 and documentation of any changes being made through the permit modification process

The annual reporting period for long-term monitoring is defined as April 1 through March 31. The annual report is due by June 30 of each CY and will cover the previous annual reporting period. Each annual report will be made available to the public.

4.8.2 Five-Year Reevaluation Report

DOE/Sandia will also submit to NMED a report every five years reevaluating the feasibility of excavation and analyzing the continued effectiveness of the selected remedy. The report will include a review of the annual long-term monitoring and maintenance reports for that five-year period and any other pertinent data, as well as additional documentation required by NMED. The main scope of the Five-Year Reevaluation Report as defined in the Final Order (Curry May 2005) is summarized as follows:

- Reevaluate the feasibility of excavating the MWL, including a review of new excavation technologies since the MWL Corrective Measures Study (CMS) Report (SNL/NM May 2003) was approved and provide an update of waste disposal pathways. Worker and site risks associated with any newly identified excavation technologies will also be assessed and reported. In summary, the MWL CMS Report "full excavation alternative" will be reviewed, reevaluated, and updated as appropriate based upon current information.

- Analyze the continued effectiveness of the ET Cover and the likelihood of contaminants reaching groundwater using current monitoring results and any other pertinent data.

- Update, if necessary, the fate and transport model for the MWL with current data. Current monitoring results will be compared to the modeling performed in 2005. If the results indicate current conditions are not significantly different from the conditions previously modeled in 2005, the fate and transport model will not be updated. If the monitoring results fall significantly outside the range of conditions previously modeled, the fate and transport model will be updated to determine the likelihood of contaminants reaching groundwater.

- All efforts to ensure that any future releases or mobilization of contaminants are detected and addressed well before any effect on groundwater or increased risk to public health or the environment occurs will be detailed and will include a summary of the multi-media long-term monitoring program.

The first five-year reevaluation period will begin upon NMED approval of this MWL LTMMP (Kieling October 2011). The first Five-Year Reevaluation Report will be submitted to NMED five years after approval of the LTMMP and include monitoring results for the first four years under the LTMMP to allow time to prepare and submit the report. Subsequent Five-Year

Reevaluation Reports will cover a full five-year monitoring period. DOE/Sandia will make the report available to the public in accordance with the requirements in the Final Order (Curry May 2005).

4.9 Potential for Exposure

The MWL ET Cover provides a significant barrier between the surface environment and the buried wastes. The following measures have been implemented to reduce the risk of exposure from the wastes buried at the MWL:

- The ET Cover is designed to minimize the potential for the migration of precipitation into the MWL.
- Monitoring of the vadose zone will be conducted to determine whether the most mobile contaminants are migrating and pose a threat to groundwater.
- Monitoring of the air and surface soil will be conducted to determine whether there is a threat to receptors at the surface.
- Security and IC measures will be maintained to restrict access to the area.
- Federal ownership and the industrial land-use designation will prevent inappropriate use of the MWL site.
- Inspections, maintenance, and repairs (as necessary) will be performed on a regularly scheduled basis and in accordance with this LTMMP.

4.10 Potential for Emergency

Due to the current conditions at the MWL, the potential for fire, explosion, or unplanned release of radionuclides or RCRA-regulated hazardous waste or hazardous waste constituents that would significantly threaten human health or the environment is very low. In the unlikely event of an emergency, the SNL/NM Emergency Operations Center will provide coordination, resources, and appropriate emergency equipment on an as-needed basis.

5.0 TRIGGERS FOR LONG-TERM MONITORING

The Final Order (Curry May 2005) required the MWL CMI Plan (SNL/NM November 2005) to include triggers (i.e., concentration limits) for media-specific constituents to be monitored after implementation of the selected remedy (ET Cover with biointrusion barrier). Trigger levels are to be implemented as part of the MWL LTMMP to provide early detection of potentially changing conditions at the surface, in the vadose zone, and in the groundwater. If a trigger is exceeded, additional testing and further investigation will be performed to provide the data needed to evaluate conditions and determine whether additional action is warranted. The comprehensive media-specific long-term monitoring program is detailed in Chapter 3.0.

Based upon the results of the probabilistic performance-assessment modeling for the MWL presented in the MWL CMI Plan (SNL/NM November 2005, Ho et al. January 2007), the following parameters were identified for long-term monitoring and the development of trigger levels:

- Surface emissions of tritium and radon
- Infiltration through the ET Cover
- Concentrations of uranium in groundwater
- Concentrations of specific VOCs in the soil vapor and groundwater

Monitoring triggers were established for these parameters and documented in the CMI Plan (SNL/NM November 2005). Some of these triggers have been changed based upon NMED CMI Plan comments (Bearzi November 2006 and October 2008a), and additional triggers have been added (triggers for the complete EPA Method 8260 VOC Target Compound List, tritium, radon, and specific metals in groundwater samples and triggers for specific metals in surface soil samples). Final media-specific trigger levels are presented in this chapter that reflect recent updates to regulatory screening levels and guidance from NMED (Bearzi October 2008a and NMED February 2012). These triggers were conservatively derived from EPA (May 2009 and November 2011), DOE (1993), and NMED (February 2012) and NMED Water Quality Control Commission (2002) regulatory standards in accordance with NMED requirements (Bearzi October 2008a). Triggers for radionuclide monitoring of surface soil and plant material are not established; however, data evaluation and reporting requirements are addressed in Section 3.6.

The trigger evaluation process is described in Section 5.1. This process will be initiated if a monitoring result, confirmed by resampling, exceeds the corresponding trigger level during long-term monitoring at the MWL. The media-specific monitoring trigger levels are presented in Section 5.2.

5.1 Trigger Evaluation Process

A trigger evaluation process will be applied during long-term monitoring activities (Figure 5.1-1) in accordance with requirements in the Consent Order (NMED April 2004) and the SNL/NM RCRA Permit (EPA August 1993). The trigger evaluation process is designed to ensure the protection of human health and the environment, while allowing adequate data collection to

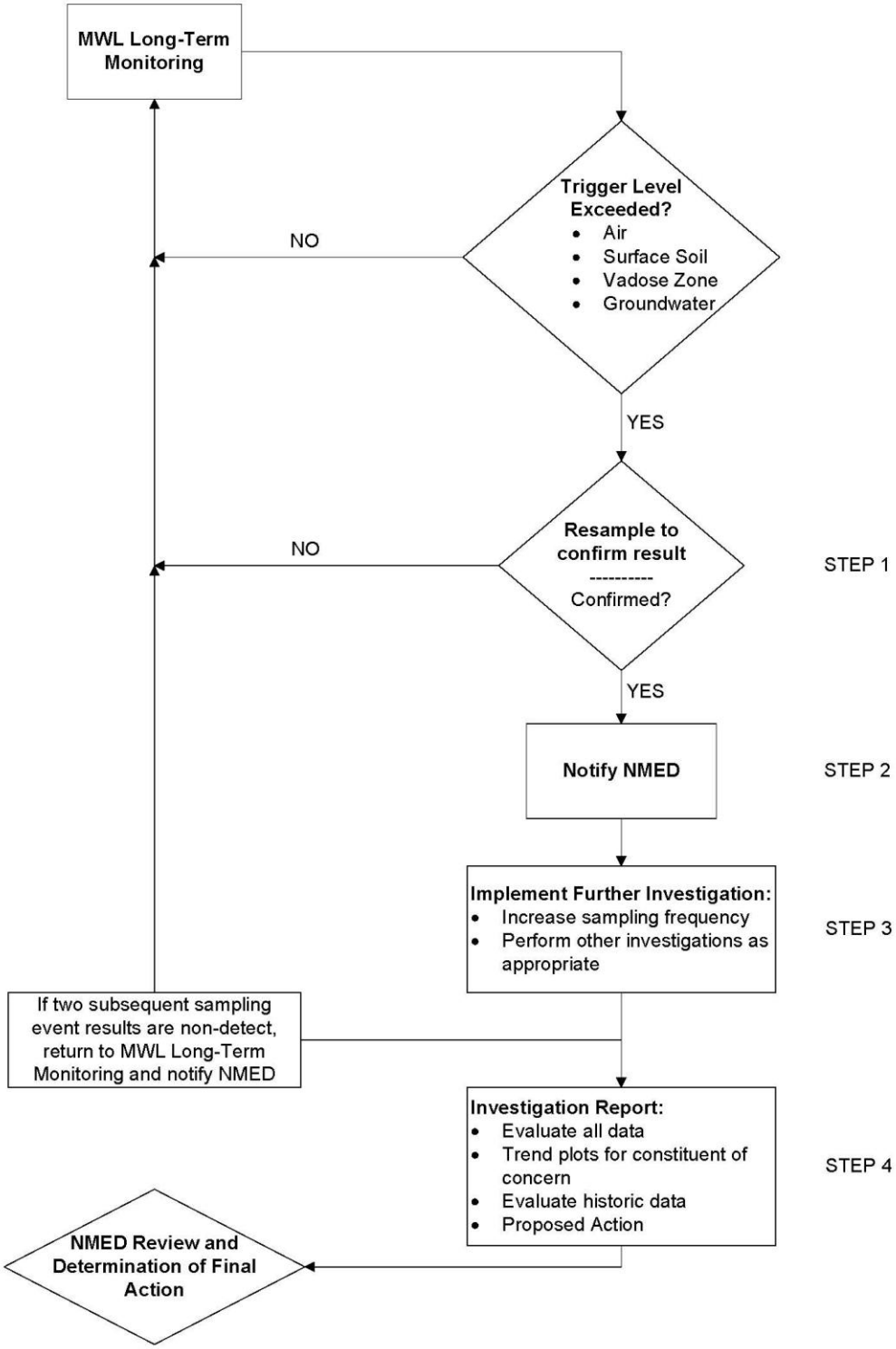

Figure 5.1-1
Trigger Evaluation Process for the Mixed Waste Landfill

eliminate field sampling and/or laboratory error and identify short-term exceedances that do not reflect long-term trends. This is particularly important relative to specific groundwater monitoring trigger levels that are at or near the analytical laboratory practical quantitation limit (PQL).

Regardless of the environmental medium, the four steps shown in Figure 5.1-1 and discussed in the following sections apply. Section 5.2 presents the media-specific trigger levels and requirements.

5.1.1 Step 1 – Resample to Confirm the Result

In the event that a monitoring result is greater than a corresponding trigger level, the first step is to *resample to confirm the result*. Resampling shall be completed within two weeks of discovery that a monitoring result is greater than a corresponding trigger level. If the average of the results for the original and resample is less than the trigger level, no further actions are required. For situations in which the exceeded trigger level is at or near the analytical laboratory detection limit, the original and resampling results will not be averaged. Instead, the resampling result will be compared directly with the trigger level; if it is below the trigger level, no further action is required. If the average result or resampling result confirms that the trigger level has been exceeded, the trigger evaluation process proceeds to *Step 2, Notification to NMED*.

5.1.2 Step 2 – Notification to NMED

The second step involves submitting *notification to NMED* following the receipt of the validated analytical results. For the resampling process, DOE/Sandia will have no more than two weeks from the date of the receipt of results from the analytical laboratory to perform final validation.

For groundwater samples, if the resampling result or the average of the original result and its resampling result exceeds any applicable New Mexico Water Quality Control Commission standard specified in 20.6.2.3103 NMAC, notice shall be given in accordance with 20.6.2.1203.A NMAC to the Chiefs of both NMED Groundwater Quality Bureau and the HWB. However, if the resampling result or the average of an original result and its resampling result is less than or equal to any applicable New Mexico Water Quality Control Commission standard, and also greater than its corresponding trigger level, notice shall be given to the Chief of NMED HWB.

The notification provided to NMED specified in this section will provide information on implementing Step 3, which is *further investigation* and, if applicable, will also contain the information required under 20.6.2.1203.A(1) NMAC.

5.1.3 Step 3 – Further Investigation

This third step includes, but is not limited to, the collection of more data at an increased frequency over the subsequent one-year period. The one-year period begins upon the date of NMED notification. Once data are collected, an *investigation report* will be prepared to meet the requirements of the fourth step.

5.1.4 Step 4 – Investigation Report

The fourth step involves compiling all relevant data and information into an *investigation report* that shall be submitted to NMED within one year of the exceedance notification. The investigation report will provide an evaluation of historical data and additional data collected as part of *Step 3, Further Investigation*. The increased frequency of data collection associated with Step 3 will ensure that adequate data are collected and evaluated to rule out false positives due to field and/or laboratory error and to identify trends that will allow the determination of appropriate follow-up actions. Trend plots and other statistical method results, as appropriate based upon the available data set(s), shall be included in the investigation report along with other relevant information (e.g., historical investigation results, inventory analysis, fate and transport modeling results, other relevant site case histories, etc.) to support recommendations for future actions.

Thus, any recommendations for further investigation and/or corrective action because of a trigger level exceedance will be based upon data trends and all available information, rather than upon a single confirmed result above the trigger level. This one-year process takes into account the conservative trigger levels, multi-media monitoring approach, extremely slow-moving nature of contaminant migration, isolated location of the site relative to receptors, and the need to collect sufficient data to confirm and characterize potentially changing site conditions.

NMED will review the investigation report and determine final actions to be implemented, which could include one or more of the following:

- No further action (i.e., resume monitoring according to the LTMMP)
- Continue increased monitoring frequency of specific media
- Conduct other investigations
- Implement corrective action

5.2 Monitoring Trigger Levels

Based upon both the results of the probabilistic performance-assessment modeling conducted for the MWL (SNL/NM November 2005, Ho et al. January 2007) and subsequent input received from NMED and the public, monitoring trigger levels have been established for the air, soil, vadose zone, and groundwater at the MWL. These trigger levels are summarized in Table 5.2-1 and discussed in the following sections. Trigger levels will be used as part of the comprehensive media-specific monitoring program described in Chapter 3.0 of this LTMMP and provide early detection of potentially changing conditions that would warrant further investigation. Should any monitored constituent exceed its respective trigger level, then the trigger evaluation process described in Section 5.1 and shown in Figure 5.1-1 will be implemented.

The regulatory standards and screening levels that were used to develop the media-specific triggers shall be periodically reviewed, at a minimum annually, to determine whether any changes by EPA or NMED have occurred. Any changes that affect a trigger level will be documented and submitted to NMED as a Class 1 permit modification with prior approval that will include the revised trigger level(s) according to NMED guidance (Bearzi October 2008a), along with an explanation of the change(s). The revised trigger level(s) will become effective after NMED approval of the permit modification.

Table 5.2-1
Summary of Long-Term Monitoring Parameters with Trigger Levels
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Sampling Media	Monitoring Parameter[a]/ Constituent of Concern	Monitoring Method	Trigger Level	Comments
Air	Radon	Track-etch detectors (at breathing level) placed at various locations at the site – sampling and analysis per Appendix C.	4 pCi/L	Samples are time-weighted average and will be collected over a 3-month period. Trigger levels apply to perimeter locations.
Surface Soil	Tritium	Grab samples of surface soil collected at four corners of the MWL – sampling and analysis per Appendix G.	20,000 pCi/L in soil moisture	Sampling being collected as part of the ongoing SNL/NM Terrestrial Monitoring Program will be continued to allow long-term data trending.
Surface Soil – Biota Monitoring	Metals	Grab samples of soil collected from animal burrows and/or ant hills on the MWL ET Cover – sampling and analysis per Appendix G.	NMED Industrial/Occupational Soil Screening Levels (Table 5.2.2-1)	Trigger levels established by NMED during the CMI Plan NOD process and updated according to the most recent NMED guidance (NMED February 2012).
Vadose Zone	VOCs in soil vapor	Soil vapor sampling and analysis at the 5 soil-vapor monitoring wells; 3 of these wells are multi-port wells and 2 are single-port wells – sampling and analysis per Appendix D.	PCE = 20 ppmv TCE = 20 ppmv Total VOCs = 25 ppmv	Trigger levels apply only to the deepest sampling ports of the 3 multi-port soil-vapor monitoring wells. All other soil-vapor data will be reported and evaluated in the annual MWL long-term monitoring and maintenance report.
Vadose Zone	Moisture content in underlying vadose zone	Neutron probe measurements made in three soil-moisture monitoring angled boreholes – sampling and analysis per Appendix E.	Average 23% volumetric soil moisture content	Trigger level applies to linear depths of 10 to 100 feet (vertical depths of 8.7 to 86.6 feet) along the neutron probe access tubes.
Groundwater	VOCs, metals, and radiological parameters	Groundwater sampling and analysis per Appendix F.	Listed in Table 5.2.4-1	Groundwater compliance network is comprised of monitoring wells MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9. Trigger levels apply to MWL-MW7, MWL-MW8, and MWL-MW9.

[a]Monitoring parameters, frequency, and analytical methods are detailed in Chapter 3.0 and Table 3.1-1.

BW = Background well.
CMI = Corrective Measures Implementation.
ET = Evapotranspirative.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
NMED = New Mexico Environment Department.
NOD = Notice of Deficiency.
PCE = Tetrachloroethane.
pCi/L = Picocurie(s) per liter.
ppmv = Parts per million by volume.
SNL/NM = Sandia National Laboratories, New Mexico.
TCE = Trichloroethene.
VOC = Volatile organic compound.

Although trigger levels for long-term monitoring have been developed for both hazardous and radioactive constituents, the trigger levels and monitoring for radionuclides are provided voluntarily by DOE/Sandia. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements of the Consent Order. Additional information on radionuclides and the scope of the Consent Order is available in Section III.A of the Consent Order (NMED April 2004).

5.2.1 Air Monitoring Trigger Levels

The trigger level for radon in air is 4 pCi/L (Table 5.2-1) and the point of compliance is the MWL perimeter (RN1 through RN10). This value is the EPA action threshold for radon in household air (EPA September 2005). This value is significantly lower than the simulated radon-gas concentrations (greater than 10,000 pCi/L) at the surface of the MWL, which yielded fluxes that exceeded the design standard of 20 pCi/m^2/s (Ho et al. January 2007).

5.2.2 Surface Soil and Biota Monitoring Trigger Levels

Surface soil trigger levels are established for tritium and metals. Tritium is the primary constituent of concern based upon the MWL Phase 2 RFI (SNL/NM September 1996) and the most mobile radionuclide disposed of at the MWL. Triggers for metals in surface soil samples collected at animal burrows and/or ant hills address concerns regarding potential mobilization of contaminants by biota.

5.2.2.1 Tritium in Surface Soil

The performance-assessment model (Ho et al. January 2007) indicates a very low (2 percent) probability that tritium emitted from the MWL may exceed the performance objective of 10 millirem/yr dose to the public via the air pathway. Therefore, a conservative trigger value of 20,000 pCi/L in surface soil at the MWL perimeter has been established. Because the trigger value is four to five orders of magnitude less than simulated concentrations that yielded exceedances in the dose via air, the trigger value serves as a conservative early detection mechanism for potential future exceedances of the tritium dose via air.

The tritium trigger applies to surface soil samples collected annually at the four corners of the MWL. Soil samples will be collected and analyzed annually as described in Section 3.3. Any increase in tritium emissions from the MWL will be indicated by elevated tritium concentrations in these soil samples relative to previous results.

5.2.2.2 Biota Monitoring

Trigger levels for metals in surface soil samples collected at animal burrows and/or ant hills are NMED industrial/occupational soil screening levels (NMED February 2012), which are presented in Table 5.2.2-1., except for cobalt, which was specified by NMED (Bearzi October 2008a). Some of the trigger levels have been changed since the CMI Plan NOD process to reflect NMED industrial/occupational soil screening level updates made in February 2012

(NMED February 2012). Surface soil samples collected at animal burrows and/or ant hills will also be analyzed for gamma-emitting radionuclides. There are no trigger levels established for radionuclides; the results will be compared with NMED-approved background activity levels (Dinwiddie September 1997) and included in the annual MWL long-term monitoring and maintenance report.

Table 5.2.2-1
Mixed Waste Landfill Surface Soil Trigger Levels

Parameter	Trigger Level in mg/kg
Arsenic	17.7
Barium	100,000
Cadmium	897
Chromium (as Chromium VI)	63.1
Lead	800
Mercury	73.6
Selenium	5,680
Silver	5,680
Copper	45,400
Nickel	22,500
Vanadium	5,680
Zinc	100,000
Cobalt	20,500
Beryllium	2,260

All trigger levels for metals are based upon NMED Industrial/Occupational Soil Screening Levels (NMED February 2012) except cobalt, which was provided by NMED (Bearzi October 2008a).
CMI = Corrective Measures Implementation.
mg/kg = Milligram(s) per kilogram.
NMED = New Mexico Environment Department.

Sampling of potentially deep-rooted vegetation growing on the ET Cover will also be performed, if present. Vegetation samples will be analyzed for gamma-emitting radionuclides. Similar to the monitoring of radionuclides in surface soil near animal burrows and/or ant hills, no trigger levels are established. These results will be reported and evaluated in the annual MWL long-term monitoring and maintenance report.

5.2.3 Vadose Zone Monitoring Trigger Levels

Long-term monitoring of the vadose zone is planned for both soil vapor and moisture content to evaluate the effectiveness of the ET Cover and ensure that MWL site conditions remain protective of human health and the environment. The trigger values for vadose zone soil vapor and moisture content are discussed in the following sections. Additional details regarding vadose zone monitoring activities are presented in Section 3.4.

5.2.3.1 Volatile Organic Compounds in Soil Vapor

Trigger levels for PCE, TCE, and total VOCs in soil vapor at the MWL are 20 parts per million by volume (ppmv) for PCE and TCE, and 25 ppmv for total VOCs as established in the MWL fate and transport model (Ho et al. January 2007). All trigger levels apply only to samples collected from the deepest sampling port (i.e., 400 feet bgs) in each of the three FLUTe™ or equivalent soil-vapor monitoring wells.

5.2.3.2 Moisture Content

Infiltration through the ET Cover will be determined by monitoring the moisture content in the vadose zone beneath the MWL as described in Section 3.4.2. A significant increase in moisture content beneath the MWL may indicate that the disposal cell cover may not be performing as originally designed, and that infiltration through the cover is greater than originally predicted.

The established trigger level is the moisture content that corresponds to an unsaturated hydraulic conductivity equal to the EPA-prescribed technical equivalence criteria of 10^{-7} cm/s (31.5 mm/yr). The moisture content at which this occurs is 23 percent by volume; therefore, the trigger level is 23 percent by volume. This value is based on the EPA-prescribed technical equivalence criteria and does not necessarily indicate that hazardous constituents or radionuclides are migrating from the MWL.

The 23-percent trigger applies to linear depths of 10 and 100 feet (vertical depths of 8.7 to 86.6 feet) along the neutron probe access tubes in the vadose zone beneath the MWL. This interval is the "regulated interval" because it lies beneath the root zone, yet is shallow enough that a response would be detected fairly rapidly if infiltration through the cover significantly increases.

5.2.4 Groundwater Monitoring Trigger Levels

Groundwater monitoring at the MWL has been conducted since September 1990 and provides more than 20 years of empirical data supporting the conclusion that the MWL has not contaminated groundwater. Monitoring triggers for VOCs, metals, and radionuclides in groundwater at the MWL are presented in Table 5.2.4-1 and discussed in the following sections. The point of compliance is at each downgradient monitoring well (MWL-MW7, MWL-MW8, and MWL-MW9) along the western perimeter of the MWL. MWL-BW2 is the background monitoring well; data from this well provide information regarding the quality of groundwater upgradient of the MWL. Additional details regarding long-term groundwater monitoring at the MWL are presented in Section 3.5.

Table 5.2.4-1
Mixed Waste Landfill Groundwater Monitoring Trigger Levels

Groundwater Monitoring Parameters	Final Trigger Levels (µg/L)[a]	Trigger Level Source[a]	2011 Laboratory Reporting Limits	
			Method Detection Limit (µg/L)	Practical Quantitation Limit (µg/L)
EPA Method 8260 Volatile Organic Compounds				
1,1,1-Trichloroethane (1,1,1-TCA)	15	25% NMED WQCC MAC	0.325	1
1,1,2,2-Tetrachloroethane	5	50% NMED WQCC MAC	0.25	1
1,1,2-Trichloroethane[b]	2.5	50% EPA MCL	0.25	1
1,1-Dichloroethane	12.5	50% NMED WQCC MAC	0.3	1
1,1-Dichloroethene	2.5	50% NMED WQCC MAC	0.3	1
1,2-Dichloroethane	2.5	50% EPA MCL	0.25	1
1,2-Dichloropropane	2.5	50% EPA MCL	0.25	1
2-Butanone (methyl ethyl ketone)[b]	1,225	25% EPA RSL	1.25	5
2-Hexanone	17	50% EPA RSL	1.25	5
4-methyl-, 2-Pentanone (Methyl isobutyl ketone)[b]	250	25% EPA RSL	1.25	5
Acetone[b]	3,000	25% EPA RSL	1.25 – 5.0	5.0 – 15.0
Benzene	2.5	50% EPA MCL	0.30 – 1.0	1.0 – 3.0
Bromodichloromethane	0.6	50% NMED SL	0.25	1
Bromoform	4.0	50% EPA RSL	0.25	1
Bromomethane	3.5	50% EPA RSL	0.3	1
Carbon disulfide	180	25% EPA RSL	1.25	5
Carbon tetrachloride	2.5	50% EPA MCL	0.3	1
Chlorobenzene	25	25% EPA MCL	0.25	1
Chloroethane (ethyl chloride)	5,250	25% EPA RSL	0.3	1
Chloroform	25	25% NMED WQCC MAC	0.25	1
Chloromethane	47	25% NMED SL	0.3	1
Dibromochloromethane	0.75	50% NMED SL	0.3	1
Ethyl benzene	175	25% EPA MCL	0.25	1
Methylene chloride	3[c]	60% EPA MCL	3	10
Styrene	25	25% EPA MCL	0.25	1
Tetrachloroethene (PCE)	2.5	50% EPA MCL	0.3	1
Toluene[b]	187.5	25% NMED WQCC MAC	0.25 – 1.0	1
Trichloroethene (TCE)	2.5	50% EPA MCL	0.25	1
Vinyl acetate	103	25% EPA RSL	1.5 – 5.0	5
Vinyl chloride	0.5	50% NMED WQCC MAC	0.5	1
Xylene	155	25% NMED WQCC MAC	0.3	1
cis-1,2-Dichloroethene	17.5	25% EPA MCL	0.3	1
cis-1,3-Dichloropropene (1,3-Dichloropropene)	2.2	50% NMED SL	0.25	1
trans-1,2-Dichloroethene	25	25% EPA MCL	0.3	1
trans-1,3-Dichloropropene (1,3-Dichloropropene)	2.2	50% NMED SL	0.25	1
Dichlorodifluoromethane	47.5	25% EPA RSL	0.3	1
Metals with Trigger Levels				
Uranium (total)	15	50% EPA MCL	0.05	0.2
Chromium (total)	43	NMED-approved background concentration	2.5	10
Cadmium	2.5	50% of EPA MCL	0.11	1
Nickel	50	25% of NMED WQCC standard of 0.2 mg/L	0.5	2

Refer to footnotes at end of table.

Table 5.2.4-1 (Concluded)
Mixed Waste Landfill Groundwater Monitoring Trigger Levels

Groundwater Monitoring Parameters	Final Trigger Levels [a]	Trigger Level Source[a]	2011 Laboratory Reporting Limits	
			Method Detection Limit (µg/L)	Practical Quantitation Limit (µg/L)
Radiological Constituents with Trigger Levels				
Tritium	4 mrem/yr	EPA MCL	—[d]	—[d]
Radon	1,000 pCi/L	No Regulatory Standard	—[d]	—[d]
Gross Alpha Activity	15 pCi/L[e]	EPA MCL	—[d]	—[d]
Gross Beta Activity	4 mrem/yr	EPA MCL	—[d]	—[d]

[a]All trigger levels reviewed and updated in February 2012 and are based upon current EPA (November 2011) RSLs for Tap Water, EPA (May 2009) MCLs, NMED WQCC (2002) MACs for Tap Water, and NMED (February 2012) SLs for Tap Water. Percentage of standard/screening level based upon NMED guidance (Bearzi October 2008a).
[b]Common laboratory contaminants specified in EPA (November 1992) technical guidance.
[c]Methylene chloride trigger level is adjusted to 60% of the EPA (May 2009) MCL, which is the analytical laboratory method detection limit.
[d]Critical level and minimum detectable activity for all radiological analyses vary greatly but are below the associated trigger level.
[e]Gross alpha activity data corrected for naturally occurring uranium in accordance with 40 CFR Parts 9, 141, and 142, Table I-4.

— = Not applicable.
µg/L = Micrograms per liter.
CFR = Code of Federal Regulations.
EPA = U.S. Environmental Protection Agency.
MAC = Maximum Allowable Concentration.
MCL = Maximum Contaminant Level.
mg/L = Milligram(s) per liter.
mrem/yr = Millirem per year.
NMED = New Mexico Environment Department.
pCi/L = Picocurie(s) per liter.
RSL = Regional Screening Level.
SL = Tap Water Screening Level.
WQCC = Water Quality Control Commission.

5.2.4.1 Volatile Organic Compounds

VOCs are of particular concern because they are highly mobile in the vapor phase. Soil-vapor surveys conducted in the mid-1990s and 2008 do not indicate significant downward VOC contaminant migration in the vapor phase. However, earlier studies (Johnson et al. 1995, Klavetter August 1995) and the probabilistic performance-assessment modeling in the CMI Plan (Ho et al. January 2007) have shown that the potential exists for VOCs to contaminate groundwater at the MWL.

Vadose zone VOC monitoring described in Section 5.2.3.1 forms the first line of defense for the long-term protection of groundwater and will provide early detection of significant downward VOC contaminant migration well before groundwater is impacted.

Groundwater monitoring represents the second line of defense for groundwater protection. VOC groundwater trigger levels have been developed for all EPA Method 8260 Target

Compound List VOCs using a conservative approach consistent with NMED requirements (Bearzi October 2008a). The groundwater trigger levels for VOCs are presented in Table 5.2.4-1 and are based upon EPA and NMED regulatory standards or tap water screening levels and NMED guidance (Bearzi October 2008a).

Five of the VOCs have trigger levels that are at or below the analytical laboratory PQL, including 1,1,2-trichloroethane, benzene, bromodichloromethane, dibromochloromethane, methylene chloride, and vinyl chloride. Methylene chloride and vinyl chloride have trigger levels set at the analytical laboratory method detection limit (MDL), which is the lowest concentration the laboratory instrumentation can detect (all detected values between the PQL and MDL are qualified as estimated by the analytical laboratory). In addition, several of the VOCs, including methylene chloride, are ubiquitous laboratory contaminants that are routinely detected in groundwater samples as a result of cross-contamination occurring in the laboratory. In addition, NMED-approved MWL Toluene Investigation Report documented that the very low concentrations of toluene detected in MWL and other groundwater samples was the result of other ambient sources and not representative of actual concentrations in groundwater (SNL/NM October 2010). For these reasons the issue of false positive results that exceed the trigger level are of particular concern relative to groundwater monitoring.

5.2.4.2 Metals

Uranium occurs naturally in groundwater beneath the MWL at concentrations ranging from 1.34 to 9.23 micrograms (μg)/L and averaging 5.97 μg/L. Total uranium concentrations in groundwater beneath the MWL are well within the total uranium ranges (0.1 to 86 μg/L) established by the U.S. Geological Survey for the Middle Rio Grande Basin (USGS 2002), but commonly exceed NMED-approved background concentration of 5.2 μg/L. Isotopic analyses of uranium have demonstrated that it is of natural origin (Goering et al. December 2002).

The probabilistic performance-assessment modeling for the MWL (Ho et al. January 2007) indicates the possibility that uranium will reach the groundwater (although none of the simulations showed the uranium concentrations exceeding the EPA Primary Drinking Water Standard of 30 μg/L). For this reason, a monitoring trigger of 15 μg/L (one-half of the EPA maximum contaminant level [MCL]) is established for uranium in MWL groundwater at the point of compliance.

Based upon NMED requirements, trigger levels are also established for total chromium, cadmium, and nickel (Bearzi October 2008a) as shown in Table 5.2.4-1.

5.2.4.3 Radionuclides

Radionuclide trigger values for groundwater are provided in Table 5.2.4-1 for tritium, radon, and gross alpha/beta activity. The trigger levels are based upon EPA MCLs except for radon, which does not have an established EPA MCL. A trigger level for radon is required by NMED (Bearzi October 2008a). There are no trigger levels for the radionuclides associated with the gamma spectroscopy analysis, but the results will be included in the annual long-term monitoring and maintenance report. Gross alpha and beta activity results provide a general screening method; they do not provide radionuclide-specific information. Naturally occurring uranium in groundwater beneath the MWL affects both radon and gross alpha activity results. In

accordance with 40 CFR, Parts 9, 141, and 142 (Table I-4), gross alpha activity results will be corrected for total uranium. This is deemed appropriate when uranium is naturally occurring and total uranium analytical results are obtained separately, as is the case with both historical and future MWL groundwater monitoring.

Based upon the probabilistic performance-assessment modeling conducted for the MWL (Ho et al. January 2007), the primary medium of concern for tritium and radon is air. Radon air monitoring and the associated trigger level are addressed in Section 5.2.1. Surface soil monitoring for tritium provides information relative to the flux of tritium from the soil to the air; this monitoring and the associated trigger level are addressed in Section 5.2.2.1. As with vadose zone VOC soil-vapor monitoring, the air and surface soil monitoring of radon and tritium, respectively, are expected to provide early detection of significant contaminant migration if any unexpected changes in conditions occur. However, groundwater monitoring for these constituents will be performed as required by NMED (Bearzi October 2008a).

5.3 Summary of Trigger Levels

Based upon the results of the probabilistic performance-assessment modeling conducted for the MWL (Ho et al. January 2007) and input from NMED and the public, monitoring trigger levels have been developed for the air, surface soil, vadose zone, and groundwater at the MWL. Specific triggers include numerical thresholds for the following:

- Radon concentrations in the air
- Tritium and metals in surface soil
- VOCs in vadose zone soil vapor
- Soil moisture in the vadose zone
- VOCs, metals, and radionuclide concentrations/activities in groundwater

The trigger values were derived from EPA (May 2009 and November 2011), DOE (1993), NMED regulatory standards/screening levels (NMED WQCC 2002 and NMED February 2012), and NMED-approved background concentration for chromium in groundwater (Dinwiddie September 1997). If a trigger is exceeded, then DOE/Sandia will initiate the trigger evaluation process (Section 5.1 and Figure 5.1-1) that will allow sufficient data collection to assess trends and recommend appropriate further investigation and/or corrective action, if necessary.

By utilizing these media-specific early detection trigger levels during long-term monitoring at the MWL, DOE/Sandia will ensure that the MWL remedy and site conditions continue to be protective of human health and the environment, while meeting the performance objectives for the ET Cover and the corrective action objectives established in the MWL CMS Final Report (SNL/NM May 2003).

6.0 INSTITUTIONAL CONTROLS

6.1 Introduction

This chapter describes the ICs to be implemented and maintained at the MWL during the long-term monitoring and maintenance period. ICs are mechanisms used to control access to and restrict the use of contaminated land, facilities, and environmental media, thereby limiting exposure to remaining contamination. ICs can take the form of administrative controls, legal controls, physical barriers or markers, and methods to preserve information and data and inform current and future generations of hazards and risks. ICs are generally used to supplement active remediation measures/final remedies (EPA September 2000) by instituting post-remediation/final remedy administrative and/or physical controls.

ICs typically used at DOE sites include the following:

- Government ownership (e.g., federal or state)
- Warning notices (e.g., no trespassing signs, notification signs for hazardous and sensitive areas)
- Entry restrictions (e.g., requirements for security badges, fencing, training for persons entering hazardous or sensitive areas)
- Resource-use management (e.g., land use and real property controls, excavation permits)
- Site information systems (e.g., information tracking systems on the location and nature of waste sites or geographic based-information archives)

6.2 Institutional Controls at the Mixed Waste Landfill

ICs are a key element of the long-term monitoring and maintenance strategy for the MWL. Various ICs are already in place for the MWL. The application of multiple ICs at the MWL is consistent with a conservative strategy that uses multiple, independent layers of controls to protect human health and the environment. Thus, if one control temporarily fails, other controls will be in place to mitigate significant consequences of the failure. The ICs applicable to the MWL are discussed in depth in the following sections.

6.2.1 Government Ownership

Government ownership is an IC that restricts or prevents unauthorized access to sites with hazardous or radioactive materials. The MWL is located on DOE-owned land in TA-III, one of five TAs at SNL/NM, and is within the boundaries of KAFB. TA-III is a test area containing numerous buildings and test facilities owned by DOE; the area is expected to remain under DOE control (and on land owned by the federal government) indefinitely.

Figure 6.2.1-1 shows the location of SNL/NM TAs and land uses within KAFB. Future land-use designations are based upon the Kirtland Area Office input for DOE Future Use Report (DOE et al. September 1995).

In case of the unlikely scenario that DOE relinquishes ownership of TA-III and the property is transferred to state or local authorities or to private ownership, the site would have to be reevaluated to determine what, if any, measures would be required to make the site acceptable for its expected land use after ownership transfer.

6.2.2 Entry Restrictions

Entry restrictions are another category of ICs imposed at the MWL. Entry restrictions include security requirements and fencing. Access to the MWL is strictly controlled because of its location on both KAFB and within TA-III, which is a restricted area. Access to KAFB is strictly limited to members of the workforce, construction/maintenance contractors, visitors with badges, and to families of military personnel who live on base. Access to KAFB is controlled 24 hours per day, 7 days per week, and is limited to personnel who have a need to enter the base. Access is restricted by armed guards at the gates to KAFB. Access to TA-III is limited to DOE-authorized personnel and is controlled using a gate.

Three tiers of fences limit access to the MWL. Both KAFB and TA-III are fenced along their perimeters. A 44-inch-high, barbed-wire fence surrounds the MWL perimeter. The fence incorporates three strands of barbed-wire with tee-posts set into the ground, and steel corner posts set in concrete.

The MWL fence has two 16-foot-long, 42-inch-high gates comprised of tubular steel with galvanized chain links, located near the northeastern and southeastern corners of the site. The gates are locked at all times except as necessary to provide access for surveillance, maintenance, and monitoring activities. This is the only perimeter security fence that is subject to the inspection, maintenance, and repair requirements of Section 4.5.

6.2.3 Warning Notices

A third category of ICs at the MWL are warning notices, including “no trespassing” signs and radiological postings for the site. To ensure visual notification, the fence line is posted with signs having at a minimum a legend reading, “Caution—Unauthorized Personnel Keep Out” and warning against entering the area without specific permission of the Owner. The signs are legible from a distance of at least 25 feet. The size of the visual warning and the spacing of the warning signs are large enough and close enough to ensure that one or more of the signs can be seen from any approach prior to an individual actually making contact with the fence line.

Radiological warning signs are also on the fence. The signs read, “Caution: Underground Radioactive Material, Controlled Area, Authorized Personnel Only.” The radiological signs are legible from a distance of at least 25 feet and are visible from any approach to the fence. Warning notices and radiological postings in Spanish are also installed on the fence.

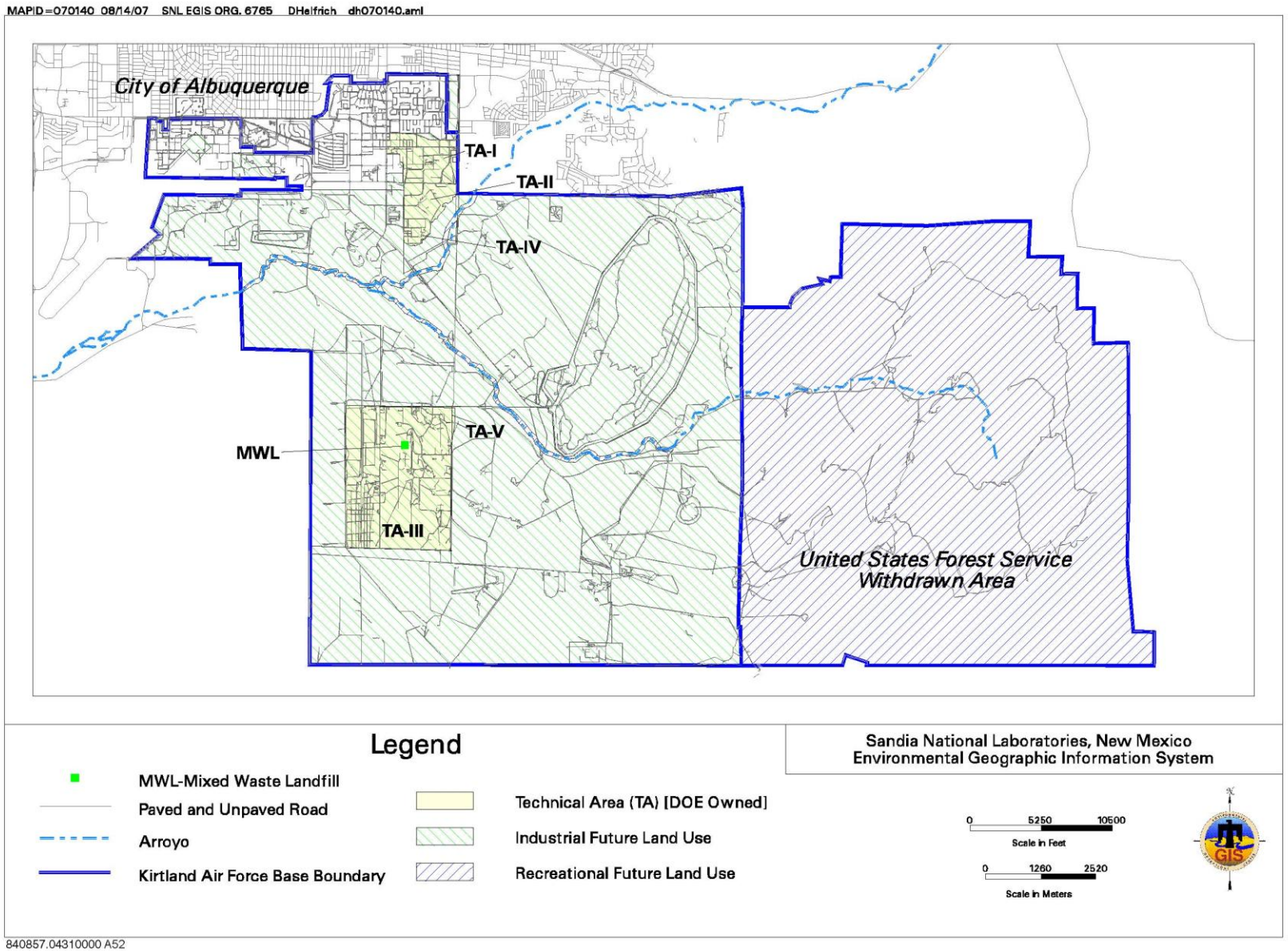

Figure 6.2.1-1
Future Land-Use Designations on Kirtland Air Force Base

6.2.4 Active Controls

Another category of ICs are active controls that rely on the presence of humans to fulfill safeguard and maintenance responsibilities. These include monitoring to ensure that contaminant migration is not occurring and the containment design is functioning appropriately and conducting routine inspections and maintenance at the site. The comprehensive, multi-media long-term monitoring program is detailed in Chapter 3.0 of this document and includes monitoring of air, soil, vadose zone soil vapor and soil moisture, and groundwater. Inspection, maintenance, and repair activities are discussed in Chapter 4.0, and the early detection trigger evaluation process is presented in Chapter 5.0.

6.2.5 Resource-Use Management

ICs addressing land use and excavation are also in place at SNL/NM and hence, the MWL. Land use within TA-III is managed in accordance with all applicable requirements. Land-use controls are mechanisms intended to ensure that land use follows the appropriate planning process and are intended to minimize the potential for unplanned disturbances of sites containing hazardous or radioactive material.

Resource-use controls at the MWL include the following:

- Excavation permits or other internal work procedures to reduce the potential for unplanned disturbances, to inform and protect workers regarding potential exposure to hazardous or radioactive waste, and to reduce the likelihood of mobilizing contaminants from contaminated areas due to human intrusion
- Radiological work permits or other internal work procedures to identify radiological conditions and establish worker protection and monitoring requirements

Land-use restrictions as defined in this LTMMP will be documented in the DOE Property Management System, and the information will be available at the time of any future property transfer.

6.2.6 Site Information Systems

SNL/NM has a number of information systems in place that help to manage activities at the MWL. These include the following:

- SNL/NM Records Center
- SNL/NM GIS [Geographic Information System] Program
- SNL/NM GEMS [Geographical Environmental Management System]

- The Government Information Department Public Reading Room at the University of New Mexico (UNM) Zimmerman Library

- SNL/NM database of institutional controls at SWMUs

The Administrative Record is the body of documents and information that was considered, or relied upon, to arrive at a final decision for remedial action or hazardous waste management at the MWL. The documents related to the MWL in the Administrative Record include, but are not limited to, RFI Work Plans, Phase 1 and Phase 2 RFI Reports, Responses to NODs, the MWL CMS Final Report, the MWL CMI Plan, the MWL CMI Report, and other relevant correspondence and documents. The Administrative Record may be reviewed at the Government Information Department at the UNM Zimmerman Library and at NMED in Santa Fe, New Mexico.

Additional information on the MWL is contained in the SNL/NM Records Center. The Records Center maintains all records on the MWL and other SWMUs at SNL/NM, including location, waste type, and current status. The Records Center is maintained by Sandia in accordance with DOE Orders on records maintenance. The long-term preservation of waste site information is one of the key responsibilities of the Records Center.

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7.0 CONTINGENCY PROCEDURES

This section details contingency procedures to be implemented if the MWL ET Cover fails to be protective of human health and the environment. Actual contingency responses will be addressed on a situation-specific basis in cooperation with NMED according to the Trigger Evaluation Process for the MWL presented in Section 5.1.

The MWL Class 3 Permit Modification for the MWL states:

> The [long-term monitoring and maintenance] plan shall also include contingency procedures that must be implemented by the Permittees if the remedy set forth in Section V.2 above [the vegetative soil cover with biointrusion barrier] fails to be protective of human health and the environment.

The MWL LTMMP is designed to provide for early detection of potentially changing conditions and allow for contingency measures to be taken, as appropriate. Contingency measures are designed to accommodate any unanticipated events, should the remedy not be protective of human health and the environment.

Possible MWL failure scenarios and contingencies are listed in Table 7-1. The contingencies identified depend heavily upon the implementation of the Trigger Evaluation Process (Section 5.1) and the results of further investigation initiated as part of the process. Trigger levels for long-term monitoring at the MWL are presented in Section 5.2. If the monitoring trigger levels are exceeded, then the Trigger Evaluation Process (Figure 5.1-1) will be initiated, as described in Section 5.1.

Should a specific trigger level be exceeded, then the process shown in Figure 5.1-1 will be used to ensure that adequate data are collected to determine whether additional actions are warranted. The increased frequency of data collection in Step 3 of the trigger evaluation process (Figure 5.1-1 and Section 5.1.3) will ensure that adequate data are collected to eliminate field sampling and/or laboratory error or short-term exceedances that do not reflect long-term trends. Thus, any recommendations for further investigation and/or corrective action because of trigger level exceedance(s) will be based upon data trends rather than upon a single detected value above the trigger level. NMED will be notified and involved throughout the process.

The Trigger Evaluation Process presented in Section 5.1 is an early detection system that allows specific contingencies to be addressed on a situation-specific basis in full coordination with NMED. An exceedance of a trigger level does not necessarily constitute failure of the remedy or site conditions that are not protective of human health and the environment. However, a confirmed trigger level exceedance does indicate that further investigation and additional data evaluation are necessary to determine whether additional actions are required to protect human health and the environment.

Table 7-1
Possible Failure Scenarios and Contingencies
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Failure Scenario	Notes	Procedure	Possible Corrective Action
Radon concentrations in air exceed trigger level of 4 pCi/L	Scenario unlikely based upon historical measurements of radon emissions from MWL without cover (Haaker January 1998).	1. Verify exceedance of trigger level. 2. If verified, notify NMED in writing. 3. Increase sampling frequency. 4. Reevaluate all relevant data. 5. Submit Investigation Report to NMED within one year of confirmed exceedance notification. 6. If data indicate persistent and increasing concentrations of radon, determine appropriate action in consultation with NMED.	1. Assess compliance with NESHAP and DOE Orders. If all regulatory standards are met, no further action is necessary. 2. Consider augmenting cover soil to reduce radon concentrations emitted to atmosphere. 3. Consider limited MWL excavation
Tritium in surface soil exceeds trigger value of 20,000 pCi/L in soil moisture	Scenario possible.	1. Verify exceedance of trigger level. 2. If verified, notify NMED in writing. 3. Increase sampling frequency. 4. Reevaluate all relevant data. 5. Submit Investigation Report to NMED within one year of confirmed exceedance notification. 6. If data indicate persistent and increasing concentrations of tritium, consider appropriate action.	1. Assess compliance with NESHAP and DOE Orders. If all regulatory standards are met, no further action is necessary. 2. Evaluate risk to human health and the environment. If risk is negligible, no further action is required. 3. If risk is significant, implement appropriate engineering and/or administrative controls to reduce risk.
Radionuclides in surface soil at animal burrows and ant hills exceed NMED-approved maximum background concentrations	Scenario likely as small exceedances of background concentrations are relatively common and not unexpected.	1. Continue to monitor annually and determine trends over time. 2. Include results in annual MWL long-term monitoring and maintenance report. 3. If data indicate persistent and increasing trend, perform risk assessment to determine appropriate actions.	1. Assess compliance with DOE Orders. If all regulatory standards are met, no further action is necessary. 2. Evaluate risk to human health and the environment. If risk is negligible, no further action is required. 3. If risk is significant, consider eliminating ant hills and removing animals creating the burrows. 4. If biotic mobilization of contaminants continues to be a major concern, consider adding additional thickness to MWL cover.

Refer to footnotes at end of table.

Table 7-1 (Continued)
Possible Failure Scenarios and Contingencies
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Failure Scenario	Notes	Procedure	Possible Corrective Action
Metals concentrations in surface soil near animal burrows and ant hills exceed trigger values (Table 5.2.2-1)	Scenario unlikely due to thickness of ET Cover and biointrusion barrier.	1. Verify exceedance of trigger level. 2. If verified, notify NMED in writing. 3. Increase sampling frequency. 4. Reevaluate all relevant data. 5. Submit Investigation Report to NMED within one year of confirmed exceedance notification. 6. If data indicate persistent and increasing concentrations of RCRA metals, determine appropriate action in consultation with NMED.	1. Assess compliance with SSLs and DOE Orders. If all regulatory standards are met, no further action is necessary. 2. Evaluate risk to human health and the environment. If risk is negligible, no further action is required. 3. Consider eliminating ant hills and removing animals creating the burrows. 4. If biotic mobilization of contaminants continues to be a major concern, consider adding additional thickness to MWL cover.
Gamma-emitting radionuclides detected in vegetation growing on ET Cover surface	Scenario unlikely due to thickness of ET Cover, inspection/repair requirement to remove potentially deep-rooted plants, and biointrusion barrier.	1. Continue to monitor annually and determine trends over time. 2. Include results in annual MWL long-term monitoring and maintenance report. 3. Eliminate deep-rooted plants on a more frequent basis.	1. Assess compliance with DOE Orders (including 450.1A [DOE 2008] and 5400.5 [DOE 1993]). If all regulatory standards are met, no further action is necessary. 2. Evaluate risk to human health and the environment. If risk is negligible, no further action is necessary. 3. If risk is significant, consider changes to monitor for and eliminate deep-rooted plants more frequently and consider design changes to the cover.

Refer to footnotes at end of table.

Table 7-1 (Continued)
Possible Failure Scenarios and Contingencies
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Failure Scenario	Notes	Procedure	Possible Corrective Action
Moisture in vadose zone at linear depths of between 10 to 100 ft exceed trigger levels	Scenario unlikely due to anticipated performance of the cover.	1. Verify exceedance of trigger level. 2. If verified, notify NMED in writing. 3. Increase sampling frequency. 4. Reevaluate all relevant data. 5. Submit Investigation Report to NMED within one year of confirmed exceedance notification. 6. If data indicate persistent and increasing moisture in vadose zone, determine appropriate action in consultation with NMED.	1. Determine whether ponding and preferential flow down the boreholes is responsible for the elevated moisture content. If preferential flow is occurring, regrade surface adjacent to soil-moisture monitoring access tubes to divert surface runoff or replace access tubes. 2. Evaluate infiltration through the cover using alternative methods such as double-ring infiltrometers or air-entry permeameters. 3. Assess performance of cover; if cover is not reducing infiltration sufficiently to meet the RCRA-prescribed equivalence criteria of 10^{-7} cm/s, determine reasons for poor performance of the cover. 4. Consider remedial measures to improve cover performance, such as discing native soil layer to increase porosity and vegetation growth characteristics. Replant native vegetation to enhance evapotranspiration.
VOCs in vadose zone exceed trigger levels	Scenario possible, based upon MWL fate and transport model results (Ho et al. January 2007).	1. Verify exceedance of trigger level. 2. If verified, notify NMED in writing. 3. Increase sampling frequency. 4. Reevaluate all relevant data. 5. Submit Investigation Report to NMED within one year of confirmed exceedance notification. 6. If data indicate persistent and increasing concentrations of VOCs in vadose zone, determine appropriate action in consultation with NMED.	1. Refine conceptual site model of contaminant distributions and transport through additional soil-vapor samples. 2. Update fate and transport model with additional data to predict potential impacts. 3. If groundwater contamination appears likely, consider corrective action before contaminants reach groundwater. 4. Corrective action may include soil-vapor extraction to reduce the contaminant source term.

Refer to footnotes at end of table.

Table 7-1 (Concluded)
Possible Failure Scenarios and Contingencies
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Failure Scenario	Notes	Procedure	Possible Corrective Action
VOC concentrations in groundwater exceed trigger levels	See Table 5.2.4-1 for trigger levels. Scenario possible based upon MWL Fate and Transport Model (Ho et al. January 2007).	1. Verify exceedance of trigger level. 2. If verified, notify NMED in writing. 3. Increase sampling frequency. 4. Reevaluate all relevant data. 5. Submit Investigation Report to NMED within one year of confirmed exceedance notification. 6. If data indicate persistent and increasing concentrations of VOCs, determine appropriate action in consultation with NMED.	1. Conduct risk assessment with contaminant data. 2. Consider additional corrective action measures based upon fate and transport model results and risk assessment results. 3. Propose possible remedial measures including monitored natural attenuation or active pump and treat. 4. Consider installation of passive venting to control VOCs in the vadose zone above the aquifer. 5. Consider controlling VOC migration through the vadose zone using soil-vapor extraction.
Metals concentration (including total uranium) in groundwater exceed trigger level	Scenario highly unlikely without significant increase in infiltration through the MWL cover.	1. Verify exceedance of trigger level. 2. If verified, notify NMED in writing. 3. Increase sampling frequency. 4. Reevaluate all relevant data. 5. Submit Investigation Report to NMED within one year of confirmed exceedance notification. 6. If data indicate persistent and increasing contamination of groundwater, determine appropriate action in consultation with NMED.	1. Conduct risk assessment with contaminant data. 2. Consider additional corrective action measures based upon fate and transport model results and risk assessment results. 3. Reduce metals concentrations through monitored natural attenuation. 4. Install pump and treat system to remediate metals in groundwater to less than the regulatory standard.

cm/s = Centimeter(s) per second.
DOE = U.S. Department of Energy.
ET = Evapotranspirative.
ft = Foot (feet).
MWL = Mixed Waste Landfill.
NESHAP = National Emissions Standards for Hazardous Air Pollutants.
NMED = New Mexico Environment Department.
pCi/L = Picocurie(s) per liter.
RCRA = Resource Conservation and Recovery Act.
SSL = Soil screening level.
VOC = Volatile organic compound.

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APPENDIX A
Installation Report for Two Soil-Vapor Monitoring Wells at the Mixed Waste Landfill

Sandia National Laboratories

Sandia National Laboratories/New Mexico Environmental Restoration Project

INSTALLATION REPORT FOR TWO SOIL-VAPOR MONITORING WELLS AT THE MIXED WASTE LANDFILL

OCTOBER 2010

United States Department of Energy
Sandia Site Office

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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LIST OF ATTACHMENTS

Attachment

1 Soil-Vapor Sampling Implants Operation Procedures from Geoprobe Systems®

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ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
CMI	Corrective Measures Implementation
DOE	U.S. Department of Energy
ER	Environmental Restoration
ET	Evapotranspirative
Geoprobe	Geoprobe Systems®
KAFB	Kirtland Air Force Base
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
PC	protective casing
RCT	Radiological Control Technician
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
Sandia	Sandia Corporation
SNL/NM	Sandia National Laboratories, New Mexico
TA-III	Technical Area III
VOC	Volatile organic compound
WDC	WDC Exploration and Wells

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1.0 INTRODUCTION

This report documents the installation of two soil-vapor monitoring wells (soil-vapor wells) at the Mixed Waste Landfill (MWL) at Sandia National Laboratories, New Mexico (SNL/NM). The activities were performed in August 2009 by the SNL/NM Environmental Restoration (ER) Operations (formerly ER Project) personnel and the drilling contractor WDC Exploration and Wells (WDC).

1.1 Site Description and History

The MWL is located in the central part of Kirtland Air Force Base (KAFB), south of the City of Albuquerque, New Mexico. Within KAFB, the MWL is located in the north-central portion of SNL/NM Technical Area-III (TA-III), on federally owned land controlled by KAFB and permitted to the U.S. Department of Energy (DOE) (Figure 1-1). The MWL accepted containerized and uncontainerized low-level radioactive waste and minor amounts of mixed waste from SNL/NM research facilities and off-site DOE and U.S. Department of Defense generators from March 1959 to December 1988. Approximately 100,000 cubic feet of low-level radioactive waste (excluding packaging, containers, demolition and construction debris, and contaminated soil) containing 6,300 curies of activity (at the time of disposal) were disposed of at the MWL. Disposal cells at the landfill are unlined and were backfilled and compacted to grade with stockpiled soil.

Two distinct disposal areas are present at the MWL: the classified area (occupying 0.6 acres) and the unclassified area (occupying 2.0 acres). Wastes in the classified area were disposed of in a series of vertical, cylindrical pits. Historical records indicate that early pits were 3 to 5 feet in diameter and 15 feet deep; later pits were 10 feet in diameter and 25 feet deep. Once pits were filled with waste, they were backfilled with soil and capped with concrete. Wastes in the unclassified area were disposed of in a series of parallel, north-south trenches. Records indicate that trenches were 15 to 25 feet wide, 150 to 180 feet long, and 15 to 20 feet deep. Trenches were backfilled with soil on a quarterly basis and, once filled with waste, were capped with the original soil that had been excavated and locally stockpiled.

Containment and disposal of routine waste commonly occurred using tied, double-polyethylene bags, sealed A/N cans (military ordnance metal containers of various sizes), fiberboard drums, wooden crates, cardboard boxes, and 55-gallon steel and polyethylene drums. Larger items, such as glove boxes, spent fuel shipping casks, and contaminated soil, were disposed of in bulk without containment. Disposal of free liquids was not allowed at the MWL, except for the 1967 disposal of 204,000 gallons of reactor coolant water in Trench D. Liquids such as acids, bases, and solvents were solidified with commercially available agents before containerization and disposal. A detailed MWL waste inventory, by pit and trench, is provided in the “Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Dated September 1996, Volumes 1 and 2” (SNL/NM June 1998).

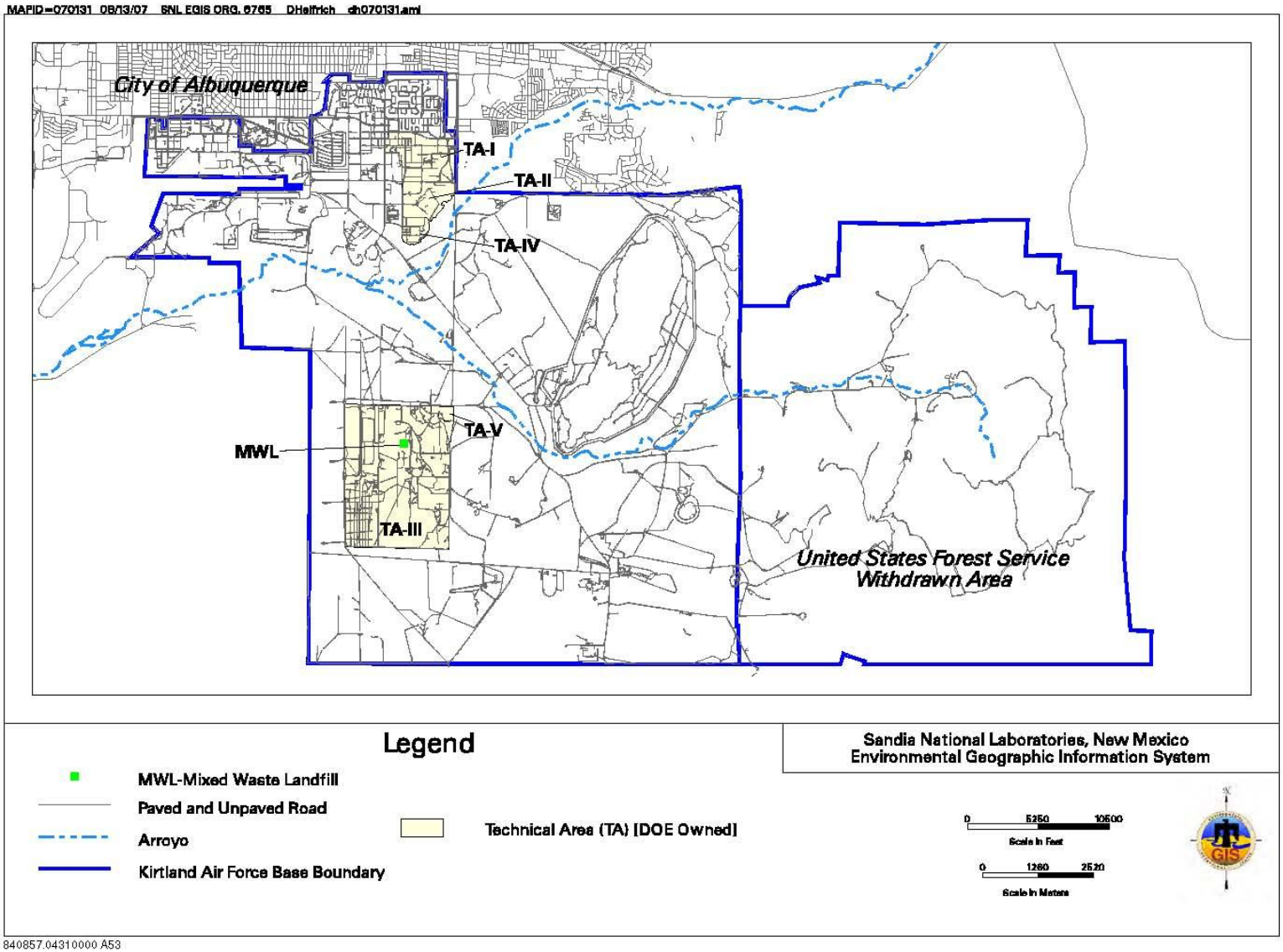

Figure 1-1
Location of the Mixed Waste Landfill, Sandia National Laboratories, and Kirtland Air Force Base

A Phase 1 Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) was conducted in 1989 and 1990 to determine whether a release of RCRA contaminants had occurred at the MWL (SNL/NM September 1990). A Phase 2 RFI was conducted from 1992 to 1995 to determine the contaminant source, define the nature and extent of contamination, identify potential contaminant transport pathways, evaluate potential risks posed by the levels of contamination identified, and provide remedial action alternatives for the MWL (SNL/NM September 1996).

Soil-vapor volatile organic compound (VOC) samples, tritium soil samples, and radon samples were collected at the MWL in 1994, 1995, and 1997, respectively. To determine whether subsurface conditions at the MWL had changed since the mid-1990s, the New Mexico Environment Department (NMED) required that additional soil-vapor VOC, tritium soil, and radon samples be collected at the site. This additional investigation was completed at the MWL in April and May 2008, and is described in the "Investigation Report on the Soil-Vapor Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill" (SNL/NM August 2008).

1.2 Soil-Vapor Well Regulatory History and Interaction

On October 10, 2008, the NMED sent a letter to the DOE National Nuclear Security Administration and Sandia Corporation (Sandia) regarding the MWL Corrective Measures Implementation (CMI) Plan (SNL/NM November 2005). The NMED letter was entitled "Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005, Sandia National Laboratories, NM5890110518, SNL-05-025" (Bearzi October 2008) and contained comments on the MWL CMI Plan. On November 26, 2008, the DOE/Sandia submitted responses to the NMED comments (Davis November 2008) and in Part 2, Comment 6 of the response letter, DOE/Sandia proposed to install two permanent soil-vapor sampling points (wells) within the MWL boundary. On December 22, 2008, the NMED conditionally approved the DOE/Sandia responses and the CMI Plan (Bearzi December 2008) and reiterated the requirement for two permanent soil-vapor points (i.e., monitoring wells) within the MWL boundary.

On May 20, 2009, locations for the two soil-vapor wells were proposed to NMED via e-mail correspondence (Sanders May 2009). These two proposed locations were selected based on the highest soil-vapor VOC detections in 1994 and 2008 subsurface soil-vapor samples collected at the MWL. NMED concurred with the two proposed locations in a reply e-mail dated May 22, 2009, which also further specified that one of the wells be installed along the now-removed original MWL boundary fence along the southern edge of the MWL classified area, near the "old acid pit" (Moats May 2009). The old acid pit was one of the names used for the waste disposal cell located at the southeast corner of the MWL classified area. NMED personnel also confirmed that both soil-vapor wells needed to be installed at a depth of 35 feet below the original surface of the MWL such that the sampling ports were approximately 10 feet below the bottom of the waste trenches and pits**.**

The proposed locations for the two soil-vapor wells that were approved by the NMED via e-mail on May 22, 2009, were further confirmed during a meeting with NMED personnel on June 29, 2009.

1.3 Objective

The objective of this project was to install two soil-vapor wells to a depth of approximately 35 feet below the original surface of the MWL, at locations approved by the NMED. A secondary objective was to minimize impact to the reseeded surface of the MWL evapotranspirative (ET) cover (hereinafter referred to as the ET Cover). This was accomplished by installing the two wells immediately after placement of the topsoil layer, but prior to tilling, seeding, and mulching this layer.

The locations of the two soil-vapor monitoring wells (MWL-SV01 and MWL-SV02) and the locations of the former waste burial trenches and cells (including the old acid waste pit) are shown in Figure 1-2.

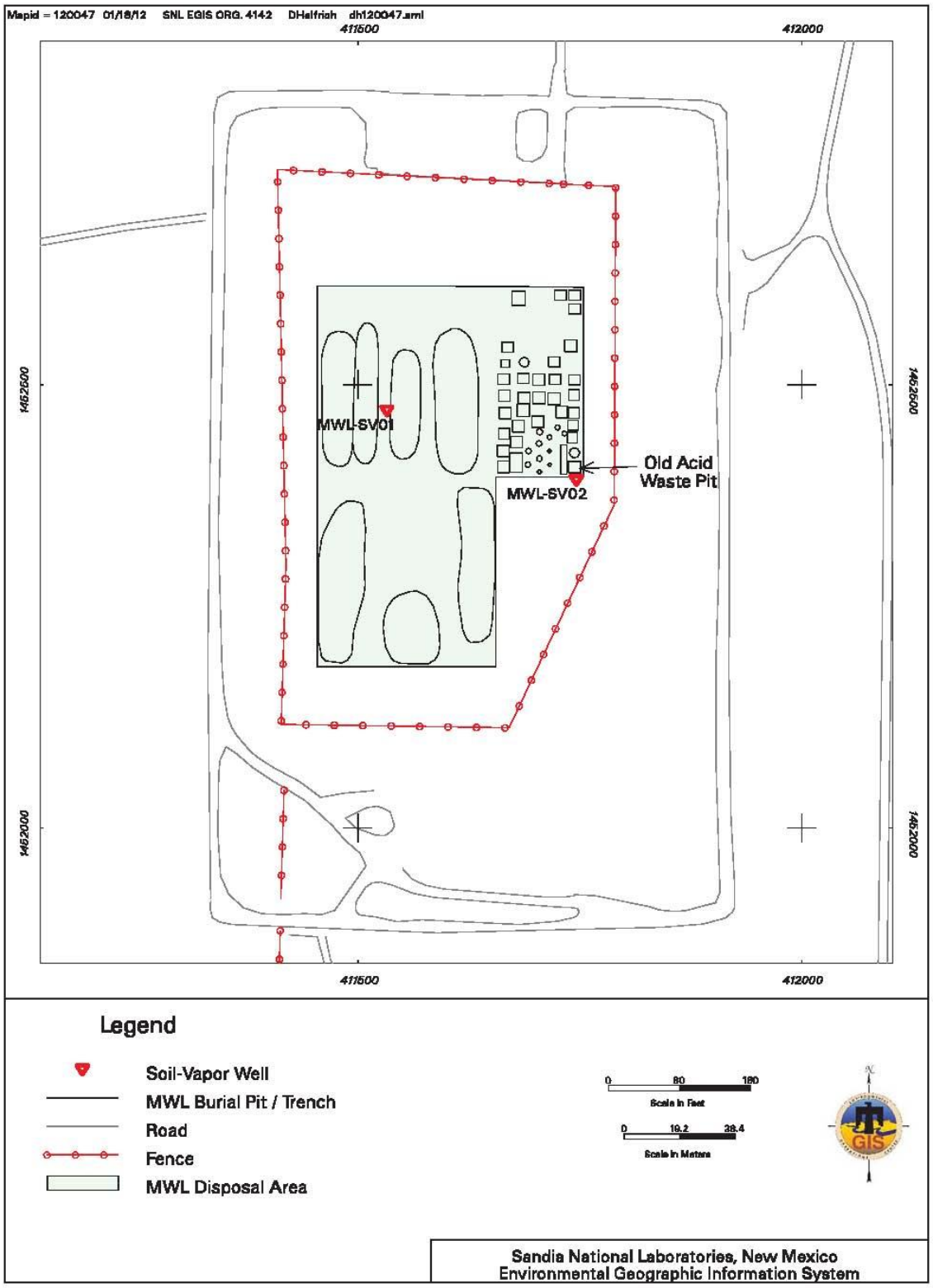

Figure 1-2
Mixed Waste Landfill Location of Soil-Vapor Wells MWL-SV01 and MWL-SV02

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2.0 SOIL-VAPOR WELL INSTALLATION

On August 5, 2009, WDC personnel mobilized a Geoprobe Systems® (Geoprobe) Model 7730DT direct-push drill rig to the decontamination pad in TA-III, and the initial equipment decontamination was performed with a pressure washer. A baseline radiological screening survey was then completed by an SNL/NM Radiological Control Technician (RCT) to confirm that the equipment was not radiologically contaminated before being brought to the MWL. No evidence of radiological contamination was detected, and the Geoprobe was transported to the first drilling location, at the southern edge of the MWL classified area (MWL-SV02 in Figure 1-2).

2.1 Soil-Vapor Well Construction

The combined thickness of both the subgrade and MWL ET Cover at MWL-SV02 was determined to be approximately 6.25 feet based upon construction surveys of the individual ET Cover layers. To meet the NMED requirement that the soil-vapor wells be completed at a depth of 35 feet below the original surface of the MWL, the targeted depth for installation of the 6-inch-long Geoprobe soil-vapor implant (i.e., screen) was 41 feet below ground surface (bgs) (top of screen) to 41.5 feet bgs (bottom of screen). Personnel from the NMED Hazardous Waste Bureau were on site for several hours the afternoon of August 6, 2009, to observe the soil-vapor well installation process.

The two soil-vapor wells were installed utilizing the procedures described in the "Implants Operation" technical literature from Geoprobe, presented as Attachment 1 of this report (Geoprobe July 2009).

MWL-SV02 was constructed in the following manner. A sacrificial stainless steel drive tip was attached to a 2.25-inch outer diameter by 4-foot-long Geoprobe rod. This rod attached to a series of other 4-foot-long rods that were hydraulically driven with the Geoprobe direct–push drilling rig to the target soil-vapor implant sampling depth (41 to 41.5 feet bgs) (Figure 2-1). After the Geoprobe rods were pushed to the required total depth, the soil-vapor implant and ¼-inch-diameter, polyethylene tubing were prepared for insertion into the inside of the rods. The soil-vapor implant consisted of a 6-inch-long by ½-inch-diameter, woven, stainless steel screen, with a conical-shaped stainless steel weight attached to the bottom. The polyethylene tubing was pushed onto a small fitting on the top of the implant (Figure 2-2), and the implant/tubing assembly was then lowered down inside the rods to 41.5 feet bgs.

Once the implant was lowered to the required depth, approximately 12 inches of 10/20 silica sand was poured into the annulus between the rods and the polyethylene tubing. The sand was installed to approximately 6 inches above the top of the implant, or 40.5 feet bgs. The silica sand was installed to create a "sand pack" around the soil-vapor screen implant, through which depth-specific soil vapor could be collected during future sampling events. Once the silica sand was installed, the remainder of the borehole from the top of the silica sand to the ground surface was sealed to ensure that soil-vapor samples would be collected from the formation at the desired depth.

Figure 2-1
Pushing the Geoprobe rods to the target soil-vapor sampling depth at the soil-vapor well MWL-SV02 location, August 5, 2009 (view to the southeast).

Figure 2-2
Geoprobe soil-vapor implant attached to 1/4-inch-diameter polyethylene tubing, which was inserted into the Geoprobe rods and lowered to the required soil-vapor sampling depth at soil-vapor well MWL-SV02 location, August 6, 2009 (view to the south).

The borehole was sealed from the top of the silica sand to the surface in the following manner. Depths to the top of materials as they were added to the borehole were determined (tagged) with a depth sounding cable provided by SNL/NM. Once the implant and 10/20 silica sand were placed, the Geoprobe rods were retracted approximately 5.5 feet, to 36 feet bgs. The section of open borehole was then backfilled through the rods with dry crushed bentonite (Baroid QuikGrout®) to a depth of approximately 38 feet bgs (2.5 feet above the top of the sand, and 2 feet below the bottom of the rods). This first lift of bentonite was then hydrated by inserting a ¾-inch-diameter rubber tube into the Geoprobe rods and lowering the tubing inside the rods to within a few inches of the top of the first bentonite lift. It was important to keep the inside of the rods dry to prevent the bentonite from sticking to and plugging up the inside of the rods as the borehole was being backfilled with the material. Once the rubber tubing was positioned at the required depth, approximately half a gallon of deionized water was poured into the tubing through a funnel and then drained into the bentonite to hydrate the material (Figure 2-3).

Once the first bentonite lift was hydrated and the rods were retracted, an additional 4 feet of borehole was backfilled with bentonite. This rod retraction/bentonite plugging and hydration procedure was repeated in approximately 4-foot lifts until the borehole was backfilled to the surface.

Care was taken to avoid damaging the polyethylene tubing as the Geoprobe rods were retracted from the borehole. The rods were also checked for potential radiological contamination by an on-site SNL/NM RCT after being withdrawn from the borehole. No radiological contamination was detected by the RCT. Once the borehole was sealed to the surface, the length of polyethylene tubing extending above the ground surface was capped, loosely coiled, and temporarily protected with a 30-gallon plastic tub.

The second soil-vapor well (MWL-SV01) was installed at a location in the northwest part of the MWL (Figure 1-2) on August 6 and August 7, 2009. The thickness of both the subgrade and MWL cover at the MWL-SV01 location was determined to be approximately 7.25 feet based upon construction surveys of the individual ET Cover layers. To meet the NMED requirement that the soil-vapor well be completed at a depth of 35 feet below the original surface of the MWL, the implant was installed at a depth of 42 to 42.5 feet bgs at this location. The installation and borehole plugging procedure previously described for MWL-SV02 was followed to complete MWL-SV01.

Upon completion of the two soil-vapor wells, the integrity of the polyethylene tubing and implant screen for each of the wells was field-checked for possible blockages or leaks by SNL/NM personnel. This was accomplished by using a portable vacuum pump to draw a test vacuum on the tubing and measuring the amount of vacuum with a gauge. The vacuum measured for the MWL-SV01 and MWL-SV02 tubing ranged from –5 to –10 inches of mercury. This was a similar range of vacuum that was measured when subsurface soil-vapor samples were previously collected with the same pump assembly at the MWL in April and May 2008. The field testing indicated that no damage or blockage had occurred to the tubing or implant screens during installation at either well.

Figure 2-3
Hydrating the bentonite plug by pouring deionized water into tubing inserted into the Geoprobe rods at soil-vapor well MWL-SV01 location, August 7, 2009 (view to the southwest).

2.2 Soil-Vapor Well Surface Completions

The surface construction of the two wells was accomplished on August 12 and August 13**,** 2009**.** For each of the soil-vapor wells a 3-foot-deep hole was carefully hand-excavated around the polyethylene tubing and bentonite-filled borehole to avoid damaging the tubing. A 6-foot-long by 6-inch-diameter piece of protective steel surface casing was installed around the tubing and into the 3-foot-deep hole. A 4-foot-square by 4-inch-thick concrete well pad was then constructed around the surface casing, and the surface casing was cemented into place. A brass cap stamped with the well name was inserted into the concrete well pad while it was still wet. Three protective bollards were also installed around the new well pad. The bases of the bollards were installed at 2 feet below the cover surface and projected 3 feet above the surface. The bollards were cemented into the ground with concrete and filled with concrete.

Once the protective casings (PCs) were installed at each well, both were filled with 10/20 silica sand from the top of the hydrated bentonite plug at the MWL ET Cover surface to within approximately 8 inches below the top of the PC. The polyethylene tubing extending above the sand was carefully coiled and stowed inside the PC, and a small rubber end cap was placed over the end of the tubing. A locking well cover was then installed on top of the PC. The final step consisted of painting the PC and bollards with high-visibility yellow paint.

The soil-vapor well construction diagrams are provided as Figures 2-4 and 2-5.

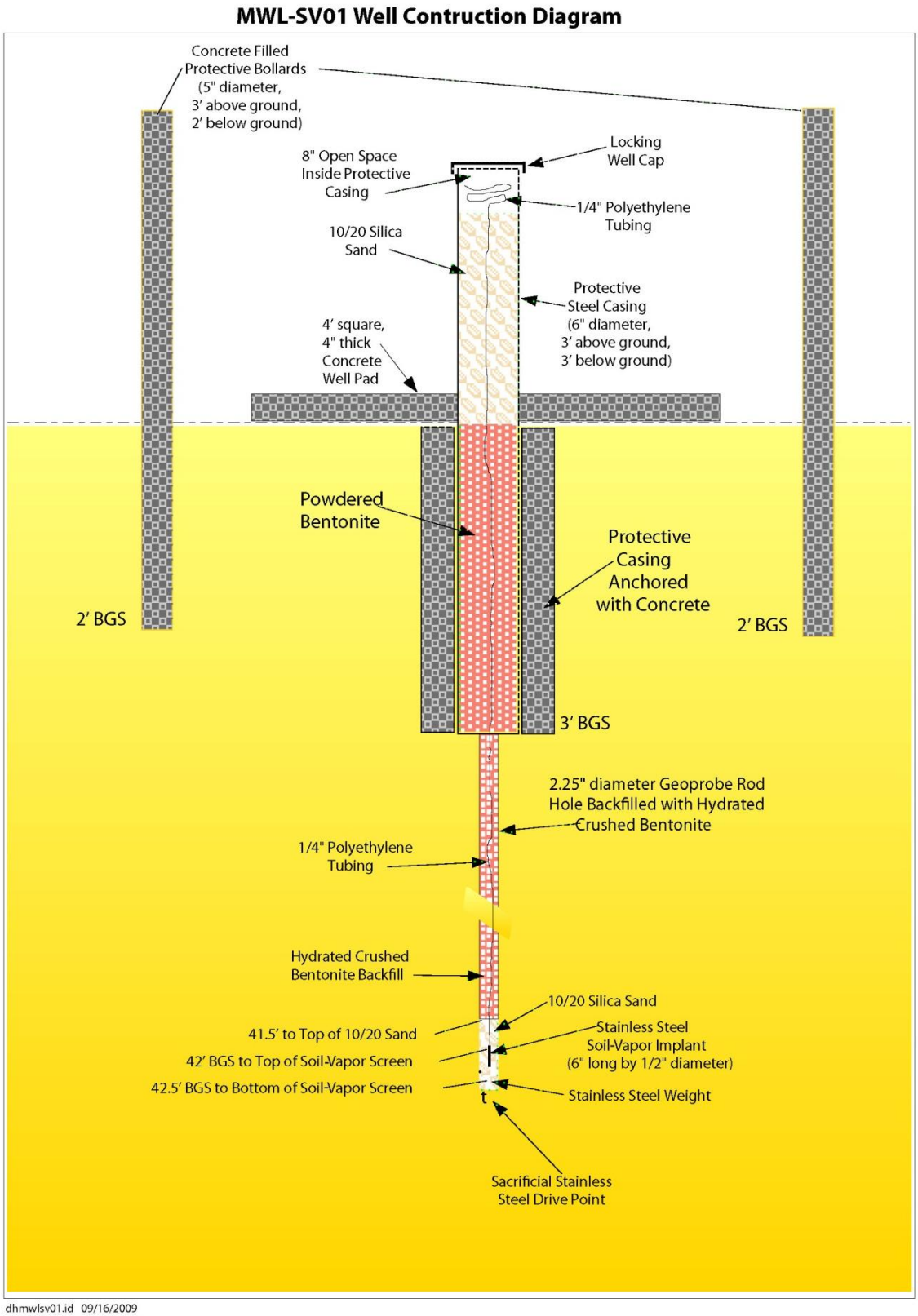

Figure 2-4
Soil-Vapor Well MWL-SV01 Construction Diagram

MWL-SV02 Well Construction Diagram

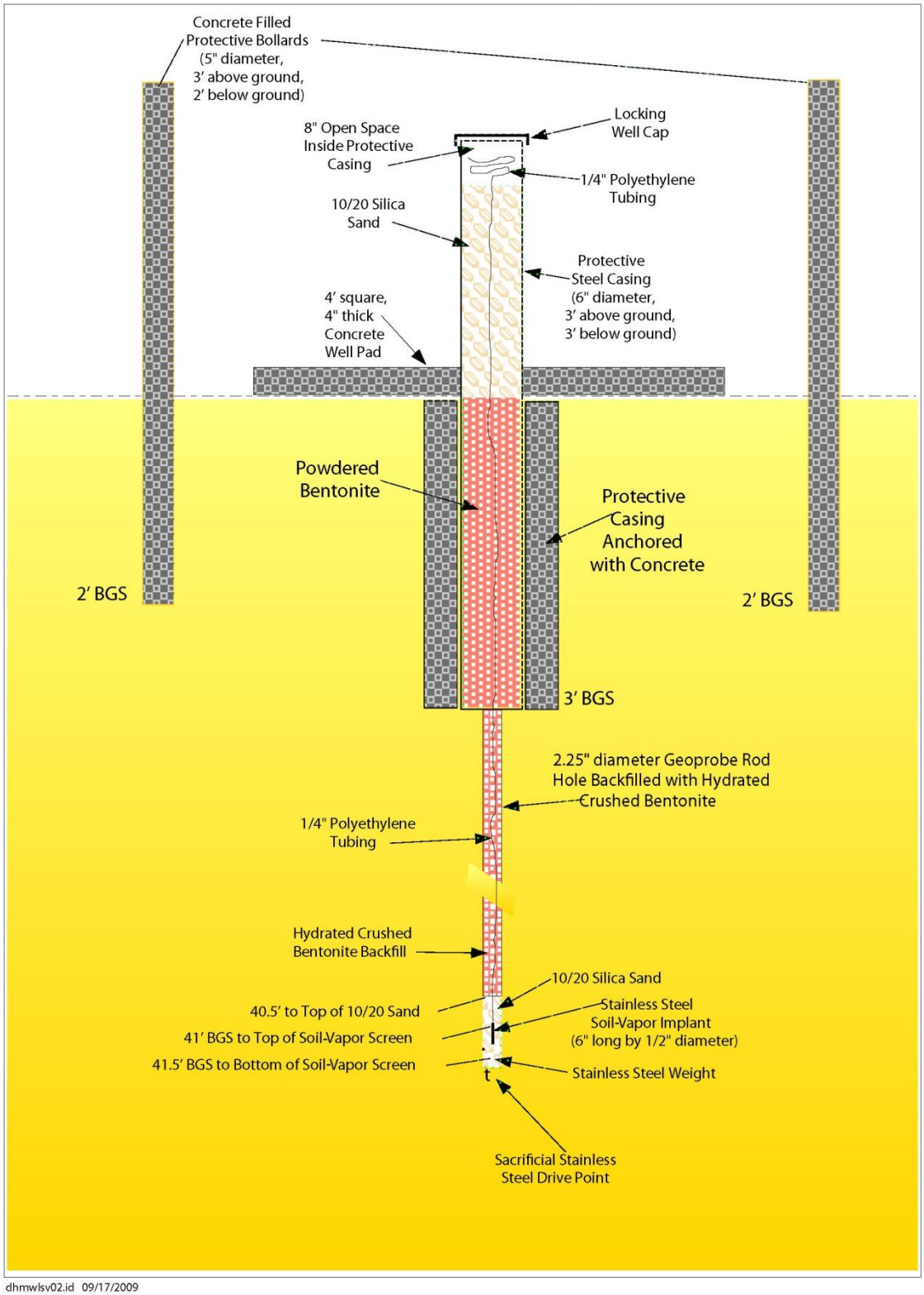

Figure 2-5
Soil-Vapor Well MWL-SV02 Construction Diagram

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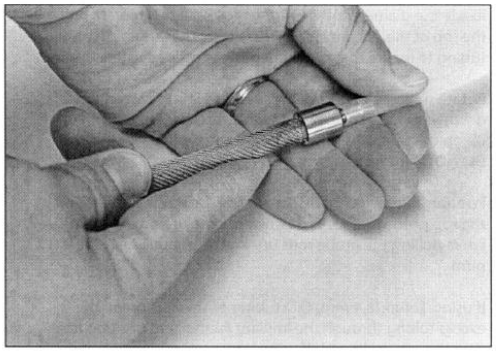
ATTACHMENT 1
Soil Vapor Sampling Implants Operation Procedures from Geoprobe Systems®

Implants Operation

from Geoprobe Systems®

www.geoprobe.com
1-800-436-7762



Attaching polyethylene tubing to the sampling implant.

Sampling Implants – Operation

Installation Instructions for Soil Gas Implants

1. Drive probe rods to the desired depth using a Point Holder (AT-13B) and an Implant Anchor/Drive Point (PR-14). DO NOT disengage the drive point when depth has been reached.

2. Attach appropriate tubing to the implant **(Figure 1)**. If tubing is pre-cut, allow it to be approximately 48 in. (1219 mm) longer than the required depth of the implant. Cover or plug the open end of the tubing.

3. Remove pull cap and lower the implant and tubing down inside the diameter of the probe rods until the implant hits the top of the Anchor/Drive Point. Note the length of the tubing to assure that proper depth has been reached.

4. Rotate tubing counterclockwise while exerting a gentle downward force to engage the PRT threads **(Figure 2)**. Pull up on the tubing lightly to test the connection. DO NOT cut excess tubing.

5. Position a Probe Rod Pull Plate or Manual Probe Rod Jack on the top probe rod. Exert downward pressure on the tubing while pulling the probe rods up. Pull up about 12 in. (305 mm).

6. If using 1/4-in. (6,4 mm) O.D. tubing or smaller, thread the excess tubing through the Implant Funnel and position it over the top probe rod. If using larger tubing, it may not be possible to install the glass beads.

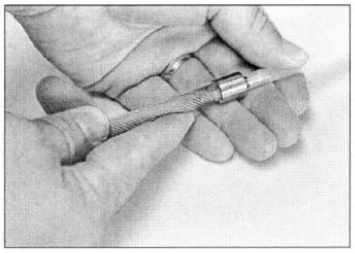


Figure 1. Attaching tubing to the sampling implant.

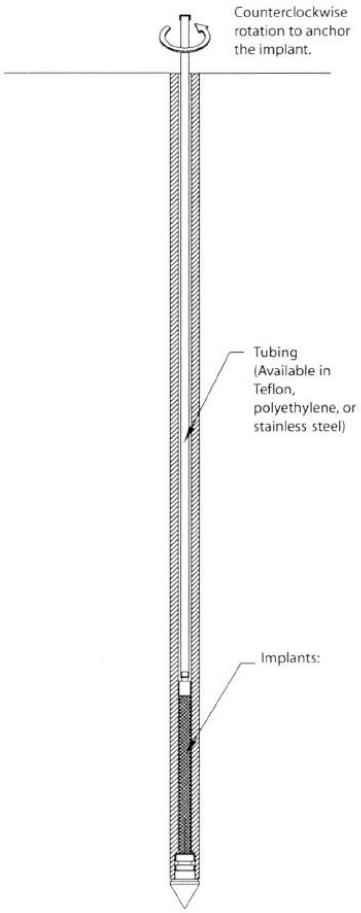


Figure 2. Once depth is achieved, the selected implant and tubing are inserted through the rods. The tubing is rotated to lock the implant into the drive point.

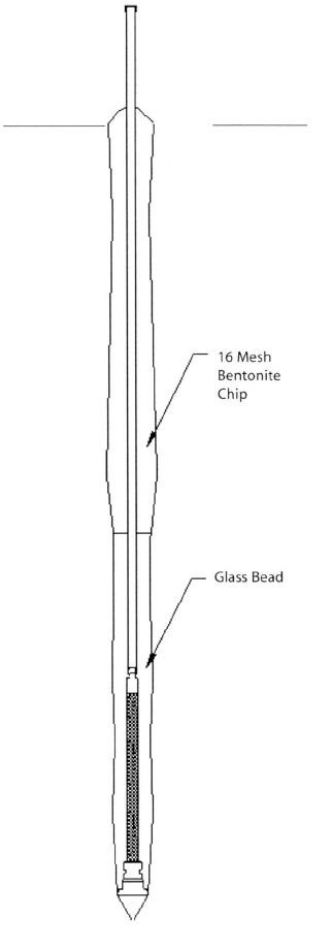


Figure 4. After the implant has been secured, the rods are removed and the annulus backfilled as appropriate.

7. Pour glass beads down the inside diameter of the probe rods around the outside of the tubing. Use the tubing to "stir" the glass beads into place around the implant. Do not lift up on tubing. It should take less than 150 mL of glass beads to fill the space around the implant.

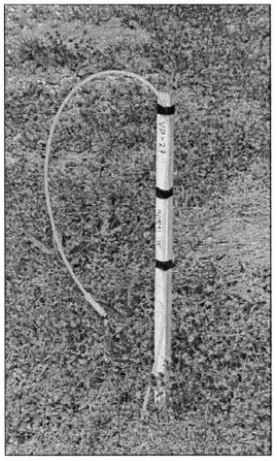
   NOTE: Backfilling through the rods with glass beads or glass beads/bentonite mixes can only be performed in the Vadose Zone, not below the water table.

8. Lift up an additional 18 to 24 in. (457 to 610 mm) and pour the bentonite seal mixture into place as in Step 7. The volume to be filled is about 154 mL per foot. It may be necessary to "chase" the seal mixture with distilled water to initiate the seal.

9. Pull the remaining rods out of the hole as in Step 5. Backfilling with sackcrete (cement/sand) or bentonite/sand may be done while removing the rods **(Figure 4)**. If the PR-14 Implant Anchor is used, the tubing may be cut flush with the top probe rod and a regular pull cap may be used to remove the remaining probe rods after Step 8.

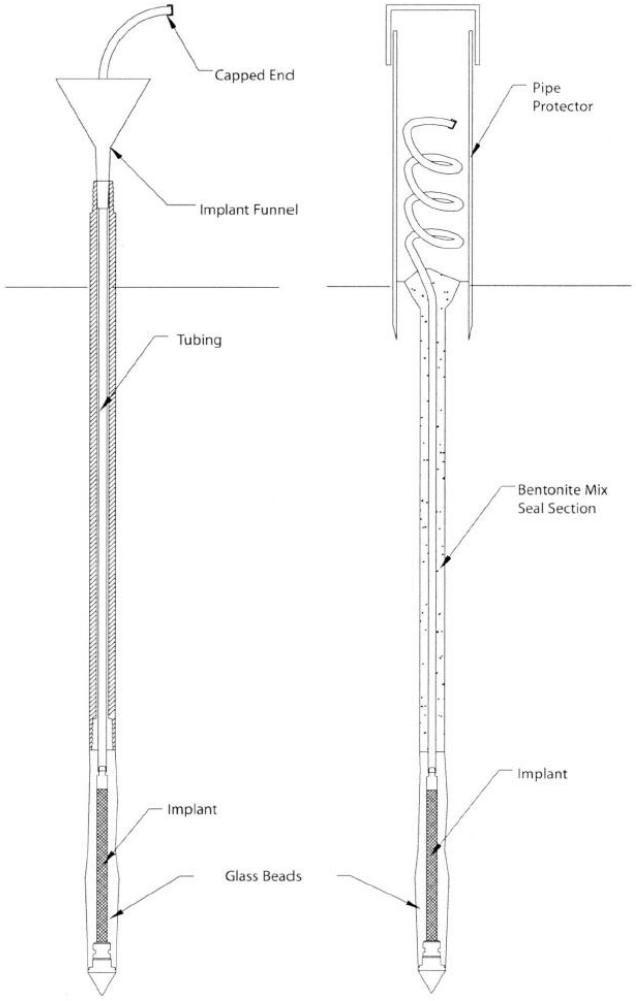
10. After the probe rods have been removed, cut the tubing at the surface, attach a connector or plug, and mark the location with a pin flag or stake. The point is ready for sampling now.

Figure 3. Glass Beads create a permeable layer around vapor sample implants.



A vapor implant location.

Sampling Implants – Operation



Backfill materials include glass beads and bentonite sealants.

Example of completed permanent soil gas monitoring point.

APPENDIX B
Summary of Cover Maintenance and Supplemental Watering Activities for the Mixed Waste Landfill Evapotranspirative Cover Calendar Years 2009 through 2011

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1.0 INTRODUCTION

Maintenance of the Mixed Waste Landfill (MWL) evapotranspirative (ET) cover (hereinafter referred to as the ET Cover) has been performed since completion of construction activities in September 2009. The following represent the primary objectives of the ET Cover maintenance efforts:

- Comply with Condition 2 of the New Mexico Environment Department (NMED) Conditional Approval of the MWL Corrective Measures Implementation (CMI) Plan (Bearzi December 2008)
  - Remove/manage Russian thistle (i.e., tumbleweed growth)
  - Implement supplemental watering as a means to help establish a mature plant community
- Promote the growth of native grass seedlings to mature, healthy plants
- Establish a self-sustaining native grass community on the ET Cover (including side slopes)

Establishing a self-sustaining native plant community that is compatible with the local east mesa ecosystem is important to long-term ET Cover performance. Native plants are ideally suited to the climate of the arid southwest. The root systems not only stabilize the ET Cover surface and minimize erosion but also take up moisture stored in the upper part of the ET Cover and transfer it to the atmosphere through transpiration. Transpiration, in combination with evaporation, prevents deeper percolation of surface water/precipitation into the subsurface where the waste is buried. Thus, native vegetation is an important component that ensures the ET Cover performs as intended.

Weed removal (Russian thistle and other invasive annual weedy species) and supplemental watering have been performed in accordance with NMED requirements and have produced positive results. ET Cover revegetation success is defined in Section 4.1 of this MWL Long-Term Monitoring and Maintenance Plan (LTMMP) as the ET Cover vegetation meeting or exceeding criteria based on the surrounding Technical Area III natural conditions for foliar coverage and percentage of native perennial grass species versus invasive annual species.

The MWL currently has a young community of native grasses established on the cover. With short term assistance these native grasses should permanently out-compete the invasive species, reducing the amount of cover maintenance required to meet successful revegetation criteria as defined in this LTMMP. Weed removal, supplemental watering, spot reseeding, and cover repair work may be required during subsequent growing seasons to maintain and enhance the current foliar coverage and balance of native grass species versus invasive annual species.

The remainder of this appendix presents the cover maintenance activities performed by calendar year (CY). For CY 2009 through CY 2011, the majority of the maintenance has been performed during the growing season (March through September).

2.0 COVER MAINTENANCE ACTIVITIES, CALENDAR YEAR 2009

During construction of the MWL ET Cover in 2009, revegetation activities were initiated on August 12, 2009, with the installation of a temporary, aboveground, sprinkler, irrigation system that covered the entire landfill surface. The temporary irrigation system was installed to provide optimal soil moisture conditions for seed germination and plant growth by maintaining moderate moisture levels within the top 3 inches of soil. Tilling, seeding, and crimping operations are detailed in the NMED-approved MWL CMI Report (SNL/NM January 2010, Revision 1) and were completed on September 2, 2009.

2.1 Temporary Irrigation System Installation

The temporary irrigation system was installed aboveground over the 4.1-acre MWL ET Cover and over approximately 2.6 additional acres of seeded area surrounding the site on August 12 and August 13, 2009. The layout of the irrigation system and the revegetated areas are depicted in Figure B-1. Prior to seeding activities, a subcontractor, Rain for Rent, Inc., installed the temporary irrigation system utilizing aluminum pipes with o-rings to seal pipe joints and hooks to connect the pipes to minimize compaction of the soil and possible seed disturbance. The main line of the system was 6 inches in diameter and each of the 17 parallel branch lines were approximately 40 feet apart. Each branch line contained between 10 and 12 sprinklers. The branch lines measured 3 inches in diameter with each sprinkler spaced 30 feet apart. Each sprinkler consisted of a nozzle with a 5/64-inch opening allowing water spray up to 33 feet (horizontal distance).

The irrigation system was connected via the 6-inch main line that extended approximately 1,000 feet to a pair of 2-inch ports on a fire hydrant located northeast of the site. The ports were connected with 2-inch backflow preventers and water meters.

2.2 Supplemental Watering Activities

According to the watering plan discussed with NMED (Wagner September 2009), the total water to be applied to the site using the supplemental irrigation system plus the naturally occurring precipitation was not to exceed an annual precipitation total of 16.5 inches for CY 2009. This annual rainfall amount (16.5 inches) is the quantity modeled as the maximum annual precipitation in the MWL CMI Plan (SNL/NM November 2005). The volume of water applied using the irrigation system was measured using the water meters and tracked in the same units as natural precipitation (i.e., inches of water on the ET Cover surface).

Based on the initial supplemental watering plan, the irrigation system was to be operated for 48 days according to the schedule provided in Table B-1. This watering schedule was previously developed for the Chemical Waste Landfill At-Grade ET Cover (SNL/NM June 2009) and approved by the NMED (Bearzi July 2009). This schedule was implemented as the starting point; the actual frequency and duration of watering was modified based upon observed field conditions and natural precipitation and to ensure the overall water budget was not exceeded.

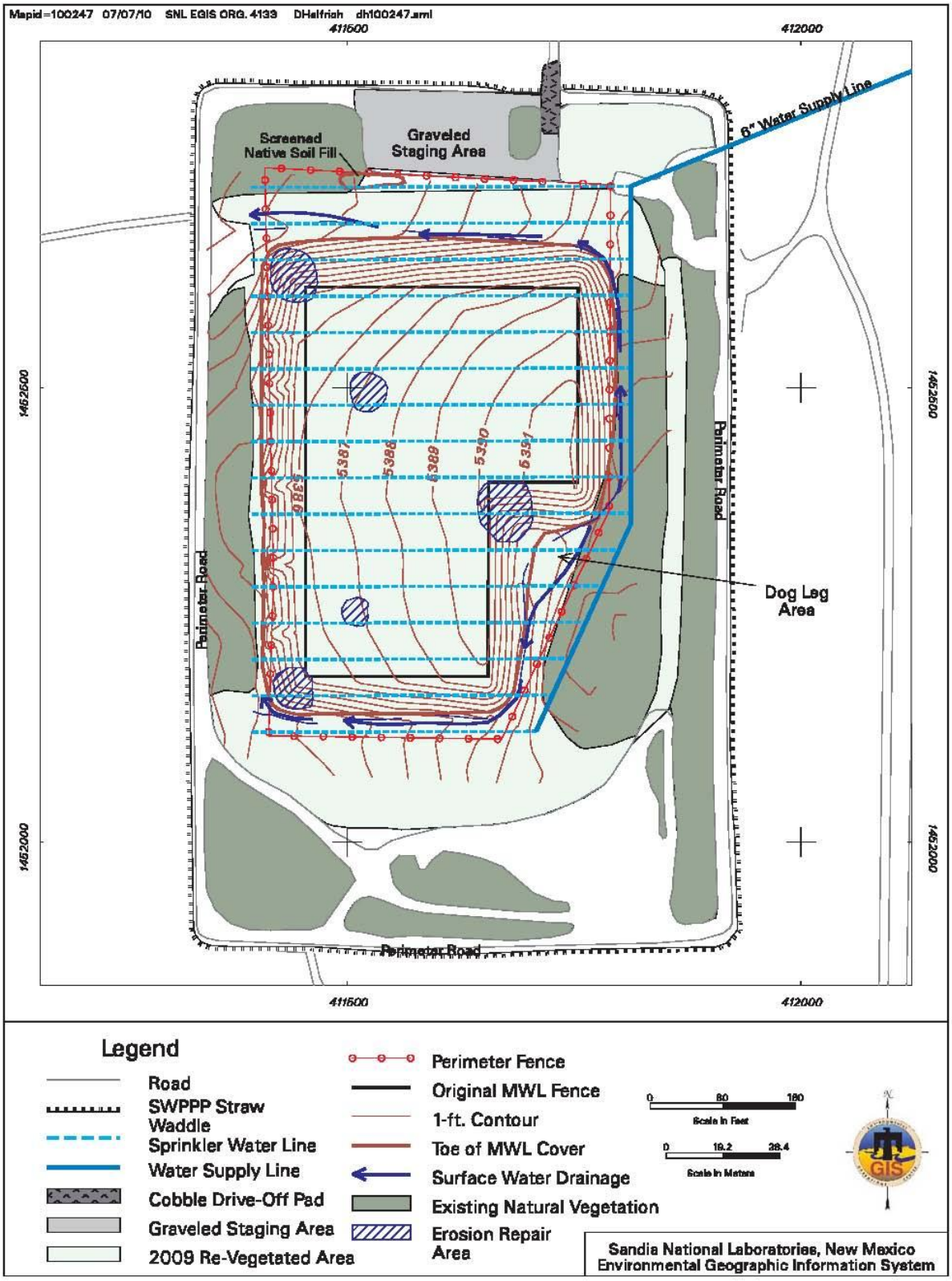

Figure B-1
MWL Temporary Irrigation System, 2009

Table B-1
Supplemental Watering Schedule
Mixed Waste Landfill Evapotranspirative Cover
Calendar Year 2009

Date Range	Watering Frequency	Time of Watering	Application Time (Hours)
Days 1-24	Daily	Morning	2
Days 25-36	Every other day	Morning	2
Days 37-48	Every third day	Morning	2.5

Supplemental watering of the MWL ET Cover vegetation was conducted from September 3 through October 20, 2009. The watering was monitored by the Sandia National Laboratories, New Mexico (SNL/NM) Staff Biologist and involved significantly less frequent daily applications. By late October, significant natural precipitation had occurred, and the cooler average temperatures indicated the end of the 2009 growing season; the supplemental watering effort was subsequently terminated.

Table B-2 summarizes the CY 2009 supplemental watering performed with the Rain-For-Rent, Inc. temporary irrigation system along with the natural precipitation monitored at both the site (during supplemental watering activities) and a nearby permanent SNL/NM meteorological monitoring station. The total for supplemental watering is conservative in that it does not factor in evaporative loss that occurred during application of the water. As shown in Table B-2, the total combined supplemental watering and natural precipitation for CY 2009 was 14.97 inches, which is 1.53 inches less than the 16.5 inches CY limit. The temporary irrigation system was removed from the site on November 3 and November 4, 2009.

Table B-2
Supplemental Watering and Natural Precipitation Summary
Mixed Waste Landfill Evapotranspirative Cover
Calendar Year 2009

Supplemental Watering Period	Number of Days Supplemental Watering Conducted	Total Monthly Gallons	Range of Daily Watering Totals (inches)	Monthly Watering Totals (inches)	Natural Precipitation (inches)
—	—	—	—	—	4.27[a]
September 3 – 30	19 out of 28 days	909,563	0.18 – 0.39	5.13	2.20
October 1 – 20	6 out of 20 days	276,907	0.21 – 0.32	1.56	0.98
—	—	—	—	—	0.83[b]
GRAND TOTALS		**1,186,470**	—	**6.69**	**8.28**
Total Supplemental + Natural Precipitation for Calendar Year 2009				**14.97**	

[a]Total natural precipitation for pre-supplemental watering period of January 1 – September 2, 2009.
[b]Total natural precipitation for post-supplemental watering period of October 21 – December 31, 2009.

3.0 COVER MAINTENANCE ACTIVITIES, CALENDAR YEAR 2010

The silt fence around the perimeter of the site established in May 2009 prior to construction of the ET Cover was replaced with straw wattles from January 5 through January 11, 2010. The perimeter site road used for routine security patrols is located inside of the straw wattles.

To reduce invasive annual weedy species competing with native vegetation for space and resources on the ET Cover, EDi Team personnel performed a final sweep of the surface to remove invasive annual plant species (i.e., weeds) from March 26 to March 31, 2010. Weed removal was done by hand and, when possible, roots were also removed. Weeds were stockpiled at the site and later transported to the Kirtland Air Force Base Landfill for disposal.

During the CY 2009 supplemental watering activities, some segments of the irrigation pipe occasionally separated and released high pressure water spray in isolated areas. This caused limited, localized erosion of the topsoil in several areas on the ET Cover. From November 17 through November 20, 2010, these areas were repaired. Also during this time frame, approximately 200 cubic yards of screened native soil remaining from cover construction operations was hauled from the MWL Borrow Area to a staging pile north of the MWL (Figure B-1). This soil was tested during 2009 cover construction and met CMI Plan specifications for use as both native and topsoil. A total of approximately 5 cubic yards of this native soil material were used for the erosion repairs. The remainder of the material was left for future cover maintenance activities. The location of the straw wattles, native soil material pile, and perimeter security road are shown in Figure B-1.

4.0 COVER MAINTENANCE ACTIVITIES, CALENDAR YEAR 2011

Cover maintenance activities conducted during CY 2011 included both supplemental watering and weed removal.

4.1 Supplemental Watering Activities

On April 1, 2011, a request to conduct supplemental watering and cover maintenance activities at the MWL (Wagner March 2011) in lieu of an approved LTMMP was approved by the NMED (Bearzi April 2011). Requirements for watering limits, tracking, and documentation are detailed in the approved letter request and are summarized as follows:

- Supplemental watering will be applied to augment natural precipitation.
- The amount of supplemental water applied and the duration of each watering event must be tracked as a precipitation event (i.e., inches of water applied) along with natural precipitation.

- No more than 3 inches of supplemental water will be applied over a 30-day period, and no more than 0.5 inches will be applied during any one-day event.

- The total water applied to any portion of the ET Cover during the CY (combination of natural and supplemental water) shall not exceed 16.5 inches.

A water meter was installed at the hydrant and used to track the volume of water applied during each watering event. The "inches of precipitation" measurement was calculated by applying the volume of water over the ET Cover surface area impacted by the watering event. The first two supplemental watering events of CY 2011 were performed in June and July using one large sprinkler operated at 16 locations to simulate 0.5 inches of rainfall across the cover (Figure B-2). A total of 56,000 gallons of water were applied per event during the morning hours to minimize evaporative loss across the 4.1-acre ET Cover (cover and side slopes). The sprinkler locations were determined by measuring the distance (i.e., radius) of the sprinkler output and then spacing the locations across the cover area to ensure complete coverage. Due to pressure loss in the sprinkler hose at the southern end of the ET Cover, the 10 southern locations were more closely spaced than the 6 northern locations (50- versus 70-foot radius) and less water was applied for each southern location (2,600 versus 5,000 gallons).

A temporary supplemental watering system (TSWS) was installed from July 19 through August 2, 2011, to allow for more efficient as-needed supplemental watering of the ET Cover. The system configuration is shown in Figure B-3 and was designed to cover approximately 80 to 90 percent of the entire ET Cover. Prior to system startup, approximately 12,600 gallons of water were used to flush the system and perform pressure and zone testing, equivalent to applying 0.11 inches of rain over the ET Cover. Seven additional supplemental 0.5-inch watering events were conducted using this system in CY 2011, a year with a dry growing season that was preceded by a very dry winter. The TSWS is comprised of seven zones and due to the size, layout, and distance from the hydrant, only one half the TSWS could be operated at one time. CY 2011 supplemental watering events were completed by September 22 and are summarized in Table B-3. The TSWS was not drained after each use; it was drained on October 5, 2011, for the winter, and the flexible fire hose, back flow preventers, and water meter were removed from the hydrant and moved to the Environmental Restoration Field Office for storage.

4.2 Weed Removal Activities

Two weed removal events were conducted at the MWL during CY 2011. The first event was conducted from August 23 through September 1, 2011, and the second event was conducted from September 20 through October 3, 2011. Weed removal was performed prior to the plants going to seed and was facilitated by supplemental watering to soften the ground that allowed for complete removal of the root system in most cases. After removal, the plants were loaded into a trailer (capacity of approximately 8 cubic yards), compressed, and transported off site to the Kirtland Air Force Base Landfill for disposal. A total of nine trailer-loads of plant material were removed during the two events.

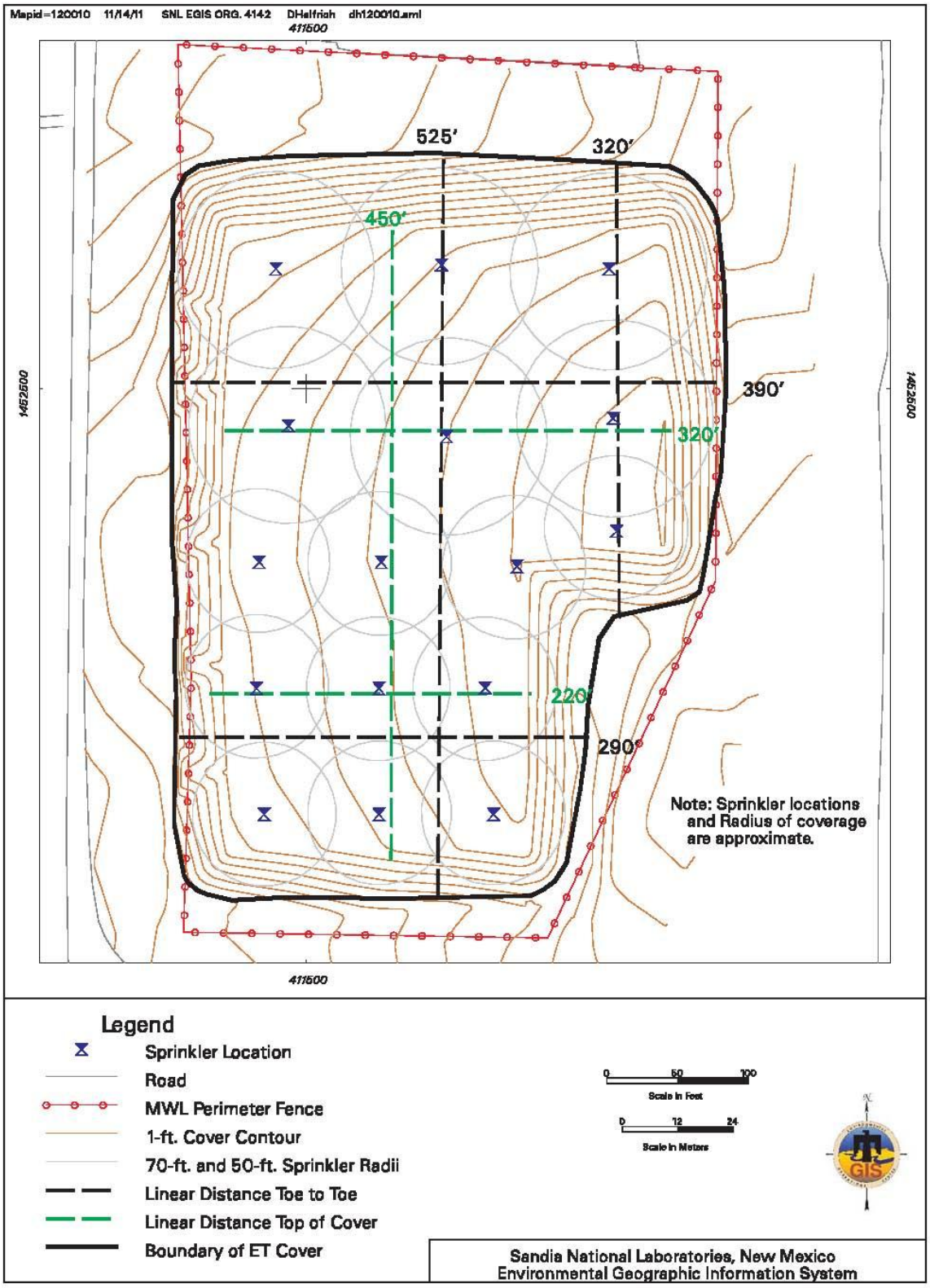

Figure B-2
Large Sprinkler Locations Used During
Supplemental Watering in 2011 for the Mixed Waste Landfill

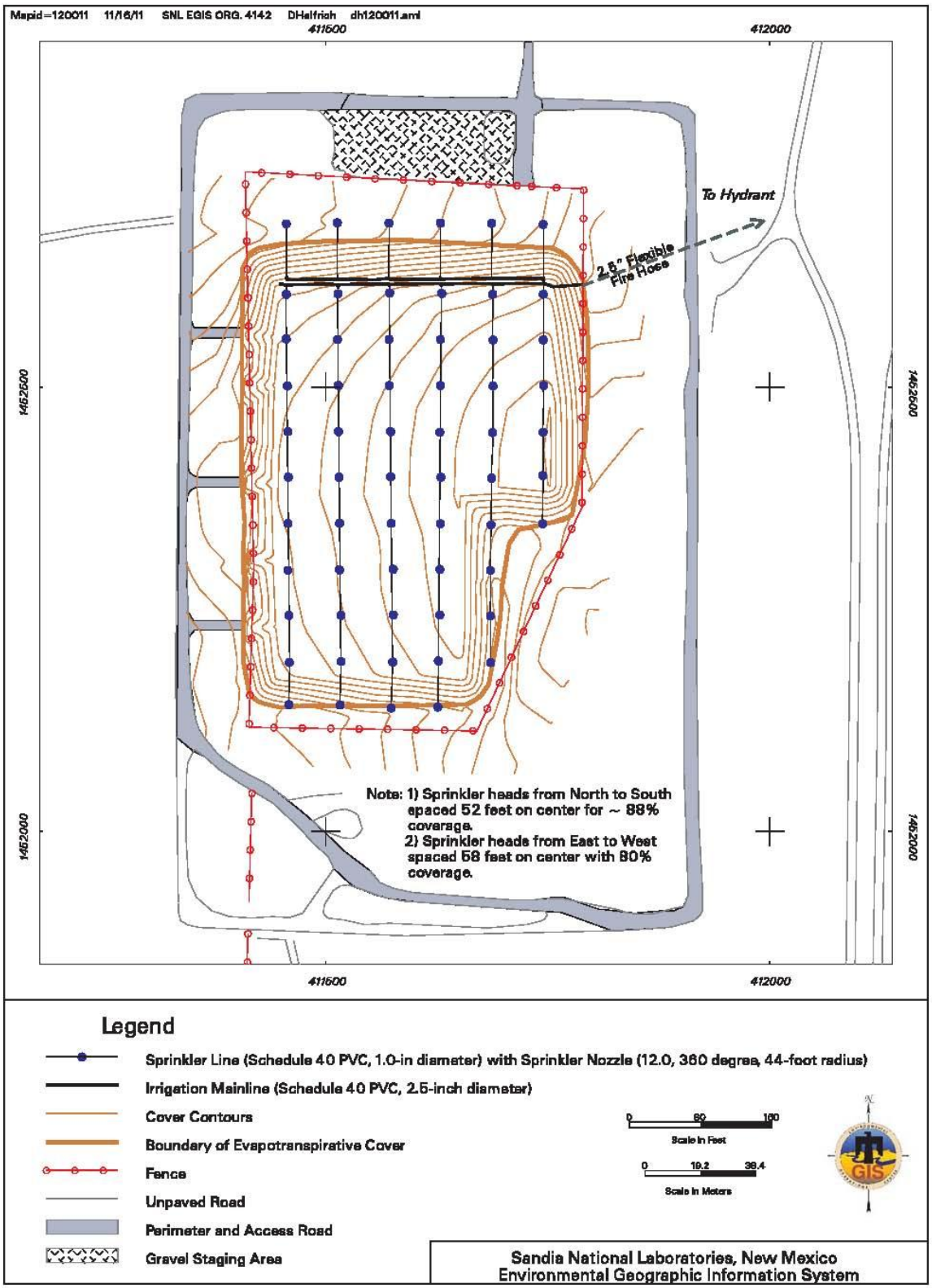

Figure B-3
Temporary Supplemental Watering System at the Mixed Waste Landfill

Table B-3
Supplemental Watering and Natural Precipitation Summary
Mixed Waste Landfill Evapotranspirative Cover
Calendar Year 2011

Supplemental Watering Event	Dates	Total Gallons Applied	Method	Total Monthly Gallons	Precipitation Equivalent (inches)	Natural Precipitation (inches)[a]
1	June 23-30	56,000	Large Sprinkler	56,000	0.5	0.21[b]
2	July 7-14	56,000	Large Sprinkler	56,000	0.5	0.71
3	August 1 and 3	12,600	TSWS	292,600	0.1	1.98
4	August 10-11	56,000	TSWS		0.5	
5	August 15-17	56,000	TSWS		0.5	
6	August 22-23	56,000	TSWS		0.5	
7	August 25-29	56,000	TSWS		0.5	
8	August 30-31	56,000	TSWS		0.5	
9	September 19-20	56,000	TSWS	112,000	1.0	0.70
10	September 21-22	56,000	TSWS			
11	October	--	--	--	--	1.35
12	November	--	--	--	--	0.22
13	December	--	--	--	--	1.70
GRAND TOTALS		**516,000**	**--**	**--**	**4.6**	**6.87**
Supplemental + Natural Precipitation for Calendar Year 2011					**11.47**	

[a]Value reflects the total natural precipitation for the entire month.
[b]Total for January through June 2011.
TSWS = Temporary supplemental watering system.

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APPENDIX C
Air Sampling and Analysis Plan for the Mixed Waste Landfill

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C-1 Radtrak® Long-Term Radon Monitoring

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1.0 INTRODUCTION

Requirements for monitoring at the Mixed Waste Landfill (MWL) are defined in the Long-Term Monitoring and Maintenance Plan (LTMMP) provided by the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia). This Air Sampling and Analysis Plan (SAP) was developed in response to a request by the New Mexico Environment Department (NMED) to monitor for potential radon emissions at the MWL, Technical Area III (TA-III), Sandia National Laboratories, New Mexico (SNL/NM).

Radon air monitoring requirements, including background information, field and analytical methods, frequency, sampling locations, and sampling rationale, are presented in the MWL LTMMP, Section 3.2.1. The trigger evaluation process and trigger level for radon in air are presented Sections 5.1 and 5.2.1, respectively of the MWL LTMMP. This Air SAP provides detailed supporting information for the long-term monitoring of radon concentrations in the air at the MWL using commercially-available track-etch radon detectors (referred to as detectors). These detectors provide an integrated average concentration of radon in air over long exposure periods, on the order of three to six months. The alternative monitoring detectors, charcoal canisters, are only useful for short exposure periods, on the order of a few days.

Radon studies conducted at the MWL in 1997 (Haaker January 1998) and 2008 (SNL/NM August 2008) summarized in Section 3.2.1 of the MWL LTMMP used four-inch-diameter activated charcoal radon canisters across the MWL surface to evaluate radon surface fluxes in the vicinity of the MWL and at background locations. Results showed that the measured radon fluxes above the MWL were not significantly different than the background values and have not significantly changed between 1997 and 2008.

1.1 Monitoring Objective

The monitoring objective of this SAP is to characterize radon emissions at the MWL in a variety of locations at the site. In addition to establishing monitoring and data quality objectives (DQOs), this SAP presents specifications for the use of radon detectors, laboratory analysis, data evaluation, records management, and reporting. This document provides sampling personnel with the necessary information to perform radon sampling in air. The results will be compared to the proposed trigger level of 4 picocuries per liter, as presented in Section 5.2.1 of the MWL LTMMP.

1.2 Scope

Upon implementation of the MWL LTMMP, monitoring (sampling) of radon emissions at the MWL will be conducted on a routine basis throughout the long-term monitoring and maintenance period for the MWL. Monitoring will be conducted quarterly for 2 years, then semiannually for the next 2 years, followed by annually thereafter. Each sampling event requires the placement of radon detectors at designated locations for each exposure period. Radon detectors will be collected and analyzed at the end of the sampling period.

2.0 BACKGROUND INFORMATION

The MWL fate and transport model predicts no potential for release of radon-222 into the atmosphere in excess of regulatory standards, as long as the sealed sources containing radium-226 within the MWL inventory remain intact (Ho et al. January 2007). However, the MWL fate and transport model also predicts that if the sealed sources containing radium-226 degrade over time, there is some potential for radon to be emitted to the atmosphere in concentrations above regulatory standards.

Because there is a potential for radon to be emitted from the MWL wastes in excess of regulatory standards, DOE /Sandia will conduct radon monitoring at the MWL surface to verify that the sealed sources remain intact, and that MWL conditions with the Evapotranspirative (ET) Cover in place continue to be protective of human health and the environment.

As described in the "Responses to the NMED Notice of Disapproval" (SNL/NM January 2007), radon will be monitored above ground surface along the MWL perimeter using track-etch radon detectors. Additional radon sampling locations are planned at locations overlying select pits and trenches in which radium-226 was disposed, and which have a potential for generating radon in the future. The track-etch technique is utilized for time-integrated analysis of radon air concentration (unit concentration per unit air volume), and will provide more useful information than time-discrete samples collected from soil-vapor samples. Radon has not been detected above background (natural environmental) levels in soils at the MWL. Any significant releases of radon in the near future are unlikely due to the nature of the radium-226 sealed sources.

3.0 DATA QUALITY OBJECTIVES

This SAP is designed to ensure that radon measurement procedures are consistent and can be used to establish radon emission trends. The DQO is to produce representative, accurate, defensible, and comparable analytical results to support the monitoring objective (i.e., provide radon emission data). This DQO will be accomplished through the implementation and use of standard operating procedures, analytical procedures/methods, quality assurance (QA) measures, quality control (QC) samples, and data evaluation protocols. Guidance on sampling protocols was also taken from the U.S. Environmental Protection Agency (EPA) (EPA July 1992).

3.1 Measurement of Radon in Air

Radon concentrations will be measured by Radtrak® radon detectors manufactured by Landauer® Incorporated (Attachment A-1) or equivalent type detectors. Radtrak® is an alpha-track radon gas detector designed to monitor radon exposure for three months to one year to obtain a long-term average concentration over time. Services provided by Landauer® include the detector, comprehensive analysis (calibration, laboratory background determination, and laboratory QA/QC tests), reporting of exposure results, and long-term storage of the processed detector for a period of at least 25 years.

Landauer® has been involved with the development of radiation monitoring services for nuclear research centers and laboratories, hospitals, medical and dental offices, universities, and other industries where radiation might be present. The highly accurate Radtrak® radon detector uses the exclusive Track-Etch® process. Radtrak® radon detectors are used by the EPA, the National Institutes of Health, the American Lung Association, and many other government and professional organizations. As long as Radtrak® radon detectors and analytical services are available through Landauer® Incorporated, this is the sampling and analysis approach that will be used. If this situation changes during the long-term monitoring period, DOE/Sandia will continue to employ an equivalent approach through other providers, if available. Should a minor change like this occur DOE/Sandia will notify NMED prior to making the change. The DOE/Sandia will request a permit modification if major changes are required to this air monitoring approach during the long-term monitoring period at the MWL (i.e., a different type of detector, such as a charcoal canister, and/or a different analytical approach will be used).

3.2 Detector Locations and Sampling Frequency

Radon levels around the perimeter of the MWL will be measured using Radtrak® radon detectors (referred to as the detectors) or equivalent type detectors. A total of 10 detectors will be placed at corners and midpoints of the perimeter fence, five detectors will be placed within the boundaries of the completed ET Cover at locations overlying pits and trenches containing the highest activities of radium-226 in their disposal inventory, and two detectors will be placed in areas determined to represent background conditions as detailed in Section 3.2.1 and Figure 3.2.1-2 of the MWL LTMMP. A field control sample (serving as a QC sample) will be prepared during each sampling event.

Table C-3.2-1 gives the sampling (detector exchange) frequency for the 5 years following implementation of the MWL LTMMP. The detectors will be placed in the field for the duration of the time period to be monitored as determined by the monitoring frequency (e.g., quarterly monitoring will be accomplished by leaving the detectors in the field for 3 months and annual monitoring will involve leaving the detectors in the field for 12 months). Detector exchange will occur at the end of the monitoring period and consist of removing the exposed detector and replacing it at the same location with an unexposed detector. The exposed detector will be sent to the Landauer® laboratory (referred to as the laboratory) or an equivalent off-site analytical laboratory for analyses.

3.3 Data Accuracy

Proper sampling procedures and use of QC samples will help reduce random and systematic sampling error or bias. Accurate estimates of radon concentration can be made reliably through the use of a qualified laboratory, appropriate methodologies, and effective QA/QC procedures. These measures along with consistent implementation of the LTMMP and this SAP will satisfy the DQO for accuracy.

Table C-3.2-1
Sampling Frequency

Time Period	Sample Frequency[a]	Sample Locations[b]	Quality Control Samples	Number Samples Per Year
Year 1	4 events (quarterly basis)	10 perimeter 2 background 5 on site	4 trip blanks (1 per event)	72
Year 2	4 events (quarterly basis)	10 perimeter 2 background 5 on site	4 trip blanks (1 per event)	72
Year 3	2 events (semi-annual basis)	10 perimeter 2 background 5 on site	2 trip blanks (1 per event)	36
Year 4	2 events (semi-annual basis)	10 perimeter 2 background 5 on site	2 trip blanks (1 per event)	36
Year 5 and subsequent years	1 event (annual basis thereafter)	10 perimeter 2 background 5 on site	1 trip blank	18

[a]Refers to the frequency in which the detectors are exchanged.
[b]Refer to Figure 3.2.1-2 of the MWL LTMMP for sample locations.

3.4 Data Consistency and Comparability

Data consistency and comparability will be achieved through implementation of this SAP, which defines field and laboratory procedures designed for this purpose. Consistency in methods and procedures will be maintained in the following areas to ensure radon emission data are consistent and that the data sets are comparable.

- Field sample collection and management
- Use of an off-site contract laboratory

After radon emission results are received from the laboratory, the SNL/NM will review the laboratory report for completeness and conformance to the monitoring objective and DQOs. If problems are noted that require corrective action during these reviews, the laboratory will be contacted for further information.

Each set of time-period results (quarter, semi-annual, annual) will be compared to the previous set, as well as the field background. This evaluation process will aid in characterization and allow analysis of trends, but will also help identify outliers or other potential indicators of error and inconsistency.

3.5 Quality Control

The QC measures ensure that data are scientifically sound and of known precision and accuracy. QC samples will be collected to help reduce random and systematic sampling error or bias. Section 3.5.3 presents the samples needed to meet the QC requirements for radon monitoring at the MWL.

3.5.1 Calibration Measures

Calibration measurements are the responsibility of the laboratory supplying/analyzing the detectors. Calibration measurements determine the response or reading of an instrument relative to a series of known values; results are used to develop correction or calibration factors. These factors are determined for a range of concentrations and exposure times, and for a range of other exposure and/or analysis conditions pertinent to the detector.

3.5.2 Laboratory Background Measures

Laboratory background measurements are made in the laboratory by analyzing unexposed detectors (laboratory blanks). The results are subtracted from the actual field measurements before calculating the reported concentration. Laboratory background levels may be due to electronic noise of the analysis system, leakage of radon into the detector, or other causes. The laboratory is responsible for routinely measuring the background of a statistically significant number of unexposed detectors from each batch or lot to establish the laboratory background for the batch and the entire measurement system.

3.5.3 Field Control Measures

Two types of field control measures will be employed for QC; a field control sample (field/trip blank) and a field background sample (natural environmental). These samples are specified in Table C-3.2-1.

A field control sample (field/trip blank) will be prepared during each sampling event. An unexposed detector will be set aside from each detector shipment, kept sealed and in a low radon environment, labeled in the same manner as the field samples to preclude special processing, and returned to the analysis laboratory along with each shipment. These field/trip blanks measure the background exposure that may accumulate during shipment and storage.

Two field (natural environmental) background samples will be collected during each sampling event at areas outside of the MWL, but within TA-III. This will allow the measurement of background radiation that is always present due to natural radon concentrations. The average of the two field background sample values will be compared to (subtracted from) the sample detectors that are placed on and around the MWL.

4.0 SAMPLING ACTIVITIES

This section describes the field and laboratory measures to be taken in providing radon measurements in air.

4.1 Field Activities

Field activities include the preparation, deployment, collection, and shipping of the detectors and the methods and procedures governing these activities. Adherence to this protocol will help ensure uniformity among measurements, and allow comparison of the results. Activities that will be conducted in preparation for or during radon emission monitoring include the following:

- Health and Safety
- Pre-Field Preparations
- Detector Deployment and Collection
- Sample Labeling
- Sample Custody Documentation
- Sample Handling and Shipment
- Waste Management

The SNL/NM Administrative Operating Procedure (AOP) and Laboratory Operating Procedure (LOP) for these activities are listed in Table C-4.1-1. This SAP represents the Field Operating Procedure. All personnel directly involved in radon emission monitoring field activities will review and abide by these procedures, this SAP, and the MWL LTMMP.

Table C-4.1-1
Reference Documentation[a]
MWL Radon Monitoring

Document[a]	Title
AOP 95-16	Sample Management and Custody
LOP 94-03	Sample Handling, Packaging, and Shipping, SMO

[a]The most current version will be used.
AOP = Administrative operating procedure.
LOP = Laboratory operating procedure.
MWL = Mixed Waste Landfill.
SMO = Sample Management Office.

DOE/Sandia will provide to the NMED within 60 days of the effective date of the MWL LTMMP in hard copy and electronic format the current versions of the AOP and LOP listed in Table C-4.1-1. DOE/Sandia shall provide NMED with any updated versions of the AOP/LOP within 30 days of their effective date. If any requirement or procedure in the AOP or LOP is found by NMED to be unacceptable for reasons including, but not limited to, the requirement or procedure will or could prevent the acquisition of representative and reliable monitoring results, the requirement or procedure shall be replaced by DOE/Sandia with a different requirement or procedure that is acceptable to NMED.

4.1.1 Health and Safety

Field operations will be conducted in an approach that prioritizes the health and safety of field personnel above all other objectives. Every team member has the authority and responsibility to stop operations if an unsafe condition develops or is observed. All sampling personnel will perform field activities in accordance with the applicable SNL/NM safety documentation.

4.1.2 Pre-Field Preparations

Sampling locations will be identified, marked, and numbered. Only the number of detectors needed for each sampling event should be ordered as close as possible to the deployment time in order to minimize chances of background exposure. All pertinent information regarding detectors, dates, and locations will be maintained on project forms or in a log book.

4.1.3 Detector Deployment and Collection

The detector and the radon-proof container will be inspected to make sure that they are intact and have not been physically damaged in shipment or handling. The sampling period (i.e., monitoring period) begins when the protective cover or bag is removed and will be noted on project forms or in a log book along with the detector number and sample location. On the same day the detectors are removed from the protective cover or bag, they will be inspected and placed in the field, starting the monitoring period. The edge of the bag will be cut carefully, or the cover removed, so that it can be reused to reseal the detector at the end of the monitoring period.

At the end of the sampling period (Table C-3.2-1), each detector will be inspected for damage or deviation from the conditions noted at the time of deployment. The time and date of removal and any observable changes to the detector will be noted on project forms or in a log book. The detectors will be resealed in the original container or another appropriate container following the instructions provided by the supplier. The detectors will be stored in a low radon environment and returned as soon as possible to the laboratory for processing.

4.1.4 Sample Labeling

Each detector is identified by a unique serial number. A unique SNL/NM Sample Management Office (SMO) issued sample identification number will be assigned to each detector. The SMO sample number will be affixed to each detector, and will be noted on the analysis request/chain-of-custody (AR/COC) form along with the manufacturer's serial number and the detector field location (i.e., "MWL-RN" number).

A SNL/NM sample label will be completed with indelible ink and affixed to each sample container. Each completed sample label should include the following information:

- SNL/NM SMO sample number
- Sample location
- Date and time of sample collection

A field log will be maintained documenting the collection of all samples.

4.1.5 Sample Custody Documentation

To ensure the integrity of samples from the time of collection through the reporting of analytical results, sample collection, handling, and custody will be documented. The continuous record of documented sample possession is referred to as the chain of custody. Primary elements in the

documentation of samples are: sample identification number, sample labels, custody tape, and the AR/COC form. SNL/NM AR/COC forms will be used to document sample information. Sample custody and documentation procedures for sampling activities are outlined in AOP 95-16 (most current revision).

4.1.6 Sample Handling and Shipment

The exposed detectors will be packaged in either the original bag or in new bags to prevent further exposure. No preservation is needed. Detector numbers, SMO sample numbers, and sample location identification will be recorded on an AR/COC form that will accompany the detectors to the laboratory.

Samples will be shipped to the analytical laboratory in accordance with SMO procedures detailed in LOP 94-03. Prior to shipment, the sample collection documentation will be verified. Any error will be noted and corrected as required by SNL/NM SMO protocols.

4.1.7 Waste Management

There will not be any waste generated during these activities.

4.2 Analytical Methods

The detectors measure the average radon concentration at the location of the detector during the sampling period. The alpha-track detector consists of a plastic housing and a radiosensitive element that records submicroscopic damage tracks as the alpha particle emissions (alpha track) from the natural decay of radon and alpha-emitting radon decay products striking the detector. At the end of the sampling period, the detectors are returned the laboratory. The detectors are placed in a caustic solution that accentuates the damage tracks so they can be counted using an automated counting system. The number of tracks per unit area is correlated to the radon concentration in air, using a conversion factor derived from data generated at the calibration facility. The number of tracks per unit of analyzed detector area produced per unit of time is proportional to the radon concentration. The detectors function as true integrators and measure the average concentration over the exposure period.

4.3 Records Management and Reporting

Records associated with the radon emission sampling activities include the MWL LTMMP, this SAP, the applicable AOP and LOP, AR/COC forms, personnel training, field documentation, laboratory analytical results, and technical data evaluations. These records will be maintained at the SNL/NM Records Center and comply with the record-keeping provisions of 20.4.1.500 New Mexico Administrative Code, incorporating Title 40 Code of Federal Regulations Section 264.74, concerning the availability, retention, and disposition of records.

Reports will be prepared and submitted to the NMED as part of the annual MWL long-term monitoring reports according to the schedule defined in the LTMMP.

5.0 REFERENCES

Haaker, R. (Sandia National Laboratories, New Mexico), January 1998. Memorandum to H. Oldewage (Sandia National Laboratories, Albuquerque, New Mexico), "Radon Flux Testing at the Mixed Waste and the Adjacent Classified Waste Landfills, Technical Area III, SNL/NM." January 19, 1998.

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ATTACHMENT C-1
Radtrak® Long-Term Radon Monitoring

LANDAUER®

Radtrak® Long-Term Radon Monitoring

Radtrak is an alpha-track radon gas detector designed to monitor radon exposure for three months to one year to obtain a long-term average concentration over time. Landauer service includes the Radtrak detector, comprehensive analysis, and a confidential report of the findings. Radtrak can be packaged for indoor or outdoor area monitoring or personnel monitoring.

Landauer is the leader and pioneer in radon gas detection and monitoring service. Since 1954, our scientists have been involved with the development of radiation monitoring services for nuclear research centers and laboratories, hospitals, medical and dental offices, universities, and other industries where radiation might be present. This experience and technology have been incorporated into Landauer's highly accurate Radtrak radon detector using our exclusive Track-Etch® process. Radtrak radon detectors are used by the Environmental Protection Agency, the National Institutes of Health, the American Lung Association, and many other government and professional organizations.

Radtrak measures the average radon concentration at the location of the detector during the monitoring period. The alpha-track detector has, inside the plastic housing, a radiosensitive element that records alpha particle emissions (alpha tracks) from the natural radioactive decay of radon.

When the detector is returned to Landauer's laboratory, the alpha tracks are counted using computer-assisted image analysis equipment. The number of alpha tracks along with the deployment time period provides the basis for calculating the average radon concentration. The report with the radon gas measurement, reported in picocuries per liter of air (pCi/l), is mailed within seven to ten days after receipt of detector.

Thoron Proof Filter

Upon request, a detector can be fitted with a thoron proof filter that provides measurement of Rn 222 only.

Technical Specifications

- The radiosensitive element is a CR-39 (allyl diglycol carbonate) based, passive alpha-track detector.
- The CR-39 is enclosed in a plastic housing composed of electrically conducting material with filtered openings to permit diffusion of radon gas only.
- Minimum level of detection is 30 pCi/l days i.e., 0.33 pCi/l based on 90 days.
- Detectors, before, during or after exposure, should not be in locations that exceed a temperature of 160°F (70°C).
- Radtrak detectors are packaged in film-foil bags that meet Military specification MIL-B-131, Class 1 to prevent exposure prior to use.
- A metallic label is provided for each detector to seal the filtered openings following the exposure period to minimize subsequent exposure to radon during the return shipment to Landauer's laboratory.
- Each detector is identified by a unique serial number laser engraved on the CR-39, printed and bar coded on the outside of Radtrak, and the film-foil bag.

Indoor Use

Monitoring indoors requires placing the detector in an upright position on a flat surface, or it may be hung from a joist or ceiling with the detector's hanger strip included with the shipment. The U.S. Environmental Protection Agency recommends the detector be placed in the lowest lived-in level of the home. It should be placed in a room that is used regularly but not a kitchen or bathroom. States or other organizations may have differing recommendations. Contact your state agency if you have a question regarding placement.

Outdoor Use

For monitoring outdoors, the detector is fastened to the bottom of a clear plastic cup. The cup is then installed inside a protective canister that has been attached to a post or other location. The protective canisters are sold separately.

Personnel Monitoring

The personnel monitor comes with a clip that easily attaches to the detector and securely fastens to clothing.

For more information on radon, refer to the U.S. Environmental Protection Agency's publication "A Citizen's Guide to Radon" at http://www.epa.gov/iaq/radon/pubs/citguide.html or contact your state department of health.

APPENDIX D
Soil-Vapor Sampling and Analysis Plan for the Mixed Waste Landfill

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1.0 INTRODUCTION

Requirements for monitoring at the Mixed Waste Landfill (MWL) are defined in the Long-Term Monitoring and Maintenance Plan (LTMMP) provided by the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia). This Sampling and Analysis Plan (SAP) provides requirements that shall be followed for collecting and analyzing volatile organic compound (VOC) soil-vapor samples from soil-vapor monitoring wells located at the MWL, Technical Area III (TA-III), Sandia National Laboratories, New Mexico (SNL/NM), during the long-term monitoring period. The long-term soil-vapor monitoring program, including the monitoring network, parameters, frequency, and reporting requirements, are detailed in Section 3.4.1 of the MWL LTMMP. The trigger evaluation process and soil-vapor trigger levels are presented in Sections 5.1 and 5.2.3 of the MWL LTMMP, respectively.

The purpose of this SAP is to document procedures for the collection and reporting of consistent, reliable, defensible, and comparable soil-vapor sampling results to be used to determine if soil vapor has the potential to contaminate groundwater. In addition to establishing data quality objectives (DQOs), this SAP presents requirements for field sampling, laboratory analysis, data validation and evaluation, and reporting. Other instructions are provided in SNL/NM Field Operating Procedures (FOPs), SNL/NM Laboratory Operating Procedures (LOPs), SNL/NM Administrative Operating Procedures (AOPs), and the SNL/NM Statement of Work (SOW) for Analytical Laboratories; however, the requirements of this SAP and the MWL LTMMP shall take precedence over any FOPs, LOPs, AOPs, or SOWs. Table D-1-1 summarizes documents that are referenced in this SAP, which can be obtained from the SNL/NM Records Center. The most current versions of these documents shall be consulted for the purpose of conducting groundwater sampling.

Table D-1-1
Reference Documentation[a]
Mixed Waste Landfill Soil-Vapor Monitoring

Document Number	Document Title
FOP 08-22	Soil Vapor Sampling
AOP 95-16	Sample Management and Custody
AOP 00-03	Data Validation Procedure for Chemical and Radiochemical Data
LOP 94-03	Sample Handling, Packaging, and Shipping
SMO 05-03	Procedure for Completing the Contract Verification Review
NA	Statement of Work for Analytical Laboratories - SNL/NM
NA	Quality Assurance Project Plan for the Sample Management Office

[a]The most current version will be used.
AOP = Administrative operating procedure.
FOP = Field operating procedure.
LOP = Laboratory operating procedure.
NA = Not applicable.
SMO = Sample Management Office.
SNL/NM = Sandia National Laboratories, New Mexico.

DOE/Sandia shall provide to the New Mexico Environment Department (NMED) within 60 days of the effective date of the MWL LTMMP in hard copy and electronic format the current versions of the FOPs, LOPs, and AOPs listed in Table D-1-1. DOE/Sandia shall provide NMED with any updated versions of the FOPs, LOPs, or AOPs within 30 days of their effective date. If any requirement or procedure in the FOPs, LOPs, or AOPs is found by NMED to be unacceptable for reasons including, but not limited to, the requirement or procedure will or could prevent the acquisition of representative and reliable groundwater sampling results, the requirement or procedure shall be replaced by DOE/Sandia with a different requirement or procedure that is acceptable to NMED.

2.0 DATA QUALITY OBJECTIVES

Soil-vapor monitoring is required to provide spatial and temporal soil-vapor concentration data for the approximately 500-foot-thick vadose zone beneath the MWL. The DQO is to produce representative, accurate, defensible, and comparable soil-vapor analytical results. This SAP is designed to ensure the DQO is met by establishing standard field methods, analytical procedures/methods, quality control measures, and data review/validation protocols for the collection, analysis, and evaluation of soil-vapor data. Results from the deepest sampling ports of the deepest soil-vapor wells will be compared to trigger levels as described in Section 5.2.3 of the MWL LTMMP.

2.1 Sampling Locations and Frequency

VOC concentrations in the vadose zone will be monitored using two existing single-port soil-vapor monitoring wells installed through the MWL evapotranspirative Cover and three proposed Flexible Liner Underground Technologies (FLUTe™) or equivalent multi-port soil-vapor monitoring wells. The three multi-port FLUTe™ or equivalent wells will provide VOC concentration data at various depths beneath the MWL, whereas the single-port soil-vapor monitoring wells will monitor VOC concentrations immediately beneath the disposal areas. Soil-vapor sampling ports are planned to be installed in each FLUTe™ or equivalent well at depths of 50, 100, 200, 300, and 400 feet below ground surface. The soil-vapor monitoring system will be sampled semiannually for the first three years and annually thereafter. The soil-vapor monitoring network is presented in detail in Section 3.4.1 and Appendix A of the MWL LTMMP.

2.2 Data Accuracy and Reproducibility

DOE/Sandia shall follow proper sampling procedures, including purging, preparation of sampling containers, and use of quality assurance (QA)/quality control (QC) samples. Accurate estimates of contaminant concentrations shall be obtained through use of qualified laboratories, appropriate analytical methods, and effective QA/QC procedures. These measures along with consistent implementation of the LTMMP and this SAP will satisfy the DQO for accuracy.

Accuracy shall be maintained and evaluated through referenced calibration standards and various laboratory control samples (typically matrix spike samples, and surrogate spike samples). A range in deviation from actual (true) concentration of 50-130% (percent recovered

or %REC) for laboratory VOC control samples shall be considered acceptable. DOE/Sandia shall immediately repeat the sampling and analysis for any sample results where the above specified quality control targets (%REC) are not met.

At least two field duplicate samples shall be collected and analyzed during each sampling event. These samples will document the precision of the sampling and analysis process. A relative percent difference (RPD) of 20% or less for each detected VOC is considered to be satisfactory.

3.0 MONITORING ACTIVITIES

This section describes the field and laboratory procedures that shall be followed to produce soil-vapor analytical results that meet the requirements of this SAP.

3.1 Field Sampling

The methods and procedures used to obtain soil-vapor samples for laboratory analysis are described below in Sections 3.2 through 3.4.

Activities that shall be conducted by DOE/Sandia in preparation for or during soil-vapor sampling include:

- Pre-field work planning;
- Vacuum check of SUMMA® canisters;
- Visual inspection of all MWL soil-vapor wells and sampling ports;
- Purging and field estimation of purge volume and total VOC concentration;
- Sample acquisition;
- Sample container documentation and packaging; and
- Sample delivery to laboratory within the method holding time.

The FOP covering these activities, as well as SMO procedures, guidance, and laboratory procedures that apply to the long-term soil-vapor monitoring program are listed in Table D-1-1 and Section 3.4.1 of the MWL LTMMP. All personnel directly involved in field activities related to soil-vapor monitoring shall review and abide by these procedures.

3.2 Pre-Field Sampling Preparations

Prior to initiating soil-vapor sampling, field personnel shall ensure that all necessary equipment is ready and properly functioning in accordance with applicable FOPs and this SAP and that the necessary arrangements have been made with the SMO and off-site analytical laboratory for sample shipment and analysis. As appropriate, operating procedures shall be reviewed and support personnel notified.

3.3 Purging and Field Estimation of Total Concentration of VOCs

At the wellhead, a vacuum pump connected to the sample tubing via a Swagelok® or equivalent fitting shall be used to purge stagnant and/or pre-existing soil vapor from the monitoring ports and sample tubing. The stream of soil vapor extracted from the sampling system shall be screened with a photoionization detector (PID) containing an ultraviolet lamp with an ionization potential of 11.8 electron volts. PID measurements shall be monitored during purging and recorded in the field book or on a sampling form. Sample collection shall commence only after at least three tubing volumes have been removed and after at least three PID measurements have stabilized to within plus or minus 10 percent.

3.4 Sample Collection

Soil-vapor samples shall be collected in 6-liter SUMMA® canisters for off-site laboratory analysis of VOCs by EPA Compendium Method TO-15 (EPA January 1999) or equivalent. The SUMMA® canisters shall be shipped from the laboratory under vacuum and connected directly to the sampling ports by Swagelok® fittings or equivalents. Soil vapor shall be drawn into the sample container by the pressure differential between the atmosphere and the container interior. After sample collection, the valve shall be closed, and the canister shall be shipped back to the laboratory with an analysis request/chain-of-custody (AR/COC) form containing the sample identification number, sample location, date and time, elevation, and ambient pressure. Field sample management shall follow AOP 95-16 and the requirements of this SAP. A Swagelok® plug or equivalent fitting shall be fastened to the canister opening to ensure that the canister remains airtight during shipment to the laboratory. The canisters require no special preservation during transport and storage.

4.0 LABORATORY ANALYSIS AND DATA REVIEW

All samples shall be submitted to an off-site analytical laboratory. The samples shall be analyzed using EPA Compendium Method TO-15 (EPA January 1999) or equivalent. DOE/Sandia shall ensure that the off-site laboratory implements the requirements of the method, including analytical method, target analytes for quantification, and internal QA/QC procedures. The target analytes are listed in Table D-4-1.

4.1 Data Verification

After soil-vapor analytical results are received from the laboratory, DOE/Sandia shall review the laboratory report for completeness and conformance to the performance criteria of the contract according to the “Procedure for Completing the Contract Verification Review,” SMO 05-03 and the requirements of this SAP. If problems are noted that require corrective action, the appropriate corrective action shall be implemented.

Table D-4-1
Mixed Waste Landfill Soil-Vapor Analyte List[a]
Mixed Waste Landfill Long-Term Monitoring Program

Compound	Compound
Acetone	1,2-Dichloropropane
Benzene	cis-1,3-Dichloropropene
Benzyl chloride	trans-1,3-Dichloropropene
Bromodichloromethane	Ethyl benzene
Bromoform	4-Ethyltoluene
Bromomethane	Hexachlorobutadiene
2-Butanone	2-Hexanone
Carbon disulfide	Methylene chloride
Carbon tetrachloride	4-Methyl-2-pentanone
Chlorobenzene	Styrene
Chloroethane	1,1,2,2-Tetrachloroethane
Chloroform	Tetrachloroethene
Chloromethane	Toluene
Dibromochloromethane	1,1,2-Trichloro-1,2,2-trifluoroethane
1,2-Dibromoethane	1,2,4-Trichlorobenzene
1,2-Dichloro-1,1,2,2-tetrafluoroethane	1,1,1-Trichloroethane
1,2-Dichlorobenzene	1,1,2-Trichloroethane
1,3-Dichlorobenzene	Trichloroethene
1,4-Dichlorobenzene	Trichlorofluoromethane
Dichlorodifluoromethane	1,2,4-Trimethylbenzene
1,1-Dichloroethane	1,3,5-Trimethylbenzene
1,2-Dichloroethane	Vinyl acetate
1,1-Dichloroethene	Vinyl chloride
cis-1,2-Dichloroethene	m-, p-Xylene
trans-1,2-Dichloroethene	o-Xylene

[a]EPA Method TO-14 analyte list that was used for the 1994 and 2008 Soil-Vapor Surveys (SNL/NM August 2008).

4.2 Data Validation

After the data verification review is completed, DOE/Sandia shall arrange for the validation of the data. The data validation process shall address field sample management and custody requirements, as well as adherence to the analytical method and internal laboratory QA/QC requirements by the off-site laboratory performing the analyses. Data qualification is based upon review of field QC data, laboratory-supplied QC data, the specific QC criteria, and the DQOs identified in the analytical method (EPA Compendium Method TO-15 procedure [EPA January 1999] or equivalent), the DQO in Section 2.0 of this SAP, and the requirements of the MWL LTMMP. Data validation shall be conducted according to the requirements of this SAP and AOP 00-03, "Data Validation Procedure for Chemical and Radiochemical Data." All associated data validation reports shall be submitted to NMED along with the results for each monitoring event in the annual MWL long-term monitoring reports.

5.0 DATA MANAGEMENT AND REPORTING

The following activities comprise data management and reporting tasks, and shall be conducted by DOE/Sandia:

- Technical evaluation and reporting; and
- Records management

5.1 Technical Evaluation and Reporting

The following specific data evaluation and reporting steps shall be followed and documented as part of the annual MWL long-term monitoring report for soil-vapor monitoring activities. Data interpretation and evaluation shall follow the procedures outlined below.

1. Show results (VOC soil-vapor concentrations) for trichloroethene (TCE), tetrachloroethene (PCE), and total VOCs in a tabulated summary;

2. As appropriate add the data to graphs to illustrate concentration versus time trends for specified monitoring ports and VOCs;

3. Compare TCE, PCE, and total VOCs concentrations for the deepest sampling ports of the deep multi-port wells to the trigger levels for TCE (20 parts per million by volume basis [ppmv]), PCE (20 ppmv), and total VOCs (25 ppmv) using the procedure discussed in Sections 5.1 and 5.2.3 of the MWL LTMMP; and

4. Provide a brief summary discussion of the soil-vapor results, and how these results relate to the potential for groundwater to be contaminated by soil vapor.

Reports will be prepared and submitted to the NMED as part of the annual MWL long-term monitoring reports according to the schedule defined in the LTMMP.

5.2 Records Management

Records associated with soil-vapor monitoring include the MWL LTMMP and this SAP, the applicable AOPs, LOPs, and FOPs, personnel training, field documentation, AR/COC forms, laboratory analytical results, data validation reports, and annual MWL long-term monitoring reports and technical data evaluations. These records will be maintained at the SNL/NM Records Center and comply with the record-keeping provisions of 20.4.1.500 New Mexico Administrative Code, incorporating Title 40 Code of Federal Regulations Section 264.74, concerning the availability, retention, and disposition of records.

6.0 REFERENCES

Sandia National Laboratories/New Mexico (SNL/NM), August 2008. "Investigation Report on the Soil-Vapor Volatile Organic Compounds, Tritium, and Radon Sampling at the Mixed Waste Landfill," Environmental Restoration Project, Sandia National Laboratories, New Mexico.

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Sandia National Laboratories/New Mexico (SNL/NM), May 2010. "Procedure for Completing the Contract Verification Review," SMO 05-03, Revision 04, Sample Management Office, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), March 2011. "SNL/NM Statement of Work for Analytical Laboratories, Revision 05," Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), May 2011. "Data Validation Procedure for Chemical and Radiochemical Data," AOP 00-03, Revision 03, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), June 2011. "Field Operating Procedure FOP 08-22, Soil Vapor Sampling," Sandia National Laboratories, Long Term Stewardship Department, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), June 2011. "Sample Management and Custody, Administrative Operating Procedure," AOP 95-16, Revision 04, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), June 2011. "Sample Handling, Packaging, and Shipping," Sample Management Office (SMO) LOP 94-03, Revision 05, Sandia National Laboratories, Albuquerque, New Mexico.

U. S. Environmental Protection Agency (EPA) January 1999. "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-15," EPA/625/R-96/010b, Center for Environmental Research Information, Office of Research and Development, US EPA, Cincinnati, Ohio.

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APPENDIX E
Soil-Moisture Monitoring Plan for the Mixed Waste Landfill

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1.0 INTRODUCTION

Requirements for monitoring at the Mixed Waste Landfill (MWL) are defined in the Long-Term Monitoring and Maintenance Plan (LTMMP) provided by the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia). This Soil-Moisture Monitoring Plan (MP) was developed for use during long-term monitoring of the vadose zone for soil moisture at the MWL, Technical Area III, Sandia National Laboratories, New Mexico (SNL/NM).

Vadose zone soil moisture monitoring requirements, including background information, field methods, frequency, sampling locations, and sampling rationale, are presented in the MWL LTMMP, Section 3.4.2. The trigger evaluation process and soil moisture trigger level are presented Sections 5.1 and 5.2.3.2 of the MWL LTMMP, respectively. This MP provides detailed supporting information for the long-term monitoring of soil moisture in the vadose zone beneath the MWL Evapotranspirative (ET) Cover using three soil moisture access tubes drilled at a 30-degree angle (from vertical) directly below waste disposal cells.

1.1 Objective

The objective of this MP is to provide soil-moisture monitoring results for the vadose zone at the MWL to evaluate the integrity and performance of the ET Cover over time. In addition to establishing monitoring and data quality objectives (DQOs), this MP presents specifications for the use and handling of the CPN 503 DR Hydroprobe® Moisture Depth Gauge (neutron probe), data evaluation, records management, and reporting. This document provides monitoring personnel with the necessary information to perform vadose zone soil moisture monitoring. The results will be compared to the soil moisture trigger level of 23 percent by volume as presented in Section 5.2.3.2 of the MWL LTMMP.

1.2 Scope

Monitoring for soil moisture in the vadose zone will be conducted on a routine basis throughout the long-term monitoring and maintenance period to assess the hydrologic performance of the ET Cover. Semi-annual monitoring is planned for the first two years after implementation of the MWL LTMMP, followed by annual monitoring thereafter. Each monitoring event requires the deployment of the neutron probe in the current monitoring system consisting of three angled access tubes. The locations of the access tubes and construction information are provided in Section 3.4.2 of the MWL LTMMP.

2.0 BACKGROUND INFORMATION

The MWL Corrective Measures Implementation Work Plan was written and submitted to the New Mexico Environment Department (NMED) in November 2005 (SNL/NM November 2005). NMED reviewed the document, and responded with a “Notice of Disapproval” (NOD) letter dated November 20, 2006 (NMED November 2006). This letter described a number of

deficiencies related to the MWL cover, construction plans, performance and fate and transport modeling, and monitoring triggers. The letter also included a requirement for soil-moisture monitoring in the vadose zone, as follows:

> "The NMED expects the vadose zone to be monitored for volatile organic compounds, tritium, and radon, in addition to soil moisture." (NMED November 2006).

In the "Responses to the NMED Notice of Disapproval" (SNL/NM December 2006), DOE/Sandia proposed soil-moisture monitoring via the current monitoring system. The soil-moisture monitoring will serve as an early-warning system for the potential migration of contaminants. Additional information regarding the proposed monitoring, including the trigger levels and depths to be monitored, were included in the DOE/Sandia responses to the second set of comments within the NOD (Part 2) (SNL/NM January 2007).

3.0 DATA QUALITY OBJECTIVES

This MP is designed to ensure that procedures are consistent and can be used to detect soil moisture beneath the ET Cover. The DQO is to produce representative, accurate, defensible, and comparable results to support the monitoring objective (i.e., provide soil-moisture data from the vadose zone beneath the ET Cover). This DQO will be accomplished through the implementation of standard operating procedures and the use of quality assurance and quality control (QA/QC) measures and data evaluation protocols.

3.1 Monitoring System

The soil-moisture monitoring system was installed in 2003, and is comprised of three boreholes drilled on a 30-degree angle from vertical to a depth of 200 linear feet and a vertical depth of 173 feet below ground surface. Each borehole was cased with drill string used to advance the borehole. The drill string is approximately 4.5 inches in diameter and is made of steel. The borehole is open to the soil in the bottom (no end cap). These are referred to as the access tubes.

During long term monitoring at the MWL, moisture readings will be taken within each access tube at intervals given in Table E-3.1-1.

Table E-3.1-1
Soil-Moisture Monitoring Frequency

Time Period	Monitoring Frequency	Access Tubes	Depths (ft bgs)
Year 1 Year 2	Semi-annual (2 events per year)	3	4-25, at 1 ft intervals 25-200, 5 ft intervals
Year 3 and subsequent years	Annually (1 event per year)	3	4-25, at 1 ft intervals 25-200, 5 ft intervals

Note: The 23-percent trigger applies to linear depths of 10 and 100 feet (vertical depths of 8.7 to 86.6 feet) along the neutron probe access tubes.
bgs = Below ground surface.
ft = Foot (feet).

3.2 Neutron Probe

The primary moisture sensor will be a CPN 503DR neutron moisture probe, or an equivalent soil moisture probe. The CPN 503DR is a geophysical means of measuring soil moisture content. The probe uses a 50.0 millicurie Americium-241:Beryllium neutron source for moisture content measurements. The probe is self-contained and includes the radioactive sources, and detectors. A neutron probe uses the absorption of emitted neutrons to calculate soil moisture content. The assumption is made that the hydrogen in soil moisture is the dominant absorber of the emitted neutrons. In the MWL soil, the calibration and QA/QC procedures to be used for the neutron probe associated with this monitoring system have not been confirmed; therefore, the following calibration and QA/QC checks are required.

3.2.1 Calibration and Correlation

The CPN 503DR neutron probe is returned to the manufacturer annually for calibration. It is adjusted to account for the decay of the Americium-241 source.

In order to convert neutron count readings measured with the calibrated CPN 503DR neutron probe to volumetric water content, a correlation study was performed in a controlled environment that duplicates as close as possible the in situ characteristics of the MWL field monitoring location. The probe is inserted into the access tube and count readings are taken as the soil moisture content in the repacked native soil is varied. The resulting count/soil moisture content relationship is used to develop a correlation curve for the instrument, which associates a neutron count to a known soil moisture content (as measured in the laboratory for the test soil layers). Technically this process is a correlation, because the probe electronics are not actually being adjusted or tuned to a known moisture content. Rather a mathematical formula is developed that correlates a neutron count to a known moisture content.

The CPN 503DR neutron probe was field-calibrated in August 2001 at the Infiltration Pilot Test Site, located approximately 500 feet west of the MWL (SNL/NM September 2001). A calibration study was conducted during which the relationship between neutron count readings measured with the CPN 503DR neutron probe and volumetric water content was determined. The results of this study determined that the relationship between volumetric water content and the neutron count ratio can be expressed as follows:

$$\theta = 17.784\ R - 2.0801$$

Where

θ = the volumetric water content, and
R = count ratio (neutron probe counts divided by the standard count)

Using this formula, measurements made with the properly calibrated CPN 503DR neutron probe can be converted to the desired units of volumetric water content for comparison to the soil moisture trigger level as discussed in Section 5.2.3.2 of the MWL LTMMP.

3.2.2 Quality Assurance and Quality Control

The CPN 503DR neutron probe is operated in accordance with the Field Operating Procedure (FOP) 10-07. A standard count will be taken once daily during each monitoring event prior to the moisture logging to ensure the highest measurement of accuracy. The standard count measures the proper function of the gauge electronics and also compensates for the source decay. This measurement shall be performed daily when used as described in the FOP 10-07.

Each new set of soil-moisture data will be compared to historical data collected. This evaluation process will be used to identify trends and help identify outliers or other potential indicators of error and inconsistency.

4.0 MONITORING ACTIVITIES

Monitoring activities include preparation for monitoring and monitoring methods and procedures governing these activities. Adherence to this protocol will help ensure uniformity among measurements, and allow comparison of the results over time. Activities that will be conducted in preparation for or during monitoring include the following:

- Safety documentation review
- Pre-monitoring activities
- Perform standard count
- Visual inspection of access tube entry point

The SNL/NM managing document for this monitoring activity is listed in Table E-4-1. This MP and the FOP integrates safety, training, field operations, data collection, and documentation requirements. All personnel directly involved in field activities will review and abide by these plans/procedures.

Table E-4-1
Reference Documentation[a]
MWL Vadose Zone Soil-Moisture Monitoring

Document[a]	Title
FOP 10-07	Field Operating Procedure for Soil Moisture Determination at the Mixed Waste Landfill Utilizing Neutron Logging

[a]The most current version will be used.
FOP = Field operating procedure.
MWL = Mixed Waste Landfill.

DOE/Sandia shall provide to the NMED within 60 days of the effective date of the MWL LTMMP in hard copy and electronic format the current version of FOP 10-07. DOE/Sandia shall provide NMED with any updated versions of this FOP within 30 days of its effective date. If any requirement or procedure in the FOP is found by NMED to be unacceptable for reasons including, but not limited to, the requirement or procedure will or could prevent the acquisition of

representative and reliable monitoring results, the requirement or procedure shall be replaced by DOE/Sandia with a different requirement or procedure that is acceptable to NMED.

4.1 Health and Safety

Field operations will be conducted in an approach that prioritizes the health and safety of field personnel above all other objectives. Every team member has the authority and responsibility to stop operations if an unsafe condition develops or is observed. All personnel will perform field activities in accordance with the applicable SNL/NM safety documentation.

4.2 Data Acquisition

A standard count will be taken and the results recorded on the FOP form or in the field logbook. After assembly of the probe and necessary cables, the probe will be lowered to each predetermined location (Table E-3.1-1) in the access tube. At each monitoring location, the neutron counts will be logged and recorded on the FOP form or in the field logbook.

The data will be transferred from the probe and to a tabular spreadsheet for data evaluation and analysis.

4.3 Waste Management

There are no hazardous wastes generated from these monitoring activities.

5.0 DATA REVIEW AND REPORTING

Review of data and field documentation will be performed for completeness and conformance to the procedures established for this activity. The data will be reviewed for representativeness of quality and comparability to determine whether the specified DQOs have been met.

5.1 Data Review

Completed field documentation will be reviewed and verified for accuracy, completeness, and conformance with established procedures. The review will occur at the end of each day in the field to allow verification, correction, and retrieval of missing information as appropriate.

5.2 Reporting

A summary report for will be prepared documenting the monitoring events and results for each annual reporting period. The summary report will include graphs that portray the results. The report will be included as part of the annual MWL long-term monitoring reports submitted to the NMED.

5.3 Records Management

Records associated with the soil-moisture monitoring, including field documentation, logging results, reports, and data evaluations, will be maintained at the SNL/NM Records Center and comply with the record-keeping provisions of 20.4.1.500 New Mexico Administrative Code, incorporating Title 40 Code of Federal Regulations Section 264.74, concerning the availability, retention, and disposition of records.

6.0 REFERENCES

New Mexico Environment Department (NMED), November 2006. "Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Work Plan, November 2005, and Requirement for Soil-Vapor Sampling and Analysis Plan, Sandia National Laboratories, EPA ID NM5890110518, HWB-05-025," November 20, 2006.

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Sandia National Laboratories/New Mexico (SNL/NM), January 2007. "Reponses to the NMED's Notice of Disapproval: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005 Comment Set 2," Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), February 2011 (or most current version). "Field Operating Procedure for Field Operating Procedure for Soil Moisture Determination at the Mixed Waste Landfill Utilizing Neutron Logging," FOP 10-07, Revision 00, Sandia National Laboratories, Albuquerque, New Mexico.

APPENDIX F
Groundwater Sampling and Analysis Plan for the Mixed Waste Landfill

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1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) provides additional requirements and specific information for the collection and analysis of samples from groundwater monitoring wells located at the Mixed Waste Landfill (MWL) during the long-term monitoring period. The long-term groundwater monitoring program is described in Section 3.5 of the MWL Long-Term Monitoring and Maintenance Plan (LTMMP). Groundwater monitoring parameters, frequency, and reporting requirements are detailed in Section 3.5.4. The trigger evaluation process and groundwater trigger levels are presented Sections 5.1 and 5.2.4 of the MWL LTMMP, respectively.

The purpose of this SAP is to document procedures for the collection and reporting of consistent, reliable, defensible, and comparable groundwater sampling results. This SAP provides additional instructions for sample collection, data management, and reporting of data that shall be followed during the long-term monitoring period. Other instructions are provided in Sandia National Laboratories/New Mexico (SNL/NM) Field Operating Procedures (FOPs), SNL/NM Laboratory Operating Procedures (LOPs), SNL/NM Administrative Operating Procedures (AOPs), and the SNL/NM Statement of Work (SOW) for Analytical Laboratories; however, the requirements of this SAP and the MWL LTMMP will take precedence over any FOPs, LOPs, AOPs, or SOWs. Table F-1-1 summarizes documents that are referenced in this SAP, which can be obtained from the SNL/NM Records Center. The most current versions of these documents shall be consulted for the purpose of conducting groundwater sampling.

The Department of Energy and Sandia Corporation (DOE/Sandia) shall provide to the New Mexico Environment Department (NMED) within 60 days of the effective date of the MWL LTMMP in hard copy and electronic format the current versions of the FOPs and AOPs listed in Table F-1-1. DOE/Sandia shall provide NMED with any updated versions of the FOPs, LOPs, or AOPs within 30 days of their effective date. If any requirement or procedure in the FOPs, LOPs, or AOPs is found by NMED to be unacceptable for reasons including, but not limited to, the requirement or procedure will or could prevent the acquisition of representative and reliable groundwater sampling results, the requirement or procedure shall be replaced by DOE/Sandia with a different requirement or procedure that is acceptable to NMED.

2.0 DATA QUALITY OBJECTIVES AND QUALITY CONTROL

The data quality objective (DQO) for groundwater monitoring is to collect representative, accurate, defensible, and comparable data to assess the concentrations of hazardous constituents in the groundwater in the uppermost aquifer underlying the MWL such that they can be compared to the trigger levels in concentration limits in Table 5.2.4-1 of the MWL LTMMP. DOE/Sandia shall evaluate accuracy, precision, representativeness, completeness, and comparability of the groundwater data to verify that data are of high quality and ensure that the DQO is met. Quality control (QC) procedures discussed in Section 4.2 of this SAP shall also be used to determine whether the DQO has been attained. QC samples generated in both the field and the laboratory shall be analyzed and evaluated.

Table F-1-1
Reference Documentation[a]
MWL Groundwater Monitoring

Document Number	Document Title
AOP 00-03	Data Validation Procedure for Chemical and Radiochemical Data
AOP 95-16	Sample Management and Custody
FOP 05-01	Groundwater Monitoring Well Sampling and Field Analytical Measurements
FOP 05-02	Groundwater Monitoring Equipment Field Check For Water Quality Measurements
FOP 05-03	Groundwater Monitoring Equipment Decontamination
FOP 05-04	Groundwater Monitoring Waste Management
LOP 94-03	Sample Handling, Packaging, and Shipping
PLA 05-09	Groundwater Monitoring Health and Safety Plan
SMO 05-03	Procedure for Completing the Contract Verification Review
Not Applicable	Statement of Work for Analytical Laboratories - SNL/NM
Not Applicable	Quality Assurance Project Plan for the Sample Management Office

[a]The most current version will be used.
AOP = Administrative operating procedure.
FOP = Field operating procedure.
LOP = Laboratory operating procedure.
MWL = Mixed Waste Landfill.
PLA = Plan.
SMO = Sample Management Office.
SNL/NM = Sandia National Laboratories, New Mexico.

Laboratory measurements shall comply with SNL/NM Sample Management Office (SMO) procedures and protocols listed in Table F-1-1, including qualification or validation of laboratory analytical data, and requirements in this SAP. The data validation review for determining the quality and usability of analytical data acquired during groundwater sampling shall be summarized in data validation reports regarding the overall quality of the data and the resulting data qualifiers. All associated data validation reports shall be submitted to NMED in the annual MWL long-term monitoring report along with the results for each monitoring event. Data not meeting DQO requirements are subject to corrective action(s) as discussed in SNL/NM SMO procedures and protocol and as discussed in Section 6.0 of this SAP.

2.1 Accuracy

Accuracy is the agreement between a measured value and an accepted reference value. When applied to a set of observed values, accuracy is influenced by a combination of a random component and a systematic bias. Accuracy shall be maintained and evaluated through referenced calibration standards, laboratory control samples (LCS), matrix spike (MS) samples, and surrogate spike samples. The bias component shall be evaluated and expressed as percent recovery (%R), as indicated in the equation below:

$$\%R = \frac{(measure\,sample\,concentration)}{true\,concentration} x100\%$$

The acceptable range for %R shall be 50-130% for volatile organic compounds (VOCs) and 75-125% for metals.

2.2 Precision

Precision is the agreement among a set of replicate measurements. Precision data shall be derived from field and laboratory duplicate samples. Precision shall be reported as relative percent difference (RPD), which is calculated as follows.

$$RPD = \frac{\left|(measured\ value\ sample 1 - measured\ value\ sample\ 2)\right|}{average\ of\ samples 1\ and\ 2} x 100\%$$

RPD results shall only be calculated for detected parameters. The acceptable range for RPD is ±20% for VOCs and ±35% for metals. Corrective action is not required for RPD results that fall outside the acceptable range in the following cases.

- parameters detected between the laboratory method detection limit and practical quantitation limit (i.e., for "J" qualified estimated results)
- parameters that occasionally are outside the acceptable range

Corrective action shall only be required if RPD results are consistently outside the acceptable range.

2.3 Completeness

Completeness is defined as a measure of the amount of usable data compared to the total amount of data required. Examples of events that reduce the amount of usable data include improperly collected and preserved samples, missed holding times, sample container breakage, and operating outside prescribed QC limits. The completeness objective is 100% for compliance data. If the completeness objective is not met and sufficient sample material remains for re-analysis, and if still appropriate, the laboratory shall repeat the analysis. Otherwise, the incomplete portion of the sampling shall be made complete by repeating the sampling and analysis as necessary. Percent completeness is expressed in the equation below:

$$\%Completeness = \frac{number\ of\ useable\ data\ points}{total\ number\ of\ samples\ required} x 100\%$$

2.4 Data Representativeness

Data representativeness is the degree to which samples represent the media they are intended to represent. To help ensure that samples are representative of formation water, DOE/Sandia shall implement the procedures in this SAP for groundwater purging and sampling. Monitoring

wells shall be adequately purged and stability of field parameters achieved prior to the collection of water samples.

2.5 Comparability

Comparability is the extent to which one data set or value can be related to another. Comparability between data sets shall be achieved through the collection and analysis of samples using consistent methods and QC criteria.

2.6 Sampling Locations and Frequency

The long-term groundwater monitoring network at the MWL is described in Section 3.5.1 and groundwater monitoring well replacement is described in Section 3.5.3 of the MWL LTMMP.

Table F-2.6-1 summarizes the groundwater parameters, methods, and frequency. Aqueous samples shall be reported in units of milligrams per liter (mg/L), micrograms (µg)/L, or picocuries per liter (pCi/L). Well completion diagrams for these wells are provided in Appendix H of the MWL LTMMP.

Table F-2.6-1
Groundwater Monitoring Parameters, Test Methods, and Monitoring Frequency
Mixed Waste Landfill Long-Term Monitoring Program

Parameter	EPA Method[a]	Monitoring Frequency
Volatile Organic Compounds	SW846-8260 or Equivalent	Semi-annual for all parameters from the MWL Groundwater Monitoring Compliance Network
Metals: total uranium, total chromium, cadmium, and nickel	SW846-6020 or Equivalent	
Tritium	EPA 906.0 or Equivalent	
Radon	SM 7500 series	
Gamma Spectroscopy (short list)	EPA 901.1 or Equivalent	
Gross Alpha/Beta activity	EPA 900.0 or Equivalent	

[a]EPA November 1986.
EPA = U.S. Environmental Protection Agency.
MWL = Mixed Waste Landfill.
SM = Standard Methods.
SW = Solid waste.

3.0 FIELD OPERATIONS

Groundwater sampling shall be conducted in accordance with this SAP and the MWL LTMMP to ensure accurate, precise, representative, complete, and comparable groundwater sampling results. Other groundwater monitoring activities shall include the measurement of water levels and calculating the direction, flow rate, and gradient of groundwater flow, the decontamination of

equipment, inspection of monitoring equipment, monitoring field water quality parameters, collecting and handling samples, and managing waste.

3.1 Safety

Field operations shall be conducted in a manner that protects the health and safety of field personnel. Every team member has the authority and responsibility to stop operations if an unsafe condition develops or is observed. All groundwater monitoring personnel shall perform field activities safely in accordance with the SNL/NM Groundwater Monitoring Health and Safety Plan (PLA 05-09).

3.2 Water Level Measurements

Water level information is used to calculate the volume of water in a well casing and the minimum amount required for purging. It is also used to determine the direction and gradient of groundwater flow. Measurements shall be referenced to a surveyed mark of known elevation at the top of each well casing. The static water level shall be measured in each well prior to purging or obtaining a sample, and measurements shall be taken to the nearest 0.01-foot using a water level indicator. Other requirements for water level measurements are provided in SNL/NM FOP 05-01. Water levels in all compliance wells shall be measured during every sampling event.

3.3 Field Water Quality Parameters

Field water quality parameters shall be collected during purging in accordance with SNL/NM FOP 05-01 and this SAP. Measurements taken shall include potential of hydrogen (pH), specific conductance (SC), temperature, and turbidity. Additional field water quality parameters shall include dissolved oxygen (DO) and oxidation-reduction potential (ORP). Field water quality parameters are as follows.

DO – The DO content of the water in percent saturation or in mg/L.

SC – The ability of a cubic centimeter of water to conduct electricity. It varies directly with the amount of ionized minerals in the water and is measured in micro-mhos per centimeter at 25 degrees Celsius (ºC).

pH – A measure of the acidity or alkalinity of a solution. Numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity.

ORP – Potential for an oxidation (loss of electrons to another atom or molecule) or reduction (gain of electrons from another atom or molecule) reaction in millivolts.

Temperature – The temperature of the water in °C.

Turbidity (nephelometric) – The cloudiness in water due to suspended and colloidal organic and inorganic material. Water turbidity is measured in Nephelometric Turbidity Units (NTUs).

3.4 Sample Collection

Sample collection procedures are provided in SNL/NM FOP 05-01 and this SAP. Groundwater monitoring shall be performed using conventional sampling methods. DOE/Sandia shall purge monitoring wells with a portable Bennett™ submersible pump system or equivalent. The pump intake shall be set at or near the bottom of the screened interval. In an effort to lower the rate of discharge for wells that purge dry, the Bennett pump system used at the MWL shall be equipped with a flow meter valve located along the water discharge line, and with small-diameter tubing for both the water discharge and air (or other drive gas) intake lines. These actions represent best faith efforts that shall be employed by DOE/Sandia to attain a pumping rate of 0.3 liters per minute (L/min) or less. If the desired pumping rate of 0.3 L/min is not achieved during a particular sampling event for a particular well that purges dry, DOE/Sandia will document in the annual MWL long-term monitoring reports their attempts to achieve the desired pumping rate that failed.

Regardless of the desired pumping rate mentioned above, the maximum pumping rate in any case shall not exceed 12 L/min, and groundwater samples collected for VOC analyses shall be collected by filling the sample containers at a flow rate not to exceed 0.1 L/min. DOE/Sandia may modify the sampling system in order to split the flow of water, such that the flow of water through one side can be reduced to a rate of 0.1 L/min or less to facilitate the filling of sample containers. The flow rate through the other side shall be the minimum rate that is reasonably achievable. Each monitoring well shall be purged a minimum of one saturated casing volume (a saturated casing volume is the volume of all static water in the well screen interval plus the volume of water in the primary and secondary filter packs adjacent to the well screen interval). Prior to the collection of groundwater samples, purging shall continue beyond one saturated casing volume until four stable measurements are obtained for turbidity, pH, temperature, and SC. Groundwater stability shall be considered acceptable when measurements are less than 5 NTU for turbidity, ± 0.1 pH units for pH, ± 1.0 °C for temperature, and ± 5% for SC. If any of the turbidity measurements are greater than 5 NTU after completing the purging a saturated casing volume, stability shall be considered acceptable when the lowest and highest of four consecutive measurements are within plus or minus 10%. If a monitoring well is purged dry prior to meeting the above purging and stability requirements, then sampling shall be conducted once the well has recovered such that the volume of water available in the well is the minimum necessary to collect the required water samples.

Samples shall be placed into clean laboratory-supplied containers. Groundwater samples shall be collected for VOC, metals, and radionuclide analyses, in that order, from each well. Samples shall not be filtered. Sample documentation and custody shall be performed in accordance with SNL/NM SMO procedures and protocols (AOP 95-16 and LOP 94-03) and this SAP. Samples shall be delivered to the shipping facility for repackaging in shipping coolers in accordance with appropriate U.S. Department of Transportation shipping regulations (Title 49 Code of Federal Regulations Parts 170–179).

3.5 Monitoring Equipment Field Checks

Monitoring instruments used to measure field water quality parameters shall be calibrated where appropriate or function-checked prior to sampling activities. Calibration and field-check instructions are presented in FOP 05-02.

3.6 Equipment Decontamination

All equipment that would come into contact with a sample, the interior of a well, or groundwater shall be decontaminated prior to entering any well or contacting any sample to prevent cross-contamination. Equipment and materials (including chemicals and protective clothing), decontamination procedures, and waste management procedures are presented in the FOPs 05-01, 05-02, 05-3, and 05-04.

3.7 Waste Management

All waste generated during groundwater sampling activities shall be managed in accordance with federal, state, and local regulations. All purge and decontamination water shall be assumed to be non-hazardous waste based upon historical analytical data. Analytical data from sampling events shall be compared to discharge and disposal criteria. The anticipated disposal path for purge water and decontamination water is discharge to the sanitary sewer. If the Albuquerque Bernalillo County Water Utility Authority discharge standards are not met, purge and decontamination water shall be managed appropriately through the SNL/NM waste management process and facilities. Personal protective equipment that comes into contact with groundwater shall be managed and disposed of as solid waste. Waste management activities associated with groundwater monitoring are discussed in FOP 05-04.

3.8 Sample Documentation and Custody

To ensure the integrity of samples from the time of collection through the reporting of analytical results, sample collection, handling, and custody shall be documented in writing. Primary elements in the documentation of samples are: sample identification numbers, sample labels, custody tape, and Analysis Request/Chain-of-Custody forms. Standardized forms shall be used to document sample information. Sample custody and documentation procedures for sampling activities are outlined in SNL/NM AOP 95-16 and LOP 94-03. These procedures, and the procedures in this SAP, shall be followed throughout each groundwater-sampling event.

3.9 Sample Shipment

Samples shall be packaged and shipped to the analytical laboratory in accordance with SMO procedures detailed in LOP 94-03. Prior to shipment, sample collection documentation shall be verified. Any error shall be noted in writing and corrected.

4.0 LABORATORY PROCEDURES AND QUALITY CONTROL SAMPLES

DOE/Sandia shall ensure that the analytical laboratory analyzes samples using U.S. Environmental Protection Agency- (EPA) approved analytical methods. The analytical laboratory shall provide appropriate sample containers prepared with the required preservative. The analytical laboratory shall prepare and submit to DOE/Sandia an analysis data report as described in Section 4.0 of the SOW for Analytical Laboratories and as required by the conditions of the MWL LTMMP and this SAP. Container types and preservation methods applicable to groundwater sampling at the MWL shall be consistent with the EPA Methods used; however, DOE/Sandia may use other appropriate test methods, container types, and preservation methods that meet the data quality requirements of MWL LTMMP and this SAP.

4.1 Analytical Laboratory

DOE/Sandia shall ensure that the analytical laboratory performs the analyses in accordance with this SAP, the MWL LTMMP, and regulatory requirements. The laboratory shall maintain written documentation of sample handling and custody, analytical results, and internal QC data. The laboratory shall analyze QC samples in accordance with this SAP and its own internal QC program. DOE/Sandia shall direct the laboratory to investigate and if necessary conduct corrective action where data are found to be outside quality acceptance limits.

Two types of additional analytical laboratory audits shall be performed as part of the sampling program: system audits and performance audits. A system audit determines whether appropriate project systems (i.e., equipment, procedures) are in place. Performance audits indicate whether the project systems are functioning properly and are capable of meeting project DQOs. These audits shall be completed as required by SMO procedures and protocols.

4.2 Quality Control

QC samples shall be collected in the field and prepared in the laboratory to ensure that the data generated meet the DQO. QC shall be achieved through adherence to requirements and procedures listed and described in Section 2.0 of this SAP. Mandatory QC samples are identified in the following sections.

4.2.1 Field Quality Control

Field QC samples are used to document data quality and identify errors that may be introduced by field conditions, in sample collection, storage, transportation, and equipment decontamination. Field QC samples submitted to the analytical laboratory shall be handled and analyzed in an identical manner as environmental samples. DOE/Sandia shall collect and analyze the following Field QC sample types: equipment blanks, duplicates, field blanks, and trip blanks.

Equipment blanks demonstrate the effectiveness of equipment decontamination and monitor the cleanliness of the sampling system. After sampling equipment decontamination has been completed, an equipment blank is produced by passing de-ionized water through the sampling system and collecting a sample of this water. Equipment blanks shall be collected at a frequency of 10 percent (minimum of one per MWL sampling event) and shall be analyzed for all of the constituents required by this SAP.

Duplicate environmental samples are collected in the field and analyzed to document the precision of the sampling and analysis process. The duplicate samples shall be collected immediately after the original environmental sample in order to reduce variability caused by time and/or the sampling process. Duplicates shall be collected and analyzed at a frequency of at least 10 percent. At least one duplicate groundwater sample shall be collected and analyzed per sampling event for each of the constituents required by this SAP.

Field blanks are collected for VOCs to assess whether any contamination of the samples was caused by ambient field conditions. The field blanks shall be prepared by pouring deionized water into sample containers at wellheads to simulate the transfer of environmental samples from the sampling system to the sample container. Field blank samples shall be collected and analyzed at a frequency of 10 percent (minimum of one per sampling event).

Trip blanks (TBs) are used to assess the potential for cross-contamination between environmental samples during sample handling and shipping activities. The TBs are to be analyzed for VOCs only. Each batch of groundwater samples to be analyzed for VOCs shall be accompanied by at least one TB during shipping. The analytical laboratory shall prepare the TB by filling a VOC-sample vial with deionized water and using the same sample preservation method designated for VOC environmental samples. Each vial shall be sealed with custody tape and dated when it is prepared. The TBs shall accompany the empty sample containers when they are shipped to the field supervisor prior to the start of sample collection. The TBs shall be taken into the field during sample collection and shall be included in the shipment of environmental samples to the laboratory. The TBs must remain sealed during this entire cycle and may be opened only for analysis on return to the analytical laboratory.

4.2.2 Laboratory Quality Control

The analytical laboratory must have established procedures that demonstrate the analytical process is in control during each sample analysis step. The procedures include LCSs, method blank samples, and MS samples.

A LCS consists of a control matrix (e.g., deionized water) spiked with known concentrations of analytes representative of the target analytes. LCSs shall be prepared and analyzed for each analytical procedure performed. LCSs shall be analyzed with each analytical batch containing environmental samples to determine accuracy of the data. The laboratory shall also evaluate the precision of the data by analyzing twice either the environmental samples, LCSs, or MS samples and calculating the RPD between corresponding results.

Method blank samples shall be used to check for contamination in the laboratory during sample preparation and analysis. Method blank samples shall be concurrently prepared and analyzed

with each analytical batch. Method blanks shall be reported in the same units as corresponding environmental samples, and the results shall be included with each analytical report.

Surrogate spike analysis shall be performed for all samples analyzed by Gas Chromatography/ Mass Spectroscopy. The surrogate compounds added to the sample shall be those specified in the applicable EPA analytical method procedure (EPA November 1986). Recovery values for surrogate compounds that are outside specified control limits require corrective action, which is detailed in the SOW for Analytical Laboratories.

The analytical process shall be systematically evaluated for the effects of indigenous constituents present in the environmental sample matrix. MS/matrix spike duplicate analyses shall be performed in accordance with the specified analytical procedures.

5.0 DATA REVIEW, VALIDATION, AND REPORTING

Data validation and review of analytical and field documentation shall be performed. Field and analytical QC data shall be reviewed for conformance to QC acceptance criteria. The entire data package shall be reviewed for completeness, comparability, representativeness, precision, and accuracy to determine whether the DQO has been met. All groundwater monitoring data shall be reported in the annual MWL long-term monitoring reports for the year for which the data were obtained.

5.1 Field Documentation Review

Completed field documentation shall be reviewed and checked for errors, completeness, and conformance with the procedures required by this SAP. The review shall occur at the end of each day in the field to allow verification, correction, and retrieval of missing information as appropriate. Field documentation found to be incomplete or to contain questionable data shall be corrected prior to finalizing the field reports. If necessary, measurements of field water quality parameters shall be repeated.

5.2 Laboratory Data Verification and Validation

DOE/Sandia shall review laboratory reports for completeness and conformance to the requirements of this SAP and to the performance criteria of the laboratory contract according to the “Procedure for Completing the Contract Verification Review,” SMO 05-03.

Upon receipt of the analytical results from the analytical laboratory, DOE/Sandia shall arrange for the validation of the data. The purpose of the validation is to determine the usability and establish the defensibility of the results in support of environmental and waste management activities. Data qualification shall be based upon review of field and laboratory-supplied QC data, the specific QC criteria identified in the procedures for the EPA-approved analytical methods, and the QC criteria for meeting the DQO identified in this SAP. Data validation shall be conducted according to the requirements of this SAP and AOP 00-03, “Data Validation

Procedure for Chemical and Radiochemical Data." All associated data validation reports shall be submitted in the annual MWL long-term monitoring report.

5.3 Data Reporting

All groundwater monitoring data shall be reported in the annual MWL long-term monitoring reports for the year for which the data were obtained. This report shall include a description of sampling activities, field water quality data, laboratory analytical results, a discussion of QC evaluations and data reviews, a description of any project variance or nonconformance, and data validation summaries. The control charts and statistical analysis shall be included, if appropriate, to show data trends over time and provide supporting information for data evaluation. Additional reporting requirements are found in Section 3.5.4 of the MWL LTMMP.

5.4 Records Management

Records associated with groundwater monitoring, including field documentation, chains of custody, laboratory analytical results, data validation reports, long-term monitoring reports, and technical data evaluations, shall be maintained at the SNL/NM Records Center and comply with the record-keeping provisions of 20.4.1.500 New Mexico Administrative Code, incorporating Title 40 Code of Federal Regulations Section 264.74, concerning the availability, retention, and disposition of records.

6.0 NON-CONFORMANCES AND VARIANCES

Corrective actions must be taken to rectify or prevent a nonconformance or variance that could adversely affect the quality of data generated. Corrective actions must be documented in writing by the persons identifying the need for action.

Any purposeful change to or deviation from the requirements of this SAP and MWL LTMMP shall take effect only after approval by NMED.

A nonconformance is any action or condition that does not meet the requirements of this SAP. The analytical laboratory, SMO, groundwater monitoring team members, or the Project Leader may identify a nonconformance. The person noting a nonconformance shall document the nonconformance in writing and suggest an appropriate corrective action. Resolution of the nonconformance shall be documented in writing and acknowledged by DOE/Sandia.

DOE/Sandia and the analytical laboratories shall have systems in place to identify QC issues and initiate corrective actions. In accordance with SMO procedures, the laboratories are required to notify the SMO of QC problems that may affect data quality. DOE/Sandia shall evaluate and determine whether data are comparable to historical values and whether or not corrective action is required based upon the specific issue. Corrective action may include documentation of QC issues in an analytical laboratory report, data qualifiers, and/or sample re-analysis. In all cases, the DQO in Section 2.0 of this SAP shall be met.

7.0 REFERENCES

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APPENDIX G
Tritium and Biota Sampling and Analysis Plan for the Mixed Waste Landfill

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1.0 INTRODUCTION

Requirements for monitoring at the Mixed Waste Landfill (MWL) are defined in the Long-Term Monitoring and Maintenance Plan (LTMMP) provided by the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia). This Tritium and Biota Sampling and Analysis Plan (SAP) was developed in response to a request by the New Mexico Environment Department (NMED) to monitor for tritium in surface soil and potential biotic mobilization of contaminants at the MWL, Technical Area III, Sandia National Laboratories, New Mexico (SNL/NM) (Bearzi November 2006).

The SNL/NM Terrestrial Surveillance Program has monitored concentrations of tritium in surface soil at the MWL on an annual basis since 1985. Biotic mobilization of contaminants that is of concern at the MWL is defined as the migration of contaminants by burrowing insects and animals (ants and rodents), and uptake by vegetation. The collection of soil samples from ant hills and/or animal burrows, and potentially deep-rooted vegetation samples can determine if contaminant mobilization has occurred via these mechanisms.

Tritium and biota monitoring requirements, including background information, field and analytical methods, frequency, sampling locations, and sampling rationale, are presented in the MWL LTMMP Sections 3.3 and 3.6, respectively. The trigger evaluation process is presented in Section 5.1 of the MWL LTMMP, and trigger levels for tritium in surface soil (collected at the four corners of the Evapotranspirative [ET] Cover) and metals in surface soil from biota sampling locations (collected from animal burrows and ant hills) are presented Section 5.2.2 of the MWL LTMMP. This SAP provides detailed supporting information for the long-term monitoring of tritium, gamma-emitting radionuclides (short list), and metals in surface soil and vegetation at the MWL.

1.1 Monitoring Objective

The LTMMP, including this SAP, is designed to ensure the monitoring of specified parameters over a period of time. The monitoring objective of this SAP is to provide analytical data in order to characterize tritium levels in the surface soil and biotic mobilization of contaminants at the MWL. In addition to establishing monitoring and data quality objectives (DQOs), this SAP presents specifications for the locations of sample collection points, sample collection procedures, laboratory analysis, data evaluation, records management, and reporting. This document provides sampling personnel with the necessary information to perform sampling of soil from the four corners of the ET Cover (tritium), burrows or nests (gamma-emitting radionuclides and metals), and vegetation (gamma-emitting radionuclides). The results for tritium and metals will be compared to the proposed trigger levels presented in the Section 5.2.2 of the MWL LTMMP. The gamma-emitting radionuclide results will be compared to background activities (biota surface soil samples) and evaluated over time to determine trends (biota surface soil and vegetation samples).

1.2 Scope

Tritium sample locations at the four corners of the ET Cover have been previously defined and are detailed in Section 3.3 of the LTMMP. These locations will continue to be sampled annually for the long-term monitoring period to allow future data to be compared to historic results.

As described in Section 4.2 of the MWL LTMMP, inspections of the ET Cover will be conducted quarterly to determine the presence of burrowing animals and/or insects and the types of vegetation present. If animal burrows, ant hills/nests, and/or potentially deep-rooted plants are identified on the ET Cover near the end of the growing season (i.e., August or September), biota sampling will occur. Biota surface soil samples will be collected from the identified locations and submitted for laboratory analysis of specific metals and radionuclides by gamma spectroscopy (short list of radionuclides). Vegetation samples will be submitted for laboratory analysis of radionuclides by gamma spectroscopy (short list of radionuclides) only.

2.0 DATA QUALITY OBJECTIVES

This SAP is designed to ensure that procedures are consistent and can be used to establish contaminant trends, if present. The DQO is to produce representative, accurate, defensible, and comparable analytical results to support the monitoring objective (i.e., provide analytical data to evaluate tritium levels in surface soil and biotic mobilization of contaminants). This DQO will be accomplished through the implementation of standard operating procedures and analytical procedures/methods through the use of quality assurance measures, quality control (QC) samples, and data evaluation protocols.

2.1 Sample Locations and Sampling Frequency

All sampling will be performed annually as required by NMED (Bearzi October 2008). The sampling locations for tritium surface soil have been previously surveyed and remain consistent with past sampling locations, as described in Section 3.3 of the MWL LTMMP.

Biota sampling locations (up to 6 total per year) will be identified during the quarterly ET Cover inspections as described in Section 4.2 of the MWL LTMMP. The number of available sampling locations is variable, depending on the presence and distribution of the insects, animals, and vegetation. Up to two animal burrows and up to two ant hills/nests will be sampled each year (i.e., annually) at the peak of the growing season (August or September) if features are identified. Up to 2 potentially deep-rooted plants will also be sampled annually in August or September if they are present on the ET Cover overlying former disposal areas. If no burrows, ant hills/nests, and potentially deep-rooted vegetation are identified during ET Cover inspections, no biota sampling will be performed. Sampling is dependent upon the presence of these features/plants.

Animal burrow, ant hill/nest, and deep-rooted vegetation sampling locations will be surveyed with a Global Positioning Satellite (GPS) unit, recorded in the SNL/NM geographic information system (GIS) database, and flagged for sampling.

2.2 Data Accuracy

Proper sampling procedures and use of QC samples such as environmental sample duplicates will help reduce random and systematic sampling error or bias. Accurate measurements can be made reliably through the use of a qualified laboratory, appropriate methodologies, and effective QC procedures. These measures along with consistent implementation of the LTMMP and this SAP will satisfy the DQO for accuracy.

Accuracy is the agreement between a measured value and an accepted reference value. When applied to a set of observed values, accuracy is a combination of a random component and a systematic bias. Accuracy will be maintained and evaluated through referenced calibration standards, laboratory control samples (LCS), matrix spike (MS) samples, and surrogate spike samples. The bias component will be evaluated and expressed as a percent recovery (% R) which is calculated as follows:

$$\%R = \frac{(measure\ sample\ concentration)}{true\ concentration} x100\%$$

Acceptance criteria are defined in the SNL/NM Statement of Work (SOW) for Analytical Laboratories (SNL/NM March 2011) and verified as part of the data validation process.

2.3 Precision

Precision is the agreement among a set of replicate measurements. Precision data will be derived from environmental and laboratory duplicate samples. Precision will be reported as the relative percent difference (RPD) which is calculated as follows:

$$RPD = \frac{|\ R_1\ -\ R_2\ |}{[(R_1\ + R_2\ )/2]} \times 100$$

RPD = Relative percent difference (rounded to nearest whole number)

R_1 = analysis result

R_2 = duplicate analysis result

An RPD less than or equal to 35 percent is considered satisfactory. Natural variation in soils is common, so an RPD greater than 35 percent in an environmental sample and duplicate pair is not necessarily indicative of a problem with data precision. Duplicate samples will not be collected for vegetation due to the difficulty in collecting a representative duplicate sample and the anticipated very low activity results.

2.4 Data Consistency and Comparability

Data consistency and comparability will be achieved through implementation of this SAP, which defines field and laboratory procedures designed for this purpose. Consistency in methods and

procedures will be maintained in the following areas to ensure tritium and biota data are consistent and that the data sets are comparable.

- Field sample collection and management
- Use of an off-site contract laboratory and approved analytical methods

After analytical results are received from the laboratory, DOE/Sandia will review the laboratory report for completeness and conformance to the sampling and data quality objectives. If problems are noted that require corrective action during these reviews, the laboratory will be contacted for further information.

Surface soil results will be compared to the trigger levels (tritium and metals), to established soil background levels (gamma emitting radionuclides and metals), and to previous results. This evaluation process will aid in characterization, allow analysis of trends, and help identify outliers or other potential indicators of error and inconsistency. Vegetation results will be tabulated and compared to other vegetation results. There are no established trigger levels or background activities for radionuclides in vegetation.

2.5 Quality Control

QC measures ensure that data are scientifically sound and of known precision and accuracy. QC samples will be collected to help reduce random and systematic sampling error or bias. Section 4.2 presents the samples needed to meet the QC requirements for tritium and biota sampling at the MWL.

3.0 SAMPLING ACTIVITIES

This section describes the field and laboratory measures to be taken in providing tritium and biota data.

3.1 Field Activities

Field activities include the preparation, identification, collection, and shipping of the samples and the methods and procedures used for these activities. Adherence to this protocol will help ensure uniformity, and allow comparison of the results. Activities that will be conducted in preparation for or during sampling include the following:

- Pre-field work planning
- Health and safety considerations
- Sample location verification (tritium sampling locations)
- ET Cover surface inspections for the presence of burrows, ant hills/nests, and vegetation (biota sampling locations)

- GPS survey/enter locations into GIS database
- Sample acquisition
- Sample documentation, handling, and shipping
- Waste management

The SNL/NM Administrative Operating Procedure (AOPs), Laboratory Operating Procedures (LOPs), and Field Operating Procedure (FOPs) for these activities are listed in Table G-3.1-1 , as well as Sample Management Office (SMO) procedures and guidance. All personnel directly involved in survey and sampling field activities will review and abide by these procedures. The most current versions of these documents will be used.

Table G-3.1-1
Reference Documentation[a]
MWL Tritium and Biota Sampling

Document Number	Document Title
AOP 95-16	Sample Management and Custody
LOP 94-03	Sample Handling, Packaging, and Shipping
AOP 00-03	Data Validation Procedure for Chemical and Radiochemical Data
SMO 05-03	Procedure for Completing the Contract Verification Review
Not Applicable	Statement of Work for Analytical Laboratories - SNL/NM
Not Applicable	Quality Assurance Project Plan for the Sample Management Office

[a]The most current version will be used.
AOP = Administrative Operating Procedure.
LOP = Laboratory Operating Procedure.
MWL = Mixed Waste Landfill.
SMO = Sample Management Office.
SNL/NM = Sandia National Laboratories/New Mexico.

DOE/Sandia shall provide to the NMED within 60 days of the effective date of the MWL LTMMP in hard copy and electronic format the current versions of the documents listed in Table G-3.1-1. DOE/Sandia shall provide NMED with any updated versions of the documents within 30 days of their effective date. If any requirement or procedure in the documents is found by NMED to be unacceptable for reasons including, but not limited to, the requirement or procedure will or could prevent the acquisition of representative and reliable monitoring results, the requirement or procedure shall be replaced by DOE/Sandia with a different requirement or procedure that is acceptable to NMED.

3.2 Health and Safety

Field operations will be conducted in an approach that prioritizes the health and safety of field personnel above all other objectives. Every team member has the authority and responsibility

to stop operations if an unsafe condition develops or is observed. All sampling personnel will perform field activities in accordance with the applicable SNL/NM safety documentation.

3.3 Surface Survey

The tritium sampling locations have been previously established and are marked in the field. Biota sampling locations will depend upon the identification of features (burrows, ant hills/nests, potentially deep-rooted vegetation) during quarterly ET Cover inspections as described in Section 2.1. All information regarding dates, locations, and species type (if available) will be maintained on sampling forms or in a log book. All sampling locations will be surveyed with a GPS unit recorded in the GIS database.

3.4 Sample Acquisition and Labeling

Samples will be collected from the designated locations following this SAP. Soil and vegetation will be placed in appropriate containers and labeled with sample identification information.

Tritium Surface Soil Sample Acquisition

Establish a 3-square-meter grid (3 meters by 1 meter) in an undisturbed area at each designated sampling location. To ensure a random sample for tritium analysis, composite approximately 3 kilograms (kg) of soil in two 1-liter wide-mouth poly bottles. Use a clean scoop, trowel, or other sampling device to collect ~2.0 kg of soil to a depth of approximately 5 centimeters (cm) from inside the grid. Collect an additional 1.0 kg to a depth of approximately 5 cm from each of the areas immediately adjacent to the grid (the 3-meter side, total of 3 kg of soil). Make sure both 1-liter poly containers are full of soil, and then seal and label the containers. Samples for analysis by gamma spectroscopy and for metals analysis may also be collected, but are not required by this SAP.

Animal Burrow and Ant Hill/Nest Sample Acquisition

At the location of the burrow or ant hill/nest, collect a grab sample of surface soil from the area immediately surrounding the burrow or hill/nest entrance using a clean scoop, trowel or other sampling device. Place the soil directly into containers provided by the laboratory for metals and gamma spectroscopy analyses. Completely fill the container to ensure adequate volume for analysis. Seal and label the container.

Vegetation Sample Acquisition

At the location of the potentially deep-rooted plant that was previously identified and marked for sampling, remove the surface portion of the plant and as much of the root system as possible. Remove as much soil as possible from the roots and lower plant. Use clippers or other cutting tools to cut the entire plant into small pieces, and place all cut plant materials into a large Ziplock bag. The grab sample should only contain plant material from a discrete plant(s)

with the potential for a deep-rooted root system. Native grasses and other plants with shallow root systems should not be sampled.

A unique SNL/NM SMO-issued sample identification number is assigned to each sample. The sample number will be affixed to or noted on the container sample label and the analysis request/chain–of-custody (AR/COC) form.

A SNL/NM sample label should be completed with indelible ink and affixed to each sample container prior to or during sampling. Each completed sample label will include the following information:

- SNL/NM SMO sample number (with sample fraction designation)
- Sample matrix type
- Sample location
- Date and time of sample collection

A field log will be maintained documenting the collection of all samples. The field log for biota sampling locations will include information on the animal or insect species, size and description of the feature, the plant species, size, condition, and description, and any other pertinent information. See Section 4.0 below for sample container information.

3.5 Equipment Decontamination

All nondisposable equipment that comes into contact with the sample will be decontaminated prior to and following the collection of each sample to prevent cross-contamination. All visible material, such as embedded soil or grass clippings, must be removed from the sampling tools by spraying with Alconox or equivalent, followed by a rinse with deionized water if they are to be used again. The fluid may be allowed to run onto the ground at the sampling site. A clean paper towel or similar adsorbent material will be used to wipe equipment after the final rinse. .

3.6 Sample Custody Documentation

To ensure the integrity of samples from the time of collection through the reporting of analytical results, sample collection, handling, and custody will be documented. The continuous record of documented sample possession is referred to as the chain of custody. Primary elements in the documentation of samples are: sample identification number, sample labels, custody tape, and the AR/COC form. Standardized forms will be used to document sample information. Sample custody and documentation procedures for sampling activities are outlined in AOP 95-16.

3.7 Sample Shipment

Samples will be shipped to the analytical laboratory in accordance with LOP 94-03. Prior to shipment, the sample collection documentation will be verified. Any error will be noted and corrected as required by SNL/NM SMO protocols.

3.8 Waste Management

Waste generated during sampling activities will be minimal and may include used personal protective equipment (i.e., gloves) and decontamination wipes. All waste generated will be managed in accordance with federal, state, and city regulations, and applicable SNL/NM requirements. Analytical data collected from the sampling event will be used to characterize any waste generated.

4.0 ANALYTICAL METHODS

The analytical laboratory will analyze samples using U.S. Environmental Protection Agency (EPA)-approved analytical methods and specified performance criteria in accordance with the SNL/NM SOW for Analytical Laboratories (SNL/NM March 2011). The analytical laboratory will provide appropriate sample containers. The analytical laboratory will prepare and submit to SNL/NM SMO an analysis data report as described in the SOW for Analytical Laboratories. Table G-4-1 summarizes analytical requirements and EPA Methods (EPA November 1986) applicable to biota monitoring at the MWL.

Table G-4-1
Laboratory Analytical Methods
MWL Tritium and Biota Sampling

Parameter	EPA Method[a]	Container Size/Type x Number
Tritium in soil moisture using liquid scintillation	EPA 906.0 or equivalent	1-liter/poly or equivalent x 2
RCRA[b] Metals plus copper, nickel, vanadium, zinc, cobalt, and beryllium	SW846-6020/7470 or equivalent	500 milliliter/glass or equivalent x 1
Gamma Spectroscopy (short list)	EPA 901.1 or equivalent	Soil: 250 milliliter poly or equivalent x 1 Vegetation: 1-gallon Ziplock bag or equivalent x 1

[a]U.S. Environmental Protection Agency, 1986 (and updates), "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd Edition, U.S. Environmental Protection Agency, Washington, D.C.
[b]RCRA metals = arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.
EPA = U.S. Environmental Protection Agency.
MWL = Mixed Waste Landfill.
RCRA = Resource Conservation and Recovery Act.
SW = Solid waste.

4.1 Analytical Laboratory

The analytical laboratory is responsible for performing analyses in accordance with this SAP, SNL/NM SOW for Analytical Laboratories, and regulatory requirements. The laboratory will maintain documentation of sample handling and custody, analytical data, and internal QC data. The laboratory will analyze QC samples in accordance with this SAP, the SNL/NM SOW for Analytical Laboratories, and its own internal QC program for indicators of analytical accuracy

and precision. The SNL/NM SMO will direct the laboratory activity, including investigation and corrective action, if necessary, for data generated outside laboratory acceptance limits.

4.2 Quality Control Samples

QC samples will be analyzed in conjunction with the soil samples to ensure that the data generated meet the DQO of this SAP. QC for the entire activity will be achieved through adherence to requirements and procedures listed and described in Section 2.0 of this SAP. Mandatory QC samples are identified in the following sections.

4.2.1 Field Quality Control Samples

Field QC samples are used to document data quality and evaluate consistency in sample collection. Field QC samples submitted to the analytical laboratory will be handled and analyzed in the same manner as environmental samples. For this limited sampling effort field QC samples include duplicate environmental samples (Table G-4.2-1).

Table G-4.2-1
Field Quality Control Samples

Sample Type	Purpose of Sample	Frequency	Acceptance Criteria	Matrix
Duplicate Samples	To evaluate the overall precision of the sampling and analysis system.	1 with each sample batch sent to the laboratory or 1 per 20 samples.	RPD less than or equal to 20 percent (guidance only)	Soil

RPD = Relative percent difference.

Duplicate environmental samples are collected in the field and analyzed to establish and document the precision of the sampling and analysis process. The duplicate samples will be collected immediately after the original environmental sample in order to reduce variability caused by time and/or sampling mechanics and are typically collected at a frequency of 5 percent (minimum of one per MWL sampling event). An RPD of 20 percent or less will be considered satisfactory. An RPD exceeding 20 percent does not require corrective action because these sample results will reflect natural variability in the sampled media (i.e., surface soil and vegetation), and for low concentrations of naturally occurring constituents significant variability is expected. Duplicate samples of vegetation may not be possible if there is not enough plant material for two samples.

4.2.2 Laboratory Quality Control Samples

The analytical laboratory must have established procedures that demonstrate the analytical process is always in control during each sample analysis step. The procedures include LCSs, method blank samples, and MS samples. Laboratories must operate in conformance with the SNL/NM SOW for Analytical Laboratories, the EPA analytical methods, and their own internal QC process. The laboratory QC sample results will be documented in a complete data report

along with the results of environmental and field QC samples. This report will be submitted to the SNL/NM SMO for review and validation as discussed in Sections 5.2 and 5.3, respectively.

5.0 DATA VALIDATION, REVIEW, AND REPORTING

Data validation and review of analytical and field documentation will be performed for completeness and conformance to the procedures established for the various activities. Field and analytical QC data will be reviewed for conformance to QC acceptance criteria. The entire data package will be reviewed for representativeness of quality and comparability to determine whether the specified DQO has been met.

5.1 Field Measurement Data and Documentation Review

Completed field documentation will be reviewed and verified for accuracy, completeness, and conformance with established procedures. The review will occur at the end of each day in the field to allow verification, correction, and retrieval of missing information as appropriate.

5.2 Laboratory Data Verification and Validation

The SNL/NM SMO will review the laboratory report for completeness and conformance to the performance criteria of the contract with the laboratory according to the SMO 05-03.

Upon receipt of the analytical results from the laboratory, the SNL/NM SMO will arrange for the validation of the data. The purpose of validation is to determine the data usability and establish the defensibility of the numerical results. Data qualification is based upon review of laboratory-supplied QC data, the specific QC criteria identified in the procedures for the EPA-approved analytical methods, and the DQO identified in this SAP. Data validation will be conducted according to the requirements of AOP 00-03.

5.3 Reporting

A report of each annual tritium and biota sampling event will be submitted to the NMED as part of the annual MWL long-term monitoring report according to the schedule in Section 4.8.1 of the MWL LTMMP. The report will include a description of sampling locations and activities, a summary of laboratory analytical results, a discussion of QC analyses and data reviews, a description of any project variance or nonconformance, and data validation summaries. In addition, tritium and metals results for surface soil samples will be compared with trigger levels.

5.4 Records Management

Records associated with the tritium and biota sampling effort, including field documentation, laboratory analytical results, data validation reports, long-term monitoring reports, and technical data evaluations, will be maintained at the SNL/NM Records Center and comply with the record-

keeping provisions of 20.4.1.500 New Mexico Administrative Code, incorporating Title 40 Code of Federal Regulations Section 264.74, concerning the availability, retention, and disposition of records.

6.0 REFERENCES

Bearzi J.P. (New Mexico Environment Department), November 2006. Letter to P. Wagner (U.S. Department of Energy) and L. Shepherd (Sandia Corporation), "Notice of Disapproval, Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005, and Requirement for Soil-Vapor Sampling and Analysis Plan, Sandia National Laboratories EPA ID NM5890110518, HWB-SNL-05-025." November 20, 2006

Bearzi J.P. (New Mexico Environment Department), October 2008. Letter to P. Wagner (U.S. Department of Energy) and F. Nimick (Sandia Corporation), "Notice of Disapproval, Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005, Sandia National Laboratories NM5890110518, SNL-05-025." October 10, 2008.

Sandia National Laboratories/New Mexico (SNL/NM) April 2010. "Quality Assurance Project Plan (QAPP) for the Sample Management Office (SMO), SMO QAPP, Revision 02," Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), May 2010. "Procedure for Completing the Contract Verification Review," SMO 05-03, Revision 04, Sample Management Office, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), March 2011. "SNL/NM Statement of Work for Analytical Laboratories, Revision 05," Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), May 2011. "Data Validation Procedure for Chemical and Radiochemical Data," AOP 00-03, Revision 03, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), June 2011. "Sample Management and Custody, Administrative Operating Procedure," AOP 95-16, Revision 04, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), June 2011. "Sample Handling, Packaging, and Shipping," Sample Management Office (SMO) LOP 94-03, Revision 05, Sandia National Laboratories, Albuquerque, New Mexico.

U.S. Environmental Protection Agency (EPA), November 1986. "Test Methods for Evaluating Solid Waste," 3rd ed., and all updates, SW-846, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.

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APPENDIX H
Mixed Waste Landfill Well Database Summary Sheets

Compliance Groundwater Monitoring Wells
MWL-BW2
MWL-MW7
MWL-MW8
MWL-MW9

Information Only Groundwater Monitoring Wells
MWL-MW4
MWL-MW5
MWL-MW6

Compliance Groundwater Monitoring Wells
MWL-BW2
MWL-MW7
MWL-MW8
MWL-MW9

Well Name:	MWL-BW2	**Drilling Contractor:**	WATER DEVELOPMENT CORP.
Project Name:	ENVIRONMENTAL RESTOR	**Drilling Method:**	AIR ROTARY CASING HAMMER
NMOSE Well File Code:	RG-90065, Point of Diversion: 99	**Borehole Depth (FBGS):**	519
Owner Name:	SNL/NM	**Casing Depth (FBGS):**	502
Date Drilling Started:	1/14/2008	**Geo Location:**	TA-III
Date Well Dev. Completed:	1/22/2008	**Completion Zone:**	ALLUVIAL MATERIAL
		Completion Formation:	SANTA FE GROUP

Survey Data

Survey Date: 3/23/2008

Surveyed By: SNL/NM

State Plane Coordinates: NAD 83

(X) Easting: 1552193.51

(Y) Northing: 1452453.21

Surveyed Evaluations (FAMSL) NAVD 88

Protective Casing: 5391.62

Top of Inner Well Casing: 5391.02

Concrete Pad: 5388.68

Ground Surface: 5388.7

Calculated Depths and Elevations

Initial Depth to Water (FBGS): 472.50

Date Intiial Depth Measured:

Last Measured Water Elevation (FAMSL): 4912.38

Date Last Measured: 10/20/2011

Miscellaneous Information

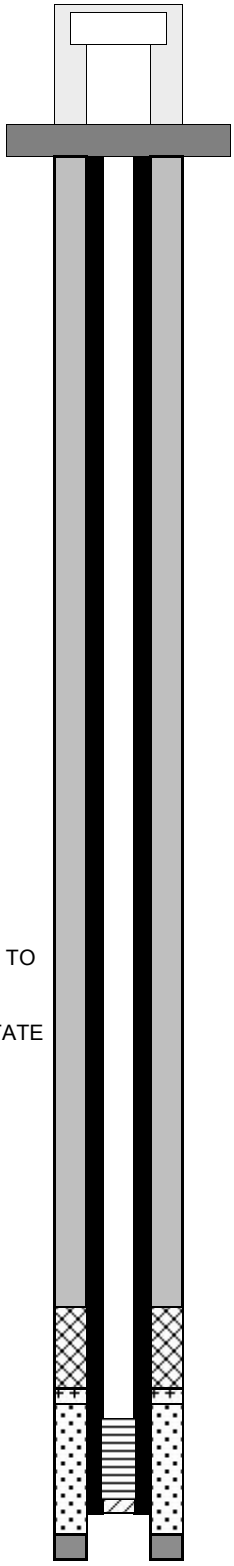
Screen Slot Size (in.): 0.01

Date Updated: 03-APR-08

Date Printed from EDMS: 12/20/2011 8:43:23 AM

Comments:

INITIAL WATER LEVEL APPROX BASED ON CONDITIONS ENCOUNTED DURING DRILLING. CUTTINGS RETURN DIMINISHED DUE TO SATURATION. BOREHOLE DIAMETER IS 11 3/4 IN. TO 300 FT. AND 9 5/8 IN. TO TD. 1/1/11 - ORIGINAL STATE PLANE FEET NAD27/NGVD29 SURVEY COORDINATES HAVE BEEN RE-PROJECTED IN STATE PLANE FEET NAD83/NAVD88 COORDINATES



Completion Data Measured Depths (FBGS)

Casing Stickup: 2.4

Interval	Material	Start	Stop	Length	ID / OD (in.)
CASING	SCHEDULE 80 PVC	0	502	502	4.767 / 5.56
GROUT/BACKFILL	BENTONITE GROUT	0	426	426	
BOREHOLE		0	300	300	11.75 /
BOREHOLE		300	519	219	9.625 /
SEAL	VOLCLAY CHIP	426	456	30	
SECONDARY PACK	#60 SAND	456	461.5	5.5	
PRIMARY PACK	#20-40 SAND	461.5	510	48.5	
SCREEN	SCHEDULE 80 PVC	467	497	30	
SUMP		497	502	5	
PLUG BACK	VOLCLAY CHIP	510	519	9	

Well Name: MWL-MW7
Project Name: MIXED WASTE LANDFILL
NMOSE Well File Code: RG-90065, Point of Diversion: 101
Owner Name: SNL/NM
Date Drilling Started: 4/25/2008
Date Well Dev. Completed: 6/24/2008

Drilling Contractor: WDC EXPLORATION & WELLS
Drilling Method: AIR ROTARY CASING HAMMER
Borehole Depth (FBGS): 498.8
Casing Depth (FBGS): 498.8
Geo Location: SNL/NM TA-III
Completion Zone: ALLUVIAL FAN FACIES
Completion Formation: SANTA FE GROUP

Survey Data

Survey Date: 7/3/2008
Surveyed By: RANDOLPH C. HEWITT SURVEYIN

State Plane Coordinates: NAD 83
(X) Easting: 1551655.45
(Y) Northing: 1452293.54

Surveyed Evaluations (FAMSL) NAVD 88

Protective Casing: 5383.62
Top of Inner Well Casing: 5383.30
Concrete Pad: 5380.96
Ground Surface: 5380.9

Calculated Depths and Elevations

Initial Depth to Water (FBGS): 485.90
Date Intiial Depth Measured:
Last Measured Water Elevation (FAMSL): 4893.95
Date Last Measured: 10/4/2011

Miscellaneous Information

Screen Slot Size (in.): 0.01
Date Updated: 07-AUG-2008
Date Printed from EDMS: 12/20/2011 8:46:09 AM

Comments:
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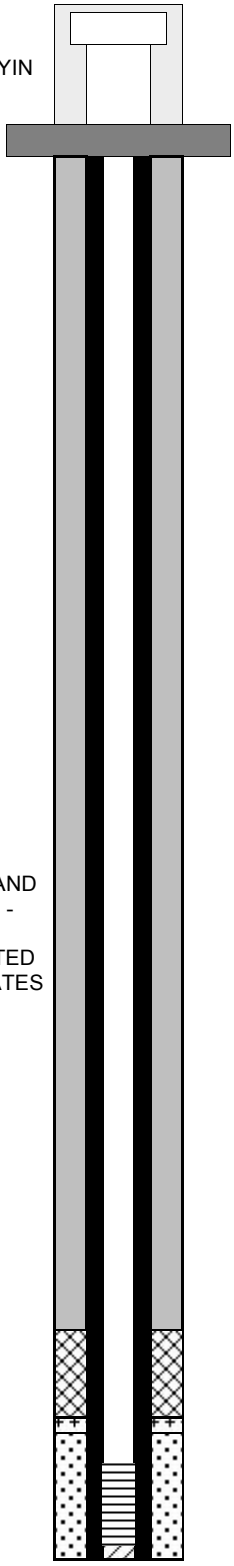

Completion Data Measured Depths (FBGS)

Casing Stickup: 2.4

Interval	Material	Start	Stop	Length	ID / OD (in.)
BOREHOLE		0	498.8	498.8	
CASING	SCHEDULE 80 PVC	0	498.8	498.8	
GROUT/BACKFILL	BENTONITE GROUT	0	417.4	417.4	
SEAL	BENTONITE CHIPS	417.4	448.6	31.2	
SECONDARY PACK	#60 SAND	448.6	453.8	5.2	
PRIMARY PACK	#20/40 SAND	453.8	498.8	45	
SCREEN	SCHEDULE 80 PVC	464.7	494	29.3	
SUMP		494	498.8	4.8	

Well Name:	MWL-MW8	**Drilling Contractor:**	WDC EXPLORATION & WELLS
Project Name:	MIXED WASTE LANDFILL	**Drilling Method:**	AIR ROTARY CASING HAMMER
NMOSE Well File Code:	RG-90065, Point of Diversion: 102	**Borehole Depth (FBGS):**	535
Owner Name:	SNL/NM	**Casing Depth (FBGS):**	500
Date Drilling Started:	5/2/2008	**Geo Location:**	SNL/NM TA-III
Date Well Dev. Completed:	6/26/2008	**Completion Zone:**	ALLUVIAL FAN FACIES
		Completion Formation:	SANTA FE GROUP

Survey Data

Survey Date: 7/3/2008

Surveyed By: RANDOLPH C. HEWITT SURVEYIN

State Plane Coordinates: NAD 83

(X) Easting: 1551655.39

(Y) Northing: 1452457.94

Surveyed Evaluations (FAMSL) NAVD 88

Protective Casing: 5385.43

Top of Inner Well Casing: 5384.67

Concrete Pad: 5382.60

Ground Surface: 5382.4

Calculated Depths and Elevations

Initial Depth to Water (FBGS): 486.70

Date Intiial Depth Measured:

Last Measured Water Elevation (FAMSL): 4893.69

Date Last Measured: 10/4/2011

Miscellaneous Information

Screen Slot Size (in.): 0.01

Date Updated: 07-AUG-2008

Date Printed from EDMS: 12/20/2011 8:46:41 AM

Comments:

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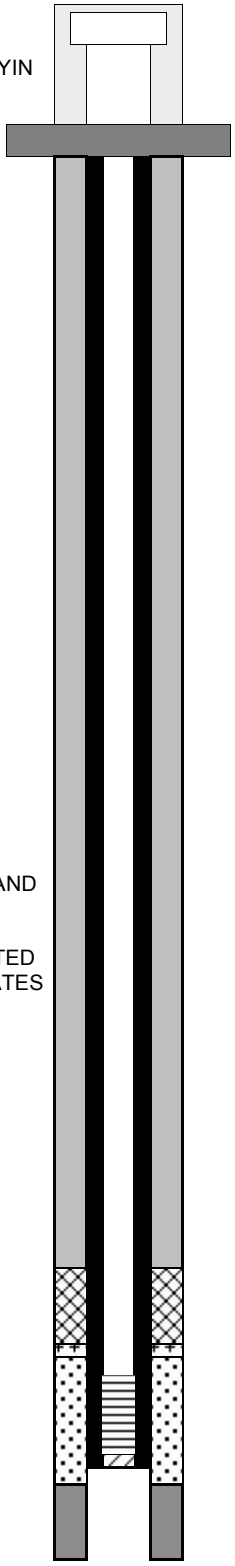


Completion Data Measured Depths (FBGS)

Casing Stickup: 2.3

Interval	Material	Start	Stop	Length	ID / OD (in.)
BOREHOLE		0	535	535	
CASING	SCHEDULE 80 PVC	0	500	500	4.767 / 5.56
GROUT/BACKFILL	BENTONITE GROUT	0	424.2	424.2	
SEAL	BENTONITE CHIPS	424.2	453	29.2	
SECONDARY PACK	#60 SAND	453	458	5	
PRIMARY PACK	#20/40 SAND	458	506.5	48.5	
SCREEN	SCHEDULE 80 PVC	465	495	30	
SUMP		495	500	5	
PLUG BACK	BENTONITE CHIPS	506.5	535	28.5	

Well Name: MWL-MW9
Project Name: MIXED WASTE LANDFILL
NMOSE Well File Code: RG-90065, Point of Diversion: 103
Owner Name: SNL/NM
Date Drilling Started: 5/13/2008
Date Well Dev. Completed: 6/30/2008

Drilling Contractor: WDC EXPLORATION & WELLS
Drilling Method: AIR ROTARY CASING HAMMER
Borehole Depth (FBGS): 535
Casing Depth (FBGS): 500
Geo Location: SNL/NM TA-III
Completion Zone: ALLUVIAL FAN FACIES
Completion Formation: SANTA FE GROUP

Survey Data

Survey Date: 7/3/2008
Surveyed By: RANDOLPH C. HEWITT SURVEYIN

State Plane Coordinates: NAD 83
(X) Easting: 1551651.13
(Y) Northing: 1452622.14

Surveyed Evaluations (FAMSL) NAVD 88

Protective Casing: 5382.50
Top of Inner Well Casing: 5381.91
Concrete Pad: 5379.70
Ground Surface: 5379.3

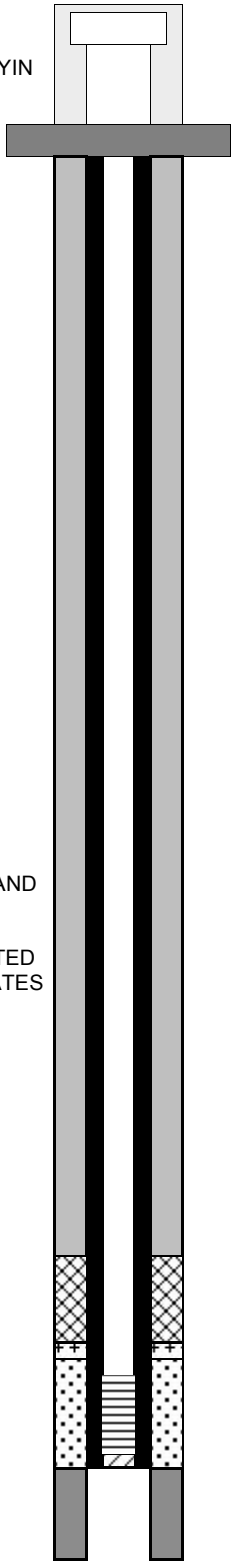
Calculated Depths and Elevations

Initial Depth to Water (FBGS): 489.50
Date Intiial Depth Measured:
Last Measured Water Elevation (FAMSL): 4890.31
Date Last Measured: 10/4/2011

Miscellaneous Information

Screen Slot Size (in.): 0.01
Date Updated: 07-AUG-2008
Date Printed from EDMS: 12/20/2011 8:47:10 AM

Comments:
BOREHOLE DIAMETER IS 11 3/4 IN. TO 200 FBGS AND 9 5/8 IN. FROM 200 FBGS TO 535 FBGS. 1/1/11 - ORIGINAL STATE PLANE FEET NAD27/NGVD29 SURVEY COORDINATES HAVE BEEN RE-PROJECTED IN STATE PLANE FEET NAD83/NAVD88 COORDINATES



Completion Data Measured Depths (FBGS)

Casing Stickup: 2.6

Interval	Material	Start	Stop	Length	ID / OD (in.)
BOREHOLE		0	535	535	
CASING	SCHEDULE 80 PVC	0	500	500	4.767 / 5.56
GROUT/BACKFILL	BENTONITE GROUT	0	419.6	419.6	
SEAL	BENTONITE CHIPS	419.6	452.5	32.9	
SECONDARY PACK	#60 SAND	452.5	458.7	6.2	
PRIMARY PACK	#20/40 SAND	458.7	500.5	41.8	
SCREEN	SCHEDULE 80 PVC	465	495	30	
SUMP		495	500	5	
PLUG BACK	BENTONITE CHIPS	500.5	535	34.5	

Information Only Groundwater Monitoring Wells
MWL-MW4
MWL-MW5
MWL-MW6

Well Name: MWL-MW4
Project Name: MIXED WASTE LANDFILL
NMOSE Well File Code: RG-90065, Point of Diversion: 38
Owner Name: SNL/NM
Date Drilling Started: 12/16/1992
Date Well Dev. Completed: 2/10/1993

Drilling Contractor: WATER DEVELOPMENT CORP.
Drilling Method: SONIC/DRY
Borehole Depth (FBGS): 558.4
Casing Depth (FBGS): 553.9
Geo Location: TA III
Completion Zone: FINE MEDIUM SAND/GRAVELLY SAND
Completion Formation: SANTA FE GROUP

Survey Data

Survey Date: 11/12/2009
Surveyed By: SURVEYING CONTROL, INC.

State Plane Coordinates: NAD 83
(X) Easting: 1551853.59
(Y) Northing: 1452629.08

Surveyed Evaluations (FAMSL) NAVD 88

Protective Casing: 5392.67
Top of Inner Well Casing: 5391.70
Concrete Pad: 5390.77
Ground Surface: 5390.2

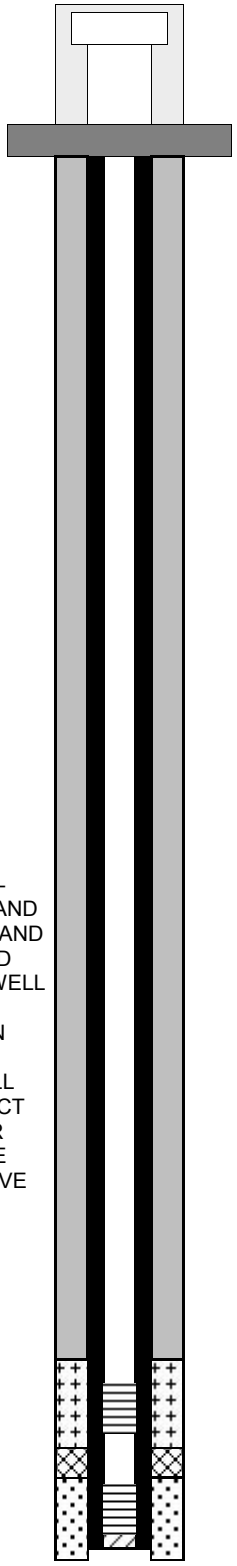
Calculated Depths and Elevations

Initial Depth to Water (FBGS): 487.00
Date Intiial Depth Measured:
Last Measured Water Elevation (FAMSL): 4890.68
Date Last Measured: 10/4/2011

Miscellaneous Information

Screen Slot Size (in.): 0.01
Date Updated: 16-FEB-12
Date Printed from EDMS: 2/16/2012 2:21:07 PM

Comments:
MWL-MW4 IS AN ANGLE WELL, INSTALLED AT A 6-DEGREE ANGLE FROM VERTICAL. THE DEPTHS AND ELEVATIONS OF WELL COMPLETION INTERVALS AND WATER LEVELS ARE NOT ADJUSTED/CORRECTED FOR THE 6 DEGREE ANGLE OF THE BOREHOLE/WELL ON THIS FORM. 2 SCREENED INTERVALS EXIST. WELL PVC & PROTECTIVE CASING EXTENDED ON 5/27/09 AND RE-SURVEYED 11/12/09. NEW N, E IS TOP CENTER OF PVC CASING. DEPTHS OF WELL MATERIALS AND SCREENS ADJUSTED TO REFLECT 5.9' RISE IN GROUND ELEVATION TO MWL COVER CONSTRUCTION. 1/1/11 - ORIGINAL STATE PLANE FEET NAD27/NGVD29 SURVEY COORDINATES HAVE BEEN RE-PROJECTED IN STATE PLANE FEET NAD83/NAVD88 COORDINATES.



Completion Data Measured Depths (FBGS)

Casing Stickup: 1.5

Interval	Material	Start	Stop	Length	ID / OD (in.)
BOREHOLE		0	558.4	558.4	/ 11
CASING	SCH 80 PVC	0	553.9	553.9	4.768 / 5.56
GROUT/BACKFILL	VOLCLAY/CONCRETE	0	478.9	478.9	
SECONDARY PACK	40/60 MESH	478.9	513.9	35	
SCREEN		488.4	508.4	20	
SEAL	VOLCLAY/BENTONITE	508.9	525.9	17	
PRIMARY PACK	40/60 MESH	525.9	558.4	32.5	
SCREEN		528.4	548.4	20	
SUMP		548.4	553.9	5.5	

Well Name: MWL-MW5
Project Name: MIXED WASTE LANDFILL
NMOSE Well File Code: RG-90065, Point of Diversion: 39
Owner Name: SNL/NM
Date Drilling Started: 10/3/2000
Date Well Dev. Completed: 11/19/2000

Drilling Contractor: STEWART BROTHERS
Drilling Method: ARCH
Borehole Depth (FBGS): 550
Casing Depth (FBGS): 521.5
Geo Location: TAIII
Completion Zone: SILTY SAND
Completion Formation: SANTA FE GROUP

Survey Data

Survey Date: 1/26/2001
Surveyed By: ALBUQUERQUE SURVEYING CO.

State Plane Coordinates: NAD 83
(X) Easting: 1551507.56
(Y) Northing: 1452358.18

Surveyed Evaluations (FAMSL) NAVD 88

Protective Casing: 5383.20
Top of Inner Well Casing: 5382.56
Concrete Pad: 5380.64
Ground Surface: 5380.4

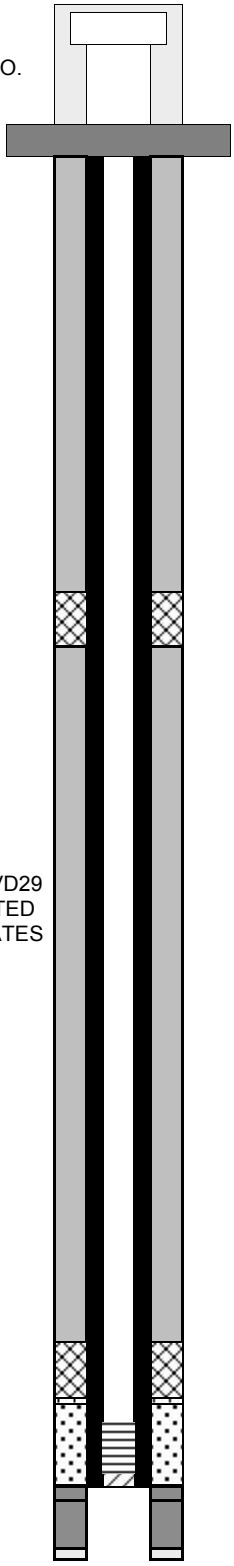
Calculated Depths and Elevations

Initial Depth to Water (FBGS): 486.59
Date Intiial Depth Measured:
Last Measured Water Elevation (FAMSL): 4889.27
Date Last Measured: 10/4/2011

Miscellaneous Information

Screen Slot Size (in.): 0.02
Date Updated: 18-APR-01
Date Printed from EDMS: 12/20/2011 8:44:47 AM

Comments:
1/1/11 - ORIGINAL STATE PLANE FEET NAD27/NGVD29 SURVEY COORDINATES HAVE BEEN RE-PROJECTED IN STATE PLANE FEET NAD83/NAVD88 COORDINATES



Completion Data Measured Depths (FBGS)

Casing Stickup: 2.2

Interval	Material	Start	Stop	Length	ID / OD (in.)
CASING	PVC	0	521.5	521.5	
BOREHOLE (1)		0	300	300	/ 11.75
GROUT/BACKFILL (1)	VOLCLAY	0	171	171	
SEAL (1)	BENTONITE PELLETS	171	192	21	
GROUT/BACKFILL (2)	VOLCLAY	192	465	273	
BOREHOLE (2)		300	550	250	/ 9.625
SEAL (2)	BENTONITE PELLETS	465	487	22	
SECONDARY PACK	#30-70 SAND	487	489	2	
PRIMARY PACK	#10-20 SAND	489	521	32	
SCREEN	5" PVC	496.5	516.5	20	
SUMP		516.5	521.5	5	
PLUG BACK (1)	BENTONITE PELLETS	521.5	527	5.5	
PLUG BACK (2)	#10-20 SAND	527	546	19	

Well Name:	MWL-MW6	**Drilling Contractor:**	STEWART BROTHERS
Project Name:	MIXED WASTE LANDFILL	**Drilling Method:**	ARCH
NMOSE Well File Code:	RG-90065, Point of Diversion: 40	**Borehole Depth (FBGS):**	550
Owner Name:	SNL/NM	**Casing Depth (FBGS):**	505.5
Date Drilling Started:	9/7/2000	**Geo Location:**	TA III
Date Well Dev. Completed:	10/19/2000	**Completion Zone:**	SAND
		Completion Formation:	SANTA FE GROUP

Survey Data

Survey Date: 1/26/2001

Surveyed By: ALBUQUERQUE SURVEYING CO.

State Plane Coordinates: NAD 83

(X) Easting: 1551171.12

(Y) Northing: 1452719.87

Surveyed Evaluations (FAMSL) NAVD 88

Protective Casing: 5375.54

Top of Inner Well Casing: 5375.31

Concrete Pad: 5372.88

Ground Surface: 5372.7

Calculated Depths and Elevations

Initial Depth to Water (FBGS): 483.84

Date Intiial Depth Measured:

Last Measured Water Elevation (FAMSL): 4888.09

Date Last Measured: 10/4/2011

Miscellaneous Information

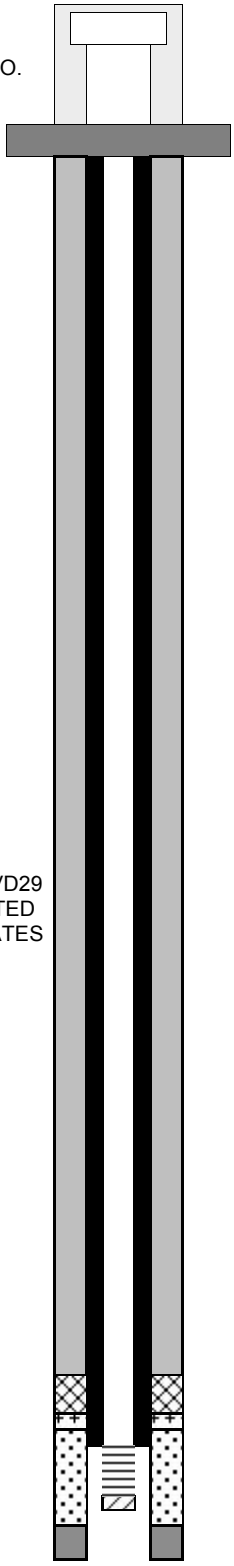
Screen Slot Size (in.): 0.02

Date Updated: 18-APR-01

Date Printed from EDMS: 12/20/2011 8:45:31 AM

Comments:

1/1/11 - ORIGINAL STATE PLANE FEET NAD27/NGVD29 SURVEY COORDINATES HAVE BEEN RE-PROJECTED IN STATE PLANE FEET NAD83/NAVD88 COORDINATES



Completion Data Measured Depths (FBGS)

Casing Stickup: 2.6

Interval	Material	Start	Stop	Length	ID / OD (in.)
BOREHOLE		0	550	550	/ 9.625
CASING	PVC	0	505.5	505.5	/ 5
GROUT/BACKFILL	VOLCLAY	0	478	478	
SEAL	BENTONITE PELLETS	478	493	15	
SECONDARY PACK	40-60 SAND	493	499	6	
PRIMARY PACK	10-20 SAND	499	537	38	
SCREEN	SCH 80 PVC	505.5	525.5	20	
SUMP		525.5	530.5	5	
PLUG BACK	NATURAL BACKFILL	537	550	13	

APPENDIX I
Mixed Waste Landfill
Long-Term Monitoring Inspection Checklists/Forms

Mixed Waste Landfill
Biology Inspection Checklist/Form

Mixed Waste Landfill
Biology Inspection Checklist/Form for the MWL Cover

Approximate vegetative coverage (actively photosynthesizing): _____ %

Approximate percent native vegetation of the total vegetative cover: _____ %

Listed below are the main plant species identified as growing on the MWL cover and the percentage of the cover populated by each species.

Scientific Name	Common Name (optional)	% of Cover[1]

Note: [1] Percentage of total MWL Cover populated by actively-photosynthesizing plants of this species

Mixed Waste Landfill
Biology Inspection Checklist/Form for the MWL Cover
(continued)

Are there any contiguous areas of no vegetation greater than 200 square feet? (approximately 14 x 14 ft)? _____

If "Yes," mark such areas on a map and attach to this checklist. Address actions and schedule to improve such area(s) in the notes section below.

Are there any very deeply rooted (roots greater than 8 feet deep at maturity) plant species present on the cover? _____

If "Yes," describe the plant(s) and their general distribution. Address actions and schedule to remove plant(s) from the cover in the notes section below.

Notes: _____

_____

_____

_____

Inspection for Animal and Insect Intrusion into MWL Cover

Are any burrows present on the cover? _____

Do any of the burrows appear to be active? _____

Any ant hills/nests? _____

Describe below observations regarding animal and insect features. If burrows with an entrance diameter of 4 inches or greater are present or appear to be that of a species that is able to burrow 6 feet deep or greater, indicate the location(s) on a map and attach to this checklist. Address actions and schedule to repair cover damage that exceeds prescribed limits. As appropriate, identify animal and insect features and have them surveyed and marked for biota sampling.

Notes: _____

_____

_____

_____

Mixed Waste Landfill
Biology Inspection Checklist/Form for the MWL Cover
(Continued)

Notes (continued):

Biological Aspects Map -- [note: sketch map to locate specific features described above will be attached as appropriate]

Inspector's Signature: _____ Date: _____

Original to: Mixed Waste Landfill Operating Record

Copy to: SNL/NM Records Center

Mixed Waste Landfill
Cover Inspection Checklist/Form

Mixed Waste Landfill
Cover Inspection Checklist/Form

1. Date of Inspection _____
2. Time of Inspection _____
3. Name of Inspector _____

Provide explanatory notes for each parameter not inspected or each action required. Include any maintenance or repair required in notes section at the end of this form.

I. COVER SYSTEM [Quarterly]			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Visible settlement of the soil cover in excess of 6 inches.			
B. Erosion of the soil cover in excess of 6 inches deep.			
C. Evidence of water ponding on the MWL cover surface in excess of 100 square feet.			
D. Animal intrusion burrows in excess of 4 inches in diameter. Note: During period when the Biology Inspection is occurring quarterly, this inspection requirement will be covered on the Biology Inspection Checklist/Form.			
E. Contiguous areas of no vegetation greater than 200 ft^2. Note: During period when the Biology Inspection is occurring quarterly, this inspection requirement will be covered on the Biology Inspection Checklist/Form.			
F. Potentially deep-rooted plants present. Note: During period when the Biology Inspection is occurring quarterly, this inspection requirement will be covered on the Biology Inspection Checklist/Form.			
II. SURFACE-WATER (STORM-WATER) DIVERSION STRUCTURES [Quarterly]			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Channel or sidewall erosion in excess of 6 inches deep.			
B. Channel sediment accumulation in excess of 6 inches deep.			
C. Debris that blocks more than 1/3 of the channel width.			

Mixed Waste Landfill
Cover Inspection Checklist/Form (continued)

III. SECURITY FENCE [Quarterly]			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Accumulation of wind-blown plants and debris.			
B. Fence wires and posts in need of repair/maintenance.			
C. Gates in need of oiling/repair/maintenance.			
D. Locks in need of cleaning or replacement.			
E. Warning signs in need of repair or replacement.			
F. Survey monuments in vicinity of MWL visible.			
IV. PREVIOUS DEFICIENCIES			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
Uncorrected/undocumented previous deficiencies.			

Mixed Waste Landfill
Cover Inspection Checklist/Form (continued)

NOTES

Note Number	Description

Mixed Waste Landfill
Cover Inspection Checklist/Form (continued)

Action (Note Number) _____ assigned to _____Date action completed_____

Action (Note Number) _____ assigned to _____Date action completed_____

Action (Note Number) _____ assigned to _____Date action completed_____

Action (Note Number) _____ assigned to _____Date action completed_____

Action (Note Number) _____ assigned to _____Date action completed_____

Additional Comments:

Inspector's Signature _____

Original to: Mixed Waste Landfill Operating Record

Copy to: SNL/NM Records Center

Mixed Waste Landfill
Groundwater Monitoring Network Checklist/Form

Mixed Waste Landfill
Groundwater Monitoring Network Checklist/Form

1. Date of Inspection _____
2. Time of Inspection _____
3. Name of Inspector _____

Provide explanatory notes for each parameter not inspected or each action required. Include any maintenance or repair required.

I. GROUNDWATER MONITORING LOCATIONS [Semiannually]			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Concrete pads, bollards, and protective casings in need of repair/maintenance.			
B. Well cover caps in need of repair/maintenance.			
C. Well casing in need of repair/maintenance.			
D. Monitoring well properly labeled.			
E. Locks in need of cleaning or replacement.			
II. GROUNDWATER SAMPLING EQUIPMENT [Semiannually]			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Sampling pump in need of repair/maintenance.			
B. Sampling assembly (e.g., tubing, gauges, and valves) in need of repair/maintenance.			
III. PREVIOUS DEFICIENCIES			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
Uncorrected/undocumented previous deficiencies.			

Mixed Waste Landfill
Groundwater Monitoring Network Checklist/Form (Continued)

NOTES

Note Number	Description

Action (Note Number) _____ assigned to _____Date action completed_____
Action (Note Number) _____ assigned to _____Date action completed_____
Action (Note Number) _____ assigned to _____Date action completed_____
Action (Note Number) _____ assigned to _____Date action completed_____

Additional Comments:

_____

_____

_____

_____

_____

Inspector's Signature _____

Original to: Mixed Waste Landfill Operating Record

Copy to: SNL/NM Records Center

Mixed Waste Landfill
Soil-Vapor Monitoring Network Checklist/Form

Mixed Waste Landfill
Soil-Vapor Monitoring Network Checklist/Form

1. Date of Inspection _____
2. Time of Inspection _____
3. Name of Inspector _____

Provide explanatory notes for each parameter not inspected or each action required. Include any maintenance or repair required.

I. SOIL–VAPOR MONITORING LOCATIONS [Semiannually or Annually]			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Concrete pads, bollards, and protective casings in need of repair/maintenance.			
B. Well cover caps in need of repair/maintenance.			
C. Well casing or sampling ports in need of repair/maintenance.			
D. Monitoring location and sampling ports properly labeled.			
E. Locks in need of cleaning or replacement.			
II. SAMPLING EQUIPMENT [Semiannually or Annually]			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Sampling pump in need of repair/maintenance.			
B. Sampling assembly (e.g., tubing, gauges, and valves) in need of repair/maintenance.			
III. PREVIOUS DEFICIENCIES			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
Uncorrected/undocumented previous deficiencies.			

Mixed Waste Landfill
Soil-Vapor Monitoring Network Checklist/Form (Continued)

NOTES

Note Number	Description

Action (Note Number) _____ assigned to _____Date action completed_____
Action (Note Number) _____ assigned to _____Date action completed_____
Action (Note Number) _____ assigned to _____Date action completed_____
Action (Note Number) _____ assigned to _____Date action completed_____

Additional Comments:

_____

_____

_____

_____

_____

Inspector's Signature _____

Original to: Mixed Waste Landfill Operating Record

Copy to: SNL/NM Records Center

Mixed Waste Landfill
Soil-Moisture Monitoring Network Checklist/Form

Mixed Waste Landfill
Soil-Moisture Monitoring Network Checklist/Form

1. Date of Inspection _____
2. Time of Inspection _____
3. Name of Inspector _____

Provide explanatory notes for each parameter not inspected or each action required. Include any maintenance or repair required.

I. SOIL–MOSITURE MONITORING LOCATIONS [Semiannually or Annually]			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
F. Concrete pads, bollards, and protective casings in need of repair/maintenance.			
G. Access tube cover caps in need of repair/maintenance.			
H. Access tube casing in need of repair/maintenance.			
I. Monitoring location properly labeled.			
J. Locks in need of cleaning or replacement.			
II. SAMPLING EQUIPMENT [Semiannually or Annually]			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Neutron probe in need of repair/maintenance.			
B. Cable reel or cable in need of repair/maintenance.			
III. PREVIOUS DEFICIENCIES			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
Uncorrected/undocumented previous deficiencies.			

Mixed Waste Landfill
Soil-Moisture Monitoring Network Checklist/Form (Continued)

NOTES

Note Number	Description

Action (Note Number) _____ assigned to _____Date action completed_____
Action (Note Number) _____ assigned to _____Date action completed_____
Action (Note Number) _____ assigned to _____Date action completed_____
Action (Note Number) _____ assigned to _____Date action completed_____

Additional Comments:

_____

_____

_____

_____

_____

Inspector's Signature _____

Original to: Mixed Waste Landfill Operating Record

Copy to: SNL/NM Records Center

Volume V

TAB 7

Notice of Public Comment Period and Public Dialogue Meeting for the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan, March 2012

From: NMED/Kieling
To: Interested Person

Back of Tab 7

SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lieutenant Governor

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

DAVE MARTIN
Secretary

BUTCH TONGATE
Deputy Secretary

JAMES H. DAVIS, Ph.D.
Director
Resource Protection Division

September 14, 2012

SUBJECT: NOTICE OF PUBLIC COMMENT PERIOD AND PUBLIC DIALOGUE MEETING FOR SANDIA NATIONAL LABORATORIES MIXED WASTE LANDFILL LONG-TERM MONITORING AND MAINTENANCE PLAN

Dear Interested Person:

Enclosed is a **Public Notice** regarding the U. S. Department of Energy (DOE)/Sandia Corporation's (Permittees) revised Long-term Monitoring and Maintenance (LTM) Plan for the Sandia National Laboratories (SNL) Mixed Waste Landfill (MWL). The LTM Plan is a requirement of HSWA Module IV, Section V.6 of the SNL Resource Conservation and Recovery Act Permit.

The DOE is owner, and Sandia Corporation, operator, of SNL. The Permittees are located at the following addresses: SNL, 1515 Eubank SE, Albuquerque, NM, 87123; and NNSA/DOE, Sandia Site Office, KAFB-East, Pennsylvania & H Street, Albuquerque, NM 87116.

The enclosed Public Notice provides locations where the LTM Plan may be reviewed by any members of the public. Comments will be received by the New Mexico Environment Department (NMED) through **5:00 p.m. MST, November 13, 2012**. Any person seeking information may contact:

William Moats
New Mexico Environment Department
Hazardous Waste Bureau
5500 San Antonio Avenue, NE
Albuquerque, NM 87109

E-mail: William.Moats@state.nm.us
Telephone: (505) 222-9551
Fax: (505) 222-9510

NMED will host a public dialogue to discuss technical issues related to the LTM Plan for Sandia National Laboratories' Mixed Waste Landfill. The public dialogue will be held at the **Cesar Chavez Community Center**, 7505 Kathrvn SE, Albuquerque, New Mexico 87108. The meeting will **start at 5:30 p.m. and conclude at 7:45 p.m.** on **October 16, 2012**. All members of the public are invited to attend this forum.

Sincerely,

John E. Kieling
Chief
Hazardous Waste Bureau

SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lieutenant Governor

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

DAVE MARTIN
Secretary

BUTCH TONGATE
Deputy Secretary

JAMES H. DAVIS, Ph.D.
Director
Resource Protection Division

PUBLIC NOTICE NO. 12-05
NEW MEXICO ENVIRONMENT DEPARTMENT
HAZARDOUS WASTE BUREAU
SANTA FE, NEW MEXICO
September 14, 2012

NOTICE OF PUBLIC COMMENT PERIOD FOR SANDIA NATIONAL LABORATORIES MIXED WASTE LANDFILL LONG-TERM MONITORING AND MAINTENANCE PLAN

The federal Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §§ 6901 to 6992(k), provides for the regulation of hazardous waste. Congress waived the immunity of the United States for actions brought under state hazardous and solid waste laws as well as under RCRA. Pursuant to Section 3006 of RCRA, 42 U.S.C § 6926, the U.S. Environmental Protection Agency (EPA) delegated to the New Mexico Environment Department (NMED), on April 16, 1985 by delegation numbers 8-31 and 8-32, the authority to enforce the New Mexico Hazardous Waste Act (HWA) and its implementing regulations, the New Mexico Hazardous Waste Management Regulations (HWMR), 20.4.1 NMAC, in lieu of EPA enforcement through RCRA. NMED has maintained its delegation from EPA over hazardous waste management in New Mexico and from time to time has amended its state program to conform to statutory or regulatory changes in RCRA. The HWMR require corrective action at solid waste management units (SWMUs) where releases of hazardous waste or hazardous constituents have or may have occurred.

The U. S. Department of Energy, owner, and Sandia Corporation, operator, (hereinafter referred to as the Permittees) have been issued a RCRA Permit for the Sandia National Laboratories (SNL) Facility, located in Bernalillo County, New Mexico, EPA ID# NM5890110518. The Permittees must comply with the HWA, the HWMR, and the SNL RCRA Permit, and must conduct corrective action as required under the SNL Order on Consent (April 29, 2004) to protect human health and the environment.

On May 26, 2005, the NMED Secretary approved a final Permit and ordered a final remedy for SNL's Mixed Waste Landfill (MWL). The Secretary also directed that the public be given the opportunity to comment on all major documents regarding the MWL prior to any final action being taken by the NMED. The Permit and final order require the Permittees to submit to the NMED for approval a Long-Term Monitoring and Maintenance (LTM) Plan. The LTM Plan was originally submitted to the NMED on September 25, 2007, but has since been withdrawn. The Permittees submitted a revised MWL LTM Plan on March 23, 2012, which is the subject of this Public Notice.

Pursuant to the Secretary's order, the NMED is seeking public comment on the revised LTM Plan prior to making a final decision on whether to approve the plan.

LOCATION OF THE SNL FACILTY AND THE MWL

The Permittees are located at the following addresses: SNL, 1515 Eubank SE, Albuquerque, NM, 87123; and NNSA/DOE, Sandia Site Office, KAFB-East, Pennsylvania & H Street, Albuquerque, NM 87116. The Permittee's primary contact for this action is Mr. John Weckerle, NNSA/Sandia Site Office, DOE, at P.O. Box 5400, Albuquerque, NM 87185.

SNL is located within the boundaries of Kirtland Air Force Base (KAFB), south of Albuquerque in Bernalillo County, New Mexico. KAFB occupies 52,233 acres. SNL research and administration facilities occupy 2,842 acres and are divided into five Technical Areas (TAs), (designated 1 through 5) and several test areas. TA-1, TA-2, and TA-4 are separate research facilities in the north-central portion of KAFB. TA-3 and TA-5 are contiguous research facilities forming a 4.5-square-mile rectangular area in the southwestern portion of KAFB. The Mixed Waste Landfill (MWL) is located approximately 5 miles southeast of the Albuquerque International Sunport and occupies 2.6 acres in the north-central portion of TA-3.

FACILITY OPERATIONS

SNL is an engineering and science laboratory owned by the DOE and operated by Sandia Corporation (a subsidiary of Lockheed Martin, Incorporated). During the late 1940's, the final assembly of nuclear weapons was conducted at SNL. Since 1949, SNL has been dedicated to research, development, and testing. Currently, SNL employs approximately 9,300 people.

The primary mission of SNL is to provide engineering and testing support for nuclear weapons components and related systems. The Facility conducts a variety of research and development programs and develops technologies and procedures to sustain, modernize, and protect the nuclear arsenal, prevent the spread of weapons of mass destruction, defend against terrorism, protect national infrastructures, ensure stable energy and water supplies, and provide new capabilities to the U. S. armed forces.

As a result of such activities, SNL has generated and continues to generate hazardous, radioactive, mixed (those wastes containing both hazardous and radioactive components), and solid wastes. From 1945 to 1988 most of these wastes were disposed of at SNL at numerous locations, which have been classified by the Department as solid waste management units (SWMUs) or areas of concern (AOCs). The SWMUs/AOCs include landfills, septic system drainfields and seepage pits, outfalls, waste piles, and test areas. Past waste management activities at SNL have caused the release of hazardous and radioactive contaminants into the environment.

The Mixed Waste Landfill is classified as SWMU 76.

DESCRIPTION AND HISTORY OF THE MIXED WASTE LANDFILL

The MWL was opened as the "TA-3 low-level radioactive waste dump" in March 1959. The MWL accepted low-level radioactive waste and mixed waste from SNL research facilities and off-site generators from March 1959 to December 1988. Approximately 100,000 cubic feet of radioactive waste containing 6,300 curies (Ci) of activity (at the time of disposal) were disposed of at the MWL in unlined trenches and pits.

Investigations at the landfill indicate that tritium is the primary contaminant that has been released from the landfill. Results of a risk assessment prepared by the Permittees indicate that releases of contaminants from the MWL pose little risk to human health or the environment under an industrial land use scenario. Tritium activities at the MWL will decrease steadily with time due to its relatively short half-life of 12.3

years. Because of tritium's short half-life and in consideration of current activity levels, the NMED does not believe that tritium releases at the MWL pose a threat to groundwater, human health, or the environment.

REGULATORY BACKGROUND

NMED issued a RCRA Permit for storage of hazardous waste at SNL on August 6, 1992. On February 6, 2002, the Permittees applied to the NMED to renew their RCRA permit (the old Permit remains in effect until a final decision is made on the renewal request; a draft permit was issued by the NMED on August 20, 2007). On October 11, 2001, the NMED directed the Permittees to conduct a Corrective Measures Study (CMS) for the MWL because of concerns raised by the public. The CMS Work Plan was approved with conditions by the NMED on October 10, 2002. After approval of the CMS Work Plan, the CMS was conducted by the Permittees to identify, develop, and evaluate corrective measures alternatives and to recommend a final remedy to be taken at the MWL. The results of the CMS were documented in a CMS Report following completion of the study; the report was transmitted to the NMED on May 21, 2003. The CMS Report was deemed complete by the NMED on January 5, 2004. On January 23, 2004, the Permittees proposed a Class 3 modification of the SNL RCRA Permit, requesting that the NMED select a final remedy for the MWL. As part of a 60-day public notice and comment period initiated by the Permittees, a public meeting was held on February 26, 2004 in Albuquerque, New Mexico. Following completion of the Permittees public comment period, the NMED issued a public notice and began its public comment period starting August 11, 2004.

A public hearing on the selection of a final remedy for the MWL was held by the NMED on December 2-3 and 8-9, 2004; the NMED public comment period was held from August 11, 2004 to December 2, 2004, and extended until December 9, 2004. Based on the administrative record and the Hearing Officer's Report, on May 26, 2005, the NMED Secretary approved a final permit and ordered a final remedy for SNL's Mixed Waste Landfill, selecting a vegetative soil cover with bio-intrusion barrier as the final remedy.

The Permittees were required under their RCRA Permit to submit to NMED a Corrective Measures Implementation (CMI) Work Plan within 180 days after approval of the final remedy. The CMI Work Plan was submitted on November 3, 2005. The CMI Work Plan was approved by the NMED on December 22, 2008. The Permittees completed implementation of the CMI Work Plan, including construction of the landfill cover, as documented in the CMI Report submitted to the NMED on January 26, 2010. NMED approved the CMI Report on October 14, 2011, indicating that the first 5-year re-evaluation of the remedy would be due 5 years after NMED approval of the LTM Plan

The SNL Permit also requires the Permittees to submit to the NMED for approval a Long-term Monitoring and Maintenance (LTM) Plan, the subject of this public notice. The Permittees submitted the first version of the LTM Plan on September 25, 2007. The first version of the plan was noticed to the public on October 31, 2007, with a time extension granted on December 17, 2007 until January 31, 2008. Although public comments were received, the NMED did not make a final decision on the first version of the LTM Plan chiefly because several of the groundwater monitoring wells at the MWL were scheduled to be replaced. The Permittees withdrew the first version of the LTM Plan on December 7, 2011.

The Permittees have replaced the several wells at the MWL, and subsequently, submitted a revised LTM Plan on March 23, 2012. As indicated above, the revised plan is the subject of this public notice. Anyone who commented on the first version of the LTM Plan will need to resubmit comments for the second version of the plan by following the procedures under the heading *Public Review of the LTM Plan* if they wish for their comments to be considered by the NMED. Anyone who has not previously submitted comments on the first version of the LTM Plan may also submit comments on the revised LTM Plan by following the procedures under the heading *Public Review of the LTM Plan.*

The LTM plan must describe the types and frequencies of monitoring and maintenance that will be conducted at the MWL to ensure protection of human health and the environment. The LTM Plan must also include all necessary physical and institutional controls to be implemented in the future at the MWL, and must include contingency procedures to be implemented if the final remedy selected for the landfill fails to be protective of human health and the environment.

PUBLIC DIALOGUE MEETING

NMED will host a public dialogue to discuss technical issues related to the LTM Plan for Sandia National Laboratories' Mixed Waste Landfill. The public dialogue will be held at the **Cesar Chavez Community Center**, 7505 Kathrvn SE, Albuquerque, New Mexico 87108. The meeting will **start at 5:30 p.m. and conclude at 7:45 p.m.** on **October 16, 2012**. All members of the public are invited to attend this forum.

PUBLIC REVIEW OF THE LTM PLAN

The LTM Plan may be reviewed by any member of the public at the following locations during the public comment period:

NMED - Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone: (505) 476-6000
Monday – Friday: 8:00 a.m. to 5:00 p.m.
Contact: Pam Allen

NMED - Hazardous Waste Bureau
District 1
5500 San Antonio Avenue, NE
Albuquerque, New Mexico 87109
Phone: (505) 222-9551
Mondays - Fridays from 8:00 a.m. to 5:00 p.m.
Contact: William Moats

The LTM Plan is also available electronically on the NMED web site at: www.nmenv.state.nm.us/HWB/snlperm.html under the link: *SNL Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill (3/23/2012)*. To obtain a copy of the Administrative Record or a portion thereof, please contact Ms. Pam Allen at (505) 476-6000, or at address given above. The Department will provide copies, or portions thereof, of the Administrative Record at a cost to the requestor.

The Department issues this public notice on **September 14, 2012**, to announce the beginning of a 60-day comment period that will end at **5:00 p.m. MST, November 13, 2012**. Any person who wishes to comment on the revised LTM Plan should submit written or electronic mail (e-mail) comment(s) with the commenter's name and address to the respective address below. Only comments and/or requests received before **5:00 p.m. MST** on **November 13, 2012** will be considered.

William Moats
Hazardous Waste Bureau - New Mexico Environment Department
5500 San Antonio Avenue, NE
Albuquerque, New Mexico 87109
E-mail: William.Moats@state.nm.us
Ref: Sandia National Laboratories – MWL LTM Plan

To be considered relevant to this matter, written comments must be based on the LTM Plan.
The NMED must ensure that the approved LTM Plan will be consistent with the New Mexico Hazardous Waste Management Regulations. Written comments submitted will become part of the Administrative Record, will be considered in formulating a final decision, and may cause the LTM Plan to be modified. NMED will respond in writing to all significant public comment. The response will specify which provisions, if any, of the LTM Plan have been changed in the final decision, and the reasons for the change. This response will also be posted on the NMED website in addition to NMED notifying all persons providing written comments. After consideration of the written public comments received, NMED will approve, or approve with modifications the LTM Plan. If NMED modifies the plan, the Permittees will be provided by certified mail a copy of the modified plan and a detailed written statement of reasons for the modifications.

The NMED will make the final decision publicly available. The NMED's decision shall constitute a final agency decision. All persons on the mailing list, or that provided written comments, or who requested notification in writing, will be notified of the final decision by mail. The final decision will become effective immediately upon service of the decision to the Permittees, unless a later date is specified.

ARRANGEMENTS FOR PERSONS WITH DISABILITIES
Persons having a disability and requiring assistance or auxiliary aid to participate in this process should contact Connie Joseph at the New Mexico Environment Department, Human Resources Bureau, P.O. Box 26110, 1190 St. Francis Drive, Santa Fe, New Mexico, 87502, telephone number: (505) 827-9769. TDY users please access her number via the New Mexico Relay Network at 1-800-659-8331.

Volume V

TAB 8

Extension of the Public Comment Period on the Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, March 2012

From: NMED/Kieling
To: SNL/Beausoleil

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NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lieutenant Governor

DAVE MARTIN
Secretary

BUTCH TONGATE
Deputy Secretary

JAMES H. DAVIS, Ph.D.
Director
Resource Protection Division

November 19, 2012

SUBJECT: EXTENSION OF THE PUBLIC COMMENT PERIOD ON THE LONG-TERM MONITORING AND MAINTENNCE PLAN FOR THE MIXED WASTE LANDFILL AT SANDIA NATIONAL LABORATORIES

Dear Interested Person:

Attached is a public notice extending the period for submission of public comments on the Long-term Monitoring and Maintenance Plan (LTM Plan) for the Mixed Waste Landfill at the Sandia National Laboratories (SNL). On September 14, 2012, the New Mexico Environment Department (NMED) issued an initial public notice to submit public comment by December 13, 2012. Since issuance of that initial notice, NMED has received requests to extend the public comment period.

The public comment period shall be extended for an additional thirty (30) day period. NMED will now receive public comment through **5:00 p.m. MST, December 13, 2012**.

Any person seeking additional information regarding this notice may contact either:

Mr. William Moats
NMED – Hazardous Waste Bureau
5500 San Antonio NE
Albuquerque, New Mexico 87109
Email: william.moats@state.nm.us
Telephone: (505) 222-9551

Sincerely,

John E. Kieling
Chief
Hazardous Waste Bureau

NEW MEXICO ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lieutenant Governor

DAVE MARTIN
Secretary

BUTCH TONGATE
Deputy Secretary

JAMES H. DAVIS, Ph.D.
Director
Resource Protection Division

PUBLIC NOTICE NO. 12-07

NEW MEXICO ENVIRONMENT DEPARTMENT
HAZARDOUS WASTE BUREAU
SANTA FE, NEW MEXICO
November 19, 2012

EXTENSION OF PUBLIC COMMENT PERIOD
FOR SANDIA NATIONAL LABORATORIES MIXED WASTE LANDFILL
LONG-TERM MONITORING AND MAINTENANCE PLAN
SANDIA NATIONAL LABORATORIES
EPA ID No. NM5890110518

This is a notice extending the period for submission of public comment on the Long-term Monitoring and Maintenance Plan (LTM Plan) for the Mixed Waste Landfill at the Sandia National Laboratories (SNL). On September 14, 2012, the New Mexico Environment Department (NMED) issued an initial public notice to submit public comment by November 13, 2012. Since issuance of that initial notice, NMED has received requests to extend the public comment period.

The public comment period shall be extended for an additional thirty (30) day period. NMED will now receive public comment through **5:00 p.m. MST, December 13, 2012**.

PUBLIC REVIEW OF THE LTM PLAN

The LTM Plan may be reviewed by any member of the public at the following locations during the public comment period with prior appointment:

NMED – Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
(505) 476-6000
Contact: Pam Allen
Monday - Friday from 8:00 a.m. to 5:00 p.m.

NMED-District 1 Albuquerque Office
5500 San Antonio NE
Albuquerque, New Mexico 87109
(505) 222-9500
Contact: William Moats
Monday - Friday from 8:00 a.m. to 5:00 p.m.

The LTM Plan is also available electronically on the NMED web site at: www.nmenv.state.nm.us/HWB/snlperm.html under Mixed Waste Landfill under Long-Term Monitoring and Maintenance Plan (3/23/2012). To obtain a copy of the LTM Plan or a portion thereof, please contact Ms. Pam Allen at (505) 476-6000, or at the address given above. NMED will provide copies, or portions thereof, of the administrative record at a cost to the requestor.

NMED issues this public notice on November 19, 2012, to announce the extension of the comment period that will end at **5:00 p.m. MST, December 13, 2012**. Any person who wishes to comment on the LTM Plan should submit written or electronic mail (e-mail) comment(s) with the commenter's name and address to the respective address below. Only comments received before **5:00 p.m. MST** on **December 13, 2012** will be considered.

William Moats
Hazardous Waste Bureau - New Mexico Environment Department
5500 San Antonio Avenue, NE
Albuquerque, NM 87109
Ref: Sandia National Laboratories – MWL LTM Plan
E-mail: William.Moats@state.nm.us

To be considered relevant to this matter, written comments must be based on the LTM Plan.

The NMED must ensure that the approved LTM Plan will be consistent with the New Mexico Hazardous Waste Act and Hazardous Waste Management Regulations. Written comments submitted will become part of the administrative record, will be considered in formulating a final decision, and may cause the LTM Plan to be modified. NMED will respond in writing to all significant public comment. The response will specify which provisions, if any, of the LTM Plan have been changed in the final decision, and the reasons for the change. This response will also be posted on the NMED website in addition to NMED notifying all persons providing written comments.

After consideration of the written public comments received, NMED will approve, or approve with modifications the LTM Plan. If NMED modifies the plan, the Permittees shall be provided by certified mail a copy of the modified plan and a detailed written statement of reasons for the modifications. The NMED will make the final decision publicly available. The NMED's decision shall constitute a final agency decision. All persons on the mailing list, or that provided written comments, or who requested notification in writing, will be notified of the final decision by mail.

The final decision will become effective immediately upon service of the decision to the Permittees, unless a later date is specified.

ARRANGEMENTS FOR PERSONS WITH DISABILITIES

Persons having a disability and requiring assistance or auxiliary aid to participate in this process should contact Connie Joseph at the New Mexico Environment Department, Human Resources Bureau, P.O. Box 26110, 1190 St. Francis Drive, Santa Fe, New Mexico, 87502, telephone number: (505) 827-9769. TDY users please access her number via the New Mexico Relay Network at 1-800-659-8331.

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TAB 9

Extension of the Public Comment Period on the Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, March 2012

From: NMED/Kieling
To: SNL/Beausoleil

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SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lieutenant Governor

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

DAVE MARTIN
Secretary

BUTCH TONGATE
Deputy Secretary

JAMES H. DAVIS, Ph.D.
Director
Resource Protection Division

December 18, 2012

SUBJECT: EXTENSION OF THE PUBLIC COMMENT PERIOD ON THE LONG-TERM MONITORING AND MAINTENNCE PLAN FOR THE MIXED WASTE LANDFILL AT SANDIA NATIONAL LABORATORIES

Dear Interested Person:

Attached is a public notice extending the period for submission of public comments on the Long-term Monitoring and Maintenance Plan (LTM Plan) for the Mixed Waste Landfill at the Sandia National Laboratories (SNL). On September 14, 2012, the New Mexico Environment Department (NMED) issued an initial public notice to submit public comment by December 13, 2012. Since issuance of that initial notice, NMED has received requests to extend the public comment period.

The public comment period shall be extended for an additional sixty (60) day period. NMED will now receive public comment through **5:00 p.m. MST, February11, 2013**.

Any person seeking additional information regarding this notice may contact either:

Mr. William Moats
NMED – Hazardous Waste Bureau
5500 San Antonio NE
Albuquerque, New Mexico 87109
Email: william.moats@state.nm.us
Telephone: (505) 222-9551

Sincerely,

John E. Kieling
Chief
Hazardous Waste Bureau

SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lieutenant Governor

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

DAVE MARTIN
Secretary

BUTCH TONGATE
Deputy Secretary

JAMES H. DAVIS, Ph.D.
Director
Resource Protection Division

PUBLIC NOTICE NO. 13-02

NEW MEXICO ENVIRONMENT DEPARTMENT
HAZARDOUS WASTE BUREAU
SANTA FE, NEW MEXICO
December 18, 2012

EXTENSION OF PUBLIC COMMENT PERIOD
FOR SANDIA NATIONAL LABORATORIES MIXED WASTE LANDFILL
LONG-TERM MONITORING AND MAINTENANCE PLAN
SANDIA NATIONAL LABORATORIES
EPA ID No. NM5890110518

This is a notice extending the period for submission of public comment on the Long-term Monitoring and Maintenance Plan (LTM Plan) for the Mixed Waste Landfill at the Sandia National Laboratories (SNL). On September 14, 2012, the New Mexico Environment Department (NMED) issued an initial public notice to submit public comment by November 13, 2012. Since issuance of that initial notice, NMED received requests to extend the public comment period. The public comment period was extended for an additional thirty (30) day period that was to end on February 11, 2013. NMED has again received additional requests to extend the comment period. NMED will now receive public comment through **5:00 p.m. MST, February 11, 2013.**

PUBLIC REVIEW OF THE LTM PLAN

The LTM Plan may be reviewed by any member of the public at the following locations during the public comment period with prior appointment:

NMED – Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
(505) 476-6000
Contact: Pam Allen
Monday - Friday from 8:00 a.m. to 5:00 p.m.

NMED-District 1 Albuquerque Office
5500 San Antonio NE
Albuquerque, New Mexico 87109
(505) 222-9500
Contact: William Moats
Monday - Friday from 8:00 a.m. to 5:00 p.m.

The LTM Plan is also available electronically on the NMED web site at: www.nmenv.state.nm.us/HWB/snlperm.html under Mixed Waste Landfill under Long-Term Monitoring and Maintenance Plan (3/23/2012). To obtain a copy of the LTM Plan or a portion thereof, please contact Ms. Pam Allen at (505) 476-6000, or at the address given above. NMED will provide copies, or portions thereof, of the administrative record at a cost to the requestor.

NMED issues this public notice on December 18, 2012, to announce the extension of the comment period that will end at **5:00 p.m. MST, February 11, 2013**. Any person who wishes to comment on the LTM Plan should submit written or electronic mail (e-mail) comment(s) with the commenter's name and address to the respective address below. Only comments received before **5:00 p.m. MST** on **February 11, 2013** will be considered.

William Moats
Hazardous Waste Bureau - New Mexico Environment Department
5500 San Antonio Avenue, NE
Albuquerque, NM 87109
Ref: Sandia National Laboratories – MWL LTM Plan
E-mail: William.Moats@state.nm.us

To be considered relevant to this matter, written comments must be based on the LTM Plan.

The NMED must ensure that the approved LTM Plan will be consistent with the New Mexico Hazardous Waste Act and Hazardous Waste Management Regulations. Written comments submitted will become part of the administrative record, will be considered in formulating a final decision, and may cause the LTM Plan to be modified. NMED will respond in writing to all significant public comment. The response will specify which provisions, if any, of the LTM Plan have been changed in the final decision, and the reasons for the change. This response will also be posted on the NMED website in addition to NMED notifying all persons providing written comments.

After consideration of the written public comments received, NMED will approve, or approve with modifications the LTM Plan. If NMED modifies the plan, the Permittees shall be provided by certified mail a copy of the modified plan and a detailed written statement of reasons for the modifications. The NMED will make the final decision publicly available. The NMED's decision shall constitute a final agency decision. All persons on the mailing list, or that provided written comments, or who requested notification in writing, will be notified of the final decision by mail.

The final decision will become effective immediately upon service of the decision to the Permittees, unless a later date is specified.

ARRANGEMENTS FOR PERSONS WITH DISABILITIES

Persons having a disability and requiring assistance or auxiliary aid to participate in this process should contact Connie Joseph at the New Mexico Environment Department, Human Resources Bureau, P.O. Box 26110, 1190 St. Francis Drive, Santa Fe, New Mexico, 87502, telephone number: (505) 827-9769. TDY users please access her number via the New Mexico Relay Network at 1-800-659-8331.

Volume V

TAB 10

Notice of Approval: Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan, March 2012

From: NMED/Blaine
To: SNL/Beausoleil

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NEW MEXICO
ENVIRONMENT DEPARTMENT

Environmental Health Division

Harold Runnels Building
1190 Saint Francis Drive (87505)
P.O. Box 5469, Santa Fe, NM 87502-5469
Phone (505) 827-0419 Fax (505) 827-0310
www.nmenv.state.nm.us

SUSANA MARTINEZ
Governor
JOHN A. SANCHEZ
Lieutenant Governor

RYAN FLYNN
Cabinet Secretary-Designate
BUTCH TONGATE
Deputy Secretary
TOM BLAINE, P.E.
Division Director

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

January 8, 2014

Geoffrey L. Beausoleil
Manager
U.S. Department of Energy
NNSA / Sandia Site Office
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Stanley A. Orrell
Director
Nuclear Energy & Fuel Cycle Programs
Sandia National Laboratories
P.O. Box 6200, MS-0771
Albuquerque, NM 87185

RE: APPROVAL
MIXED WASTE LANDFILL LONG-TERM MONITORING AND MAINTENANCE PLAN, MARCH 2012
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-12-007

Dear Mr. Beausoleil and Mr. Orrell:

The New Mexico Environment Department (NMED) hereby approves the Sandia National Laboratories Long-Term Monitoring and Maintenance Plan (LTMMP) for the Mixed Waste Landfill, March 2012, submitted to the NMED on March 23, 2012.

NMED held a public meeting on the LTMMP on October 16, 2012; the U. S. Department of Energy and Sandia Corporation assisted the NMED at this meeting by providing information on the plan to the public and answering questions. NMED also conducted a public comment period for the LTMMP from September 14, 2012, to February 11, 2013, for a total of 150 days. Numerous comments from the public were received. A copy of NMED's response to public comment is enclosed with this letter. The LTMMP was not changed as a result of public comment.

The monitoring systems at the MWL that are not yet in place need to be deployed prior to the Permittees requesting a modification to the permit for corrective action complete status.

If you have any questions regarding this matter, please contact John Kieling, Chief, Hazardous Waste Bureau, at (505) 476-6035.

Sincerely,

Tom Blaine, P.E.
Director
Environmental Health Division

Enclosure

cc: J. Kieling, NMED HWB
D. Cobrain, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE OB
L. King, EPA Region 6 (6PD-N)
J. Weckerle, NNSA/SSO, MS 0184
J. Cochran, SNL, MS 0719
File: SNL 2013 and Reading

Volume V

TAB 11

Work Plan for the Installation of 3 Soil-Vapor Monitoring Wells at the Mixed Waste Landfill

From: SNL/Beausoleil
To: NMED/Kieling

Back of Tab 11

SNL MWL

National Nuclear Security Administration
Sandia Field Office
P. O. Box 5400
Albuquerque, NM 87185

ENTERED

RECEIVED
JAN 22 2014
NMED
Hazardous Waste Bureau

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

JAN 15 2014

Mr. John E. Kieling
Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Bldg. 1
Santa Fe, NM 87505

Subject: Department of Energy/National Nuclear Security Administration Sandia National Laboratories Environmental Restoration Operations *Work Plan for the Installation of Three Soil-Vapor Monitoring Wells (MWL-SV03, MWL-SV04, and MWL-SV05) at the Mixed Waste Landfill, January 2014*

Dear Mr. Kieling:

Enclosed is the *Work Plan for the Installation of Three Soil-Vapor Monitoring Wells (MWL-SV03, MWL-SV04, and MWL-SV05) at the Mixed Waste Landfill, January 2014.* This Work Plan describes the procedures and construction specifications for the installation of three multiport soil-vapor monitoring wells at the Mixed Waste Landfill (MWL) as required by the *Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill.* Installation fieldwork will begin after the New Mexico Environment Department approves this Work Plan.

If you have questions, please contact me at (505) 845-5398 or John Weckerle of my staff at (505) 845-6026.

Sincerely,

Geoffrey L. Beausoleil
Manager

Enclosure

cc:
See Page 2

cc w/enclosure :
William Moats, NMED-HWB (**Certified Mail**)
5500 San Antonio Dr., NE
Albuquerque, NM 87109

Laurie King, EPA, Region 6 (**Certified Mail**)
1445 Ross Ave., Ste. 1200
Dallas, TX 75202

Thomas Skibitski, NMED-OB, MS-1396

Zimmerman Library, UNM
MSC05 3020
1 University of New Mexico
Albuquerque, NM 87101-0001

SNL ES&H Records Center, SNL/NM, MS-0718

cc w/o enclosure:
Amy Blumberg, SNL/NM, MS-0141
John Cochran, SNL/NM, MS-0718
Peter Davies SNL/NM, MS-0721
David Miller, SNL/NM, MS-0718
Mike Mitchell, SNL/NM, MS-0719
Joanna Serra, NA-00-10, HQ/FORS
Joe Estrada, SFO/ENG, MS-0184
John Weckerle, SFO/ENG, MS-0184
13-394-506456

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Work Plan for the Installation of Three Soil-Vapor Monitoring Wells (MWL-SV03, MWL-SV04 and MWL-SV05) at the Mixed Waste Landfill, January 2014**

Document author: **John Copland, Department 06234**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 1/13/14
Date

Peter Davies, Director
Nuclear Energy & Fuel Cycle Programs
Center 6200
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ 15 JAN 2014
Date

Geoffrey Beausoleil
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Sandia National Laboratories

Work Plan for the Installation of Three Soil-Vapor Monitoring Wells (MWL-SV03, MWL-SV04, and MWL-SV05) at the Mixed Waste Landfill

January 2014

U.S. DEPARTMENT OF ENERGY

Environmental Restoration Operations
Sandia National Laboratories/New Mexico

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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Acronyms and Abbreviations

AOP	Administrative Operating Procedure
ARCH	Air-Rotary Casing-Hammer
bgs	below ground surface
CSSP	Contract-Specific Safety Plan
DC	Drilling Contractor
DOE	U. S. Department of Energy
ER	Environmental Restoration
ET	Evapotranspirative
FLUTe™	Flexible Liner Underground Technologies
FOP	Field Operating Procedure
ft	feet or foot
HASP	health and safety plan
HWB	Hazardous Waste Bureau
LTMMP	Long Term Monitoring and Maintenance Plan
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
NMOSE	New Mexico Office of the State Engineer
NNSA	National Nuclear Security Administration
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
Sandia	Sandia Corporation
SNL/NM	Sandia National Laboratories/New Mexico
SFO	Sandia Field Office (formerly Sandia Site Office)
SS	stainless steel
SWMU	Solid Waste Management Unit
TA	Technical Area
VOC	volatile organic compound
WMP	Waste Management Plan

1. PROJECT AND SITE INFORMATION

This Work Plan describes the procedures that will be followed to by the U.S. Department of Energy/National Nuclear Security Administration/Sandia Field Office (DOE/NNSA/SFO) and Sandia Corporation (Sandia), hereafter referred to as DOE/Sandia, for the installation of three soil-vapor monitoring wells at the Mixed Waste Landfill (MWL), Sandia National Laboratories/New Mexico (SNL/NM). The MWL is located in Technical Area (TA) III as shown on Figure 1. The MWL is managed as Solid Waste Management Unit (SWMU) 76.

Task Description:	SNL/NM SWMU 76 – installation of three soil-vapor monitoring wells (MWL-SV03, MWL-SV04, and MWL-SV05) at the MWL and the preparation of a Well Installation Report
Scheduled Start Date of Work:	May 2014 – start of field work is contingent upon New Mexico Environment Department (NMED) Approval of this Work Plan
Estimated Completion Date:	September 2014 – submittal of the Well Installation Report to NMED

As noted above, the tentative start date for the field work is May 2014. After installation, the three new soil-vapor monitoring wells will be used for the collection of vadose-zone samples for volatile organic compound (VOC) analyses. Each monitoring well will be constructed of either a Flexible Liner Underground Technologies (FLUTe™) borehole liner or an equivalent multi-port well constructed using a bundle of stainless-steel (SS) tubing. Each monitoring well will have five soil-vapor sampling ports set at depths ranging from 50 to 400 feet (ft) below ground surface (bgs). Soil-vapor sampling will be conducted in accordance with the Sampling and Analysis Plan presented in Appendix D of the *Long Term Monitoring and Maintenance Plan for the Mixed Waste Landfill* (LTMMP) (SNL/NM March 2012).

The selection of the well type (FLUTe™ or equivalent) will be determined by DOE/Sandia after completion of the contracting process with the drilling contractor (DC). Both types of soil-vapor wells have been successfully used at other SWMUs/Areas of Concern (AOCs) at SNL/NM. The FLUTe™ well design has proven to be successful in providing representative soil-vapor samples for the Tijeras Arroyo Groundwater investigation since 2001. The equivalent well design has proven to be successful in providing representative soil-vapor samples for the TA-V investigation since 2004.

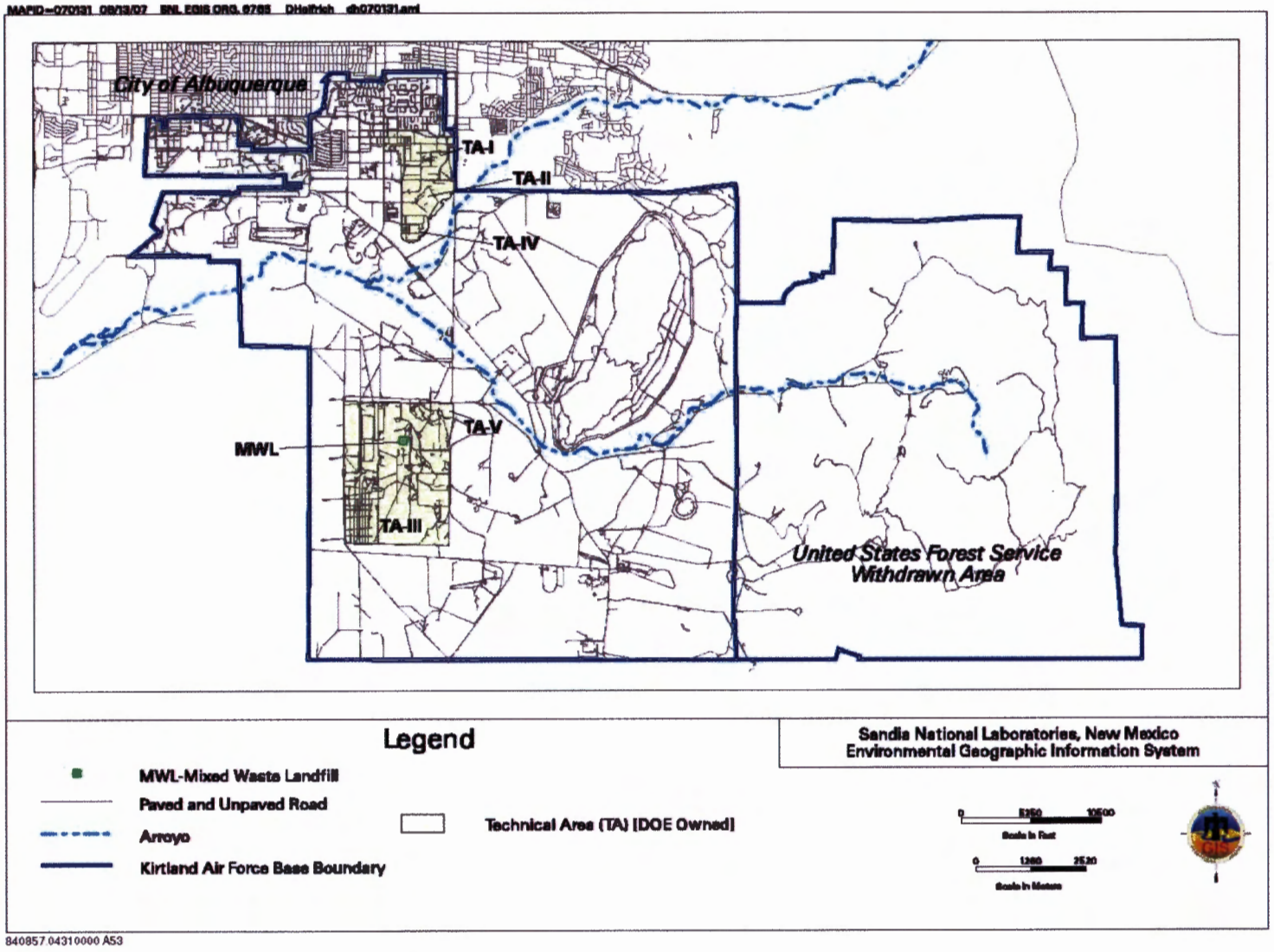

Figure 1. Location of the Mixed Waste Landfill at Sandia National Laboratories/New Mexico and Kirtland Air Force Base

2. REGULATORY CRITERIA

The NMED Hazardous Waste Bureau (HWB) provides regulatory oversight of DOE/Sandia's Environmental Restoration (ER) efforts and implements and enforces regulations mandated by the Resource Conservation and Recovery Act (RCRA). All ER Operations SWMUs and Areas of Concern are listed in Module IV of the SNL/NM RCRA Part B Operating Permit, *Special Conditions Pursuant to the 1984 Hazardous and Solid Waste Amendments (HSWA) to RCRA for Sandia National Laboratories* (NMED 1993). In April 2004, a Compliance Order on Consent (the Order) (NMED April 2004) became effective between the NMED and DOE/Sandia, which specifically identified SWMU 76 (the MWL) as requiring corrective action. The MWL is also subject to corrective action under 20.4.1.500 New Mexico Administrative Code incorporating 40 CFR 264.101. The NMED HWB is the lead regulatory agency and oversees corrective action at the MWL under the provisions of the Order (NMED April 2004) issued pursuant to the New Mexico Hazardous Waste Act and addresses requirements concerning nitrate and perchlorate pursuant to the New Mexico Solid Waste Act.

The NMED Final Order on the MWL (Curry May 2005) and the related Class 3 Permit Modification require an LTMMP to address monitoring, inspection, maintenance, physical and institutional controls, and reporting for the MWL following remedy implementation. This Work Plan describes the proposed installation of three soil-vapor monitoring wells as required by the LTMMP (SNL/NM March 2012). The LTMMP was approved by NMED on January 8, 2014 (Kieling January 2014).

This Work Plan outlines the activities and procedures to install three multiport soil-vapor monitoring wells at the MWL. The following tasks will be completed:

- Submit this Work Plan to the NMED for review and approval.
- Conduct the drilling and well-installation activities in accordance with the NMED-approved Work Plan using a DC licensed by the New Mexico Office of the State Engineer (NMOSE).
- Submit a Well Installation Report to the NMED that describes the field activities for the three monitoring wells.
- Collect soil-vapor samples from the three monitoring wells in accordance with the NMED-approved LTMMP Sampling and Analysis Plan.

Because the soil-vapor monitoring wells will not reach groundwater, a well permit from the NMOSE is not required (NMOSE August 2005). The applicable SNL/NM Field Operating Procedures (FOPs) and Administrative Operating Procedures (AOPs) will be used. The requirements of this Work Plan and the LTMMP will take precedence over any FOPs and AOPs.

3. PRE-FIELD ACTIVITIES

The pre-field activities that will be completed prior to drilling operations include the preparation, review, and approval of:

- The contract (Statement of Work),
- SNL/NM excavation (dig) permit,
- SNL/NM site-specific Health and Safety Plan (HASP),
- DC's Contract-Specific Safety Plan (CSSP),
- SNL/NM National Environmental Policy Act Checklist,
- SNL/NM Waste Management Plan (WMP),
- SNL/NM Field Work Checklist (punchlist), and
- SNL/NM Readiness Review.

4. HEALTH AND SAFETY

The field personnel will perform field activities safely in accordance with the HASP and CSSP. Level D personal protective equipment is anticipated for all drilling and well installation operations. Training records associated with the drilling personnel will be maintained on site and will be available at the commencement of drilling activities. The field personnel will operate under both the HASP and CSSP and will have SNL/NM-required training, including 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response training and a current 8-hour annual-refresher course.

An SNL/NM Subject Matter Expert will perform a safety inspection of the drill rig and associated equipment before drilling commences. If any of the items are found to be in poor repair, significantly different than bid by the DC, or inadequate, the SNL/NM representative may delay commencement of drilling until the DC provides the equipment/services required. Daily equipment inspections for the drill rig and support equipment shall be documented by the DC and the records maintained on site. Noticeable drips of hydraulic oil, fuel, or other fluids will be contained by plastic sheeting placed under the rig at each drilling location. The leaks will either be repaired immediately at the site, the rig will be removed from the site for required repairs, or the DC will provide a substitute rig.

Prior to the start of drilling operations, SNL/NM Facilities Engineering will complete an Excavation (dig) Permit for the vicinity of the three proposed wells. SNL/NM personnel will mark on the ground surface the buried utilities that may be present at each of the drilling locations. The DC will physically verify that buried utilities are not present by "potholing" with a hand shovel to a depth of 3 ft bgs at each drilling location. If needed, the DC can adjust each drilling location by a maximum of 10 ft laterally to ensure safe drilling operations relative to buried utilities and/or other features (i.e., adjacent monitoring wells or fence) that limit adequate working space. However, buried utilities or overhead power lines are not anticipated to be a concern at the MWL.

5. EQUIPMENT DECONTAMINATION

The drill rig and associated equipment will be decontaminated with a pressure washer or steam cleaner prior to use at each drilling location. The decontamination work will be conducted at either the SNL/NM decontamination pad in TA-III or at Building 9925 - Environmental Resources Field Operations. Decontamination waste (water and soil) will be contained in polyethylene drums and placed on spill control pallets. The waste will be managed in accordance with the site-specific WMP. The drill rig and associated equipment will be decontaminated after the last well is installed and prior to leaving SNL/NM property.

6. DRILLING AND WELL INSTALLATION

The proposed locations of the three multiport soil-vapor monitoring wells (MWL-SV03, MWL-SV04, and MWL-SV05) are shown on Figure 2, and on Figure 3.4.1-1 of the LTMMP (SNL/NM March 2012). The FLUTe™ or equivalent wells will be installed in vertical boreholes located immediately outside the perimeter of the Evapotranspirative (ET) Cover near locations where the highest concentrations of VOCs have been detected during soil-vapor studies at the MWL. Figure 2 also shows the existing locations of the two single-port soil-vapor monitoring wells (MWL-SV01 and MWL-SV02) previously installed in 2009. Soil-vapor sampling ports will be installed in each multiport soil-vapor monitoring well at depths of approximately 50, 100, 200, 300, and 400 ft bgs. None of the boreholes will reach groundwater, which is approximately 500 ft bgs at the MWL.

The boreholes will be drilled using the Air-Rotary Casing-Hammer (ARCH) method. Temporary steel drive casing will be run to total depth in order to prevent borehole sloughing. The unconsolidated lithologies are anticipated to consist of clay, silt, sand, gravel, and cobbles. Environmentally-friendly lubricants such as Matex Thread Compound ES (a vegetable oil based material) will be used for lubricating the drive-casing joints. Minimal amounts of water (but no other foams/liquids) in the form of "mist" may be introduced into the borehole or drive casing to aid in the lifting of cuttings to the ground surface. The potable water will be obtained from fire hydrants or drop pipes that are connected to the Kirtland Air Force Base water distribution system.

The soil-vapor monitoring wells will be constructed of either a FLUTe™ liner (Section 6.1) or equivalent well materials (Section 6.2). The wells will be installed through the temporary steel drive casing (nominal 6-inch or 10-inch diameter depending on installation method used), and completed using either the FLUTe™ liner (6-inch diameter) or the equivalent bundle of SS tubing (10-inch diameter). No solvents, cleaners, or lubricants will be used for construction of the monitoring wells. To preserve the integrity of the well materials and ensure accurate completion depths, the FLUTe™ liner or the SS bundle will be suspended in the drive casing/borehole as the sand packs, bentonite-pellet seal, and annular seal are installed.

6.1 FLUTe™ Well Design

The FLUTe™ liners will be assembled at the factory prior to shipment to SNL/NM. The liners will be constructed of approximately 6-inch diameter, 400-ft long nylon tubes. Sampling ports will be set at the prescribed depths and attached to 0.25-inch diameter polyethylene tubing. Each sampling interval will span a minimum depth interval of 5 ft. A FLUTe™ technician will assist the DC personnel in the installation of the FLUTe™ liners at each of the drilling locations. At each location, the FLUTe™ liner will be set to the total depth of the borehole. Clean silica sand will be gravity fed into the liner so that the liner and sampling ports are firmly pressed against the borehole wall. The drive casing will be progressively pulled from the borehole as sand is added. The upper end of the FLUTe™ liner will be attached to a 5-ft length of 6-inch diameter Schedule 40 polyvinyl chloride (PVC) blank casing and sealed with a PVC cap. The polyethylene tubing will be terminated with quick-connect couplings. Each piece of tubing will be clearly and permanently labeled to indicate the depth of the respective sampling port. The well head completion design is discussed below in Section 6.4.

6.2 Equivalent Well Design

The equivalent well design will incorporate five SS soil-vapor screens that are connected to individual lengths of 0.25-inch diameter SS tubing. For each well, the tubing will be attached to a SS cable that has a tensioning weight on the lower end. The screens, tubing, and weight will be attached to the cable using SS hose clamps. Each screen will be connected to its individual piece of tubing using a Swagelok® fitting.

Ten linear ft of sand pack will be placed adjacent to each of the soil-vapor screens. To limit the potential for bentonite chips to obstruct the screens, 6 ft of sand will be placed above the mid-point of the screen, and 4 ft of sand will be placed below the mid-point of the screen. Each soil-vapor screen will be 1-ft long and constructed of SS woven mesh. The sand packs will be separated by bentonite chips that are installed in 10-ft lifts and individually hydrated.

To aid in the proper depth placement of materials, the tubing bundle will be installed in temporary 4-inch diameter PVC casing that will be centered inside the drive casing. The PVC casing will allow for accurate depth measurements with a tag line. Clean silica sand and bentonite chips will be gravity fed into the annulus between the PVC casing and the drive casing. Water for hydrating the bentonite chips will be poured into the PVC casing. As the backfilling progresses, successive sections of PVC casing and drive casing will be pulled from the borehole.

The upper end of each segment of SS tubing will be terminated with a quick-connect coupling. Each segment will be clearly and permanently labeled to indicate the depth of the respective sampling port. The well head completion design is discussed below in Section 6.4.

6.3 Acceptance Criteria

SNL/NM personnel will use the following acceptance criteria to ensure that each soil-vapor monitoring well is installed in compliance with the NMED-approved LTMMP:

- The DC's drill rig and associated equipment (drive casing, rods, bits, etc.) must be adequately decontaminated based upon visual inspections.
- Well materials must be in "new" condition with no observable contamination (spills, stains, paint, dirt, etc.) and arrive at the drill site in unopened, factory sealed plastic bags or similar containers.
- After well installation, each sampling port must be located within plus or minus 10 vertical ft of the planned depth.
- Each sampling port must be functional for sample collection. This will be verified using a vacuum pump after well installation. If any port fails the test, NMED will be notified and the sampling port will be replaced if required.
- Well head completions must meet industry standards for strength and appearance.
- The ground surface must be smoothed and the drilling equipment removed following well installation at all three locations and at any temporary storage/lay down areas.

6.4 Well Head Design

Each well will be completed with a monument (stovepipe) and a concrete pad. The stovepipe will be constructed of a 6-ft length of 10-inch diameter, steel casing. The stovepipe will extend approximately 30 inches above the concrete pad. A locking lid will be attached to the stovepipe. The pad will be 3-ft by 3ft square and 10-inches thick. The concrete forms will be constructed of 2x12-inch lumber. Each pad will contain steel rebar (#4, 0.5-inch diameter) set on plastic supports in a square pattern around the stovepipe. The top of the each concrete pad will be set approximately 2 inches above grade and sloped to direct precipitation away from the well. A brass identification marker will be set in the concrete before it fully cures. Three, 4-inch diameter concrete-filled, steel guard posts (bollards) will be placed around the pad, equidistant from the stovepipe. A padlock will secure the stovepipe lid. The stovepipe and bollards will be painted high-visibility yellow.

7. WASTE MANAGEMENT

A site-specific WMP will be prepared for this well installation task. Waste generation will be kept to a minimum. Borehole cuttings will be contained within an area adjacent to the well. Management and final disposition of cuttings will be in accordance with the site-specific WMP. The waste will be managed in accordance with federal, state, and local regulations. The cuttings will be managed as non-regulated waste, unless sample analytical results or process knowledge indicates that the waste needs to be managed as hazardous and/or radioactive waste. Analytical data from previous drilling activities will be used as applicable.

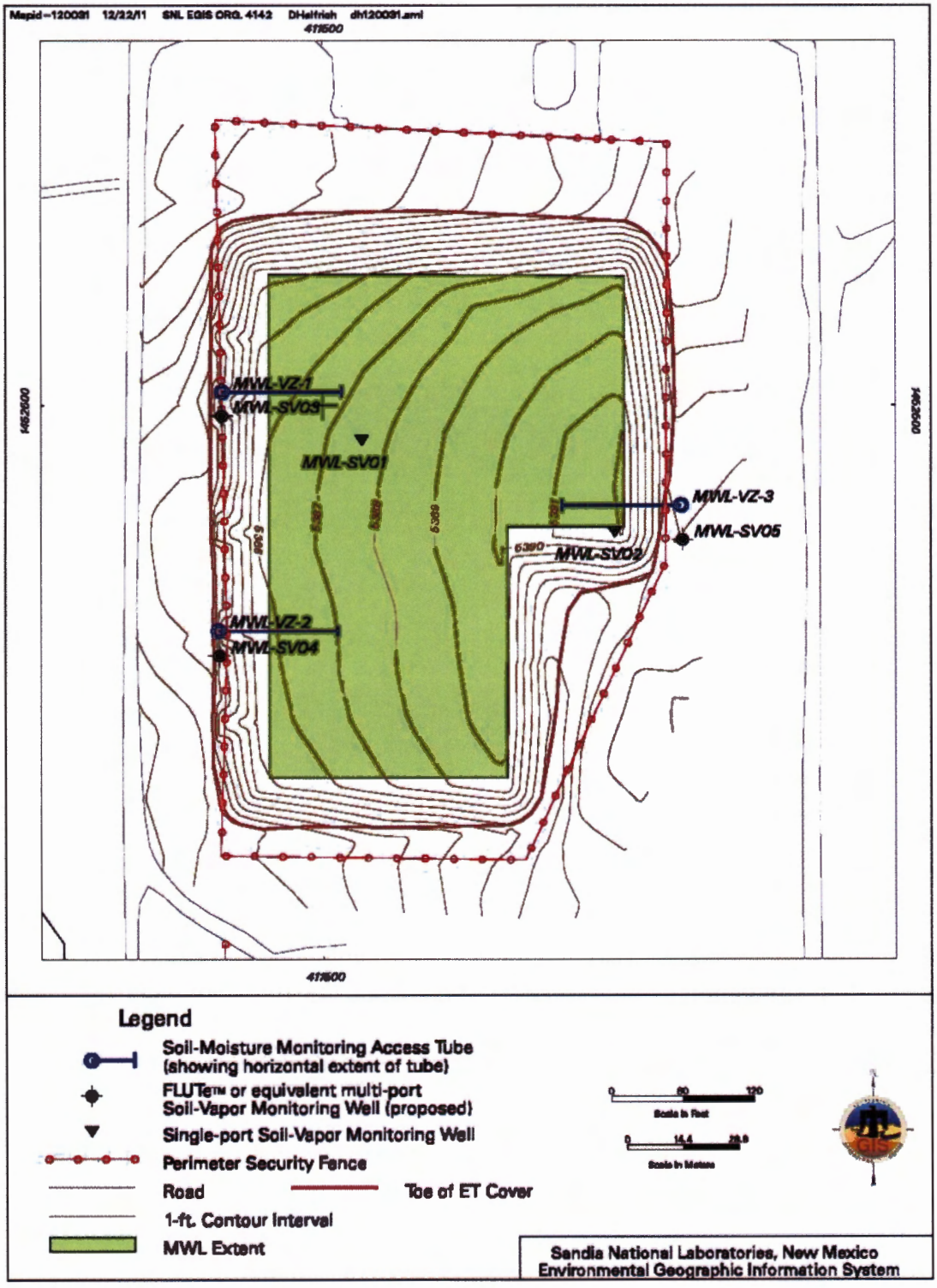

Figure 2. Proposed Soil-Vapor Monitoring Wells at the Mixed Waste Landfill

8. RECORDS MANAGEMENT

Records associated with the drilling and well installation activities will be submitted to and maintained by the SNL/NM Customer Funded Records Center. The following list of documents will be prepared as part of the drilling and well installation activities:

- Well-file contents checklist,
- Statement of Work,
- Lithologic (borehole) logs,
- Well construction data summary sheets,
- Well construction diagrams,
- Copy of geologist's field logbook,
- DC daily reports,
- Survey coordinates/elevations from a State of New Mexico licensed surveyor,
- Location map,
- Waste management documentation, and
- Photographs.

9. REPORTING

A Well Installation Report will be prepared following the well installations and will document the field activities. The Well Installation Report will contain a narrative describing the work performed and any variances to this Work Plan. The report will also include the relevant portions of 37 informational elements as required in Section VIII.D of the Order (NMED April 2004).

10. SCHEDULE

Initiation of field work is dependent upon NMED's approval of this Work Plan. However, pre-field activities will commence prior to NMED approval to expedite the installation schedule, but will not be completed until NMED approval is received. The monitoring wells will be installed as soon as possible after NMED's approval of the Work Plan. Per the requirements of the Order, DOE/Sandia will notify the NMED in writing, by e-mail, or by fax a minimum of 15 days prior to commencing field work. Soil-vapor sampling will commence after successful well installation and vadose-zone equilibration. The Well Installation Report will be submitted within three months after completion of the wells.

11. REFERENCES

Curry, R., May 2005. "Final Order, State of New Mexico Before the Secretary of the Environment in the Matter of Request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill, Sandia National Laboratories, Bernalillo County, New Mexico," EPA ID# 5890110518." May 26, 2005.

Kieling January 2014. Letter to G. Beausoleil (U.S. Department of Energy) and S. Orrell (Sandia Corporation), "Approval: Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan, March 2012, Sandia National Laboratories, EPA ID# NM5890110518, HWB-SNL-12-007." January 8, 2014.

New Mexico Environment Department (NMED), 1993. *Module IV: Hazardous and Solid Waste Amendment (HSWA) Portion for Solid Waste Management Units (Module IV to the RCRA Part B Permit, NM5890110518),* New Mexico Environment Department, Santa Fe, New Mexico. 1993.

New Mexico Environment Department (NMED), April 2004. "Compliance Order on Consent Pursuant to the New Mexico Hazardous Waste Act 74-4-10: Sandia National Laboratories Consent Order," New Mexico Environment Department, Santa Fe, New Mexico. April 24, 2004.

New Mexico Office of the State Engineer (NMOSE), August 2005. "Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells," New Mexico Office of the State Engineer, Santa Fe, New Mexico. August 31, 2005.

Sandia National Laboratories, New Mexico (SNL/NM), March 2012. *Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill*, Environmental Restoration Operations, Sandia National Laboratories, Albuquerque, New Mexico.

Volume V

TAB 12

Notice of Approval: Work Plan for the Installation of 3 Soil-Vapor Monitoring Wells at the Mixed Waste Landfill

From: NMED/Blaine
To: SNL/Beausoleil

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NEW MEXICO
ENVIRONMENT DEPARTMENT

Environmental Health Division

Harold Runnels Building
1190 Saint Francis Drive (87505)
P.O. Box 5469, Santa Fe, NM 87502-5469
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SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lieutenant Governor

RYAN FLYNN
Cabinet Secretary-Designate

BUTCH TONGATE
Deputy Secretary

TOM BLAINE, P.E.
Director
Environmental Health Division

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

February 14, 2014

Geoffrey L. Beausoleil
Manager
U.S. Department of Energy
NNSA / Sandia Site Office
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Stanley A. Orrell
Director
Nuclear Energy & Fuel Cycle Programs
Sandia National Laboratories
P.O. Box 6200, MS-0771
Albuquerque, NM 87185

RE: APPROVAL
WORK PLAN FOR THE INSTALLATION OF THREE SOIL-VAPOR MONITORING WELLS (MWL-SV03, MWL-SV04, AND MWL-SV05) AT THE MIXED WASTE LANDFILL, JANUARY 2014
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-14-001

Dear Mr. Beausoleil and Mr. Orrell:

The New Mexico Environment Department (NMED) has received the U. S. Department of Energy (DOE) and Sandia Corporation (collectively, the Permittees) document entitled *Work Plan for the Installation of Three Soil-Vapor Monitoring Wells (MWL-SV03, MWL-SV04, and MWL-SV05) at the Mixed Waste Landfill* (Work Plan) dated January 2014, and submitted to the NMED on January 15, 2014. The NMED hereby approves the Work Plan.

If you have any questions regarding this matter, please contact Mr. William Moats of my staff at (505) 222-9551.

Sincerely,

Tom Blaine, PE
Director
Environmental Health Division

cc: J. Kieling, NMED HWB
D. Cobrain, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE OB
L. King, EPA Region 6 (6PD-N)
J. Weckerle, NNSA/SSO, MS 0184
J. Cochran, SNL, MS 0719

File: SNL 2014 MWL and Reading

Volume V

TAB 13

Mixed Waste Landfill Annual Long-Term Monitoring and Maintenance Report, January - March 2014, June 2014

From: SNL/Todd
To: NMED/Cobrain

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SNL MWL

Department of Energy
National Nuclear Security Administration
Sandia Field Office
P. O. Box 5400
Albuquerque, NM 87185

JUN 18 2014

ENTERED

RECEIVED

JUN 24 2014

NMED
Hazardous Waste Bureau

Mr. Dave Cobrain
Manager
Permits Management Program
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Dr. East, Bldg 1
Santa Fe, NM 87505

Subject: Submittal of Mixed Waste Landfill Annual Long-Term Monitoring and Maintenance Report, January – March 2014, Environmental Protection Agency Identification Number NM5890110518

Dear Mr. Cobrain:

The Department of Energy/National Nuclear Security Administration and Sandia Corporation (Sandia) are submitting the *Mixed Waste Landfill Annual Long-Term Monitoring and Maintenance Report, January – March 2014*, dated June 2014, to the New Mexico Environment Department (NMED). This submittal is required by Section 4.8.1 of the Mixed Waste Landfill (MWL) Long-Term Monitoring and Maintenance Plan (LTMMP) that was approved by the NMED on January 8, 2014.

This document is comprised of a main report and one annex that provide information for LTMMP activities conducted at the MWL during the first partial annual reporting period of January 8 through March 31, 2014. All required monitoring, inspection, maintenance, and repair activities are being implemented in accordance with the MWL LTMMP. Supplemental information is included in this report regarding the ongoing implementation effort. The report and supporting documentation satisfy requirements listed in Section 4.8.1 of the MWL LTMMP.

If you have questions, please contact John Weckerle of my staff at (505) 845-6026.

Sincerely,

James W. Todd
Assistant Manager

Enclosure

See Page 2

cc w/out enclosure:
Mr. John E. Kieling
Chief
Permits Management Program
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Dr. East, Bldg 1
Santa Fe, NM 87505

cc w/enclosure:
William Moats
Hazardous Waste Bureau
New Mexico Environment Department
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Thomas Skibitski, NMED/OB
Thomas.skibitski@state.nm.us

John Weckerle, SFO/ENG, MS-0184

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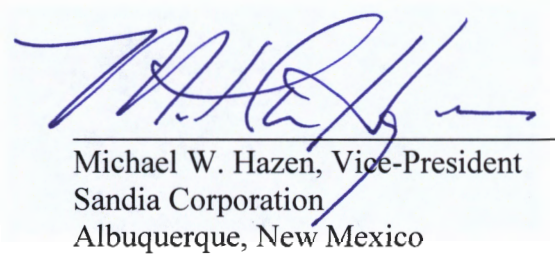
Amy Blumberg, SNL/NM, MS-0141
SNL Customer Funded Record Center, MS-0651
SFO Legal File
SFO Waste Management File
14-504-580931

Submittal of Mixed Waste Landfill Annual Long-Term Monitoring and Maintenance Report, January--March 2014

Sandia National Laboratories
Albuquerque, New Mexico
EPA ID No. NM5890110518

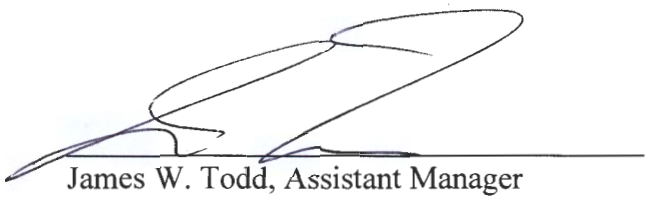
CERTIFICATION STATEMENT

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.



Michael W. Hazen, Vice-President
Sandia Corporation
Albuquerque, New Mexico
Operator

11 June 2014
Date signed



James W. Todd, Assistant Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Field Office
Owner

18 June 2014
Date signed

MIXED WASTE LANDFILL
ANNUAL LONG-TERM MONITORING & MAINTENANCE REPORT
JANUARY – MARCH 2014

SANDIA NATIONAL LABORATORIES, NEW MEXICO
LONG-TERM STEWARDSHIP
MIXED WASTE LANDFILL LONG-TERM MONITORING & MAINTENANCE PLAN

JUNE 2014

United States Department of Energy
Sandia Field Office

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

MIXED WASTE LANDFILL
ANNUAL LONG-TERM MONITORING AND MAINTENANCE REPORT
JUNE 2014

Facility: Mixed Waste Landfill

Location: Sandia National Laboratories
Albuquerque, New Mexico

EPA ID No.: NM5890110518

Permit Basis: Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan, submitted March 2012, effective January 8, 2014.

Owner: United States Department of Energy
Sandia Field Office
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Operator: Sandia Corporation
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Annex

A Mixed Waste Landfill, SWMU 76, Inspection Forms/Checklists

ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
CFR	Code of Federal Regulations
CMI	Corrective Measures Implementation
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ET	evapotranspirative
ft	foot (feet)
KAFB	Kirtland Air Force Base
LTMM	Long-Term Monitoring and Maintenance
LTMMP	Long-Term Monitoring and Maintenance Plan
MWL	Mixed Waste Landfill
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
RCRA	Resource Conservation and Recovery Act
SAP	sampling and analysis plan
Sandia	Sandia Corporation
SNL	Sandia National Laboratories
SNL/NM	Sandia National Laboratories, New Mexico
SWMU	Solid Waste Management Unit
TA	Technical Area
VOC	volatile organic compound

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1.0 INTRODUCTION

Sandia National Laboratories (SNL) is a multi-purpose engineering and science laboratory owned by the U.S. Department of Energy (DOE)/National Nuclear Security Administration. SNL is managed and operated by Sandia Corporation (Sandia), a wholly-owned subsidiary of Lockheed Martin Corporation. SNL/New Mexico (SNL/NM) is located within the boundaries of Kirtland Air Force Base (KAFB), immediately southeast of the City of Albuquerque in Bernalillo County, New Mexico (Figure 1-1). The Mixed Waste Landfill (MWL) is a Solid Waste Management Unit (SWMU) at SNL/NM and is located 4 miles south of SNL/NM's central facilities and 5 miles southeast of the Albuquerque International Sunport. The MWL is located in the north-central portion of Technical Area (TA)-III at SNL/NM (Figure 1-2).

The MWL (SWMU 76) is undergoing corrective action in accordance with the following regulatory criteria:

- New Mexico Administrative Code (NMAC), Title 20, Chapter 4, Part 1, Section 600 (20.4.1.600 NMAC) incorporating Title 40 of the Code of Federal Regulations (CFR), Part 264 (40 CFR 264.101)

- Module IV of Resource Conservation and Recovery Act (RCRA) Permit No. NM5890110518 (U.S. Environmental Protection Agency [EPA] August 1993), as revised and updated

  New Mexico Secretary of the Environment's Final Order in the matter of request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill No. HWB 04-11(M) (Final Order) (Curry May 2005)

  - Granting approval of New Mexico Environment Department (NMED) Class 3 Permit Modification for the MWL (NMED August 2005)

- Compliance Order on Consent (Consent Order) (NMED April 2004)

The MWL disposal area comprises 2.6 acres. During operations, the MWL accepted containerized and uncontainerized low-level radioactive waste and minor amounts of mixed waste from SNL/NM research facilities and off-site DOE and U.S. Department of Defense generators from March 1959 to December 1988. More specific information regarding the MWL inventory and past disposal practices is presented in the MWL Phase 2 RCRA Facility Investigation Report (Peace et al. September 2002) and in the MWL LTMMP (SNL/NM March 2012).

On May 26, 2005, NMED issued the Final Order (Curry May 2005) selecting a vegetative soil cover with biointrusion barrier as the final remedy for the MWL, hereinafter referred to as the MWL evapotranspirative (ET) Cover. The NMED Final Order, granting approval for the August 2005 Class 3 Permit Modification to Module IV of the RCRA Permit, requires a Long-Term Monitoring and Maintenance Plan (LTMMP). The LTMMP is to address monitoring, inspection, maintenance/repair, physical and institutional controls, and reporting at the MWL following remedy implementation. Deployment of the MWL ET Cover was completed in September 2009.

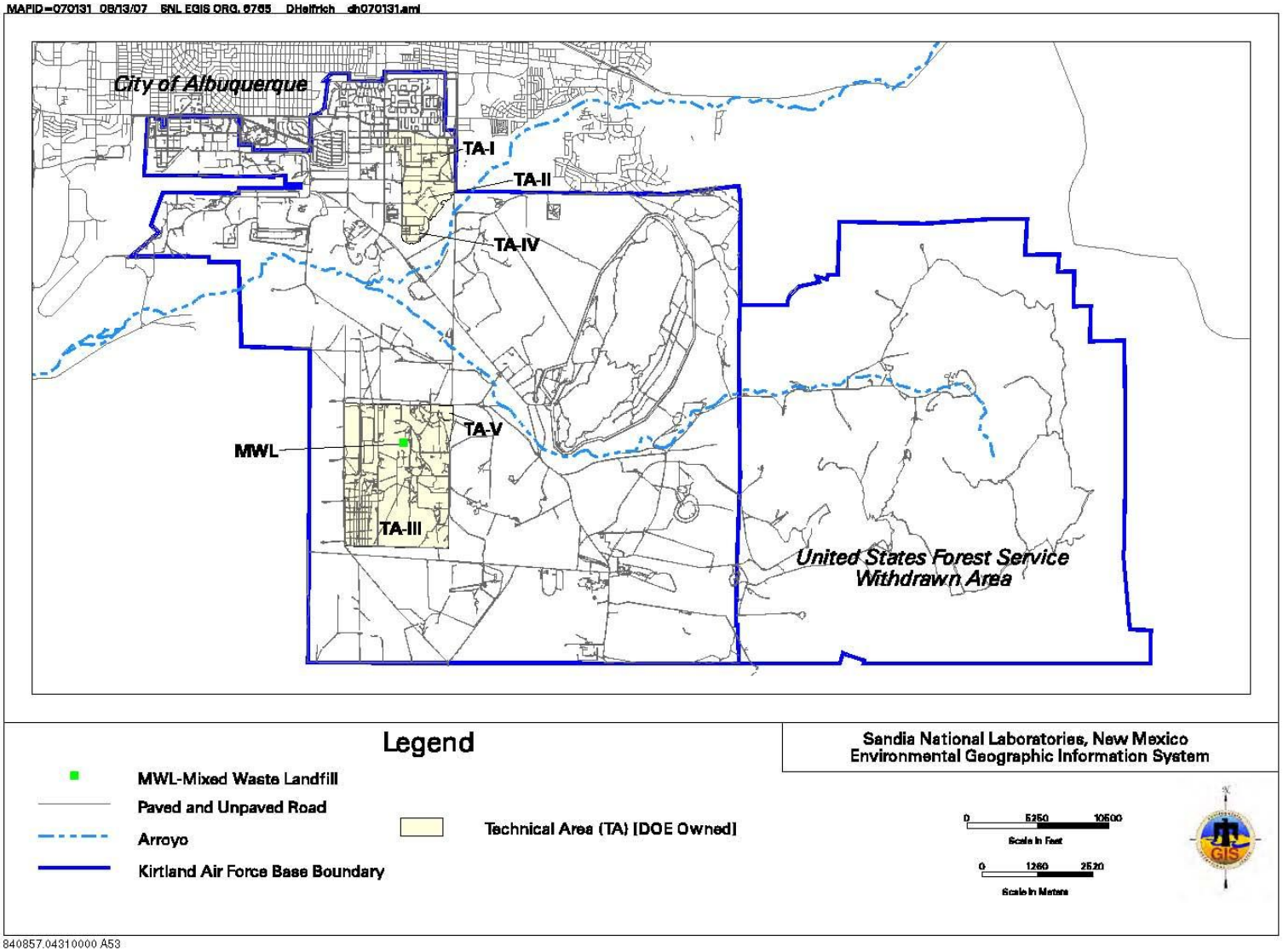

Figure 1-1
Location of the Mixed Waste Landfill with respect to Kirtland Air Force Base and the City of Albuquerque

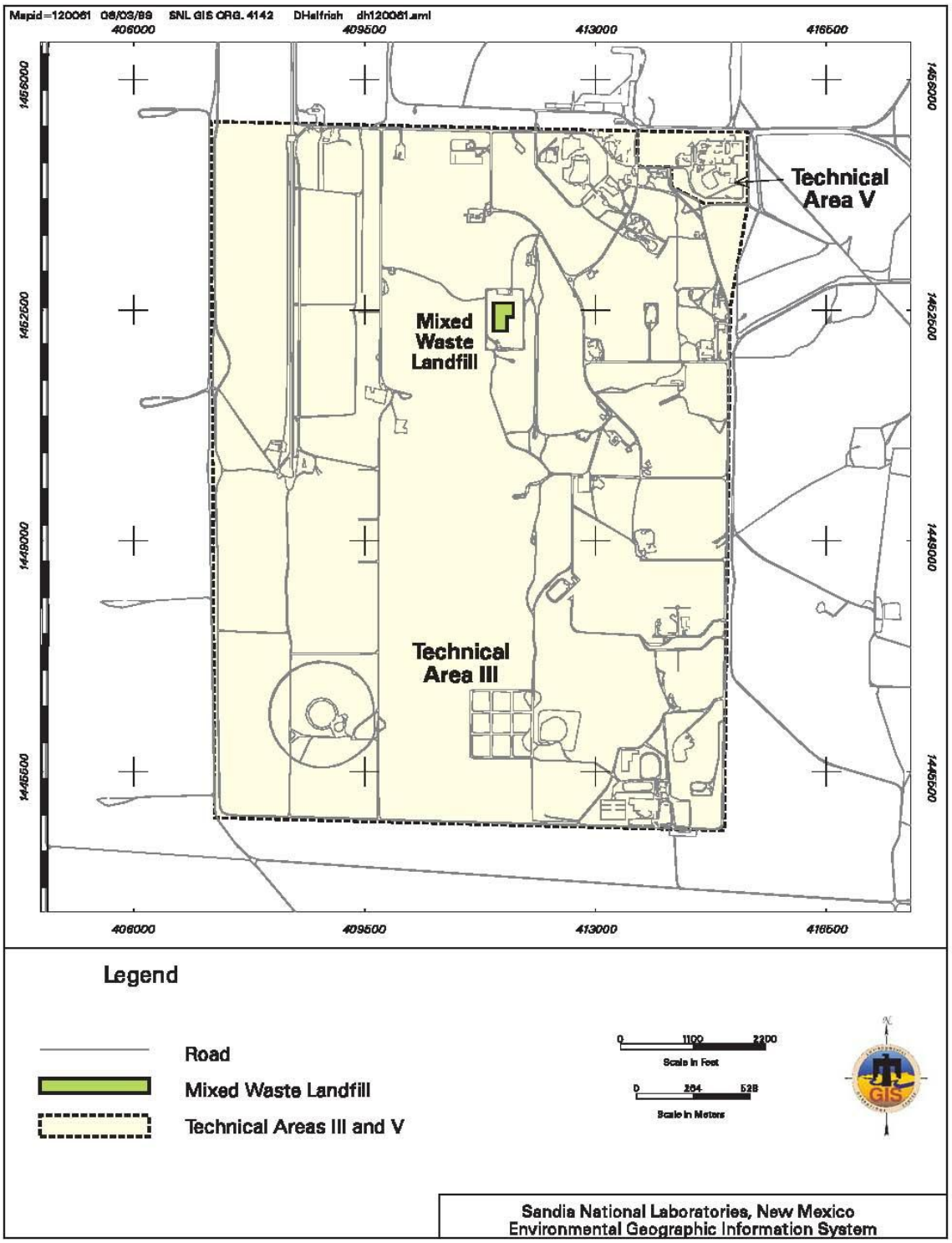

Figure 1-2
Location of the Mixed Waste Landfill within Technical Area III

The MWL Corrective Measures Implementation (CMI) Report (SNL/NM January 2010, Revision 1) documenting ET Cover construction in accordance with the MWL CMI Plan (SNL/NM November 2005) was approved by NMED on October 14, 2011 (Bearzi October 2011). The MWL LTMMP (SNL/NM March 2012) was submitted within 180 days of NMED approval of the CMI Report as stipulated in the NMED approval letter and as required by the Final Order (Curry May 2005). NMED approved the MWL LTMMP on January 8, 2014 (Blaine January 2014) after a public meeting held on October 16, 2012 and a 150-day public comment period. The NMED approval of the LTMMP included responses to public comments received during the 150-day public comment period (Blaine January 2014).

1.1 Purpose and Scope

The purpose of this MWL Annual Long-Term Monitoring and Maintenance (LTMM) Report is to document monitoring, inspection, maintenance, and repair activities conducted during the initial reporting period, as well as the physical and institutional controls. For the MWL, the annual LTMM reporting period is from April 1 through March 31 of the next year, with the annual report due to NMED by June 30. Because the LTMMP became effective on January 8, 2014, this first annual report documents LTMM activities conducted from January 8 through March 31, 2014 and fulfills the MWL LTMMP requirement for annual reporting to the NMED.

The scope of this report includes documentation of all monitoring and inspection activities required for the reporting period January 8 through March 31, 2014. No monitoring activities were required during this time period. Two quarterly inspections were required and performed as summarized below.

- One quarterly Biology Inspection (i.e., ET Cover vegetation and signs of animal activity).
- One quarterly ET Cover Surface and Physical Controls Inspection (i.e., ET Cover surface, storm-water diversion structures, perimeter fence, locks, gates, signs, and survey monuments).

In addition, this first MWL Annual LTMM Report also includes information regarding the full implementation of all LTMMP requirements that will be documented in the June 2015 Annual LTMM Report.

1.2 Report Organization

This report is organized as follows:

- Chapter 1 presents background information, purpose and scope, and report organization.
- Chapter 2 provides a summary of LTMMP monitoring and inspection requirements.

- Chapter 3 presents the results of the two quarterly inspections performed during the reporting period.
- Chapter 4 presents a summary of MWL LTMMP implementation and regulatory submittals.
- Chapter 5 presents a general summary and conclusions for the January 8 through March 31, 2014 reporting period.
- Chapter 6 lists the references cited in this report.

An annex is provided that includes supporting information as follows:

- Annex A – Inspection Forms/Checklists

Future MWL Annual LTMM Reports will contain documentation of monitoring, inspection, maintenance/repair activities for a complete reporting year (April 1 through March 31).

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2.0 MONITORING AND INSPECTION REQUIREMENTS

Monitoring, inspection, maintenance, and repair requirements are defined in Chapters 3 and 4 of the MWL LTMMP and are briefly summarized in this chapter. Monitoring requirements are described in Section 2.1. Monitoring activities generate empirical data that are evaluated to assess site conditions. Inspection requirements are described in Section 2.2 and include requirements to perform maintenance and/or repairs. As a whole, these activities ensure the physical controls at the MWL (SWMU 76) are maintained and perform as designed.

2.1 Monitoring Requirements

The primary objective of the monitoring activities at the MWL is to ensure that the ET Cover and site conditions are protective of human health and the environment. Monitoring activities include sampling and analysis of air, surface soil, vadose zone (volatile organic compounds in soil vapor and soil moisture content), groundwater, and biota (surface soil and vegetation). The multi-media monitoring program is summarized in Table 2-1 that details information for each monitoring activity, including the sampling media, monitoring parameters, frequency, number of samples, locations, and monitoring methods. Sampling and analysis plans (SAPs) for each monitoring activity are included in the MWL LTMMP, Appendices C through G.

2.2 Inspection, Maintenance, and Repair Requirements

The primary objective of inspection, maintenance, and repair activities at the MWL is to ensure that the ET Cover, other physical controls at the site (i.e., surface-water diversion features, perimeter security fence, and survey monuments), and the monitoring systems (groundwater and vadose zone networks) perform as designed. Inspection, maintenance, and repair activities are organized, performed, and documented as shown below.

Inspection Description	Inspection Performed By	Inspection Form
Biology Inspection (i.e., ET Cover vegetation and signs of animal activity)	Staff Biologist	*Biology Inspection Checklist/Form*
ET Cover Surface and Physical Controls (i.e., ET Cover surface, storm-water diversion structures, perimeter fence, locks, gates, signs, and survey monuments)	Field Technician	*Cover Inspection Checklist/Form*
Groundwater, Soil-Vapor, and Soil-Moisture Monitoring Networks and Sampling Equipment	Field Technician (Member of Sampling Team)	*Monitoring Network-Specific Inspection Forms* (3 separate forms)

Table 2-1
Summary of Long-Term Monitoring Parameters, Frequencies, and Methods
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Sampling Media	Monitoring Parameters[a]/ Constituents of Concern	Monitoring Frequency[a]	Number of Samples Per Event	Locations	Monitoring Method[b]	Comments
Air	Radon	Year 1 – Quarterly Year 2 – Quarterly Year 3 – Semiannual Year 4 – Semiannual Year 5 and subsequent years – Annual	17	10 detectors placed at corners and midpoints of perimeter fence 5 detectors placed on completed cover 2 detectors at background locations	Track-etch detectors (at breathing level); sampling and analysis per Appendix C	Samples are time-weighted average and will be collected over a 3-month period. The first quarterly monitoring period began in January 2014.
Surface Soil	Tritium	Annual	4	One sample collected from each corner of the MWL ET Cover.	Grab samples of soil collected; moisture extracted and analyzed for tritium using liquid scintillation method per Appendix G	Samples collected from the MWL ground surface at the four corners of the ET Cover.
Vadose Zone	VOCs in soil vapor	Year 1 – Semiannual Year 2 – Semiannual Year 3 – Semiannual Year 4 and subsequent years – Annual	17	Samples collected from 3 perimeter multi-port FLUTe™ or equivalent wells (MWL-SV03, MWL-SV04, and MWL-SV05) and 2 single-port soil-vapor monitoring points installed through the ET Cover (MWL-SV01 and MWL-SV02)	Sampling and analysis of soil vapor per Appendix D	The 3 multiport FLUTe™ wells or equivalent will be installed May-June 2014 at the MWL perimeter. Sampling port depths of 50, 100, 200, 300, and 400 ft bgs. The 2 existing single-port soil-vapor monitoring points have a sampling port approximately 35 ft below the original ground surface.

Refer to footnotes at end of table.

Table 2-1 (Continued)
Summary of Long-Term Monitoring Parameters, Frequencies, and Methods
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Sampling Media	Monitoring Parameters[a]/ Constituents of Concern	Monitoring Frequency[a]	Number of Samples Per Event	Locations	Monitoring Method[b]	Comments
Vadose Zone	Moisture content underneath the ET Cover	Year 1 – Semiannual Year 2 – Semiannual Year 3 and subsequent years – Annual	171	3 soil-moisture monitoring access tubes Measurements obtained at 1-ft increments from 4 ft to 25 ft bgs, then 5-ft increments to total depth of the access tube (200 linear ft)	Soil-moisture monitoring per Appendix E	Moisture content in vadose zone beneath the cover is measured using a neutron probe to evaluate moisture infiltration through the ET Cover.
Groundwater	VOCs, metals, tritium, radon, gamma-emitting radionuclides (short list), and gross alpha/beta activity	Semiannual	4	MWL compliance groundwater monitoring well network: MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9	Sampling and Analysis of groundwater samples per Appendix F	Monitoring wells MWL–MW4, MWL-MW5, and MWL-MW6 will be retained for information only.
Biota – Surface Soil	RCRA Metals plus Cu, Ni, V, Zn, Co, and Be; and gamma-emitting radionuclides (short list)	Annual	Up to 4 (2 each, if they exist)	Variable - ant hills and animal burrows on the MWL ET Cover located during Biology Inspections, if present	Grab sampling and analysis of surface soil at animal burrow and/or ant hill features per Appendix G	Soil sampling will be performed in August or September to evaluate potential for mobilization of contaminants by biota. If no features are identified, no samples will be collected.

Refer to footnotes at end of table.

Table 2-1 (Concluded)
Summary of Long-Term Monitoring Parameters, Frequencies, and Methods
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Sampling Media	Monitoring Parameters[a]/ Constituents of Concern	Monitoring Frequency[a]	Number of Samples Per Event	Locations	Monitoring Method[b]	Comments
Biota – Cover Vegetation	Gamma-emitting radionuclides (short list) in vegetation	Annual	Up to 2 if they exist	Variable - potentially deep-rooted vegetation identified during Biology Inspections, if present, overlying former disposal areas	Grab sampling and analysis of vegetation, including the plant and root system per Appendix G	Vegetation sampling will be performed in August or September to evaluate potential for mobilization of contaminants by plants. If no potentially deep-rooted plants are present, no samples will be collected.

[a]Monitoring parameters and frequency will be reevaluated every five years in the Five-Year Reevaluation Report.
[b]Sampling and Analysis Plans in appendices of the MWL LTMMP (March 2012).
bgs = Below ground surface.
ET = Evapotranspirative.
FLUTe™ = Flexible Liner Underground Technologies.
ft = Foot (feet).
LTMMP = Long-Term Monitoring and Maintenance Plan (SNL/NM March 2012).
MWL = Mixed Waste Landfill.
RCRA = Resource Conservation and Recovery Act.
VOC = Volatile organic compound.

Inspection parameters, specifications, frequency, and repair requirements are detailed in Chapter 4 of the MWL LTMMP, and summarized in Table 2-2. Long-term monitoring inspection checklists/forms are contained in the MWL LTMMP, Annex I. Repair work is initiated as needed based upon the results of the inspections.

The following sections provide additional information on inspections and associated maintenance/repairs.

2.2.1 Biology Inspection

The Biology Inspection that focuses on ET Cover vegetation is to be accomplished in a two-phase approach. The first phase concentrates on establishing the vegetation on the ET Cover from seed to a mature plant community such that successful revegetation criteria are met. These criteria are defined in MWL LTMMP, Section 4.1 and are presented below.

- Total percent foliar coverage equals 20 percent (i.e., 20 percent of the land surface is covered with living plants versus 80 percent bare surface area);
- Of the 20 percent total foliar coverage, 50 percent or greater comprises native perennial species, and 50 percent or less comprises annual species; and
- No contiguous bare spots greater than 200 square feet (approximately 14 by 14 feet).

During this first phase of vegetation inspection a staff biologist must inspect and document the inventory of the main flora populating the cover on a quarterly basis, as well as documenting signs of animal and insect activity. Once successful revegetation criteria are met, the second phase of cover vegetation inspection begins. During this phase the staff biologist inspection frequency changes to annual and occurs near the end of the growing season (August-September) to most accurately determine the coverage of living plants.

At the end of each reporting year, the staff biologist must compile the results of the quarterly inspections (or annual inspection), summarize local climate trends, and present recommendations in a summary report to be included in the Annual LTMM Report along with the inspection form(s).

If parameter specifications are exceeded they will be noted on the *Biology Inspection Checklist/Form* and appropriate maintenance/repairs will be completed within 60 days. Reseeding repairs may be delayed until the appropriate time during the growing season (Table 2-2).

Table 2-2
Summary of Inspection, Maintenance, and Repair Requirements
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

MWL System to be Inspected	Inspection Parameters	Inspection Frequency	Maintenance Implementation	Maintenance/ Repair Frequency[a]
ET Cover Surface	Vegetation Inventory	Quarterly until vegetation is established, annually thereafter by a staff biologist[b]	Soil augmentations and/or reseeding	Within 60 days of discovery of needed repairs. Reseeding repairs may be delayed to await appropriate growing season.
	Contiguous areas of no vegetation >200 ft^2		Revegetate barren areas that exceed prescribed limits	
	Animal intrusion burrows in excess of 4 inches in diameter		Repair cover system damage that exceeds prescribed limits	
ET Cover Surface	Settlement of cover surface in excess of 6 inches	Quarterly by a field technician	Repair cover system damage that exceeds prescribed limits	Within 60 days of discovery of needed repairs. Reseeding repairs may be delayed to await appropriate growing season.
	Erosion of cover soil in excess of 6 inches deep			
	Ponding of water on the ET Cover surface in excess of 100 ft^2			
	Animal intrusion burrows in excess of 4 inches in diameter			
	Contiguous areas of no vegetation >200 ft^2 [c]		Revegetate barren areas that exceed prescribed limits[c]	Within 60 days of discovery of needed repairs.
Surface-Water Drainage Features	Channel or sidewall erosion in excess of 6 inches deep	Quarterly by a field technician	Repair erosion that exceeds prescribed limits	Within 60 days of discovery of needed repairs.
	Accumulations of sediment in excess of 6 inches deep or debris that blocks more than 1/3 of the channel width		Remove sediment and debris accumulations that exceed prescribed limits	
Soil-Vapor Monitoring Wells, Soil-Moisture Monitoring Access Tubes, and Groundwater Monitoring Wells	Concrete pads, stanchions, and protective casings	Groundwater and Vadose Zone Network Components: Field technician to inspect at same frequency/time that monitoring occurs	Maintain, clean, repair, replace, re-label, as appropriate	Within 60 days of discovery of needed repairs.
	Well cover caps and Swagelok® (or equivalent) dust caps			
	Monitoring wells and soil-vapor sampling port labels			
	Locks			
	Sampling pumps and tubing			
	Neutron probe and cable system			

Refer to footnotes at end of table.

Table 2-2 (Concluded)
Long-Term Monitoring, Inspection, and Maintenance Schedule
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

MWL System to be Inspected	Inspection Parameters	Inspection Frequency	Maintenance Implementation	Maintenance/ Repair Frequency[a]
Fence	Presence of wind-blown plants and debris	Quarterly by a field technician	Remove wind-blown plants and debris	Within 60 days of discovery of needed repairs.
	Condition of fence wires, posts, gates, gate locks, warning signs, and survey monuments in the local area		Repair broken wire sections and posts, repair/oil gates, clean/replace locks, repair/replace warning signs, clear dirt/debris from monuments	

[a]Maintenance/repairs will be performed as necessary, based upon the results of inspections.
[b]As explained in Section 2.2.1, the transition from quarterly to annual inspections by a staff biologist is based upon meeting successful revegetation criteria as determined by the staff biologist.
[c]Barren areas exceeding >200 ft^2 will not require corrective action after ET Cover vegetation is determined to have met successful revegetation criteria if they are the result of relatively short-term climate stresses (e.g., severe short-term drought), and the staff biologist determines they will naturally fill in over time. However, these areas will be noted and tracked during inspections and reviewed annually by the staff biologist to determine whether action is required based upon comparison to surrounding vegetation.
ET = Evapotranspirative.
ft^2 = Square feet.
MWL = Mixed Waste Landfill.

2.2.2 ET Cover Surface and Physical Controls Inspection

The ET Cover surface, side slopes, and physical controls (i.e., storm-water diversion structures, perimeter fence, locks, gates, signs, and survey monuments) are inspected by a field technician on a quarterly basis. All inspection parameters, specifications, and required maintenance/repair activities are detailed in Table 2-2. Documentation of animal burrows in excess of 4 inches in diameter and contiguous areas lacking vegetation in excess of 200 square feet will be noted quarterly on the *Biology Inspection Checklist/Form* and do not need to be noted on the *Cover Inspection Checklist/Form* until successful revegetation criteria have been met. These features will be noted on both the quarterly *Cover Inspection* and annual *Biology Inspection Checklists/Forms* once the Biology Inspection frequency changes to annual.

If parameter specifications are exceeded they will be noted on the *Cover Inspection Checklist/Form* and appropriate maintenance/repairs will be completed within 60 days. Reseeding repairs may be delayed until the appropriate time during the growing season (Table 2-2). The inspection forms will be included in the MWL Annual LTMM Report.

2.2.3 Monitoring Networks and Sampling Equipment

Groundwater monitoring wells, soil-vapor monitoring wells, soil-moisture monitoring access tubes, and associated sampling/monitoring equipment are inspected at the same frequency and during the associated monitoring events. All inspection parameters, specifications, and required maintenance/repair activities are detailed in Table 2-2. The inspections and any associated maintenance and repair activities will be documented on monitoring network-specific inspection checklists/forms. There is a separate inspection checklist/form for each of the three monitoring networks and associated sampling/monitoring equipment.

If conditions are observed that require maintenance, repair, or replacement they will be noted on the associated *Monitoring Network Inspection Checklist/Form* and appropriate actions will be completed within 60 days. The inspection forms will be included in the MWL Annual LTMM Report.

3.0 INSPECTION, MAINTENANCE, AND REPAIR RESULTS

This chapter presents a summary of inspection, maintenance, and repair activities conducted during the reporting period January through March 2014. The MWL inspections conducted during the reporting period are summarized below.

- Biology Inspection (vegetation and signs of animal activity)
- ET Cover and Physical Controls Inspection (ET Cover surface, surface-water diversion feature, perimeter security fence, security signs, gates, locks, and survey monuments)

Two quarterly inspections were performed in February 2014 and were documented on the *Biology Inspection Checklist/Form* (Biology Inspection) and the *Cover Inspection Checklist/Form* (ET Cover and Physical Controls Inspection). The inspection forms are included in Annex A of this report and the results of these inspections are described in the following sections.

3.1 Biology Inspection

The quarterly Biology Inspection of the ET Cover was conducted on February 18, 2014 by the staff biologist. The inspection was conducted during the latter part of the 2013 – 2014 winter season so the native grass vegetation was largely dormant. However, the general health of the native grasses and the foliar coverage was excellent and exceeded the criteria for successful revegetation (see Section 2.2.1 and Annex A). Three native grass species comprise the 51 percent foliar coverage, with almost no non-native vegetation present. There were no contiguous barren areas greater than 200 square feet and no potentially deep-rooted plants were observed. Approximately eight ant hills/burrows and two small mammal burrows (diameter less than 4 inches) were observed and noted. No maintenance or repairs were required based on the February 2014 Biology Inspection. The inspection form is provided in Annex A and includes photographs of the ET Cover vegetation taken during the inspection.

The ET Cover was seeded in September 2009 and inspections and maintenance have been conducted since that time, including supplemental watering. The supplemental watering activities were approved by the NMED (Bearzi December 2008 and April 2011), incorporated directly into the MWL LTMMP (SNL/NM March 2012), and have been critical to establishing a robust community of native grasses on the ET Cover. Although 2010 through 2012 meteorological conditions (i.e., lack of significant rainfall events that fully saturated the soil) caused significant vegetation stress, the ET Cover foliar coverage and vegetation meet successful revegetation criteria due to supplemental watering. This was also the case in 2013 based on the results of a Biology Inspection performed on September 10, 2013 at the end of the 2013 growing season. This inspection was performed prior to NMED-approval of the MWL LTMMP but is provided in Annex A as supplemental information. The large size of the native grass clumps and their relative abundance/coverage indicate a mature, healthy native grass population. ET Cover vegetation monitoring and inspection will continue on a quarterly basis through the 2014 growing season (i.e., two additional inspections will be conducted in May and August-September).

3.1.1 ET Cover Supplemental Watering and Maintenance

The MWL LTMMP addresses all cover maintenance and supplemental watering activities from the completion of the ET Cover in September 2009 through 2011. Supplemental watering activities performed in 2012 and 2013 are summarized below, and were critical to establishing the healthy native grasses depicted in the photographs included with the *Biology Inspection Checklist/Forms* provided in Annex A. No supplemental watering activities were conducted during the January through March 2014 reporting period. Minor maintenance in response to the ET Cover Surface and Physical Controls Inspection is discussed in the next section.

Calendar Year	Months When Supplemental Watering Was Performed	Inches of Supplemental Water Applied[a]	Supplemental Water + Natural Precipitation[b] for the Year (in inches)
2012	June – September	5.5	5.5 + 4.51 = **10.01**
2013	May – August	5	5 + 12.11 = **17.11**

[a] Supplemental water was applied over the entire ET Cover area using a temporary, above-ground sprinkler system. The volume of water used was tracked and converted to "inches of precipitation" for the ET Cover surface area.
[b] Natural precipitation determined from the SNL/NM A36 Meteorological Monitoring Station in TA-III.

No more than 3 inches of supplemental water was applied during any 30-day period, and no more than 0.5 inches of supplemental water was applied during any one day. As stated in Section 4.2.3 of the MWL LTMMP (SNL/NM March2012), the total water applied to the ET Cover (natural plus supplemental) should not exceed 16.5 inches for a calendar year.

In order to determine the appropriate quantity of supplemental water, SNL personnel used the average precipitation during the past 15 years to estimate the precipitation expected during each month of 2012 and 2013.

The last 2013 supplemental watering event was conducted in August. As of the end of August the total natural precipitation plus supplemental watering was equivalent to 11.3 inches of precipitation, well below the 16.5 inch limit. The 15-year average for the remaining months (September through December) as calculated from the SNL/NM A36 meteorological station located in TA-III is only 3.04 inches, so the anticipated total for 2013 was approximately 14.34 inches. However, three of the remaining four months experienced above average precipitation, including a record amount of precipitation in September 2013.

The table below provides a summary of the 15-year average versus the 2013 actual precipitation for September through December 2013. The table shows that for the final four months of 2013 the actual precipitation exceeded the 15-year average by 2.77 inches.

2013 Month	Estimated Precipitation (15-Year Average)	Actual Recorded Precipitation	2013 Precipitation Deviation from the 15-Year Average
September	0.99	4.12	+3.13
October	1.11	0.16	-0.95
November	0.44	0.82	+0.38
December	0.50	0.71	+0.21
Totals	**3.04**	**5.81**	**2.77**

As a result, the total natural and supplemental precipitation for 2013 exceeded 16.5 inches by 0.61 inches. This exceedance is small and should be taken in context with the totals for 2010, 2011, and 2012, which were all well below 16.5 inches (9.67, 11.47, and 10.01 inches, respectively).

ET Cover maintenance performed in 2012 and 2013 included the removal of annual weedy species and erosion repair on the ET Cover side slopes. In 2012 two weed removal efforts were conducted within the perimeter fence during September and October. All weeds were removed by hand and disposed of at the KAFB Landfill. Approximately 91 cubic yards of compressed weeds were removed from the ET Cover and side slopes, comprised mostly of Russian thistle, snakeweed, and kochia.

In 2013 erosion repair work was conducted in August and November to address small rills that formed on the northern and western ET Cover side slopes during strong monsoonal rainfall events that occurred in July and September. Stockpiled ET Cover soil material from the 2009 ET Cover construction effort was used along with a combination of compost, clean silica sand, rounded river rock (3/4-inch), and the original ET Cover native grass seed mix to repair and seed the rill areas in August. In November repairs were made in the same general areas with slightly larger rounded river rock (2 to 4-inch) and stockpiled ET Cover soil material (no additional seeding was performed). All materials were placed on the side slopes using hand tools and wheel barrows to minimize impact to the existing native grasses. In November the rounded river rock and soil material were tamped into the larger rills to improve compaction and long-term stability. Approximately 60 cubic yards of compressed weeds were also removed from the ET Cover and perimeter area just outside the fence line during November 2013 and composted as green waste through the SNL/NM green waste exchange program with the Albuquerque Bernalillo County Water Use Authority. Most of this volume originated from the ET Cover perimeter area outside the fence; the ET Cover itself had only minor weed growth.

3.2 ET Cover Surface and Physical Controls Inspection

The one quarterly inspection of the ET Cover Surface and Physical Controls for the reporting period was conducted on February 18, 2014 by a field technician. Parameters requiring maintenance/repair included the accumulation of tumbleweeds in the perimeter fence and a warning sign at the northwest corner of the site (needed replacement). Work to remove the large accumulation of tumbleweeds from the perimeter fence began on March 31 and will be concluded in early April 2014. The warning sign was replaced on February 24, 2014. No other cover or physical control elements required repairs or maintenance.

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4.0 LONG-TERM MONITORING & MAINTENANCE IMPLEMENTATION

This chapter presents an overview of the implementation of all MWL LTMMP monitoring, inspection, and maintenance/repair activities. The overall implementation schedule and regulatory submittals are presented in the following sections.

4.1 Implementation Schedule

All monitoring and inspection activities are being implemented in accordance with the requirements of the MWL LTMMP (SNL/NM March 2012). Table 4-1 presents implementation schedule information for all inspection and monitoring activities. ET Cover inspections are on a quarterly schedule, which started in February 2014. Monitoring network and sampling equipment inspections occur at the same frequency and time as the associated monitoring events, and will begin in April 2014.

Air monitoring for radon was initiated in January 2014 and the detectors will be sent to the analytical laboratory in early April 2014. These data will be included in the June 2015 MWL Annual LTMM Report. Annual surface soil sampling for tritium will be conducted in July-August 2014. Biota monitoring will be conducted in August-September after the quarterly Biology Inspection. Sampling locations are determined by the staff biologist based on their August-September Biology Inspection, which is scheduled near the end of the growing season when plant, animal, and insect activity is highest.

In general, monitoring activities that occur at a semiannual frequency (groundwater monitoring and vadose zone monitoring for soil moisture and soil vapor) will occur in April and October of each year to allow sufficient time for laboratory analysis, data review/validation, date evaluation, and final reporting. The exception in 2014 is related to soil-vapor monitoring, which will not occur until the three proposed FLUTe™ multi-port soil-vapor monitoring wells are installed (anticipated installation period is May-July). The first semiannual sampling event will be initiated two months after installation to allow the soil vapor in the vadose zone to equilibrate after drilling activities are completed (anticipated sampling event in late August/September).

Figure 4-1 presents a timeline for all required inspection and monitoring activities since the MWL LTMMP became effective on January 8, 2014. As shown in Figure 4-1, quarterly inspections (Biology and ET Cover Surface and Physical Controls) were implemented in February and were the only activities completed by the end of the reporting period for this first MWL Annual LTMM Report (i.e., March 31 2014). The annual LTMM reporting periods for this report and the June 30, 2015 report are shown at the top of Figure 4-1 and by the vertical, dashed red lines. The first quarterly radon air monitoring event began in January and will conclude in early April 2014; the data were not available in time to include in this report. The January through April 2014 air monitoring results and all other inspection and monitoring activities shown on Figure 4-1 occurring between the red dashed lines will be documented in the June 2015 MWL Annual LTMM Report. LTMM activities associated with the reporting period for the June 2016 report are not included on Figure 4-1.

Table 4-1
Summary of 2014 Inspection and Monitoring Implementation
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Inspection or Monitoring Activity	Parameters	Frequency	Implementation Schedule Comments[a]
Biology Inspection	ET Cover	Quarterly	Inspections in February, May, August, and November 2014
Surface & Physical Controls Inspection	ET Cover and Perimeter	Quarterly	Inspections in February, May, August, and November 2014
Monitoring Network Inspections	Well & Sampling Equipment	Variable	Inspections will occur at the frequency and same time as the associated monitoring.
Air	Radon	Quarterly	The 2014 quarterly monitoring periods are January-March, April-June, July-September, and October-December. The January-March 2014 data will be presented in the June 2015 Report.
Surface Soil	Tritium	Annual	Samples will be collected in July-August 2014.
Vadose Zone	VOCs in soil vapor	Semiannual	Installation of the 3 multiport FLUTe™ wells is planned for May-June 2014. The first sampling event for all soil-vapor wells is planned for August-September 2014. The next sampling event is planned for December 2014 or January 2015. In 2015 sampling will occur in April and October.
Vadose Zone	Moisture content underneath the ET Cover	Semiannual	Vadose zone soil moisture monitoring will be conducted in April and October 2014.
Groundwater	VOCs, metals, tritium, radon, and other radiological parameters	Semiannual	Groundwater monitoring will be conducted in April and October 2014.
Biota – Surface Soil	Metals; and gamma-emitting radionuclides (short list)	Annual	Soil sampling will be performed in August or September 2014 after the Biology Inspection.
Biota – Cover Vegetation	Gamma-emitting radionuclides (short list) in vegetation	Annual	Vegetation sampling will be performed in August or September to evaluate potential for mobilization of contaminants by plants. If no potentially deep-rooted plants are present, no samples will be collected.

[a]All monitoring data collected in 2014 will be presented in the June 2015 MWL Long-Term Monitoring & Maintenance Annual Report. Timing of monitoring and inspections may vary pending unforeseen events.
ET = Evapotranspirative.
FLUTe™ = Flexible Liner Underground Technologies.
VOC = Volatile organic compound.

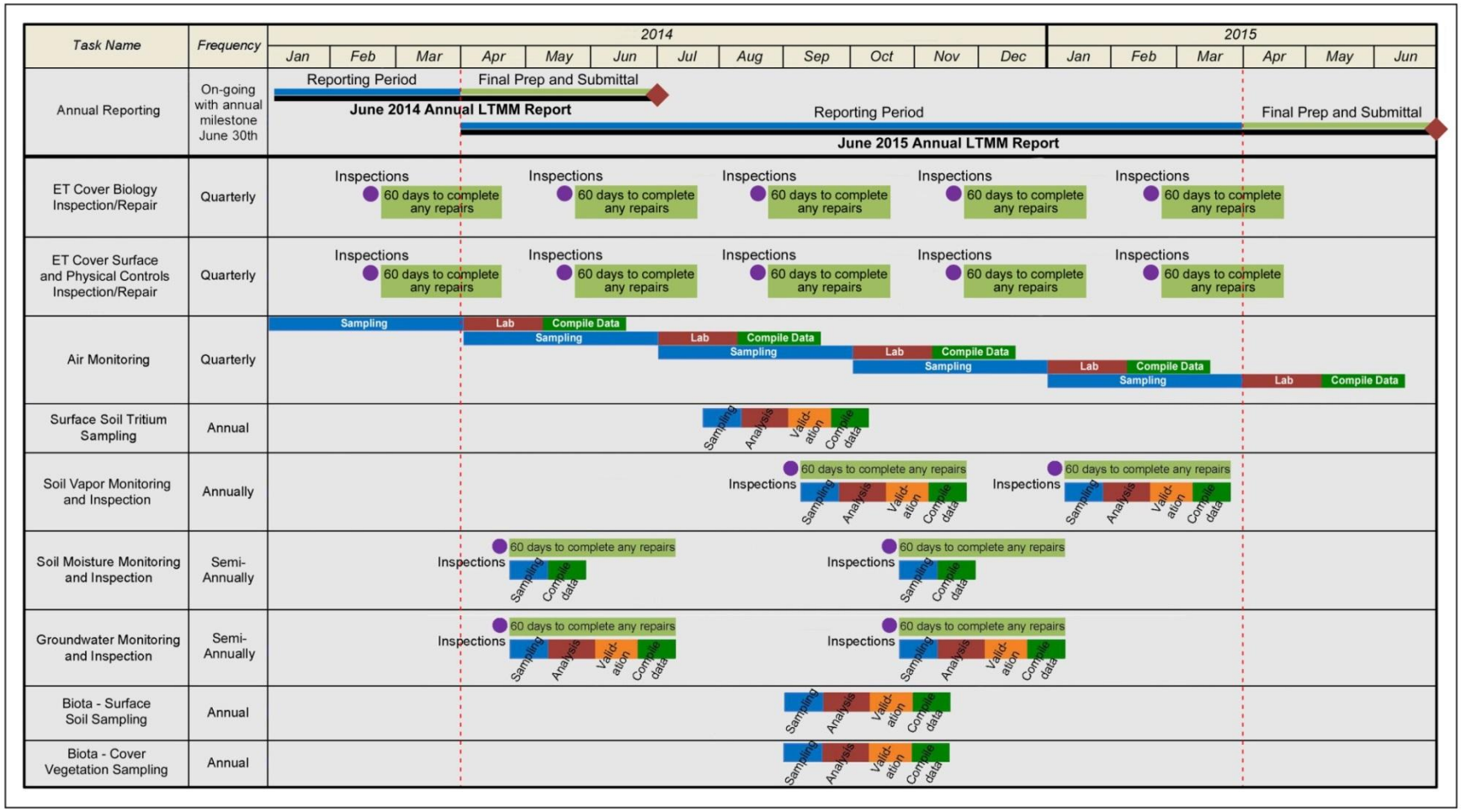

Figure 4-1
Time Line Showing Implementation of Required Long-Term Monitoring and Maintenance Activities at the Mixed Waste Landfill

4.2 Regulatory Submittals

The *Work Plan for the Installation of Three Soil-Vapor Monitoring Wells (MWL-SV03, MWL-SV04, and MWL-SV05) at the Mixed Waste Landfill* (SNL/NM January 2014) was submitted to the NMED on January 15, 2014 (SNL/NM January 2014). This Work Plan was approved by NMED on February 14, 2014 (Blaine February 2014). DOE/Sandia submitted all reference documents cited in Appendices C through G of the MWL LTMMP (i.e., the monitoring SAPs) on March 6, 2014 within 60 days of LTMMP approval in accordance with MWL LTMMP requirements (Beausoleil March 2014).

5.0 SUMMARY AND CONCLUSIONS

As of January 8, 2014 the MWL LTMMP (SNL/NM March 2012) became effective and all required inspection and monitoring activities are being implemented at the MWL. This first MWL Annual LTMM Report documents the implementation effort as well as the quarterly inspections performed during the first partial reporting period (i.e., January 8 through March 31, 2014). The supplemental watering activities for the MWL ET Cover conducted in 2012 and 2013 are also documented. Based upon the inspections performed, the MWL ET Cover and Physical Controls are functioning as designed, and only minimal maintenance was required. The ET Cover vegetation meets successful revegetation criteria in large part due to supplemental watering activities conducted in 2009, 2011, 2012, and 2013.

The *Work Plan for the Installation of Three Soil-Vapor Monitoring Wells (MWL-SV03, MWL-SV04, and MWL-SV05) at the Mixed Waste Landfill* (SNL/NM January 2014) was submitted to the NMED in January 2014 and was approved by NMED on February 14, 2014 (Blaine February 2014). Drilling and installation field work is ongoing and should be completed by early July 2014. The required submittal of all reference documents cited in Appendices C through G of the MWL LTMMP were submitted to the NMED on March 6, 2014, within 60 days of LTMMP approval (Beausoleil March 2014).

Future MWL Annual LTMM Reports will contain documentation for a complete reporting year (April 1 through March 31) of monitoring, inspection, maintenance, and repair activities.

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6.0 REFERENCES

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EPA, see U.S. Environmental Protection Agency.

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Annex A
Mixed Waste Landfill
SWMU 76
Inspection Forms/Checklists

Biology Inspections

- **February 18, 2014 Inspection**
- **September 10, 2013 Inspection**

ET Cover Surface and Physical Controls Inspection

- **February 18, 2014**

Mixed Waste Landfill
SWMU 76

Biology Inspection

February 18, 2014

February 18, 2014

Mixed Waste Landfill
Biology Inspection Checklist/Form for the MWL Cover

Approximate vegetative coverage (actively photosynthesizing)*: 51 %

Approximate percent native vegetation of the total vegetative cover: 99 %

Listed below are the main plant species identified as growing on the MWL cover and the percentage of the cover populated by each species.

Scientific Name	Common Name (optional)	% of Cover[1]
Pleuraphis 'jamesii'	James' galleta	45.0
Bouteloua gracilis	Blue grama	2.5
Sporobolus flexuosus	Mesa dropseed	3.5
Gutierrezia sarothrae	Broom Snake weed	Trace**
Bouteloua eriopoda	Black grama	Trace
Sphaeralcea species	Globemallow	Trace

Note: [1] Percentage of total MWL Cover populated by actively-photosynthesizing plants of this species

* Living plants per Section 4.1 of the MWL LTMMP.

** Trace = species present at a rate of less than one-half of one-percent.

Mixed Waste Landfill
Biology Inspection Checklist/Form for the MWL Cover
(continued)

Are there any contiguous areas of no vegetation greater than 200 square feet? (approximately 14 x 14 ft)? No

If "Yes," mark such areas on a map and attach to this checklist. Address actions and schedule to improve such area(s) in the notes section below.

Are there any very deeply rooted (roots greater than 8 feet deep at maturity) plant species present on the cover? No

If "Yes," describe the plant(s) and their general distribution. Address actions and schedule to remove plant(s) from the cover in the notes section below.

Notes: _____

Inspection for Animal and Insect Intrusion into MWL Cover

Are any burrows present on the cover? Yes

Do any of the burrows appear to be active? No

Any ant hills/nests? Yes

Describe below observations regarding animal and insect features. If burrows with an entrance diameter of 4 inches or greater are present or appear to be that of a species that is able to burrow 6 feet deep or greater, indicate the location(s) on a map and attach to this checklist. Address actions and schedule to repair cover damage that exceeds prescribed limits. As appropriate, identify animal and insect features and have them surveyed and marked for biota sampling.

Notes: Burrow entrances are smaller than 4-inches in diameter. No burrow appears to be that of a species able to burrow six feet or greater.

Mixed Waste Landfill
Biology Inspection Checklist/Form for the MWL Cover
(Continued)

Notes (continued):

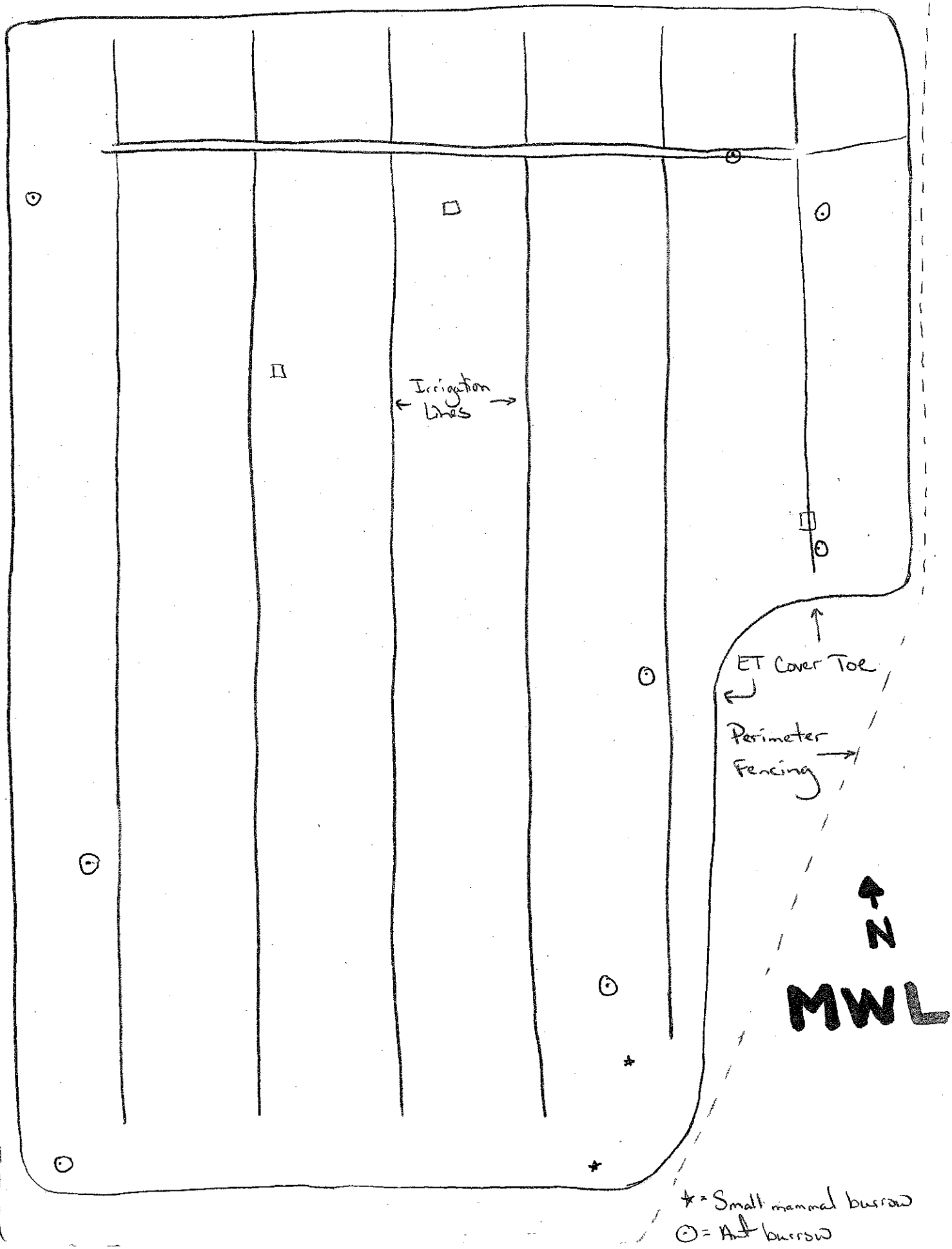
The ET cover continues to be in excellent shape with even coverage across the cover. Little has changed since the 9/10/13 inspection, only fewer annual plant species present due to winter dormancy.

Biological Aspects Map -- [note: sketch map to locate specific features described above will be attached as appropriate]

Inspector's Signature: _____ Date: 2/18/14

Original to: Mixed Waste Landfill Operating Record

Copy to: SNL/NM Records Center


Irrigation Lines
ET Cover Toe
Perimeter Fencing
N
MWL
★ = Small mammal burrow
⊙ = Ant burrow

Looking north from approximate center of ET cover

Looking east from approximate center of ET cover

Looking south from approximate center of ET cover

Looking west from approximate center of ET cover

West Slope: looking south from northern end

South portion of cover; facing north from center southern edge of cover

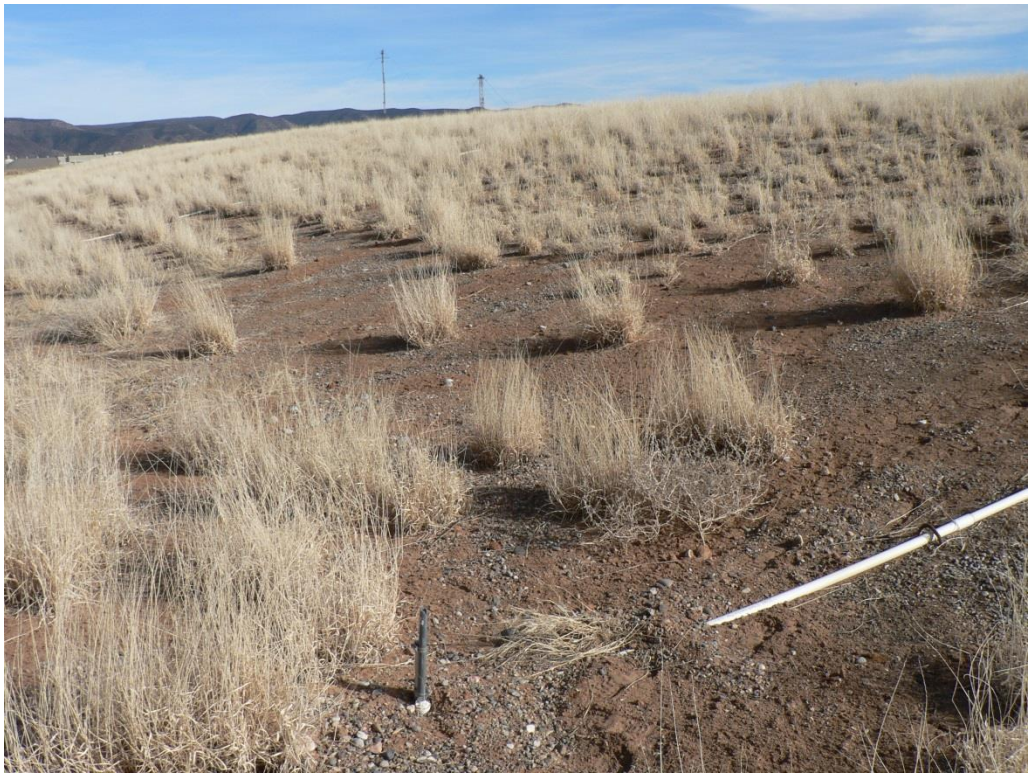
South slope of cover

East slope of cover: southern end

East slope of cover: northern end

Northeast corner of cover: facing southwest

North slope of cover: facing west from the eastern portion of slope



North slope of cover: facing east from the western portion of slope

Northwest corner of cover: facing center of cover
(This small area has the lowest density of native perennial plants on the cover)

Mixed Waste Landfill
SWMU 76

Biology Inspection

September 10, 2013

Mixed Waste Landfill
Biology Inspection Checklist/Form for the MWL Cover

Approximate vegetative coverage (actively photosynthesizing)*: 56 %

Approximate percent native vegetation of the total vegetative cover: 96 %

Listed below are the main plant species identified as growing on the MWL cover and the percentage of the cover populated by each species.

Scientific Name	Common Name (optional)	% of Cover[1]
Pleuraphis jamesii	James' galleta	46
Bouteloua eriopoda	Black grama	4
Sporobolus flexuosus	Mesa dropseed	3
Xanthisma spinulosum	Tansy aster	Trace**
Salsola tragus	Russian thistle	Trace
Bouteloua barbata	Six-weeks grama	Trace
Sporobolus contractus	Spike dropseed	Trace
Bouteloua curtipendula	Side-oats grama	Trace
Dasyochloa pulchella	Low woolly grass	Trace
Gutierrezia sarothrae	Broom snakeweed	Trace
Helianthus species	Sunflower species	Trace
Panicum capillare	Witch grass	Trace
Chenopodium incanum	Mealy goosefoot	Trace
Sphaeralcea hastulata	Wrinkled globemallow	Trace
Sphaeralcea angustifolia	Narrowleaf globemallow	Trace

Note: [1] Percentage of total MWL Cover populated by actively-photosynthesizing plants of this species

* Living plants per Section 4.1 of the MWL LTMMP.

** Trace = species present at a rate of less than one-half of one percent.

Mixed Waste Landfill
Biology Inspection Checklist/Form for the MWL Cover
(continued)

Are there any contiguous areas of no vegetation greater than 200 square feet? (approximately 14 x 14 ft)? No.

If "Yes," mark such areas on a map and attach to this checklist. Address actions and schedule to improve such area(s) in the notes section below.

Are there any very deeply rooted (roots greater than 8 feet deep at maturity) plant species present on the cover? No.

If "Yes," describe the plant(s) and their general distribution. Address actions and schedule to remove plant(s) from the cover in the notes section below.

Notes: _____

Inspection for Animal and Insect Intrusion into MWL Cover

Are any burrows present on the cover? Yes

Do any of the burrows appear to be active? No

Any ant hills/nests? Yes

Describe below observations regarding animal and insect features. If burrows with an entrance diameter of 4 inches or greater are present or appear to be that of a species that is able to burrow 6 feet deep or greater, indicate the location(s) on a map and attach to this checklist. Address actions and schedule to repair cover damage that exceeds prescribed limits. As appropriate, identify animal and insect features and have them surveyed and marked for biota sampling.

Notes: Burrow entrances are smaller than 4 inches in diameter. No burrow appears to be that of a species able to burrow six feet or greater.

Mixed Waste Landfill
Biology Inspection Checklist/Form for the MWL Cover
(Continued)

Notes (continued):

The ET cover is in excellent shape. The two largest bare areas observed in the May 2013 inspection have significantly filled in with native grass species during the 2013 growing season. All side slopes have good coverage of native grasses. Extremely little weed growth was observed on the cover during this inspection.

The native grasses have developed into fully mature clumps. Abundant above-ground biomass was observed in this inspection. The clumps have barren interspaces between them which mimic the native grass ecosystems in the surrounding areas. The natural spacing between clump grasses allows for full root development of each plant. A mature root system enables better uptake of nutrients and water, enriching the health of each plant and enabling each plant to best withstand drought conditions. The grass clumps have set abundant seed, further indicating a very healthy community of native grasses on the ET cover.

Biological Aspects Map -- [note: sketch map to locate specific features described above will be attached as appropriate]

Inspector's Signature: _____ Date: 9/10/2013

Original to: Mixed Waste Landfill Operating Record

Copy to: SNL/NM Records Center

Looking north from approximate center of ET cover

Looking east from approximate center of ET cover

Looking south from approximate center of ET cover

Looking west from approximate center of ET cover

West Slope: looking north from southern end

West Slope: looking south from northern end

Southwest corner of cover: facing center of cover

South slope of cover

Southeast corner of cover: facing center of cover

West slope of cover: southern end

Northeast portion of cover: facing northeast

West slope of cover: northern end

Northeast corner of cover: facing west

Northeast portion of cover: facing northwest

North slope of cover: facing west from the eastern portion of slope

North slope of cover: facing east from the western portion of slope

Northwest corner of cover: facing center of cover
(This small area has the lowest density of native perennial plants on the cover)

Mixed Waste Landfill
SWMU 76

ET Cover Surface and Physical Controls Inspection

February 18, 2014

Mixed Waste Landfill
Cover Inspection Checklist/Form

1. Date of Inspection 2/18/14
2. Time of Inspection @ 1400
3. Name of Inspector Don M Watenpaugh

Provide explanatory notes for each parameter not inspected or each action required. Include any maintenance or repair required in notes section at the end of this form.

I. COVER SYSTEM [Quarterly]			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Visible settlement of the soil cover in excess of 6 inches.	yes	NO	
B. Erosion of the soil cover in excess of 6 inches deep.	yes	NO	
C. Evidence of water ponding on the MWL cover surface in excess of 100 square feet.	yes	NO	
D. Animal intrusion burrows in excess of 4 inches in diameter. Note: During period when the Biology Inspection is occurring quarterly, this inspection requirement will be covered on the Biology Inspection Checklist/Form.	yes	NO	
E. Contiguous areas of no vegetation greater than 200 ft^2. Note: During period when the Biology Inspection is occurring quarterly, this inspection requirement will be covered on the Biology Inspection Checklist/Form.	yes	NO	
F. Potentially deep-rooted plants present. Note: During period when the Biology Inspection is occurring quarterly, this inspection requirement will be covered on the Biology Inspection Checklist/Form.	yes	NO	
II. SURFACE-WATER (STORM-WATER) DIVERSION STRUCTURES [Quarterly]			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Channel or sidewall erosion in excess of 6 inches deep.	Yes	NO	
B. Channel sediment accumulation in excess of 6 inches deep.	Yes	NO	
C. Debris that blocks more than 1/3 of the channel width.	Yes	NO	

Mixed Waste Landfill
Cover Inspection Checklist/Form (continued)

III. SECURITY FENCE [Quarterly]			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Accumulation of wind-blown plants and debris.	yes	yes	1
B. Fence wires and posts in need of repair/maintenance.	yes	ND	
C. Gates in need of oiling/repair/maintenance.	yes	ND	
D. Locks in need of cleaning or replacement.	yes	ND	
E. Warning signs in need of repair or replacement.	yes	yes	2
F. Survey monuments in vicinity of MWL visible.	yes	ND	

IV. PREVIOUS DEFICIENCIES			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
Uncorrected/undocumented previous deficiencies.	NA	NA	

Mixed Waste Landfill
Cover Inspection Checklist/Form (continued)

NOTES

Note Number	Description
1	Accumulation of Russian Thistle along East & west Fence. Work Order has been Submitted to Purchasing For Sequoia Landscaping to perform removal
2	Danger warning Sign on NW corner of MWL Fence needs to be replaced

Mixed Waste Landfill
Cover Inspection Checklist/Form (continued)

Action (Note Number) 1 assigned to Don Schofield Date action completed 4/4/14

Action (Note Number) 2 assigned to Robert Ziock Date action completed 2/24/14

Action (Note Number) _____ assigned to _____ Date action completed _____

Action (Note Number) _____ assigned to _____ Date action completed _____

Action (Note Number) _____ assigned to _____ Date action completed _____

Additional Comments:

#1 Weeds were removed from fence line by Sequoia Landscaping.

#2 New Danger/Warning sign installed to replace damaged one.

Inspector's Signature _____

Original to: Mixed Waste Landfill Operating Record

Copy to: SNL/NM Records Center

Volume V

TAB 14

Notice of Approval: Mixed Waste Landfill Annual Long-Term Monitoring & Maintenance Report, January - March 2014, June 2014

From: NMED/Kieling
To: SNL/Beausoleil

Back of Tab 14

NEW MEXICO
ENVIRONMENT DEPARTMENT

SUSANA MARTINEZ
Governor
JOHN A. SANCHEZ
Lieutenant Governor

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

RYAN FLYNN
Cabinet Secretary
BUTCH TONGATE
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

August 6, 2014

Geoffrey L. Beausoleil
Manager
U.S. Department of Energy
NNSA / Sandia Site Office
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Michael W. Hazen
Vice-President,
Infrastructure Operations
Sandia National Laboratories
P.O. Box 6200, MS 0771
Albuquerque, NM 87185-0727

RE: APPROVAL
MIXED WASTE LANDFILL ANNUAL LONG-TERM MONITORING & MAINTENANCE REPORT, JANUARY – MARCH 2014, JUNE 2014
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-14-010

Dear Mr. Beausoleil and Mr. Hazen:

The New Mexico Environment Department has reviewed the document: *Mixed Waste Landfill Annual Long-Term Monitoring & Maintenance Report, January – March 2014,* June 2014, with cover letter dated June 18, 2014, submitted by the U. S. Department of Energy (DOE) on behalf of itself and Sandia Corporation (collectively, the Permittees). The report is hereby approved.

If you have any questions regarding this matter, please contact Mr. Brian L. Salem of my staff at (505) 222-9576.

Sincerely,

John E. Kieling
Chief
Hazardous Waste Bureau

cc: D. Cobrain, NMED HWB
W. Moats, NMED HWB
B. Salem, NMED HWB
T. Skibitski, NMED DOE OB
L. King, EPA-6
P. Puissant, SNL, MS-0729
J. Cochran, SNL, MS 0719
J. Weckerle, DOE/NNSA MS-0184

File: SNL 2014 and Reading

Volume V

TAB 15

Mixed Waste Landfill FLUTe™ Soil-Vapor Monitoring Well

Installation Report, September 2014

From: SNL/Todd
To: NMED/Kieling

Back of Tab 15

National Nuclear Security Administration

Department of Energy
National Nuclear Security Administration
Sandia Field Office
P. O. Box 5400
Albuquerque, NM 87185

SEP 1 0 2014

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

Mr. John E. Kieling
Chief
Permits Management Program
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Bldg. 1
Santa Fe, NM 87505

Subject: Department of Energy/National Nuclear Security Administration Sandia National Laboratories Environmental Restoration Operations *Installation of Three FLUTe™ Soil-Vapor Monitoring Wells (MWL-SV03, MWL-SV04, and MWL-SV05) at the Mixed Waste Landfill.*

Dear Mr. Kieling:

The Department of Energy/National Nuclear Security Administration and Sandia Corporation (Sandia) are submitting the final report *Installation of Three FLUTe™ Soil-Vapor Monitoring Wells (MWL-SV03, MWL-SV04, and MWL-SV05) at the Mixed Waste Landfill*. Submittal of this report to the New Mexico Environment Department (NMED), Hazardous Waste Bureau (HWB) is required by the NMED-approved *MWL Soil-Vapor Well Installation Plan*, dated January 2014, and completes the deployment of all monitoring systems required by the *Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan* (LTMMP) in accordance with the NMED LTMMP approval letter dated January 8, 2014.

The enclosed report documents the field activities for the three soil-vapor monitoring wells. The first semiannual soil-vapor monitoring event will be conducted in September 2014 and will be reported in the next *MWL Annual Long-Term Monitoring and Maintenance Report* in accordance with LTMMP requirements (submittal to NMED in June 2015).

If you have questions, please contact me at (505) 284-6668 or John Weckerle of my staff at (505) 845-6026.

Sincerely,

James W. Todd
Assistant Manager for Engineering

Enclosure

cc: See Page 2

cc w/enclosure (Certified Mail):
William Moats
NMED-HWB
5500 San Antonio Dr., NE
Albuquerque, NM 87109

Laurie King
EPA, Region 6
1445 Ross Ave., Ste. 1200
Dallas, TX 75202

cc w/enclosure:
David Cobrain,
NMED-HWB
2905 Rodeo Park Drive East, Bldg. 1
Santa Fe, NM 87505

Thomas Skibitski
NMED-OB, MS-1396
SNL ES&H Records Center
SNL/NM, MS-0718

Zimmerman Library
University of New Mexico
MSC05 3020
1 University of New Mexico
Albuquerque, NM 87101-0001

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CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Environmental Restoration Operations Installation of Three FLUTe™ Soil-Vapor Monitoring Wells (MWL-SV03, MWL-SV04, and MWL-SV05) at the Mixed Waste Landfill.**

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Installation of Three FLUTe™ Soil-Vapor Monitoring Wells (MWL-SV03, MWL-SV04, and MWL-SV05) at the Mixed Waste Landfill

September 2014

United States Department of Energy
Sandia Field Office

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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ACRONYMS AND ABBREVIATIONS

ARCH	air rotary casing hammer
bgs	below ground surface
CSS	Colorado Silica Sand
DOE	U.S. Department of Energy
ER	Environmental Restoration
FLUTe™	Flexible Liner Underground Technology, Ltd.™
ft	foot or feet
HWB	Hazardous Waste Bureau
LTMMP	Long Term Monitoring and Maintenance Plan
MWL	Mixed Waste Landfill
mil	thousandth of an inch
NMED	New Mexico Environment Department
NMOSE	New Mexico Office of the State Engineer
OD	outside diameter
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
Sandia	Sandia Corporation
SNL/NM	Sandia National Laboratories, New Mexico
SWMU	Solid Waste Management Unit
TA	Technical Area
TD	total depth
the Order	Compliance Order on Consent
YJ	Yellow Jacket Drilling Services, Inc.

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1.0 INTRODUCTION

1.1 Report Objective

This installation report describes the May through July 2014 drilling activities performed for the installation of three multi-port soil-vapor monitoring wells (MWL-SV03, MWL-SV04, and MWL-SV05) at the Mixed Waste Landfill (MWL), which is located at Sandia National Laboratories, New Mexico (SNL/NM). SNL/NM is managed and operated by Sandia Corporation (Sandia), a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy (DOE)/National Nuclear Security Administration. The MWL is designated as Solid Waste Management Unit (SWMU) 76 and is located in Technical Area (TA) III (Figure 1-1). The locations of the three soil-vapor monitoring wells (MWL-SV03, MWL-SV04, and MWL-SV05) are shown in Figure 1-2.

1.2 Regulatory Criteria

The New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) provides regulatory oversight of the SNL/NM Environmental Restoration (ER) efforts and implements and enforces regulations mandated by the Resource Conservation and Recovery Act (RCRA). All ER Operations SWMUs and Areas of Concern are listed in Module IV of the SNL/NM RCRA Part B Operating Permit, *Special Conditions Pursuant to the 1984 Hazardous and Solid Waste Amendments to RCRA for Sandia National Laboratories* (NMED 1993). In April 2004, a Compliance Order on Consent (the Order) (NMED April 2004) became effective between the NMED, DOE, and Sandia, which specifically identified SWMU 76 (the MWL) as requiring corrective action. The MWL is also subject to corrective action under 20.4.1.500 New Mexico Administrative Code incorporating 40 Code of Federal Regulations 264.101. The NMED HWB is the lead regulatory agency and oversees corrective action at the MWL under the provisions of the Order (NMED April 2004) issued pursuant to the New Mexico Hazardous Waste Act and addresses requirements concerning nitrate and perchlorate pursuant to the New Mexico Solid Waste Act.

The NMED Final Order on the MWL (Curry May 2005) and the related Class 3 Permit Modification require an MWL long-term monitoring and maintenance plan (LTMMP) to address monitoring, inspection, maintenance, physical and institutional controls, and reporting for the MWL following remedy implementation. The MWL LTMMP (SNL/NM March 2012) was approved by NMED on January 8, 2014 (Blaine January 2014) and required the installation of three soil-vapor monitoring wells to complete the LTMMP monitoring systems. The Soil-Vapor Monitoring Well Installation Work Plan (the Work Plan; SNL/NM January 2014) was approved by NMED in February 2014 (Blaine February 2014). All associated drilling and installation field work was performed in accordance with the NMED-approved Work Plan. Variances related to difficulties encountered at the original MWL-SV03/BH16 location are discussed in Sections 2.2 and 3.0.

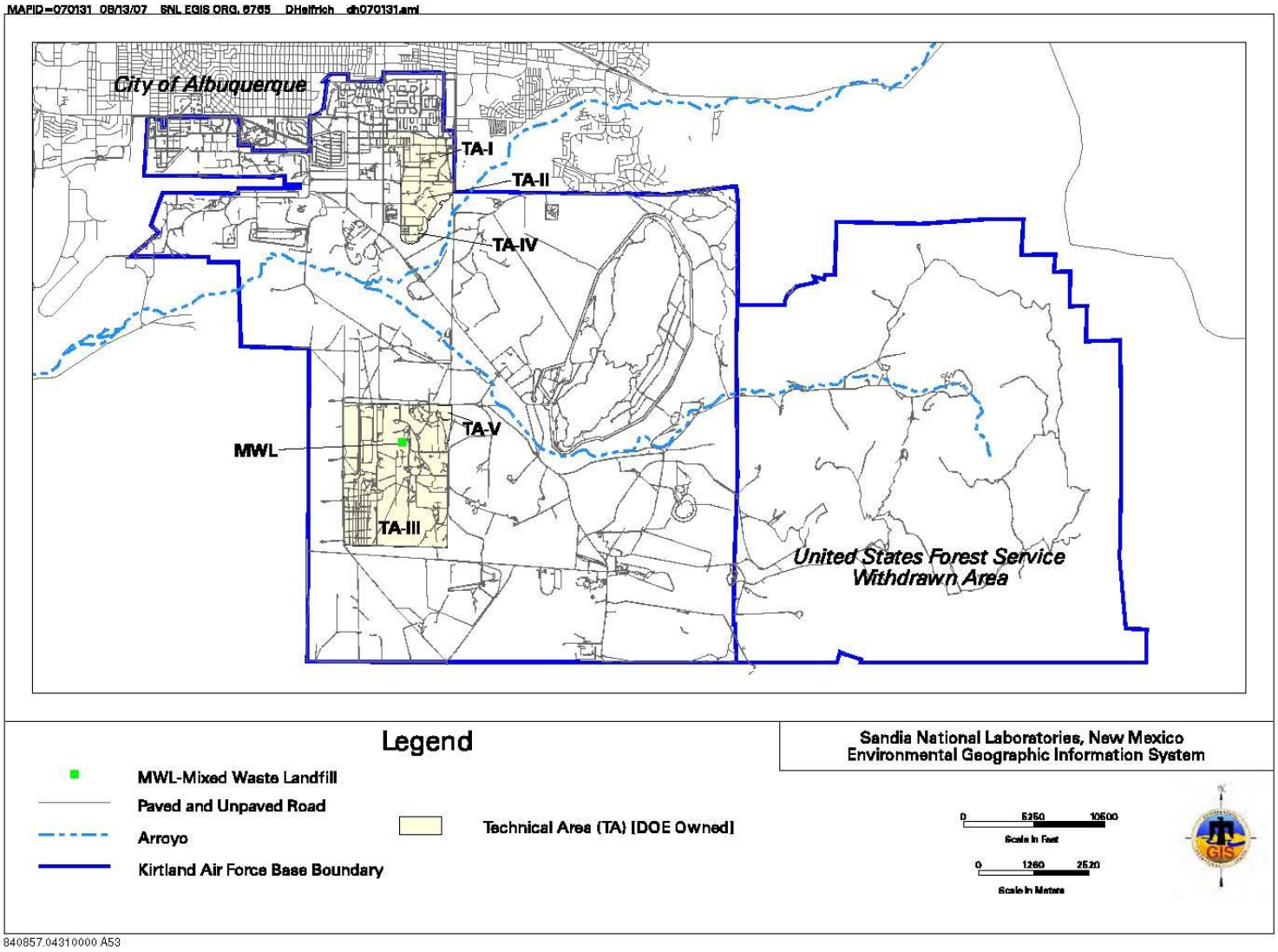

Figure 1-1
Location of the Mixed Waste Landfill at Sandia National Laboratories, New Mexico and Kirtland Air Force Base

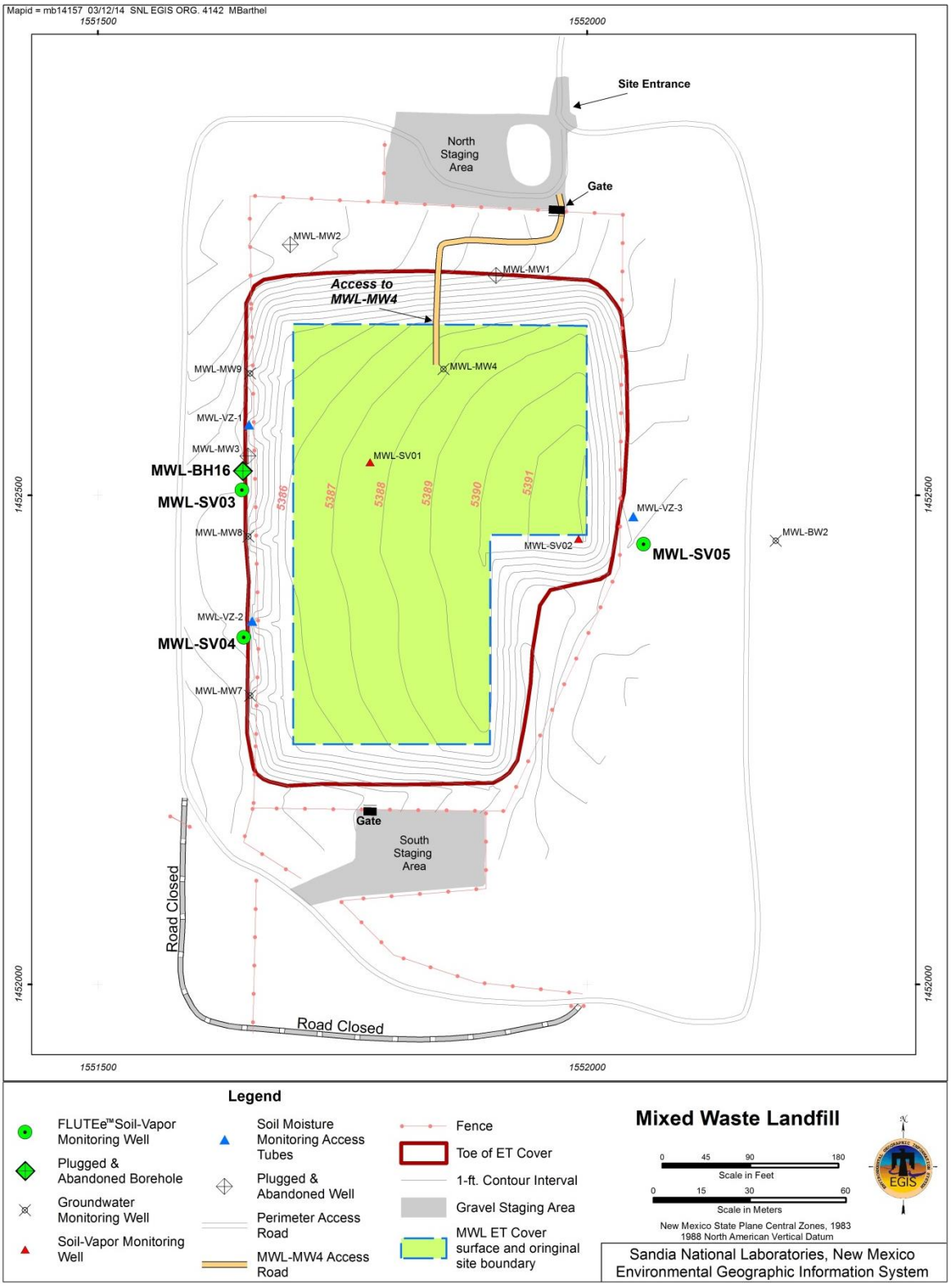

Figure 1-2
Location Map of Monitoring Wells at the Mixed Waste Landfill

The Work Plan (SNL/NM January 2014) outlined the activities and procedures for installing three multiport soil-vapor monitoring well at the MWL. The following tasks were specified in the Work Plan:

- Conduct the drilling and well-installation activities in accordance with the NMED-approved Work Plan using a drilling contractor licensed by the New Mexico Office of the State Engineer (NMOSE).
- Submit a Well Installation Report to the NMED that describes the field activities for the three soil-vapor monitoring wells within three months after completion of the wells.
- Verify that all sampling ports at the new three wells are functioning appropriately for future sampling to be conducted in accordance with the NMED-approved LTMMP Sampling and Analysis Plan after vadose zone equilibration.

This well-installation report satisfies the reporting requirements for the NMED as specified in the Order (NMED April 2004) by including the 27 reporting elements for each newly installed monitoring well (Appendix B). Because the three soil-vapor monitoring wells (MWL-SV03, MWL-SV04, and MWL-SV05) did not intercept groundwater, NMOSE well permits were not required. However, the procedures used at the MWL were in general accordance with the "Rules and Regulations Governing Well Driller Licensing; Construction, Repair, and Plugging of Wells" (NMOSE August 2005). The plugging of borehole MWL-BH16 (a failed first attempt at the MWL-SV03 FLUTe™ location described in Section 2.2) did not require an NMOSE permit because the borehole did not intercept groundwater.

The applicable SNL/NM Field Operating Procedures and accompanying Administrative Operating Procedures were used. Additional field documentation such as pages from the field logbook, equipment inspections, and safety records are on file at the SNL/NM Customer Funded Records Center.

The field activities were supervised by SNL/NM staff from ER Operations (Department 6234) and Long-Term Stewardship (Department 4142). The drilling contractor was Yellow Jacket Drilling Services, Inc. (YJ), an NMOSE-approved well driller operating under license WD-1458. Under subcontract with YJ, field engineers from Flexible Liner Underground Technology, Ltd.™ (FLUTe™) assisted in the installation of the three soil-vapor monitoring wells.

1.3 Report Organization

This report is organized as follows:

- Chapter 2.0 describes the drilling and installation of soil-vapor monitoring wells MWL-SV03, MWL-SV04, and MWL-SV05. The plugging of borehole MWL-BH16 is also discussed.
- Chapter 3.0 describes variances from the Work Plan.
- Chapter 4.0 lists the references cited in this report.

The following appendices provide supplemental information:

- Appendix A provides Lithologic Logs for Soil–Vapor Monitoring Wells MWL-SV03, MWL-SV04, and MWL-SV05.
- Appendix B contains the Well Construction Data Sheets for Soil–Vapor Monitoring Wells MWL-SV03, MWL-SV04, and MWL-SV05.
- Appendix C presents the Well Construction Diagrams for Soil–Vapor Monitoring Wells MWL-SV03, MWL-SV04, and MWL-SV05.
- Appendix D presents the Well Database Summary Forms for Soil–Vapor Monitoring Wells MWL-SV03, MWL-SV04, and MWL-SV05.
- Appendix E provides the Lithologic Log for Borehole MWL-BH16.
- Appendix F provides photographs of drilling and well-installation activities.

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2.0 SOIL-VAPOR MONITORING WELL INSTALLATION

The Soil-Vapor Monitoring Well Installation Work Plan (SNL/NM January 2014) allowed for the installation of two different types soil-vapor monitoring well designs at the MWL; either FLUTe™ borehole liners or stainless-steel tubing bundles. The FLUTe™ design was selected because of its simplicity. The impermeable borehole liner is pressed firmly against the borehole wall by clean silica sand that is installed into the center of the liner. The sand and impermeable liner design effectively isolate the discrete sampling intervals without requiring multiple lifts of bentonite chips, which are required as part of the stainless-steel tubing bundle design.

The following section describes the drilling and installation of soil-vapor monitoring wells MWL-SV03, MWL-SV04, and MWL-SV05. The plugging of borehole MWL-BH16 is also discussed.

2.1 Equipment Decontamination and Environmentally Sensitive Practices

Prior to the start of drilling at each borehole, the drilling equipment (rig, bits, drive casing, and pipe) was decontaminated with a pressure washer at the Environmental Resources Field Operations decontamination pad in TA-III. During drilling and well installation, environmentally sensitive protocols were used to ensure that the monitoring wells would produce representative soil-vapor samples at various depths from the vadose zone. For example, Bulls Eye® thread compound (a vegetable oil-based material) manufactured by Jet-Lube Inc. was used on the drill-pipe threads. Drill cuttings and other materials generated as part of the drilling and installation work were handled as specified in the project-specific waste management plan in accordance with applicable state and federal regulations.

2.2 Drilling Activities

Drilling activities began at the MWL on May 23, 2014. The chronology of events is summarized in Table 2-1. The four boreholes were drilled using the air rotary casing hammer (ARCH) technique using an 8.5-inch diameter tri-cone bit and 9.625-inch outside diameter (OD) drive casing. Three boreholes were converted to soil-vapor monitoring wells. All four boreholes were advanced using a GEFCO Speedstar 50K-CH drilling rig with its onboard air compressor (Figure 2-1). After encountering much difficulty drilling the MWL-BH16 borehole to the required total depth (TD) due to a zone of swelling clay, an improved drilling technique was used. For drilling at the other three locations, the potential effects of swelling clay was mitigated by: increasing the diameter of the drive shoe (the leading edge of the drive casing), using an additional stand-alone air compressor to aid in lifting the drill cuttings, and reducing the amount of misting water used for lifting the cuttings to the ground surface.

Figure 2-1
GEFCO Speedstar 50K-CH Drill Rig at Soil-Vapor Monitoring Well MWL-SV03 along the Western Perimeter Fence of the MWL

Table 2-1
Chronology of Drilling and Well Installation Events at the MWL

Location	Drilling Start Date	Drilling Stop Date	Total Depth of Borehole (ft bgs)	Liner Installation Beginning Date	Liner Installation Completion Date	Final Flow Test Date
MWL-BH16	May 23, 2014	May 28, 2014	324	n.a.	n.a.	n.a.
MWL-SV03	June 19, 2014	June 19, 2014	410	June 23, 2014	June 27, 2014	July 23, 2014
MWL-SV04	June 3, 2014	June 5, 2014	407	June 6, 2014	June 12, 2014	July 15, 2014
MWL-SV05	June 30, 2014	June 30, 2014	410	July 3, 2014	July 2, 2014	July 15, 2014

Note: Bentonite grout/chips were used on 4 days (June 13, June 16, June 23, and June 29, 2014) to plug borehole MWL-BH16.
bgs = Below ground surface.
ft = Foot (feet).
MWL = Mixed Waste Landfill.
n.a. = Not applicable.

The lithologic logs (Appendix A) for the four boreholes are based upon drill cuttings collected at the cyclone air-discharge outlet. The cuttings consisted of unconsolidated sediments corresponding to the alluvial-fan lithofacies of the Santa Fe Group. The cuttings were comprised mostly of poorly sorted sands and occasional sandy gravels that were derived from a variety of source rocks (limestone, sandstone, granite / granitic gneiss, and metamorphic units). Layers of silty/clayey sediments were intermittently observed, mostly below 340 feet (ft) below ground surface (bgs). At approximately 100 ft bgs in all of the boreholes, the strata characteristics changed from dry to moist. No wet (i.e., saturated) conditions were observed and groundwater was not encountered at any of the four drilling locations.

At the planned location for monitoring well MWL-SV03 as specified in the Work Plan (SNL/NM January 2014), many drilling difficulties were encountered. As explained below, the borehole at this location could not be advanced to the planned total depth. After discussing with NMED during a June 4, 2014 site visit to observe the drilling project, the following actions were agreed upon relative to the original MWL-SV03 drilling location.

- Decommission the failed borehole in accordance with typical borehole plugging and abandonment procedures.
- Drill and install well MWL-SV03 approximately 20 feet to the south (Figure 1-2).
- Document the change as a variance in the Well Installation Report

To minimize confusion, the originally planned location for the well was designated as borehole MWL-BH16, which is sequential with the list of historical MWL boreholes from the Phase 2 RCRA Facility Investigation.

The drilling difficulties at borehole MWL-BH16 were mostly the result of layers of swelling clay sporadically encountered at depths ranging from approximately 180 to 250 ft bgs. The swelling clay layers created so much friction against the drill casing that hammering the drive casing below 324 ft bgs could not be achieved. To adjust for the swelling clay, the drive casing was tripped out in preparation for using a larger diameter drill bit. During this process, a tri-cone bit was inadvertently dropped into the open borehole and fell to a depth of approximately

225 ft bgs. Video logging on June 2, 2014 showed that the bit was inverted in the borehole with the threads pointing downward. Efforts to retrieve the bit with a specially designed tool were unsuccessful. The retrieval effort pushed the bit to 250 ft bgs and resulted in borehole slough to 218 ft bgs. After discussing the situation with NMED staff at the MWL site on June 4, 2014, agreement was reached to plug the borehole with bentonite grout/chips. After tagging the borehole depth (i.e., top of slough) at 216 ft bgs on June 13, 2014, a 2-inch diameter, steel tremie pipe was used to fill the borehole from the 216 ft bgs depth up to 3 ft bgs with Quik-Grout® (Baroid-Halliburton bentonite grout). Over the following weekend, the grout dropped to 134 ft bgs as measured on June 16, 2014. Given the borehole characteristics, this drop in the grout level occurred because a significant amount of grout had flowed past the bit and down to the borehole TD (i.e., 324 ft bgs). The grout was topped off to the ground surface on June 16, 2014. The top of grout was measured at 35 ft bgs on June 17, 2014. On June 23, 2014, the top of grout was measured at 110 ft bgs suggesting that the some portion of grout had flowed into a porous horizon. On June 23, 2014, bentonite chips (Baroid-Halliburton Holeplug® 3/8-inch grade) were used to fill the borehole from 110 to 7 ft bgs. The chips were hydrated with potable water at approximately 5-ft intervals. The use of bentonite chips was intended to limit the hydraulic-head effects induced by a standing column of grout. On June 24, 2014, the top of bentonite chips was stable at 7 ft bgs. Quik-Grout was subsequently used on June 29, 2014 to fill the borehole from 7 to 0.5 ft bgs. A concrete pad was installed on July 8, 2014 over borehole MWL-BH16 that is similar to the monitoring-well pads (i.e., size and thickness of concrete).

The drilling of subsequent boreholes and the installation of soil-vapor monitoring wells MWL-SV03, MWL-SV04, and MWL-SV05 progressed more efficiently after implementing the use of a larger diameter drive shoe and a larger capacity, stand-alone air compressor. After setting up the drill rig and air compressor at a particular location, drilling of a borehole to TD required one to two days. Installation of a borehole liner required two to four days per location. Well construction details and diagrams are presented in Appendices B and C, respectively. The series of photographs in Appendix F illustrate the liner-installation procedure.

2.3 Well Installation Process

The well installation process used for each soil-vapor monitoring well is generally as follows:

- Using the ARCH technique, the drive casing was advanced to approximately 410 ft bgs. (Specific details for each monitoring well are listed on the Well Construction Data Sheets in Appendix B). Removal of cuttings from the drive casing was facilitated by intermittently injecting a mist of clean water (obtained from a nearby TA-III fire hydrant) into the drill string (drill pipe and bit).

- After reaching TD, additional water was injected into the drill string to remove any smeared clay from the interior of the drive casing.

- Air injection was used for at least one hour to thoroughly dry the interior of the drive casing.

- The drill string was extracted from the drive casing.

- The TD of the drive casing/borehole was tagged with a fiberglass tape measure.

- As needed, clean Colorado Silica Sand (CSS) 8x12 sand was used to raise the TD by a few ft.

- A 25-pound weight was attached to the lower end of the FLUTe™ borehole liner.

- The lower end of the borehole liner was uncoiled from the transport reel and inserted in the drive casing.

- The liner was allowed to slowly slide down to the desired TD by gravity alone. To reduce friction between the borehole liner and the PVC tremie pipe, approximately 5 pounds of talc (magnesium silicate powder) was used for each well location. The talc was hand applied to the exterior of the tremie pipe and by blowing talc into the tremie pipe using an electric leaf blower.

- A weight scale was used to determine that the borehole liner was properly suspended from the drill-rig mast and not stuck to the drive casing.

- A 4-inch diameter polyvinyl chloride (PVC) casing was inserted to the full depth of the liner. This approximately 400 ft length of PVC was subsequently used as a tremie pipe.

- Sand was hand poured into a funnel at the upper end of the PVC tremie pipe. Approximately 420 50-pound bags of CSS 8x12 sand were used per liner.

- The top of sand was tagged at approximately 3-ft intervals using a fiberglass tape measure. These measurements were used to verify that the sand had not bridged at too shallow of a depth. The sand serves to press the liner firmly against the borehole wall. As a result, the final-installed diameter of the liner is the borehole diameter (approximately 10.75 inches).

- As the sand was poured, the tremie pipe and drive casing were incrementally raised and removed from the borehole.

- After the sand was brought to 10 ft bgs, the final lengths of PVC tremie pipe and drive casing were removed from the borehole.

- A steel stovepipe was lowered over the liner and temporarily suspended from a fork lift as sand was poured along the outside of the liner up to 3 ft bgs.

- The stovepipe was lowered until the lower edge rested on the sand at 3 ft bgs.

- Sand was hand poured into the liner up to the ground surface.

- Wooden concrete forms and a square grid of steel rebar were installed around the stovepipe. Concrete was poured and hand trowelled. The pad dimensions were 3-ft by 3-ft by 10-inches thick. A brass ID marker stamped with the corresponding well name was inserted into the curing concrete. Three protective bollards were installed around the pad and set in concrete.

- After the concrete pad had cured overnight, the borehole liner was draped over the edge of the stovepipe and secured with a stainless-steel hose clamp. The base of the FLUTe™ protective cover (top hat) was bolted to stovepipe.

- Each piece of sample tubing was inserted into a Swagelok® pass-through fitting in the PVC well cap. Port numbers and depth values on the well cap correspond to the FLUTe™ manufacturing marks on the sample tubing.

- Flow testing was conducted using a vacuum pump drawing 22 inches of mercury (in. Hg) to verify that the sample ports were functional in accordance with the Work Plan (SNL/NM January 2014). The results are listed in Table 2-2. Each segment of sample tubing at all three monitoring wells flowed at an appropriate rate for obtaining representative soil-vapor samples based on tubing diameter and sampling interval depth. The flow rates varied from 8 to 57 standard cubic ft per hour. The flow rates decreased with depth at an anticipated function of increasing friction losses in the tubing.

- The FLUTe™ top hat was closed and secured with a pad lock.

2.4 FLUTe™ Well Design

The FLUTe™ well design is an innovative approach for obtaining representative soil-vapor samples from the vadose zone. The borehole liners were manufactured at the FLUTe™ facility in Velarde, New Mexico using specifications listed in the Work Plan (SNL/NM January 2014). The liners are constructed of ballistic nylon (denier 840) with an impermeable 0.6-mil (thousandth of an inch) urethane coating on the inner surface. Running lengthwise along the interior of each liner is a pair of tubing sleeves constructed of ballistic nylon (denier 210) with an impermeable 0.4-mil urethane coating on the inner surfaces. The sleeves contain the segments of sample tubing (0.25-inch OD high-density polyethylene [HDPE]. At the required spacing (50, 100, 200, 300, and 400 ft bgs), the lower ends of the sample tubing terminate at polyurethane feed-through fittings. Sample tubing is attached to the pass-through fitting with an oetiker clamp. The open end of each fitting is protected by a two-part permeable spacer that extends around the entire circumference of the liner and is 5 ft high. The five permeable spacers are constructed of low density polyethylene (LDPE) fabrics. The outer part consists of permeable filter fabric (uncoated denier 210) that covers a 0.25-inch thick layer of open-diamond fabric mesh. The permeable spacers (i.e., sample ports) allow soil vapor from 5-ft intervals to reach the corresponding feed-through fitting. The feed-through fittings are located at the vertical mid-point of the corresponding spacer.

2.5 Surveying

Surveying of the borehole and monitoring wells with sub-meter accuracy was conducted using the Global Positioning System and a hand-held Trimble GeoXH receiver. These preliminary coordinates and elevations are listed on the corresponding Well Construction Data Sheets (Appendix B) and the Well Database Summary Forms (Appendix D). The northing and easting coordinates for the center of each borehole and monitoring well are provided in New Mexico Central Zone State Plane coordinates based upon the North American Datum of 1983. The elevations are based upon the North American Vertical Datum of 1988.

Table 2-2
Summary of Construction Details for the FLUTe™ Soil-Vapor Monitoring Wells at the MWL

Well ID No.	Sampling Port ID No.	Depth of Feed-through Fitting (ft, bgs)	Top of Permeable Spacer (ft bgs)	Bottom of Permeable Spacer (ft bgs)	Tested flow rate (scfh)	Resulting vacuum (in. Hg)	Length of Tubing (ft)	Volume of Tubing (ft^3)	Volume of Permeable Spacer (ft^3)	Total Volume of Tubing and Permeable Spacer (ft^3)
MWL-SV03	50	47	44.5	49.5	51	-9	51	0.0080	0.3178	0.3258
	100	97	94.5	99.5	47	-12	101	0.0159	0.3178	0.3337
	200	197	194.5	199.5	39	-14	201	0.0317	0.3178	0.3495
	300	297	294.5	299.5	15	-20.5	301	0.0474	0.3178	0.3652
	400	397	394.5	399.5	8	-20.5	401	0.0632	0.3178	0.3810
MWL-SV04	50	47	44.5	49.5	47	-14	51	0.0080	0.3178	0.3258
	100	97	94.5	99.5	44	-14	101	0.0159	0.3178	0.3337
	200	197	194.5	199.5	35	-16	201	0.0317	0.3178	0.3495
	300	297	294.5	299.5	34	-16	301	0.0474	0.3178	0.3652
	400	397	394.5	399.5	30	-17	401	0.0632	0.3178	0.3810
MWL-SV05	50	49.5	47	52	57	-13	51.5	0.0081	0.3178	0.3259
	100	99.5	97	102	40	-16	101.5	0.0160	0.3178	0.3338
	200	199.5	197	202	38	-16	201.5	0.0317	0.3178	0.3495
	300	299.5	297	302	34	-17	301.5	0.0475	0.3178	0.3653
	400	399.5	397	402	32	-19	401.5	0.0633	0.3178	0.3811

bgs = Below ground surface.
FLUTe™ = Flexible Liner Underground Technology, Ltd.™
ft = Foot (feet).
ft^3 = Cubic foot (cubic feet).
ID No. = Identification Number.
in. Hg = Inches of mercury.
MWL = Mixed Waste Landfill.
scfh = Standard cubic feet per hour.

More accurate land surveying is scheduled for obtaining northing/easting coordinates and elevations with accuracy of 0.01 ft. Registered surveyors from Surveying Control Inc. will conduct the surveying. The more accurate coordinates and elevations will be incorporated in the SNL/NM Environmental Data Management System and subsequent reports. The final land survey information will not affect the sample-port depth information summarized in Table 2-2 and the completion figures provided in Appendices B and C. However, the respective elevations will be updated as noted above.

3.0 VARIANCES FROM WORK PLAN

As mentioned in Section 2.2, the location for monitoring well MWL-SV03 was moved 20 ft to the south from the location specified in the Work Plan (SNL/NM January 2014). This places monitoring well MWL-SV03 in an undisturbed location with respect to the MWL-BH16 borehole (drilling and decommissioning). This relocation of MWL-SV03 and the decommissioning of borehole MWL-BH16 are variances that were discussed with NMED staff during their on-site visit on June 4, 2014. The Work Plan allowed for up to a 10-foot relocation to account for logistical issues. The 20-foot movement was agreed upon to ensure the MWL-SV03 monitoring well would not be adversely impacted by the MWL-BH16 borehole. The lateral distance between the monitoring well and the MWL perimeter fence remains the same (Figure 1-2).

No other variances from the Work Plan occurred. The other two monitoring wells (MWL-SV04, and MWL-SV05) were installed within one ft of the corresponding planned locations. The sampling ports for the three monitoring wells are installed within 3 vertical ft of the planned depths.

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4.0 REFERENCES

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NMED, see New Mexico Environment Department.

NMOSE, see New Mexico Office of the State Engineer.

SNL/NM, see Sandia National Laboratories, New Mexico.

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APPENDIX A
Lithologic Logs for Soil-Vapor Monitoring Wells MWL-SV03, MWL-SV04, and MWL-SV05

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-SV03	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: 404 FT BGS	OWNER NAME: U.S. DOE	DATE STARTED: 19 June 2014
GROUND ELEVATION: 5,380** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 19 June 2014
BOREHOLE DEPTH: 410 FT BGS	DTW: Not Applicable (NA)	WELL COMPLETED: 23 July 2014
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 1 of 5
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
0	Ground surface, SW, sand, poorly sorted, light to medium brown, 7.5 YR_7/6, dry. 90% very fine grain to pebbly sand, 10% silt and clay. Source rocks: mostly granitic, few metamorphics (quartzite), minor mafics. Subangular to subrounded grains.		
10	10 ft, SW, sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 90% very fine grain to pebbly sand, 10% silt and clay. Source rocks: mostly granitic, few metamorphics (quartzite), minor mafics. Subangular to subrounded grains.		SW
20	20 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 40% very fine to medium sand, 30% coarse to pebbly sand, 30% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Angular to subrounded grains.		SC
30			
40	40 ft, SW, sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 60% coarse to pebbly sand, 30% very fine to medium sand, 10% silt and clay. Source rocks: mostly metamorphics (quartzite and greenstone), lesser granitic, sandstone, and limestone, minor mafics. Angular to subrounded grains. Pebbles are mostly angular quartzite.		
50			
60	60 ft, SW, sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 60% coarse to pebbly sand, 35% fine to medium sand, 5% silt and clay. Source rocks: mostly metamorphics (quartzite and lesser greenstone), lesser granitic, limestone, minor mafics. Subangular to subrounded grains. Occasional angular quartzite gravel up to 2-inch diameter.		SW
70			
80	80 ft, SW, sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 70% very fine to medium sand, 25% coarse to pebbly sand, 5% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), sandstone, minor mafics. Subangular to subrounded grains.		
90			
100			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
** Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,380** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1551647.52** Easting: 1452505.31**

146239.02002000_MWL-SV03.A1

Date: 8/19/14

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-SV03	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: 404 FT BGS	OWNER NAME: U.S. DOE	DATE STARTED: 19 June 2014
GROUND ELEVATION: 5,380** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 19 June 2014
BOREHOLE DEPTH: 410 FT BGS	DTW: Not Applicable (NA)	WELL COMPLETED: 23 July 2014
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 2 of 5
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
100	100 ft, SW, sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 60% medium to coarse sand, 35% pebbly sand to gravel, 5% silt and clay. Source rocks: metamorphics (quartzite and greenstone), granitic, minor mafics. Subangular to subrounded grains. Occasional limestone gravel up to 1.5-inch diameter.		
110			
120	120 ft, SW, and, poorly sorted, medium brown, 7.5 YR_7/4, moist. 75% medium to pebbly sand, 20% very fine to medium sand, 5% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), minor mafics. Subangular to subrounded grains. Occasional granitic and metamorphics gravels up to 1.5-inch diameter.		
130			SW
140	140 ft, SW, sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 50% fine to medium sand, 40% coarse to pebbly sand, 10% silt and clay. Source rocks: granitic, metamorphics (quartzite, greenstone, phyllite, and schist), minor mafics. Subangular to subrounded grains.		
150			
160	160 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 60% fine to medium sand, 20% coarse to pebbly sand, 20% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), minor mafics. Subangular to subrounded grains.		
170			SC
180	180 ft, SW, gravelly sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 65% fine to coarse sand, 25% gravel, 10% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains.		
190			SW
200			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
** Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,380** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1551647.52** Easting: 1452505.31**

146239.02002000_MWL-SV03.A2

Date: 8/19/14

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-SV03	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: 404 FT BGS	OWNER NAME: U.S. DOE	DATE STARTED: 19 June 2014
GROUND ELEVATION: 5,380** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 19 June 2014
BOREHOLE DEPTH: 410 FT BGS	DTW: Not Applicable (NA)	WELL COMPLETED: 23 July 2014
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 3 of 5
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
200	200 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 60% fine to medium sand, 20% coarse to pebbly sand, 20% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), minor mafics. Subangular to subrounded grains.		
210			
220	220 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 60% fine to medium sand, 20% coarse to pebbly sand, 20% silt and clay. Source rocks: predominantly granitic, lesser metamorphics (quartzitic and granitic), and limestone, minor mafics. Subangular to subrounded grains. Occasional limestone gravel up to 0.75-inch diameter.		SC
230			
240	240 ft, SW, gravelly sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 55% coarse to pebbly sand, 30% fine to medium sand, 10% gravel, 5% silt and clay. Source rocks: predominantly metamorphics (quartzite, greenstone, phyllite, and schist) and granitic, few limestone and sandstone, minor mafics. Subangular to subrounded grains. Gravel is solely limestone up to 0.75-inch diameter.		SW
250			
260	260 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 50% fine to medium sand, 25% coarse to pebbly sand, 25% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), and sandstone, few limestone, minor mafics. Subangular to subrounded grains.		SC
270			
280	280 ft, SW, sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 60% fine to medium sand, 25% coarse sand, 15% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains.		SW
290			
300			

No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
** Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,380** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1551647.52** Easting: 1452505.31**

146239.02002000_MWL-SV03.A3

Date: 8/19/14

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-SV03	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: 404 FT BGS	OWNER NAME: U.S. DOE	DATE STARTED: 19 June 2014
GROUND ELEVATION: 5,380** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 19 June 2014
BOREHOLE DEPTH: 410 FT BGS	DTW: Not Applicable (NA)	WELL COMPLETED: 23 July 2014
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 4 of 5
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
300	300 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 60% fine to medium sand, 20% coarse sand, 20% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, minor mafics. Subangular to subrounded grains.		
310			
320	320 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 50% very fine to medium sand, 30% coarse to pebbly sand, 20% silt and clay (increased plasticity). Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, and sandstone, minor mafics. Subangular to subrounded grains.		SC
330			
340	340 ft, CL, sandy clay, moderately sorted, medium brown, 7.5 YR_7/4, moist. 85% silt and clay, 10% very fine to medium sand, 5% coarse sand. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains.		CL
350			
360	360 ft, SC, clayey sand, moderately sorted, light brown, 7.5 YR_7/6, moist. 80% silt and clay, 10% very fine to medium sand, 10% coarse sand. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains.		
370			
380	380 ft, SC, clayey sand, moderately sorted, light brown, 7.5 YR_7/6, moist. 80% silt and clay, 10% very fine to medium sand, 10% coarse sand. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains.		SC
390			
400			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
** Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,380** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1551647.52** Easting: 1452505.31**

146239.02002000_MWL-SV03.A4

Date: 8/19/14

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-SV03	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: 404 FT BGS	OWNER NAME: U.S. DOE	DATE STARTED: 19 June 2014
GROUND ELEVATION: 5,380** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 19 June 2014
BOREHOLE DEPTH: 410 FT BGS	DTW: Not Applicable (NA)	WELL COMPLETED: 23 July 2014
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 5 of 5
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
400	400 ft, SC, clayey sand, poorly sorted, light brown, 7.5 YR_7/6, moist. 80% silt and clay, 10% very fine to medium sand, 10% coarse sand. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains. Occasional metamorphics (quartzite and greenstone) gravel up to 0. 5-inch diameter.		
410	410 ft, SC, clayey sand, poorly sorted, light brown, 7.5 YR_7/6, moist. 80% silt and clay, 10% very fine to medium sand, 10% coarse sand. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains. Borehole total depth.		SC
420			
430			
440			
450			
460			
470			
480			
490			
500			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
** Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,380** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1551647.52** Easting: 1452505.31**

146239.02002000_MWL-SV03.A5

Date: 8/19/14

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Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-SV04	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: 404 FT BGS	OWNER NAME: U.S. DOE	DATE STARTED: 3 June 2014
GROUND ELEVATION: 5,380** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 5 June 2014
BOREHOLE DEPTH: 407 FT BGS	DTW: Not Applicable (NA)	WELL COMPLETED: 15 July 2014
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 1 of 5
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
0	Ground surface, SW, sand, poorly sorted, light to medium brown, 7.5 YR_7/6, dry. 90% very fine grain to pebbly sand, 10% clay and silt. Source rocks: mostly granitic, few metamorphics (quartzite), sandstone, minor mafics. Subangular to subrounded grains.		
10	10 ft, SW, sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 90% very fine grain to pebbly sand, 10% clay and silt. Source rocks: mostly granitic, few metamorphics (quartzite), sandstone, minor mafics. Subangular to subrounded grains.		SW
20			
30	30 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 65% coarse to pebbly sand, 10% very fine to medium sand, 25% clay and silt. Source rocks: mostly granitic, few metamorphics (quartzite), sandstone, minor mafics. Subangular to subrounded grains. Occasional limestone gravel to 2-inch diameter.		
40	40 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 65% coarse to pebbly sand, 10% very fine to medium sand, 25% clay and silt. Source rocks: mostly granitic, few metamorphics (quartzite), sandstone, minor mafics. Subangular to subrounded grains.		
50			
60	60 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 70% very fine to pebbly sand, 30% clay and silt. Source rocks: granitic, metamorphics (quartzite and greenstone), sandstone, limestone, minor mafics. Subangular to subrounded grains.		SC
70			
80	80 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 75% coarse to pebbly sand, 25% clay and silt. Source rocks: granitic, metamorphics (quartzite and greenstone), sandstone, minor mafics. Subangular to subrounded grains.		
90			
100			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
** Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,380** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1551649.18** Easting: 1452354.66**

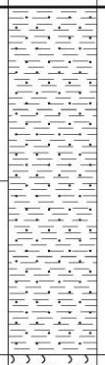
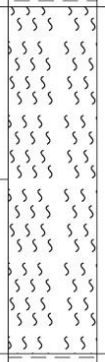
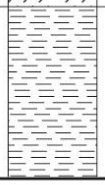
146239.02002000_MWL-SV04.A1

Date: 8/19/14

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-SV04	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: 404 FT BGS	OWNER NAME: U.S. DOE	DATE STARTED: 3 June 2014
GROUND ELEVATION: 5,380** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 5 June 2014
BOREHOLE DEPTH: 407 FT BGS	DTW: Not Applicable (NA)	WELL COMPLETED: 15 July 2014
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 2 of 5
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
100	100 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 60% coarse to pebbly sand, 40% clay and silt. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains.		SC
120	120 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 70% medium to pebbly sand, 30% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains. Occasional limestone gravel to 0.75-inch diameter.		
140	140 ft, ML, clay, medium brown, 7.5 YR_7/4, moist. 90% clay and silt, 10% fine to coarse sand. Source rocks: granitic, limestone, metamorphics (quartzite), minor mafics. Subangular to subrounded grains.		ML
160	160 ft, ML, clay, low plasticity, medium brown, 7.5 YR_7/4, moist. 90% clay and silt, 10% fine to coarse sand. Source rocks: granitic, limestone, metamorphics (quartzite), minor mafics. Subangular to subrounded grains.		
180	180 ft, CL, sandy clay, medium brown, 7.5 YR_7/4, moist. 75% silt and clay, 25% very fine grain to coarse sand. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains.		CL
200			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
** Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,380** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1551649.18** Easting: 1452354.66**

146239.02002000_MWL-SV04.A2

Date: 8/19/14

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-SV04	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: 404 FT BGS	OWNER NAME: U.S. DOE	DATE STARTED: 3 June 2014
GROUND ELEVATION: 5,380** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 5 June 2014
BOREHOLE DEPTH: 407 FT BGS	DTW: Not Applicable (NA)	WELL COMPLETED: 15 July 2014
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 3 of 5
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
200	200 ft, SP, sand, well sorted, medium brown, 7.5 YR_7/4, moist. 80% fine sand, 10% medium to coarse sand, 10% silt and clay. Source rocks: granitic, metamorphics, (greenstone, phyllite and schist) limestone, sandstone, minor mafics. Subangular to subrounded grains.		SP
220	220 ft, SW, sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 80% fine to coarse sand, 10% pebbles, 10% silt and clay. Source rocks: predominantly sandstone fragments, lesser granitic, limestone, minor mafics. Subangular to subrounded grains.		SW
240	240 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 70% very fine to pebbly sand, 30% silt and clay. Source rocks: predominant metamorphics (quartzite and greenstone), few granitic, limestone, sandstone, minor mafics. Subangular to subrounded grains.		SC
260	260 ft, SM, sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 60% fine sand, 25% coarse sand to small gravel, 15% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains.		SM
280	280 ft, SM, sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 60% fine sand, 30% coarse sand to small gravel, 10% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), sandstone, minor mafics. Subangular to subrounded grains.		
290			
300			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
** Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,380** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1551649.18** Easting: 1452354.66**

146239.02002000_MWL-SV04.A3

Date: 8/19/14

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-SV04	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: 404 FT BGS	OWNER NAME: U.S. DOE	DATE STARTED: 3 June 2014
GROUND ELEVATION: 5,380** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 5 June 2014
BOREHOLE DEPTH: 407 FT BGS	DTW: Not Applicable (NA)	WELL COMPLETED: 15 July 2014
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 4 of 5
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
300	300 ft, SW, sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 85% fine to coarse sand, 10% very fine sand, 5% clay and silt, few pebbles. Source rocks: mostly granitic and metamorphics (quartzite and greenstone), few sandstone, minor mafics. Subangular to subrounded grains.		SW
320	320 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 50% very fine to medium sand, 30% coarse to pebbly sand, 20% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains.		
340	340 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 50% very fine to medium sand, 30% coarse sand, 20% silt and clay, few pebbles. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains.		SC
360	360 ft, SC, clayey sand, poorly sorted, light brown, 7.5 YR_7/6, moist. 70% very fine to coarse sand, 30% clay and silt, few pebbles. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains.		
380	380 ft, CL, clay, low plasticity, light brown, 7.5 YR_7/6, moist. 90% clay and silt, 10% very fine sand.		CL
400			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
** Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,380** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1551649.18** Easting: 1452354.66**

146239.02002000_MWL-SV04.A4

Date: 8/19/14

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-SV04	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: 404 FT BGS	OWNER NAME: U.S. DOE	DATE STARTED: 3 June 2014
GROUND ELEVATION: 5,380** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 5 June 2014
BOREHOLE DEPTH: 407 FT BGS	DTW: Not Applicable (NA)	WELL COMPLETED: 15 July 2014
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 5 of 5
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
400	400 ft, CL, clay, low plasticity, light brown, 7.5 YR_7/6, moist. 90% clay and silt, 10% very fine sand.		CL
410	407 ft, CL, clay, low plasticity, light brown, 7.5 YR_7/6, moist. 90% clay and silt, 10% very fine sand. Total depth of borehole.		
420			
430			
440			
450			
460			
470			
480			
490			
500			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
** Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,380** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1551649.18** Easting: 1452354.66**

146239.02002000_MWL-SV04.A5

Date: 7/22/14

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Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-SV05	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: 406.5 FT BGS	OWNER NAME: U.S. DOE	DATE STARTED: 30 June 2014
GROUND ELEVATION: 5,387** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 30 June 2014
BOREHOLE DEPTH: 410 FT BGS	DTW: Not Applicable (NA)	WELL COMPLETED: 15 July 2014
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 1 of 5
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
0	Ground surface, SW, and, poorly sorted, light to medium brown, 7.5 YR_7/6, dry. 80% very fine grain to medium sand, 10% coarse to pebbly sand, 10% silt and clay. Source rocks: granitic, metamorphics (quartzite), limestone, minor mafics. Subangular to subrounded grains. Few caliche nodules.		SW
10	10 ft, SW, sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 80% very fine grain to medium sand, 10% coarse to pebbly sand, 10% silt and clay. Source rocks: granitic, metamorphics (quartzite), limestone, minor mafics. Subangular to subrounded grains. Few caliche nodules.		
20			
30	30 ft, SW, sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 80% very fine grain to medium sand, 10% coarse to pebbly sand, 10% silt and clay. Source rocks: predominantly granitic, few metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains.		
40	40 ft, SW, gravelly sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 75% medium to coarse sand, 10% gravel, 10% very fine to fine sand, 5% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, minor mafics. Angular to subrounded grains. Gravel up to 0.5-inch diameter.		
50			
60	60 ft, SW, sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 75% medium to coarse sand, 10% gravel, 10% very fine to fine sand, 5% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, minor mafics. Subangular to subrounded grains.		
70			
80	80 ft, SW, sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 75% medium to coarse sand, 10% gravel, 10% very fine to fine sand, 5% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, minor mafics. Subangular to subrounded grains.		
90			
100			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
** Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,387** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1552058.06** Easting: 1452449.91**

146239.02002000_MWL-SV05.A1

Date: 8/19/14

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-SV05	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: 406.5 FT BGS	OWNER NAME: U.S. DOE	DATE STARTED: 30 June 2014
GROUND ELEVATION: 5,387** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 30 June 2014
BOREHOLE DEPTH: 410 FT BGS	DTW: Not Applicable (NA)	WELL COMPLETED: 15 July 2014
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 2 of 5
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
100	100 ft, SW, sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 60% fine to medium sand, 30% coarse to pebbly sand, 10% silt and clay. Source rocks: mostly limestone, lesser granitic, metamorphics (quartzite and greenstone), sandstone, minor mafics. Subangular to subrounded grains. Gravel up to 0.75-inch diameter.		SW
120	120 ft, GW sandy gravel, poorly sorted, medium brown, 7.5 YR_7/4, moist. 50% medium to pebbly sand, 30% gravel, 10% very fine to fine grain sand, 10% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, few sandstone, minor mafics. Angular to subrounded grains. Occasional granitic and limestone gravels up to 0.75-inch diameter.		GW
140	140 ft, SW, sand, medium brown, 7.5 YR_7/4, moist. 70% very fine to fine sand, 10% coarse sand, 20% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains.		
160	160 ft, SW, Sand, medium brown, 7.5 YR_7/4, moist. 70% fine grain to coarse sand, 10% pebbly sand to gravel, 20% silt and clay. Source rocks: granitic, limestone, metamorphics (quartzite), minor mafics. Angular to subrounded grains. Few quartzite gravels up to 2-inch diameter.		SW
180	180 ft, SW, Gravelly sand, medium brown, 7.5 YR_7/4, moist. 45% very fine grain to medium sand, 25% coarse sand, 20% gravel, 10% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, few sandstone, minor mafics. Subangular to subrounded grains. Occasional quartzitic gravel up to 0.75-inch diameter and limestone gravel up to 1-inch diameter.		
200			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
** Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,387** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1552058.06** Easting: 1452449.91**

146239.02002000_MWL-SV05.A2

Date: 8/19/14

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-SV05	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: 406.5 FT BGS	OWNER NAME: U.S. DOE	DATE STARTED: 30 June 2014
GROUND ELEVATION: 5,387** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 30 June 2014
BOREHOLE DEPTH: 410 FT BGS	DTW: Not Applicable (NA)	WELL COMPLETED: 15 July 2014
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 3 of 5
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
200	200 ft, SM, sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 70% very fine to fine sand, 10% medium to coarse sand, 20% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, few sandstone, minor mafics. Subangular to subrounded grains.		
210			
220	220 ft, SM, coarse sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 50% very fine to fine sand, 20% medium to coarse sand, 10% gravel, 20% silt and clay. Source rocks: predominantly granitic and limestone, lesser metamorphics (quartzitic and granitic), few sandstone, minor mafics. Subangular to subrounded grains. Occasional limestone gravel up to 0.75-inch diameter.		
230			
240	240 ft, SM, sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 45% very fine to medium sand, 10% coarse sand, 10% pebbly sand, 35% silt and clay. Source rocks: predominantly metamorphics (quartzite, greenstone, phyllite, and schist) and granitic, few limestone and sandstone, minor mafics. Angular to subrounded grains.		SM
250			
260	260 ft, SM, sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 60% very fine to medium sand, 20% coarse to pebbly sand, 20% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains.		
270			
280	280 ft, SW, gravelly sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 40% very fine to fine sand, 30% medium to coarse sand, 10% gravel, 20% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), few sandstone, minor mafics. Subangular to subrounded grains. Occasional granitic gravel up to 0.75-inch diameter, limestone gravel up to 0.5-inch diameter, metamorphics gravel up to 1-inch diameter, and limestone gravel up to 0.5-inch diameter.		SW
290			
300			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
** Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,387** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1552058.06** Easting: 1452449.91**

146239.02002000_MWL-SV05.A3

Date: 8/19/14

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-SV05	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: 406.5 FT BGS	OWNER NAME: U.S. DOE	DATE STARTED: 30 June 2014
GROUND ELEVATION: 5,387** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 30 June 2014
BOREHOLE DEPTH: 410 FT BGS	DTW: Not Applicable (NA)	WELL COMPLETED: 15 July 2014
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 4 of 5
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
300	300 ft, SM, sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 70% very fine to medium sand, 10% coarse to pebbly sand, 20% silt and clay. Source rocks: granitic, limestone, and metamorphics (quartzite and greenstone), few sandstone, minor mafics. Subangular to rounded grains. Occasional quartzite gravel up to 0.75-inch diameter.		
310			
320	320 ft, SM, sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 70% very fine to medium sand, 10% coarse sand, 20% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, and sandstone, minor mafics. Subangular to rounded grains.		
330			SM
340	340 ft, SM, sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 70% very fine to medium sand, 10% coarse sand, 20% silt and clay. Source rocks: mostly granitic, lesser metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains.		
350			
360	360 ft, SC, clayey sand, poorly sorted, light brown, 7.5 YR_7/6, moist. 70% very fine to coarse sand, 30% silt and clay. Source rocks: mostly granitic, lesser metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains.		
370			
380	380 ft, SC, clayey sand, poorly sorted, light brown, 7.5 YR_7/6, moist. 70% very fine to coarse sand, 30% silt and clay. Source rocks: mostly granitic, lesser metamorphics (quartzite and greenstone), limestone, minor mafics. Subangular to subrounded grains.		SC
390			
400			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
** Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,387** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1552058.06** Easting: 1452449.91**

146239.02002000_MWL-SV05.A4

Date: 8/19/14

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-SV05	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: 406.5 FT BGS	OWNER NAME: U.S. DOE	DATE STARTED: 30 June 2014
GROUND ELEVATION: 5,387** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 30 June 2014
BOREHOLE DEPTH: 410 FT BGS	DTW: Not Applicable (NA)	WELL COMPLETED: 15 July 2014
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 5 of 5
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
400	400 ft, SC, clayey sand, well sorted, light brown, 7.5 YR_7/6, moist. 70% very fine sand, 30% silt and clay. Subangular to subrounded grains.		SC
410	410 ft, SC, clayey sand, well sorted, light brown, 7.5 YR_7/6, moist. 70% very fine sand, 30% silt and clay. Subangular to subrounded grains. Borehole total depth.		
420			
430			
440			
450			
460			
470			
480			
490			
500			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
** Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,387** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1552058.06** Easting: 1452449.91**

146239.02002000_MWL-SV05.A5

Date: 8/19/14

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APPENDIX B
Well Construction Data Sheets for Soil-Vapor Monitoring Wells
MWL-SV03, MWL-SV04, and MWL-SV05

Well Construction Data Sheet for MWL-SV03
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
1. Well name/number	MWL-SV03. Soil-vapor monitoring well with a borehole liner manufactured by Flexible Liner Underground Technology, Ltd.™ (FLUTe™).
2. Date of well construction	FLUTe™ liner installation completed on 27 June 2014. Installation of FLUTe™ well cap and acceptance flow test of 23 July 2014 is completion date.
3. Drilling method	Air rotary casing hammer. Drilling (air injection) completed on 19 June 2014.
4. Drilling contractor and name of driller	Yellow Jacket (YJ) Drilling Services, Inc., Randall Hatfield. GEFCO Speedstar 50K-CH, serial number 907609, YJ rig #121.
5. Borehole diameter and well casing diameter	Borehole: 10.75-inch OD drive shoe (leading end of drive casing) from 0 to 410 ft bgs. Casing (FLUTe™ liner): constructed of 11-inch diameter, ballistic nylon fabric. Final-installed diameter of the liner is the borehole diameter.
6. Well depth	Bottom edge of borehole liner set at 404 ft bgs. Top edge of liner set at 3 ft above grade.
7. Casing length	407 ft, from lower edge of end weight to upper edge of borehole liner in monument (stovepipe).
8. Casing materials	Liner constructed of ballistic nylon (denier 840) with impermeable 0.6-mil urethane coating on inner surface. Tubing sleeves constructed of ballistic nylon (denier 210) with impermeable 0.4-mil urethane coating on inner surface. Sample tubing (0.25-inch diameter high-density polyethylene [HDPE] runs vertically in sleeves. End weight (4.5-inch OD, capped PVC pipe, 25-lb ballast) inserted in lower end of liner and secured with stainless-steel hose clamps and 10-mil PASCO No. 9052, 2-inch wide PVC pipe-wrap tape. Liner filled with 436 bags (50-lbs each) of CSS 8x12 sand from end weight up to ground surface.
9. Casing and screen joint type	Continuous piece of 11-inch diameter flexible borehole liner. Sleeves and spacers were fused to liner using radio-frequency welding and nylon stitching in factory. No adhesives used.
10. Screened interval	Five permeable spacers on outside of liner: 44.5 to 49.5 ft bgs, 94.5 to 99.5 ft bgs, 194.5 to 199.5 ft bgs, 294.5 to 299.5 ft bgs, and 394.5 to 399.5 ft bgs.
11. Screen materials	Two-part permeable spacers are constructed of low density polyethylene (LDPE). The outer part consists of permeable filter fabric (uncoated denier 210) that covers a 0.25-inch thick layer of open-diamond fabric mesh. Each segment of sample tubing terminates at a feed-through fitting set at the mid-point of corresponding spacer. Each spacer surrounds entire circumference of the liner.

Well Construction Data Sheet for MWL-SV03 (Continued)
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
12. Screen slot size and design	n.a. (not applicable)
13. Filter pack material and gradation	n.a.
	n.a.
14. Filter pack volume (calculated and actual)[b]	n.a.
	n.a.
15. Filter pack placement method	n.a.
16. Filter pack interval(s)	n.a.
17. Annular sealant composition	n.a.
18. Annular sealant placement method	n.a.
19. Annular sealant volume (calculated and actual)	Calculated: n.a.
	Actual: n.a.
20. Annular sealant interval(s)	n.a.
21. Surface sealant composition	Duke City Redi-Mix Inc. delivery truck with 4,000 psi concrete. Square pattern of 0.5-inch rebar.
22. Surface seal placement method	Hand troweled.
23. Surface sealant volume (calculated and actual)	Calculated: 7.5 ft^3 (pad)
	Actual: 7.5 ft^3 (pad)
24. Surface sealant interval	Above grade concrete pad
25. Surface seal and well apron design and construction	3-ft by 3-ft by 10-inch-thick concrete pad. Three concrete-filled 3-inch diameter steel bollards. Concrete collar along stovepipe extends to 2 ft bgs.
26. Well development procedure and turbidity measurements	n.a.
27. Well development purge volume(s) and stabilization parameter measurements	n.a.
28. Type and design and construction of protective casing	6-ft length of 10.75-inch OD carbon steel surface casing. Extends 3 ft above ground surface. Monument capped with FLUTe™ metal enclosure (“top hat”). Well cap (1.5 ft length of 6-inch ID, PVC pipe) has five pass-through Swagelok® fittings. Quick-connect Swagelok® fittings with sampling interval identified are attached to each segment of tubing for sample collection.
29. Well cap and lock	FLUTe™ enclosure with padlock.
30. Ground surface elevation	5,380* ft amsl, datum for sampling ports
31. Survey reference point elevation on well casing	n.a.
32. Top of monitoring well casing elevation	n.a.
33. Top of protective steel casing elevation	n.a.
34. Name of geologist	John R. Copland

Well Construction Data Sheet for MWL-SV03 (Concluded)
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
35. Initial water level	n.a.
36. Final water level	n.a.
37. Date of well development	n.a.

[a]New Mexico Environment Department, April 2004. "Compliance Order on Consent Pursuant to the New Mexico Hazardous Waste Act," § 74-4-10, New Mexico Environment Department, Santa Fe, New Mexico.
[b]Filter pack volume for a groundwater well is defined as the total volume of filter-pack sand placed in well annulus (adjacent to the casing, screen, and sump) and below the sump (if applicable).

amsl = Above mean sea level.
bgs = Below ground surface.
CSS = Colorado Silica Sand (Oglebay Norton Industrial Sands Inc.).
FLUTe™ = Flexible Liner Underground Technology, Ltd.™
ft = Foot (feet).
ft^3 = Cubic foot (cubic feet).
HDPE = High density polyethylene.
ID = Inside diameter.
lb = Pounds.
LDPE = Low density polyethylene.
mil = Thousandth of an inch.
MWL = Mixed Waste Landfill.
n.a. = Not applicable.
OD = Outside diameter.
psi = Pounds per square inch.
PVC = Polyvinyl chloride.
YJ = Yellow Jacket (YJ) Drilling Services, Inc.

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Well Construction Data Sheet for MWL-SV04
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
1. Well name/number	MWL-SV04. Soil-vapor monitoring well with a borehole liner manufactured by Flexible Liner Underground Technology, Ltd.™ (FLUTe™).
2. Date of well construction	FLUTe™ liner installation completed on 12 June 2014. Installation of FLUTe™ well cap and acceptance flow test on 15 July 2014 is completion date.
3. Drilling method	Air rotary casing hammer. Drilling (air injection) completed on 5 June 2014.
4. Drilling contractor and name of driller	Yellow Jacket (YJ) Drilling Services, Inc., Randall Hatfield. GEFCO Speedstar 50K-CH, serial number 907609, YJ rig #121.
5. Borehole diameter and well casing diameter	Borehole: 10.75-inch OD drive shoe (leading end of drive casing) from 0 to 398 ft bgs, 8.5-inch tri-cone bit from 398 to 407 ft bgs. Casing (FLUTe™ liner): constructed of 11-inch diameter, ballistic nylon fabric. Final-installed diameter of the liner is the borehole diameter.
6. Well depth	Bottom edge of liner set at 404 ft bgs. Top edge of liner set at 2 ft above grade.
7. Casing length	406 ft, from lower edge of end weight to upper edge of liner in monument (stovepipe).
8. Casing materials	Liner constructed of ballistic nylon (denier 840) with impermeable 0.6-mil urethane coating on inner surface. Tubing sleeves constructed of ballistic nylon (denier 210) with impermeable 0.4-mil urethane coating on inner surface. Sample tubing (0.25-inch diameter high-density polyethylene [HDPE] runs vertically in sleeves. End weight (6.5-inch OD, PVC pipe, 25-lb ballast) inserted in lower end of liner and secured with stainless-steel hose clamps and 10-mil PASCO No. 9052, 2-inch wide PVC pipe-wrap tape. Liner filled with 437 bags (50-lbs each) of CSS 8 x12 sand from end weight up to ground surface.
9. Casing and screen joint type	Continuous piece of 11-inch diameter flexible borehole liner. Sleeves and spacers were fused to liner using radio-frequency welding in factory. No adhesives used.
10. Screened interval	Five permeable spacers on outside of liner: 44.5 to 49.5 ft bgs, 94.5 to 99.5 ft bgs, 194.5 to 199.5 ft bgs, 294.5 to 299.5 ft bgs, and 394.5 to 399.5 ft bgs.
11. Screen materials	Two-part permeable spacers are constructed of low density polyethylene (LDPE). The outer part consists of permeable filter fabric (uncoated denier 210) that covers a 0.25-inch thick layer of open-diamond fabric mesh. Each segment of sample tubing terminates at a feed-through fitting set at the mid-point of corresponding spacer. Each spacer surrounds entire circumference of the liner.

Well Construction Data Sheet for MWL-SV04 (Continued)
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
12. Screen slot size and design	n.a. (not applicable)
13. Filter pack material and gradation	n.a.
	n.a.
14. Filter pack volume (calculated and actual)[b]	n.a.
	n.a.
15. Filter pack placement method	n.a.
16. Filter pack interval(s)	n.a.
17. Annular sealant composition	n.a.
18. Annular sealant placement method	n.a.
19. Annular sealant volume (calculated and actual)	Calculated: n.a.
	Actual: n.a.
20. Annular sealant interval(s)	n.a.
21. Surface sealant composition	Duke City Redi-Mix Inc. delivery truck with 4,000 psi concrete. Square pattern of 0.5-inch rebar.
22. Surface seal placement method	Hand troweled.
23. Surface sealant volume (calculated and actual)	Calculated: 7.5 ft^3 (pad)
	Actual: 7.5 ft^3 (pad)
24. Surface sealant interval	Above-grade concrete pad
25. Surface seal and well apron design and construction	3-ft by 3-ft by 10-inch-thick concrete pad. Three concrete-filled 3-inch diameter steel bollards. Concrete collar along stovepipe extends to 2 ft bgs.
26. Well development procedure and turbidity measurements	n.a.
27. Well development purge volume(s) and stabilization parameter measurements	n.a.
28. Type and design and construction of protective casing	6-ft length of 10.75-inch OD carbon steel surface casing. Extends 3 ft above ground surface. Monument capped with FLUTe™ metal enclosure (“top hat”). Well cap (1.5 ft length of 6-inch ID, PVC pipe) has five pass-through Swagelok® fittings. Quick-connect Swagelok® fittings with sampling interval identified are attached to each segment of tubing for sample collection.
29. Well cap and lock	FLUTe™ enclosure with padlock.
30. Ground surface elevation	5,380* ft amsl, datum for sampling ports
31. Survey reference point elevation on well casing	n.a.
32. Top of monitoring well casing elevation	n.a.
33. Top of protective steel casing elevation	n.a.
34. Name of geologist	John R. Copland

Well Construction Data Sheet for MWL-SV04 (Concluded)
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
35. Initial water level	n.a.
36. Final water level	n.a.
37. Date of well development	n.a.

[a]New Mexico Environment Department, April 2004. "Compliance Order on Consent Pursuant to the New Mexico Hazardous Waste Act," § 74-4-10, New Mexico Environment Department, Santa Fe, New Mexico.
[b]Filter pack volume for a groundwater well is defined as the total volume of filter-pack sand placed in well annulus (adjacent to the casing, screen, and sump) and below the sump (if applicable).

amsl = Above mean sea level.
bgs = Below ground surface.
CSS = Colorado Silica Sand (Oglebay Norton Industrial Sands Inc.).
FLUTe™ = Flexible Liner Underground Technology, Ltd.™
ft = Foot (feet).
ft^3 = Cubic foot (cubic feet).
HDPE = High density polyethylene.
ID = Inside diameter.
lb = Pounds.
LDPE = Low density polyethylene.
mil = Thousandth of an inch.
MWL = Mixed Waste Landfill.
n.a. = Not applicable.
OD = Outside diameter.
psi = Pounds per square inch.
PVC = Polyvinyl chloride.
YJ = Yellow Jacket (YJ) Drilling Services, Inc.

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Well Construction Data Sheet for MWL-SV05
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
1. Well name/number	MWL-SV05. Soil-vapor monitoring well with a borehole liner manufactured by Flexible Liner Underground Technology, Ltd.™ (FLUTe™).
2. Date of well construction	FLUTe™ liner installation completed on 3 July 2014. Installation of FLUTe™ well-cap and acceptance flow test on 15 July 2014 is completion date.
3. Drilling method	Air rotary casing hammer. Drilling (air injection) completed on 2 July 2014.
4. Drilling contractor and name of driller	Yellow Jacket (YJ) Drilling Services, Inc., Randall Hatfield. GEFCO Speedstar 50K-CH, serial number 907609, YJ rig #121.
5. Borehole diameter and well casing diameter	Borehole: 10.75-inch OD drive shoe (leading end of drive casing) from 0 to 410 ft bgs. Casing (FLUTe™ liner): constructed of 11-inch diameter, ballistic nylon fabric. Final-installed diameter of the liner is the borehole diameter.
6. Well depth	Bottom edge of liner set at 406.5 ft bgs. Top edge of liner set at 1.5 ft above grade.
7. Casing length	408 ft, from lower edge of end weight to upper edge of liner in monument (stovepipe).
8. Casing materials	Liner constructed of ballistic nylon (denier 840) with impermeable 0.6-mil urethane coating on inner surface. Tubing sleeves constructed of ballistic nylon (denier 210) with impermeable 0.4-mil urethane coating on inner surface. Sample tubing (0.25-inch diameter high-density polyethylene [HDPE] runs vertically in sleeves. End weight (6.5-inch OD, PVC pipe, 25-lb ballast) inserted in lower end of liner and secured with stainless-steel hose clamps and 10-mil PASCO No. 9052, 2-inch wide PVC pipe-wrap tape. Liner filled with 458 bags (50-lbs each) of CSS 8x12 sand from end weight up to ground surface.
9. Casing and screen joint type	Continuous piece of 11-inch diameter flexible borehole liner. Sleeves and spacers were fused to liner using radio-frequency welding in factory. No adhesives used.
10. Screened interval	Five permeable spacers on outside of liner: 47 to 52 ft bgs, 97 to 102 ft bgs**,** 197 to 202 ft bgs, 297 to 302 ft bgs, and 397 to 402 ft bgs.
11. Screen materials	Two-part permeable spacers are constructed of low density polyethylene (LDPE). The outer part consists of permeable filter fabric (uncoated denier 210) that covers a 0.25-inch thick layer of open-diamond fabric mesh. Each segment of sample tubing terminates at a feed-through fitting set at the mid-point of corresponding spacer. Each spacer surrounds entire circumference of the liner.

Well Construction Data Sheet for MWL-SV05 (Continued)
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
12. Screen slot size and design	n.a. (not applicable)
13. Filter pack material and gradation	n.a.
	n.a.
14. Filter pack volume (calculated and actual)[b]	n.a.
	n.a.
15. Filter pack placement method	n.a.
16. Filter pack interval(s)	n.a.
17. Annular sealant composition	n.a.
18. Annular sealant placement method	n.a.
19. Annular sealant volume (calculated and actual)	Calculated: n.a.
	Actual: n.a.
20. Annular sealant interval(s)	n.a.
21. Surface sealant composition	Duke City Redi-Mix Inc. delivery truck with 4,000 psi concrete. Square pattern of 0.5-inch rebar.
22. Surface seal placement method	Hand troweled.
23. Surface sealant volume (calculated and actual)	Calculated: 7.5 ft^3 (pad)
	Actual: 7.5 ft^3 (pad)
24. Surface sealant interval	Above grade concrete pad
25. Surface seal and well apron design and construction	3-ft by 3-ft by 10-inch-thick concrete pad. Three concrete-filled 3-inch diameter steel bollards. Concrete collar along stovepipe extends to 2 ft bgs.
26. Well development procedure and turbidity measurements	n.a.
27. Well development purge volume(s) and stabilization parameter measurements	n.a.
28. Type and design and construction of protective casing	6-ft length of 10.75-inch OD carbon steel surface casing. Extends 3 ft above ground surface. Monument capped with FLUTe™ metal enclosure (“top hat”). Well cap (1.5 ft length of 6-inch ID, PVC pipe) has five pass-through Swagelok® fittings. Quick-connect Swagelok® fittings with sampling interval identified are attached to each segment of tubing for sample collection.
29. Well cap and lock	FLUTe™ enclosure with padlock.
30. Ground surface elevation	5,387* ft amsl, datum for sampling ports
31. Survey reference point elevation on well casing	n.a.
32. Top of monitoring well casing elevation	n.a.
33. Top of protective steel casing elevation	n.a.
34. Name of geologist	John R. Copland

Well Construction Data Sheet for MWL-SV05 (Concluded)
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
35. Initial water level	n.a.
36. Final water level	n.a.
37. Date of well development	n.a.

[a]New Mexico Environment Department, April 2004. "Compliance Order on Consent Pursuant to the New Mexico Hazardous Waste Act," § 74-4-10, New Mexico Environment Department, Santa Fe, New Mexico.
[b]Filter pack volume for a groundwater well is defined as the total volume of filter-pack sand placed in well annulus (adjacent to the casing, screen, and sump) and below the sump (if applicable).

amsl = Above mean sea level.
bgs = Below ground surface.
CSS = Colorado Silica Sand (Oglebay Norton Industrial Sands Inc.).
FLUTe™ = Flexible Liner Underground Technology, Ltd.™
ft = Foot (feet).
ft^3 = Cubic foot (cubic feet).
HDPE = High density polyethylene.
ID = Inside diameter.
lbs = Pounds.
LDPE = Low density polyethylene.
mil = Thousandth of an inch.
MWL = Mixed Waste Landfill.
n.a. = Not applicable.
OD = Outside diameter.
psi = Pounds per square inch.
PVC = Polyvinyl chloride.
YJ = Yellow Jacket (YJ) Drilling Services, Inc.

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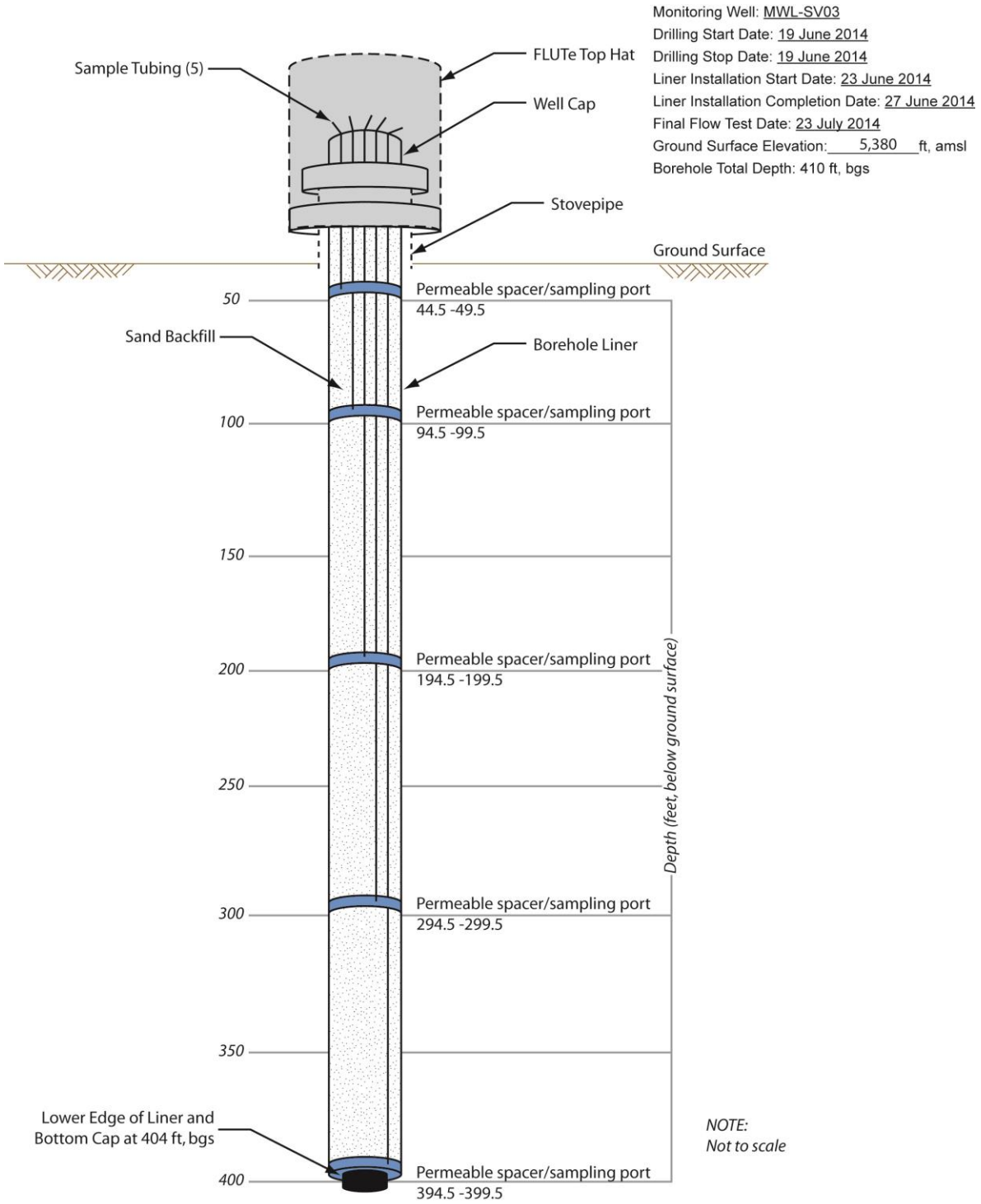
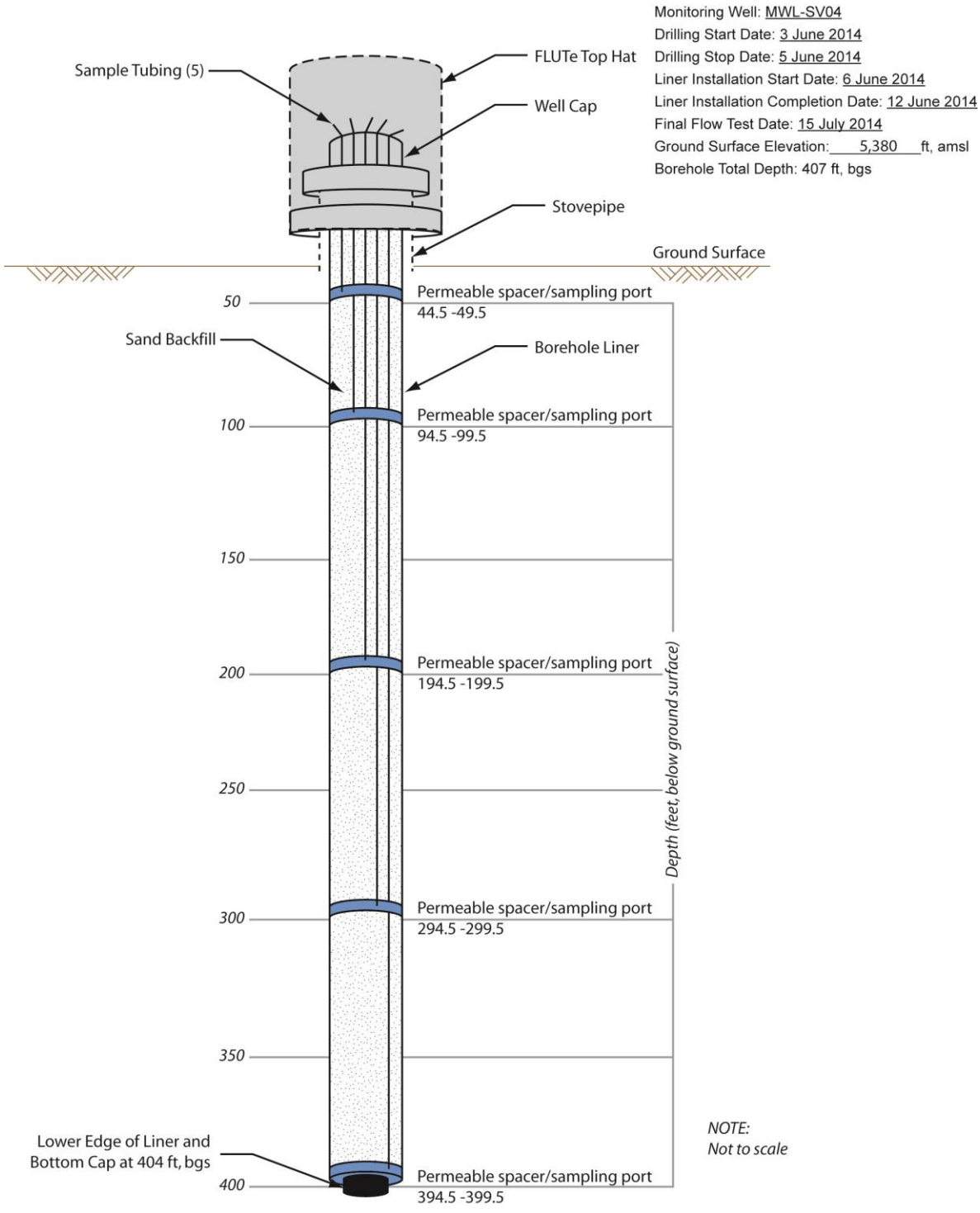
APPENDIX C
Well Construction Diagrams for Soil-Vapor Monitoring Wells
MWL-SV03, MWL-SV04, and MWL-SV05



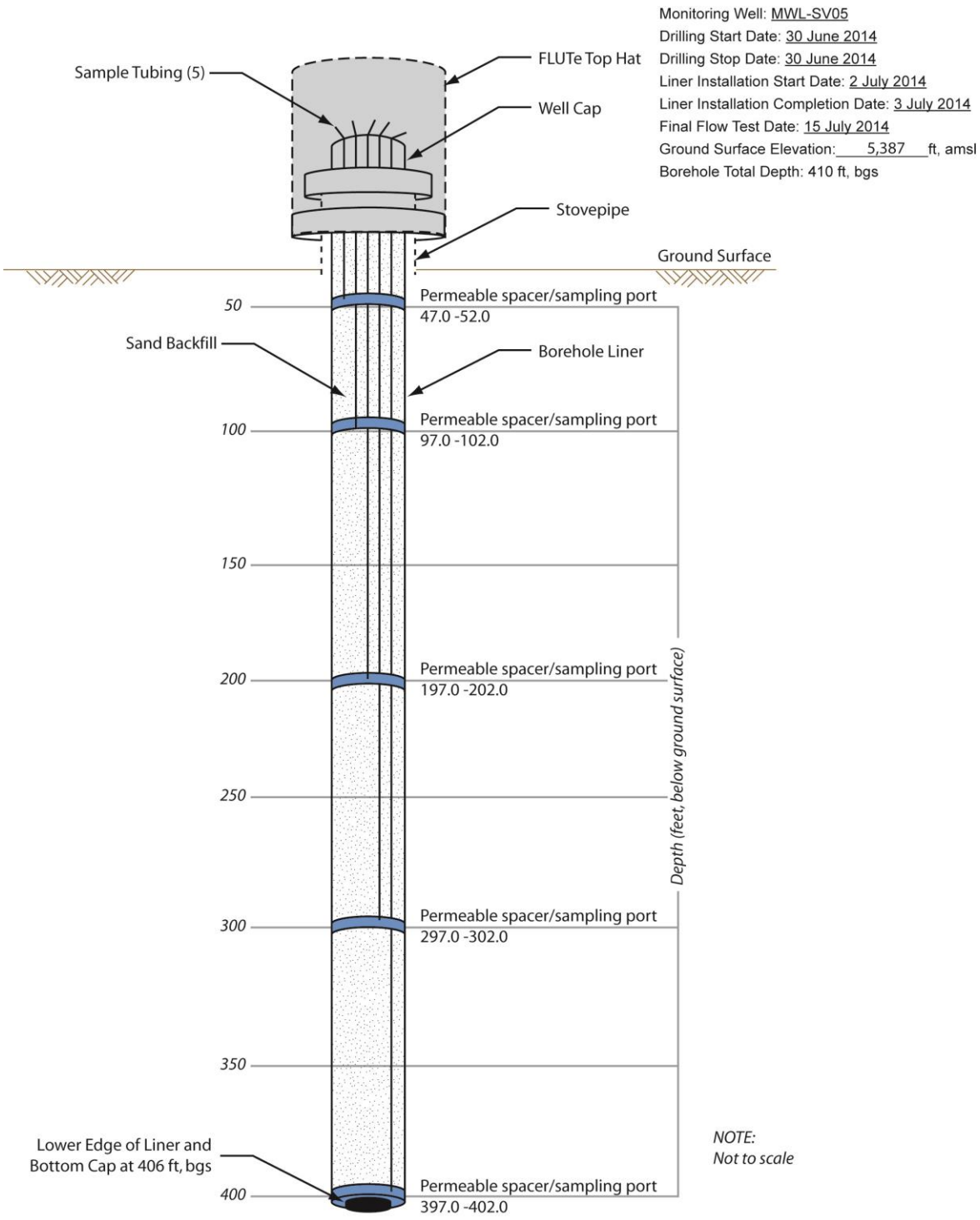
Soil Vapor Monitoring Well MWL-SV03

146239.02002000.A2



Soil Vapor Monitoring Well MWL-SV04

146239.02002000.A3



Soil Vapor Monitoring Well MWL-SV05

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APPENDIX D
Well Database Summary Forms for Soil-Vapor Monitoring Wells
MWL-SV03, MWL-SV04, and MWL-SV05

Well Name:	MWL-SV03
Project Name:	MIXED WASTE LANDFILL
NMOSE Well File Code:	
Owner Name:	SNL/NM
Date Drilling Started:	6/19/2014
Date Well Dev. Completed:	7/23/2014

Drilling Contractor:	YELLOW JACKET DRILLING SERVICE
Drilling Method:	AIR ROTARY CASING HAMMER
Borehole Depth (FBGS):	410
Casing Depth (FBGS):	404
Geo Location:	WEST SIDE OF MWL
Completion Zone:	ALLUVIAL-FAN LITHOFACIES
Completion Formation:	SANTA FE GROUP

Survey Data

Survey Date:	7/9/2014
Surveyed By:	SNL/NM
State Plane Coordinates: NAD 83	
(X) Easting:	1551647.52
(Y) Northing:	1452505.31

Surveyed Elevations (FAMSL)

Protective Casing:	
Top of Inner Well Casing:	
Concrete Pad:	
Ground Surface:	5380.0

Calculated Depths and Elevations

Initial Depth to Water (FBGS):	
Date Initial Depth Measured:	
Last Measured Water Elevation (FAMSL):	
Date Last Measured:	

Miscellaneous Information

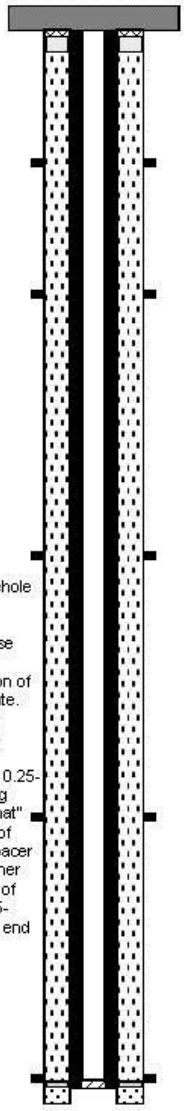
Screen Slot Size (in.): n/a

Date Updated: 13-AUG-14

Date Printed from EDMS: 8/13/2014 4:15:48 PM

Comments:

Soil-vapor monitoring well was constructed with a borehole liner manufactured by Flexible Liner Underground Technology, Ltd. (FLUTe). Drilling (air injection) completed on 19 June 2014, and equilibration of vadose zone began immediately thereafter. FLUTe liner installation was completed on 21 June 2014. Installation of well cap and flowtest of 23 July 2014 is completion date. Liner (flexible casing) constructed of 11-inch diameter, urethane coated, ballistic nylon fabric. Each sampling interval constructed of a two-piece LDPE permeable spacer on outside of liner consisting of filter fabric and 0.25-inch thick diamond mesh. Each piece of sample tubing (0.25-inch OD, HDPE) extends from cap in steel "top hat" and terminates at feed-through fitting set at mid-point of corresponding permeable spacer. Each permeable spacer is 5-ft long and spans entire circumference of liner. Liner is filled with CSS 8x12 sand. Final-installed diameter of liner is the borehole diameter. End weight (capped 4.5-inch OD PVC pipe, 25 pound ballast) inserted in lower end of liner. Rat hole beneath liner filled with CSS 8x12 sand. Stovepipe OD is 10.75 inches.



Completion Data Measured Depths (FBGS)

Casing Stickup:

Interval	Material	Start	Stop	Length	ID / OD (in.)
BOREHOLE		0	410	410	/ 10.5
CASING	COATED NYLON	0	404	404	/ 11
SEAL	CONCRETE	0	2	2	10.75 / 13
PRIMARY PACK	CSS 8X12 SAND	8.5	401.5	393	/ 11
SGSP 50	PERMEABLE LDPE	44.5	49.5	5	/ 11
SGSP 100	PERMEABLE LDPE	94.5	99.5	5	/ 11
SGSP 200	PERMEABLE LDPE	194.5	199.5	5	/ 11
SGSP 300	PERMEABLE LDPE	294.5	299.5	5	/ 11
SGSP 400	PERMEABLE LDPE	394.5	399.5	5	/ 11
SLOUGH	NATIVE SAND	401.5	404	2.5	4.5 / 11
BOTTOM CAP/SUMP	SCHEDULE 40 PVC	401.5	404	2.5	/ 4.5
PRIMARY PACK	CSS 8X12 SAND	404	410	6	/ 11

Well Name:	MWL-SV04
Project Name:	MIXED WASTE LANDFILL
NMOSE Well File Code:	
Owner Name:	SNL/NM
Date Drilling Started:	6/3/2014
Date Well Dev. Completed:	7/15/2014

Drilling Contractor:	YELLOW JACKET DRILLING SERVICE
Drilling Method:	AIR ROTARY CASING HAMMER
Borehole Depth (FBGS):	407
Casing Depth (FBGS):	404
Geo Location:	WEST SIDE OF MWL
Completion Zone:	ALLUVIAL-FAN LITHOFACIES
Completion Formation:	SANTA FE GROUP

Survey Data

Survey Date:	7/9/2014
Surveyed By:	SNL/NM
State Plane Coordinates: NAD 83	
(X) Easting:	1551649.18
(Y) Northing:	1452354.66

Surveyed Elevations (FAMSL)

Protective Casing:	
Top of Inner Well Casing:	
Concrete Pad:	
Ground Surface:	5380.0

Calculated Depths and Elevations

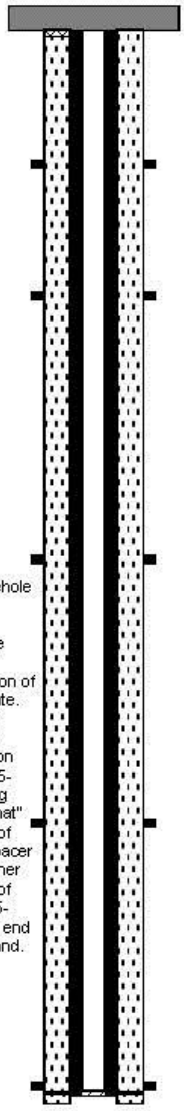
Initial Depth to Water (FBGS):	
Date Initial Depth Measured:	
Last Measured Water Elevation (FAMSL):	
Date Last Measured:	

Miscellaneous Information

Screen Slot Size (in.):	n/a
Date Updated:	13-AUG-14
Date Printed from EDMS:	8/13/2014 4:16:32 PM

Comments:

Soil-vapor monitoring well was constructed with a borehole liner manufactured by Flexible Liner Underground Technology, Ltd. (FLUTe). Drilling (air injection) completed on 5 June 2014, and equilibration of vadose zone began immediately thereafter. FLUTe liner installation was completed on 12 June 2014. Installation of well cap and flowtest of 15 July 2014 is completion date. Liner (flexible casing) constructed of 11-inch diameter, urethane coated, ballistic nylon fabric. Each sampling interval constructed of a two-piece permeable spacer on outside of liner consisting of LDPE filter fabric and 0.25-inch thick diamond mesh. Each piece of sample tubing (0.25-inch OD, HDPE) extends from cap in steel "top hat" and terminates at feed-through fitting set at mid-point of corresponding permeable spacer. Each permeable spacer is 5-ft long and spans entire circumference of liner. Liner is filled with CSS 8x12 sand. Final-installed diameter of liner is the borehole diameter. End weight (capped 6.5-inch OD PVC pipe, 25 pound ballast) inserted in lower end of liner. Rat hole beneath liner filled with CSS 8x12 sand. Stovepipe OD is 10.75 inches.



Completion Data Measured Depths (FBGS)

Casing Stickup:

Interval	Material	Start	Stop	Length	ID / OD (in.)
CASING	COATED NYLON	0	404	404	/ 11
PRIMARY PACK	CSS 8X12 SAND	0	402.5	402.5	/ 11
BOREHOLE		0	398	398	/ 10.5
SEAL	CONCRETE	0	2	2	10.75 / 13
SGSP 50	PERMEABLE LDPE	44.5	49.5	5	/ 11
SGSP 100	PERMEABLE LDPE	94.5	99.5	5	/ 11
SGSP 200	PERMEABLE LDPE	194.5	199.5	5	/ 11
SGSP 300	PERMEABLE LDPE	294.5	299.5	5	/ 11
SGSP 400	PERMEABLE LDPE	394.5	399.5	5	/ 11
BOREHOLE		398	407	9	/ 8.5
SLOUGH	NATIVE SAND	402.5	404	1.5	8.5 / 11
BOTTOM CAP/SUMP	SCHEDULE 40 PVC	402.5	404	1.5	/ 6.5
PRIMARY PACK	CSS 8X12 SAND	404	407	3	/ 11

Well Name:	MWL-SV05	**Drilling Contractor:**	YELLOW JACKET DRILLING SERVICE
Project Name:	MIXED WASTE LANDFILL	**Drilling Method:**	AIR ROTARY CASING HAMMER
NMOSE Well File Code:		**Borehole Depth (FBGS):**	410
Owner Name:	SNL/NM	**Casing Depth (FBGS):**	406.5
Date Drilling Started:	6/30/2014	**Geo Location:**	EAST SIDE OF MWL
Date Well Dev. Completed:	7/15/2014	**Completion Zone:**	ALLUVIAL-FAN LITHOFACIES
		Completion Formation:	SANTA FE GROUP

Survey Data

Survey Date: 7/9/2014
Surveyed By: SNL/NM

State Plane Coordinates: NAD 83
(X) Easting: 1552058.06
(Y) Northing: 1452449.91

Surveyed Elevations (FAMSL)

Protective Casing:
Top of Inner Well Casing:
Concrete Pad:
Ground Surface: 5387.0

Calculated Depths and Elevations

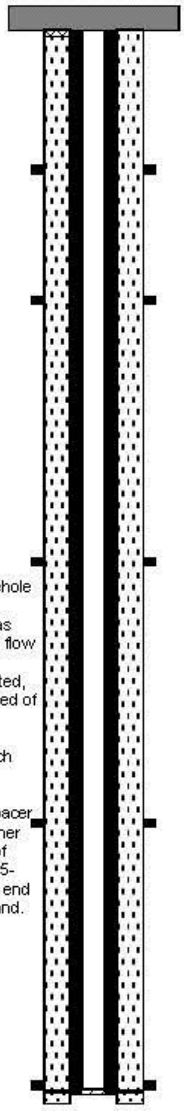
Initial Depth to Water (FBGS):
Date Initial Depth Measured:
Last Measured Water Elevation (FAMSL):
Date Last Measured:

Miscellaneous Information

Screen Slot Size (in.): n/a
Date Updated: 13-AUG-14
Date Printed from EDMS: 8/13/2014 4:17:08 PM

Comments:

Soil-vapor monitoring well was constructed with a borehole liner manufactured by Flexible Liner Underground Technology, Ltd. (FLUTe). FLUTe liner installation was completed on 3 July 2014. Installation of well cap and flow test of 15 July 2014 is completion date. Liner (flexible casing) constructed of 11-inch diameter, urethane coated, ballistic nylon fabric. Each sampling interval constructed of a two-piece permeable spacer on outside of liner consisting of LDPE filter fabric and 0.25-inch-thick diamond mesh. Each piece of sample tubing (0.25-inch OD, HDPE) extends from cap in steel "top hat" and terminates at feed-through fitting set at mid-point of corresponding permeable spacer. Each permeable spacer is 5-ft long and spans entire circumference of liner. Liner is filled with CSS 8x12 sand. Final-installed diameter of liner is the borehole diameter. End weight (capped 6.5-inch OD PVC pipe, 25 pound ballast) inserted in lower end of liner. Rat hole beneath liner filled with CSS 8x12 sand. Stovepipe OD is 10.75 inches.



Completion Data Measured Depths (FBGS)

Casing Stickup:

Interval	Material	Start	Stop	Length	ID / OD (in.)
BOREHOLE		0	410	410	/ 10.5
CASING	COATED NYLON	0	406.5	406.5	/ 11
PRIMARY PACK	CSS 8X12 SAND	0	405	405	/ 11
SEAL	CONCRETE	0	2	2	10.75 / 13
SGSP 50	PERMEABLE LDPE	47	52	5	/ 11
SGSP 100	PERMEABLE LDPE	97	102	5	/ 11
SGSP 200	PERMEABLE LDPE	197	202	5	/ 11
SGSP 300	PERMEABLE LDPE	297	302	5	/ 11
SGSP 400	PERMEABLE LDPE	397	402	5	/ 11
BOTTOM CAP/SUMP	SCHEDULE 40 PVC	405	406.5	1.5	/ 6.5
SLOUGH	NATIVE SAND	405	406.5	1.5	6.5 / 11
PRIMARY PACK	CSS 8X12 SAND	406.5	410	3.5	/ 11

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APPENDIX E
Lithologic Log for Borehole MWL-BH16

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-BH16	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: Not Applicable (NA)	OWNER NAME: U.S. DOE	DATE STARTED: 23 May 2014
GROUND ELEVATION: 5,380** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 28 May 2014
BOREHOLE DEPTH: 324 FT BGS	DTW: NA	WELL COMPLETED: NA
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 1 of 4
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
0	Ground surface, SW, sand, poorly sorted, light to medium brown, 7.5 YR_7/6, dry. 90% very fine grain to pebbly sand, 10% silt and clay. Source rocks: mostly granitic, few metamorphics (quartzite), minor mafics. Subangular to subrounded grains.		
10	10 ft, SW, sand, poorly sorted, light to medium brown, 7.5 YR_7/4, dry. 90% very fine grain to pebbly sand, 10% silt and clay. Source rocks: mostly granitic, few metamorphics (quartzite), minor mafics. Subangular to subrounded grains.		SW
20	20 ft, GW, sandy gravel, poorly sorted, light to medium brown, 7.5 YR_7/4, dry. 60% very fine to pebbly sand, 35% gravel, 10% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, minor mafics. Subangular to subrounded sand. Angular limestone and quartzite gravels up to 0.75-inch diameter.		
30			GW
40	40 ft, GW, sandy gravel, poorly sorted, light to medium brown, 7.5 YR_7/4, dry. 60% very fine to pebbly sand, 30% gravel, 10% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, minor mafics. Subangular to subrounded sand. Angular limestone and quartzite gravels up to 0.75-inch diameter.		
50	50 ft, SC, Clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 80% fine to pebbly sand, 20% silt and clay. Source rocks: mostly metamorphics (quartzite and greenstone), lesser granitic, limestone, minor mafics.		
60	60 ft, SC, Clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 70% fine to pebbly sand, 30% silt and clay. Source rocks: mostly metamorphics (quartzite and greenstone), lesser granitic, limestone, minor mafics. Subangular to subrounded grains. Occasional angular quartzite gravel up to 0.75-inch diameter.		
70			SC
80	80 ft, SC, Clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 70% fine to pebbly sand, 30% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, minor mafics. Subangular to subrounded grains. Start of poor return of cuttings. Start to inject more water to aid in lifting cuttings.		
90			
100			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
**Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary, Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,380** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1551648.22** Easting: 1452524.56**

146239.02002000_MWL-BH16.A1

Date: 8/19/14

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-BH16	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: Not Applicable (NA)	OWNER NAME: U.S. DOE	DATE STARTED: 23 May 2014
GROUND ELEVATION: 5,380** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 28 May 2014
BOREHOLE DEPTH: 324 FT BGS	DTW: NA	WELL COMPLETED: NA
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 2 of 4
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
100	100 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4, dry. 70% fine to pebbly sand, 30% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, minor mafics. Subangular to subrounded grains. Poor returns.		SC
120	120 ft, SW, sand, poorly sorted, medium brown, 7.5 YR_7/4, moist. 90% fine to pebbly sand, 10% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, minor mafics. Subangular to subrounded grains. Poor returns.		SW
140	140 ft, GW, sandy gravel, poorly sorted, medium brown, 7.5 YR_7/4 . 90% fine to pebbly sand, 10% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), sandstone, minor mafics. Subangular to subrounded sand. Few limestone and quartzite gravels up to 0.75-inch diameter. Poor returns.		GW
160	160 ft, CL, sandy clay, poorly sorted, medium brown, 7.5 YR_7/4. 70% silt and clay, 30% fine to pebbly sand. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, minor mafics. Subangular to subrounded grains. Poor returns.		CL
180	180 ft, CL, sandy clay, poorly sorted, medium brown, 7.5 YR_7/4. 70% silt and clay, 30% fine to pebbly sand. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, minor mafics. Subangular to subrounded grains. Occasional limestone gravel to 0.5-inch diameter. Poor returns.		
190			
200			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
**Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary, Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,380** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1551648.22** Easting: 1452524.56**

146239.02002000_MWL-BH16.A2

Date: 8/19/14

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-BH16	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: Not Applicable (NA)	OWNER NAME: U.S. DOE	DATE STARTED: 23 May 2014
GROUND ELEVATION: 5,380** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 28 May 2014
BOREHOLE DEPTH: 324 FT BGS	DTW: NA	WELL COMPLETED: NA
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 3 of 4
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
200	200 FT, CL, sandy clay, poorly sorted, medium brown, 7.5 YR_7/4. 90% silt and clay, 10% very fine to coarse sand. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains. Poor returns.		
210			
220	220 ft, CL, sandy clay, poorly sorted, medium brown, 7.5 YR_7/4. 70% silt and clay, 30% very fine to coarse sand. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains. Poor returns.		
230			
240	240 ft, CL, sandy clay, poorly sorted, medium brown, 7.5 YR_7/4. 70% silt and clay, 30% very fine to coarse sand. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains. Poor returns.		
250			CL
260	260 ft, CL, sandy clay, poorly sorted, medium brown, 7.5 YR_7/4. 60% silt and clay, 40% very fine to coarse sand. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains. Very poor returns.		
270			
280	280 ft, CL, sandy clay, poorly sorted, medium brown, 7.5 YR_7/4. 70% silt and clay, 30% very fine to coarse sand. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains. Very poor returns.		
290			
300			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
**Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary, Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,380** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1551648.22** Easting: 1452524.56**

146239.02002000_MWL-BH16.A3

Date: 8/19/14

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-BH16	PROJECT NAME: SNL/NM Soil-vapor Monitoring Well, Mixed Waste Landfill, SWMU 76	
WELL DEPTH: Not Applicable (NA)	OWNER NAME: U.S. DOE	DATE STARTED: 23 May 2014
GROUND ELEVATION: 5,380** FT AMSL	GWL: Groundwater Not Encountered	DATE COMPLETED: 28 May 2014
BOREHOLE DEPTH: 324 FT BGS	DTW: NA	WELL COMPLETED: NA
LOWEST SAMPLING DEPTH: NA*	GEOLOGIST: John R. Copland	PAGE: 4 of 4
DRILLING METHOD: Air Rotary Casing Hammer		REVIEWER: Michael F. Skelly

DEPTH (feet) bgs	LITHOLOGIC DESCRIPTION BASED ON CUTINGS	LITHOLOGIC SYMBOL	USCS SYMBOL
300	300 ft, CL, sandy clay, poorly sorted, medium brown, 7.5 YR_7/4. 80% silt and clay, 20% very fine to coarse sand. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, sandstone, minor mafics. Subangular to subrounded grains. Very poor returns.		
310			CL
320	320 ft, SC, clayey sand, poorly sorted, medium brown, 7.5 YR_7/4. 70% very fine to medium sand, 30% silt and clay. Source rocks: granitic, metamorphics (quartzite and greenstone), limestone, and sandstone, minor mafics. Subangular to subrounded grains. Unable to push drive casing below 320 ft bgs.		
330	Total Depth of Borehole is 324 ft bgs. Tri-cone bit (8.5-inch diameter) was inadvertently dropped into the open borehole after tripping out the drive casing and drill string. Driller could not fish out the drill bit with an overshot tool. The drill bit is lodged in borehole at 250 ft bgs. Borehole abandoned.		
340			
350	Borehole plugged with bentonite grout/chips in multiple lifts during 13 – 29 June, 2014. Use Quik-Grout® (Baroid-Halliburton bentonite grout) and Holeplug® chips (Baroid-Halliburton 3/8-inch grade bentonite chips) that were hydrated every 5 ft with fire-hydrant water. Concrete pad installed with concrete extending to 0.5 ft bgs in the borehole. Grout from 0.5 ft bgs to 7 ft bgs. Chips from 7 ft bgs to 110 ft bgs. Grout from 110 ft bgs to at least 250 ft bgs where drill bit is lodged. Grout emplaced with tremie pipe above drill bit. Volumetric calculations suggest that much grout flowed past the drill bit and grout extends from 250 ft bgs to the borehole total depth of 324 ft bgs.		
360			
370			
380			
390			
400			

NOTES: No petroleum odors or stains observed in cuttings. *No samples submitted for chemical analysis.
**Preliminary (9 July 2014) Survey Data

Drilling Contractor: Yellow Jacket Drilling Services, Inc.
Completion Formation: Tertiary, Santa Fe Formation; Alluvial-fan lithofacies
Borehole Diameter: 10.75 inches

Elevation: 5,380** ft amsl, NAVD 88
Coordinate System: SPC NM Central NAD 83
Northing: 1551648.22** Easting: 1452524.56**

146239.02002000_MWL-BH16.A4

Date: 8/19/14

APPENDIX F
Photographs of Drilling and Well Installation Activities at the MWL

Figure F-1
Drill rig at soil-vapor monitoring well MWL-SV03 with soil-moisture monitoring access tube MWL-VZ-1 in the foreground.

Figure F-2
Uncoiling FLUTe™ borehole liner from the shipping reel at soil-vapor monitoring well MWL-SV03. The permeable spacer (i.e., sampling port) is the outer white fabric.

Figure F-3
Inserting FLUTe™ borehole liner into the drive casing for soil-vapor monitoring well MWL-SV03.

Figure F-4
One of five permeable spacers for soil-vapor monitoring well MWL-SV03. The outer permeable fabric (white) covers the diamond mesh. The impermeable borehole liner is the black fabric.

Figure F-5
Attaching the bottom weight to the lower end of the
FLUTe™ borehole liner for soil-vapor monitoring well MWL-SV04.

Figure F-6
Use of weight scale to verify that FLUTe™ borehole liner is deployed to the proper depth in the drive casing prior to inserting the tremie pipe at soil-vapor monitoring well MWL-SV04.

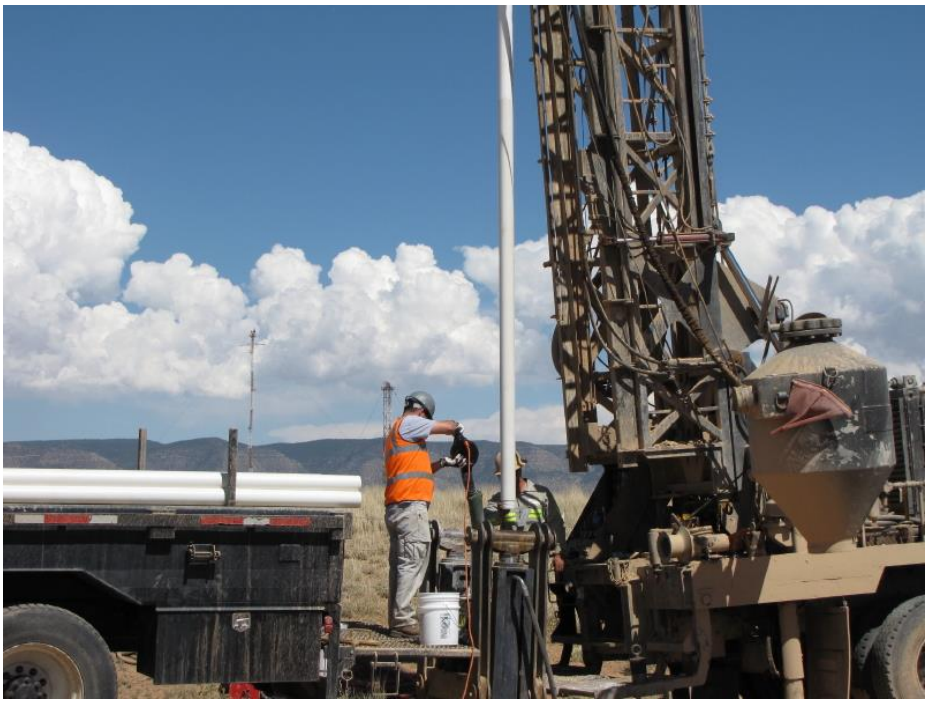

Figure F-7
Inserting PVC tremie pipe into FLUTe™ borehole liner for soil-vapor monitoring well MWL-SV03.

Figure F-8
Pouring sand into funnel attached to PVC tremie pipe inside the FLUTe™ borehole liner for soil-vapor monitoring well MWL-SV03. Rope and carabineer are used to maintain tension on the liner. Hydraulic jack for pulling the drive casing is visible in the foreground.

Figure F-9
Securing FLUTe™ borehole liner while joint of drive casing is being removed for soil-vapor monitoring well MWL-SV03. Tensioning rope and PVC tremie pipe are visible.

Figure F-10
Removing joints of PVC tremie pipe and drive casing during the installation of the FLUTe™ borehole liner for soil-vapor monitoring well MWL-SV04.

Figure F-11
Sample tubing exiting yellow sleeves on FLUTe™ borehole liner for soil-vapor monitoring well MWL-SV03. PVC tremie pipe has been removed and the last joint of drive casing is visible. Carabineer is attached to fabric loop stitched to upper edge of borehole liner.

Figure F-12
Wooden concrete form and steel rebar set around the stovepipe for well MWL-SV03. The concrete form for borehole MWL-BH16 is visible in background.

Figure F-13
Flow testing with a vacuum pump of the sample ports at soil-vapor monitoring well MWL-SV03.

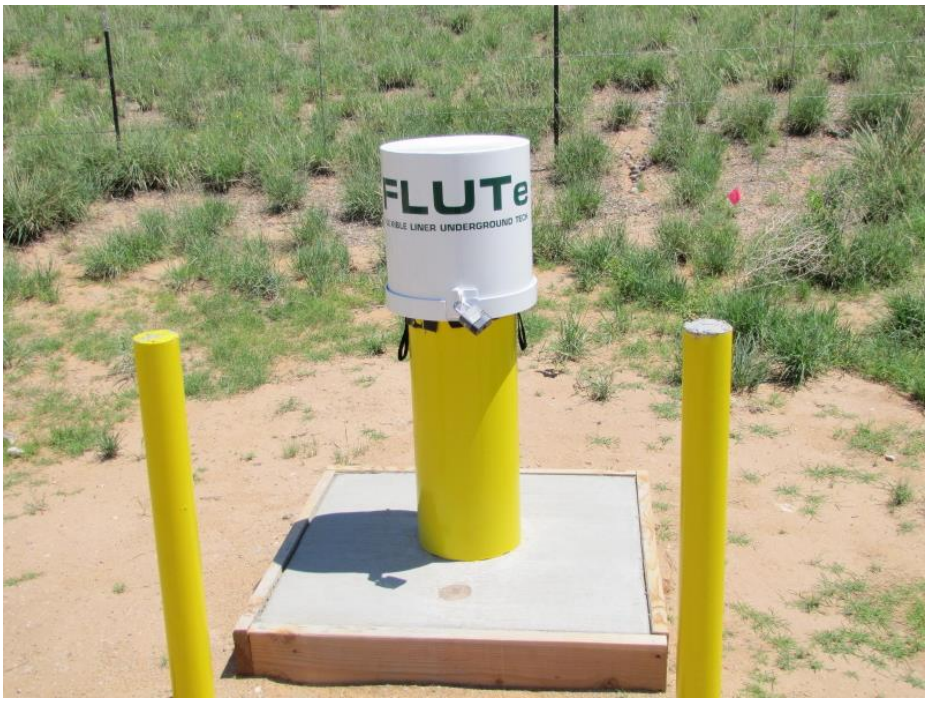

Figure F-14
Competed installation for soil-vapor monitoring well MWL-SV03.

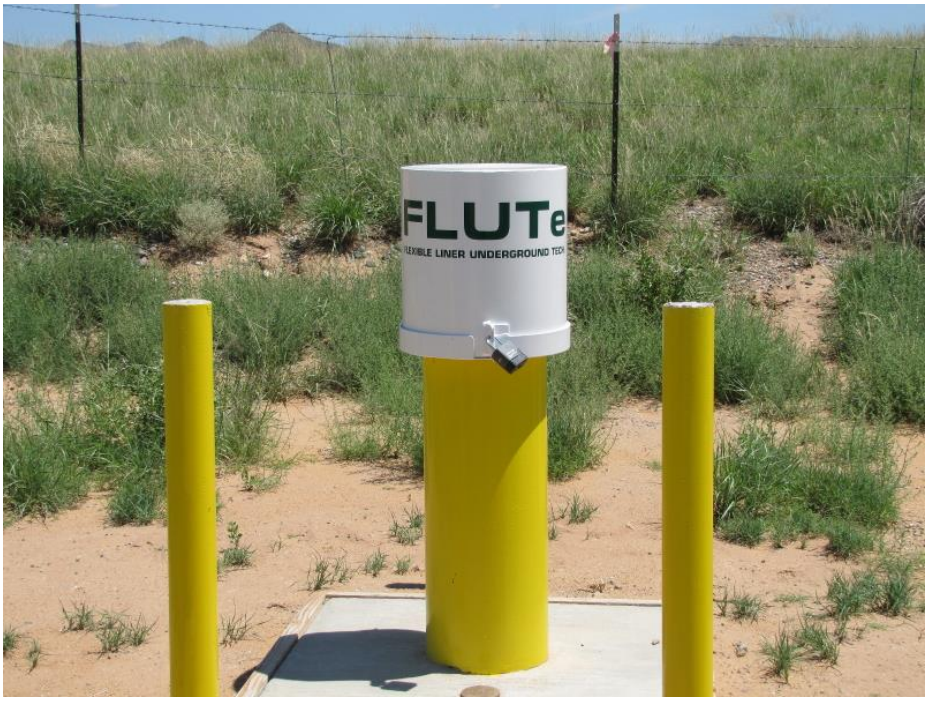

Figure F-15
Competed installation for soil-vapor monitoring well MWL-SV04.

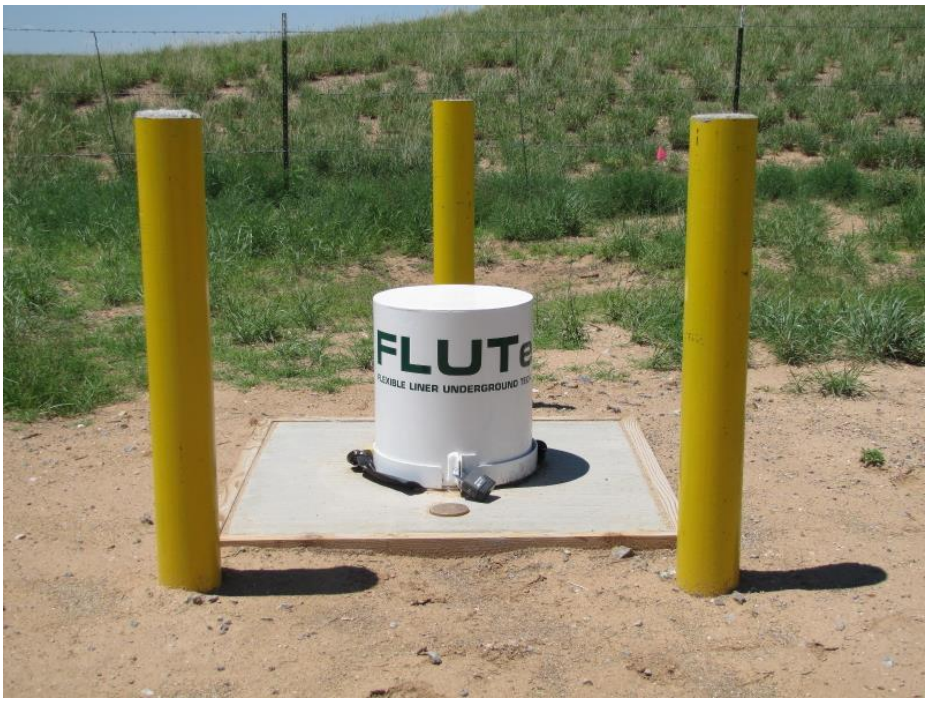

Figure F-16
Competed installation for soil-vapor monitoring well MWL-SV05.

Volume V

TAB 16

Notice of Approval: Mixed Waste Landfill FLUTe™ Soil-Vapor Monitoring Well Installation Report, September 2014

From: NMED/Kieling
To: SNL/Beausoleil

Back of Tab 16

NEW MEXICO
ENVIRONMENT DEPARTMENT

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

SUSANA MARTINEZ
Governor
JOHN A. SANCHEZ
Lieutenant Governor

RYAN FLYNN
Cabinet Secretary
BUTCH TONGATE
Deputy Secretary

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

September 25, 2014

Geoffrey L. Beausoleil
Manager
U.S. Department of Energy
P.O. Box 5400, MS-0184
Albuquerque, NM 87185-5400

Peter B. Davies
Director,
Nuclear Energy & Fuel Cycle Programs
P.O. Box 6200, MS-0721
Albuquerque, NM 87185

SUBJECT: APPROVAL
INSTALLATION OF THREE FLUTE™ SOIL-VAPOR MONITORING WELLS (MWL-SV03, MWL-SV04, AND MWL-SV05) AT THE MIXED WASTE LANDFILL, SEPTEMBER 2014
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-14-012

Dear Mr. Beausoleil and Mr. Davies:

The New Mexico Environment Department has reviewed the subject report concerning the installation of three soil-vapor monitoring wells at the Mixed Waste Landfill (MWL) submitted by the U. S. Department of Energy (DOE) on behalf of itself and Sandia Corporation (collectively, the Permittees). The soil-vapor wells were installed pursuant to the MWL Long-Term Monitoring and Maintenance Plan and are the last components of the monitoring systems to be deployed under that plan. The subject report is hereby approved.

If you have any questions regarding this matter, please contact Mr. William Moats of my staff at (505) 222-9551.

Sincerely,

John E. Kieling
Chief
Hazardous Waste Bureau

cc: D. Cobrain, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED RPD and DOE OB
L. King, EPA Region 6 (6PD-N)
J. Weckerle, NNSA/SSO, MS 0184
J. Cochran, SNL, MS 0719

File: SNL 2014 and Reading

Sandia National Laboratories

Justification for Class 3 Permit Modification
Corrective Action Complete with Controls
Solid Waste Management Unit 76
Mixed Waste Landfill

October 2014

Volume VI of VIII
Long-Term Monitoring and Maintenance Plan
Reference Documents

Environmental Restoration Operations

U.S. DEPARTMENT OF ENERGY

United States Department of Energy
Sandia Field Office

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Justification for Class 3 Permit Modification, Mixed Waste Landfill
Volume VI Long-Term Monitoring and Maintenance Plan – Reference Documents
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2	Submittal of Updated Reference Documents Cited in the Mixed Waste Landfill Long-Term Monitoring & Maintenance Plan	SNL/ Todd	NMED/ Kieling	07/09/2014	310
3	NMED Receipt of Submittal of Updated Reference Documents Cited in the Mixed Waste Landfill Long-Term Monitoring & Maintenance Plan	NMED/ Kieling	SNL/ Beausoleil	08/04/2014	2

Mixed Waste Landfill – Justification Binder Index

Date	From	To	Description	Volume	Tab	Number of Pages
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Class 3 Permit Modification for Corrective Measures and Final Order						
05/26/2005	State of NM/ Curry	DOE/Sandia	Final Order in the Matter of Request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill No. HWB 04-11(M)	I	1	6
08/02/2005	NMED/Kieling	SNL/Wagner	Remedy Decision and Class 3 Permit Modification Request to Incorporate into RCRA Permit Corrective Measures for Mixed Waste Landfill (SWMU 76)	I	2	50
Corrective Measures Implementation Plan						
09/07/2005	NMED/Bearzi	SNL/Wagner	Time Extension Request Approval Regarding Mixed Waste Landfill Corrective Measures Implementation Plan and Report, August 4, 2005	I	3	2
11/03/2005	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Corrective Measures Implementation Plan November 2005	I	4	370
12/09/2005	NMED/Kieling	Interested Citizen	Notice of Public Comment Period for Mixed Waste Landfill Corrective Measures Implementation Work Plan, November 2005 (Including Fate and Transport Model)	I	5	6
04/24/2006	SNL/Wagner	NMED/Bearzi	Response to Public Comments Regarding The Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005	I	6	40
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05/25/2006	NMED/Kieling	SNL/Wagner	Notice of 14 Day Public Comment Period for the Mixed Waste Landfill Corrective Measures Implementation Work Plan, November 2005	I	8	8
11/20/2006	NMED/Bearzi	SNL/Wagner	NOD (Part 1 and 2 Comments): Mixed Waste Landfill Corrective Measures Implementation Work Plan November 2005, and Requirement for Soil-Vapor Sampling and Analysis Plan	I	9	8
11/21/2006	NMED/Kieling	Interested Citizen	NMED Responses to Public Comments on the Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005	I	10	62
11/2006	NMED/ Moats et. al	Interested Citizen	Evaluation of the Representativeness and Reliability of Groundwater Monitoring Well Data, Mixed Waste Landfill (referenced as part of 11/21/2006 NMED Responses to Public Comments on Corrective Measures Implementation Plan)	I	11	90

Mixed Waste Landfill – Justification Binder Index (Continued)

Date	From	To	Description	Volume	Tab	Number of Pages
12/21/2006	SNL/Wagner	NMED/Bearzi	DOE/Sandia Responses to NOD Part 1 Comments and Submittal of Soil-Vapor Sampling and Analysis Plan: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005	I	12	92
01/19/2007	SNL/Wagner	NMED/Bearzi	DOE/Sandia Responses to the NOD Part 2 Comments: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005 (Includes submittal of the 2nd Edition of Appendix E, SAND2007-0170)	I	13	36
10/10/2008	NMED/Bearzi	SNL/Wagner	Second NOD: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005	I	14	8
11/26/2008	SNL/Davis	NMED/Bearzi	DOE/Sandia Responses to Second NOD: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005	I	15	16
12/22/2008	NMED/Bearzi	SNL/Davis	Conditional Approval: Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005	I	16	4
02/12/2009	SNL/Davis	NMED/Bearzi	Replacement Pages for the Mixed Waste Landfill Corrective Measures Implementation Plan, November 2005.	I	17	6
VOLUME II: CORRECTIVE MEASURES IMPLEMENTATION PLAN – SOIL-VAPOR INVESTIGATION AND SUBGRADE PREPARATION						
Corrective Measures Implementation Plan – Soil-Vapor Investigation						
12/21/2006	SNL/Wagner	NMED/Bearzi	Soil-Vapor Sampling and Analysis Plan for Soil-Vapor Volatile Organic Compounds, Tritium, and Radon at the Mixed Waste Landfill	II	1	24
02/05/2007	NMED/Kieling	Interested Citizen	NMED Notice of Public Comment Period on Mixed Waste Landfill Soil-Vapor Sampling and Analysis Plan	II	2	6
04/13/2007	NMED/Kieling	Interested Citizen	Notice of Public Dialogue on the Mixed Waste Landfill Soil-Vapor Sampling and Analysis Plan	II	3	4
02/14/2008	NMED/Bearzi	SNL/Wagner	Response to Public Comment and Approval with Modifications Soil-Vapor Sampling and Analysis Plan for the Mixed Waste Landfill	II	4	4
02/15/2008	NMED/Kieling	Interested Party	Notice of Approval and Response to Public Comment on Soil-Vapor Sampling and Analysis Plan for Mixed Waste Landfill	II	5	24
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Corrective Measures Implementation Plan – Subgrade Preparation						
07/12/2006	SNL/Wagner	NMED/Curry	Notification of Current and Planned Field Work at the Mixed Waste Landfill	II	10	2
09/18/2006	NMED/Bearzi	SNL/Wagner	Fence Removal and Subgrade Preparation, Mixed Waste Landfill	II	11	2
03/13/2007	SNL/Wagner	NMED/Bearzi	Notification of Precautionary Measures to Prevent Damage to the Mixed Waste Landfill Subgrade Pending Installation of the Cover	II	12	4
03/23/2007	NMED/Bearzi	SNL/Wagner	Mixed Waste Landfill Corrective Measures Implementation Plan, Letter of March 13, 2007	II	13	2
08/10/2007	SNL/Wagner	NMED/Bearzi	Extension Request for Submittal of Burn Site Corrective Measures Evaluation Report and Mixed Waste Landfill Corrective Measures Implementation Report	II	14	4
08/23/2007	NMED/Bearzi	SNL/Wagner	Extension Request for Submittal of Burn Site Corrective Measures Evaluation Report and Mixed Waste Landfill Corrective Measures Implementation Report	II	15	2
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09/30/2009	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Quarterly Progress Report ET Cover Project May-July 2009	III	3	80
11/18/2009	NMED/Bearzi	SNL/Davis	NMED Response: Mixed Waste Landfill Quarterly Progress Report ET Cover Construction Project May- July 2009	III	4	2
12/21/2009	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Quarterly Progress Report ET Cover Construction Project August-October 2009	III	5	38
04/08/2010	NMED/Bearzi	SNL/Wagner	NMED Response: Mixed Waste Landfill Quarterly Progress Report ET Cover Project August-October 2009	III	6	2
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Mixed Waste Landfill – Justification Binder Index (Continued)

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04/28/2011	NMED/Moats	SNL/Cochran	Email from William Moats Dated 4/28/11 Notice of Approval Request to Install Access Gate at South End of Mixed Waste Landfill	III	9	2
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06/26/2014	NMED/Kieling	SNL/ Beausoleil	Reclamation of the Mixed Waste Landfill Borrow Pit, Letter of December 9, 2013	III	11	2
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01/28/2011	NMED/Kieling	Interested Citizen	Extension of Public Comment Period for Sandia National Laboratories Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	14	2
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05/20/2011	NMED/Kieling	SNL/Wagner	NMED Response to Public Comments Regarding the Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	16	16
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10/14/2011	NMED/Kieling	SNL/Wagner	Notice of Approval Mixed Waste Landfill Corrective Measures Implementation Report, January 2010	III	18	2
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12/21/2011	NMED/Kieling	SNL/Wagner	Withdrawal of Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan, September 2007	V	5	4
03/23/2012	SNL/Sena	NMED/Kieling	Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, March 2012	V	6	278
09/14/2012	NMED/Kieling	Interested Person	Notice of Public Comment Period and Public Dialogue Meeting for the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan, March 2012	V	7	6
11/19/2012	NMED/Kieling	SNL/ Beausoleil	Extension of the Public Comment Period on the Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, March 2012	V	8	4
12/18/2012	NMED/Kieling	SNL/ Beausoleil	Extension of the Public Comment Period on the Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill, March 2012	V	9	4
01/08/2014	NMED/Blaine	SNL/ Beausoleil	Notice of Approval: Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan, March 2012	V	10	2
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02/14/2014	NMED/Blaine	SNL/ Beausoleil	Notice of Approval: Work Plan for the Installation of 3 Soil-Vapor Monitoring Wells at the Mixed Waste Landfill	V	12	2
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07/09/2014	SNL/Todd	NMED/Kieling	Submittal of Updated Reference Documents Cited in the Mixed Waste Landfill Long-Term Monitoring & Maintenance Plan	VI	2	310

Mixed Waste Landfill – Justification Binder Index (Continued)

Date	From	To	Description	Volume	Tab	Number of Pages
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01/30/2006	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Annual Groundwater Monitoring Report, April 2005	VII	1	56
12/13/2006	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Annual Groundwater Monitoring Report, April 2006 Sampling Event	VII	2	50
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11/09/2010	NMED/Bearzi	SNL/Wagner	Notice of Approval: Mixed Waste Landfill Groundwater Monitoring Report Calendar Year 2009	VII	9	2
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06/19/2007	NMED/Bearzi	SNL/Wagner	NOD: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2	VIII	3	4
07/02/2007	NMED/Bearzi	SNL/Wagner	Replacement of Mixed Waste Landfill Groundwater Monitoring Wells MWL-MW1 and MWL-MW3	VIII	4	2
08/03/2007	SNL/Wagner	NMED/Bearzi	Response to NOD: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1; Installation of Well MWL-BW2, April 9, 2007; and Submittal of Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1; Installation of Well MWL-BW2, Revision 1	VIII	5	32
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10/12/2007	NMED/Bearzi	SNL/Wagner	Correction for Notice of Approval Dated October 10, 2007 Regarding Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2,	VIII	8	2
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12/05/2007	SNL/Wagner	NMED/Bearzi	Response to October 30, 2007 Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Wells MWL-MW1 and MWL-MW3; Installation of Wells MWL-MW7 and MWL-MW8	VIII	10	6
02/12/2008	NMED/Bearzi	SNL/Wagner	Location of Monitoring Wells MWL-MW7 and MWL-MW8	VIII	11	2
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03/21/2008	NMED/Bearzi	SNL/Wagner	Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-MW2, Installation of Well MWL-MW9	VIII	13	2
04/23/2008	SNL/Wagner	NMED/Bearzi	Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2	VIII	14	62

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09/23/2008	SNL/Davis	NMED/Bearzi	Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Wells MWL-MW1, MWL-MW2, MWL-MW3, Installation of Wells MWL-MW7, MWL-MW8, MWL-MW9	VIII	16	150
10/03/2008	SNL/Davis	NMED/Bearzi	Responses to NOD: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2	VIII	17	14
10/31/2008	NMED/Bearzi	SNL/Wagner	Notice of Approval: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2	VIII	18	2
01/15/2009	NMED/Bearzi	SNL/Davis	Notice of Approval: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Wells MWL-MW1, MWL-MW2, MWL-MW3, Installation of Wells MWL-MW7, MWL-MW8, MWL-MW9	VIII	19	2
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08/18/2010	SNL/Wagner	NMED/Bearzi	Mixed Waste Landfill Toluene Investigation Report, August 2010	VIII	23	236
09/28/2010	NMED/Bearzi	SNL/Wagner	NOD: Mixed Waste Landfill Toluene Investigation Report August 2010	VIII	24	2
10/14/2010	SNL/Wagner	NMED/Bearzi	Response to September 28, 2010, NMED comments on the Mixed Waste Landfill Toluene Investigation Report	VIII	25	142
01/13/2011	NMED/Bearzi	SNL/Wagner	Notice of Approval: Mixed Waste Landfill Toluene Investigation Report, Revised October 2010	VIII	26	2
05/20/2014	SNL/Todd	NMED/Kieling	Mixed Waste Landfill Groundwater Monitoring Report - Monitoring Well MWL -MW4 Metals Data – Calendar Year 2013	VIII	27	44
07/24/2014	NMED/Kieling	SNL/ Beausoleil	Mixed Waste Landfill Groundwater Monitoring Report – Monitoring Well MWL-MW4 Metals Data – Calendar Year 2013, May 2014 (NMED Recommendations Letter)	VIII	28	2

Volume VI

TAB 1

Submittal of Reference Documents Cited in the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan

From: SNL/Todd
To: NMED/Kieling

Back of Tab 1

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National Nuclear Security Administration
Sandia Field Office
P. O. Box 5400
Albuquerque, NM 87185

MAR 0 6 2014

Mr. Dave Cobrain
Manager
Permits Management Program
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Dr. East, Bldg. 1
Santa Fe, NM 87505

Subject: Submittal of Reference Documents Cited in the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan for Sandia National Laboratories/New Mexico, Environmental Protection Agency Identification Number NM5890110518

Dear Mr. Cobrain:

The Department of Energy/National Nuclear Security Administration and Sandia Corporation (Sandia) are submitting the enclosed reference documents to the New Mexico Environment Department (NMED) in accordance with Appendices C through G of the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan (LTMMP). This submittal is required within 60 days of NMED approval of the LTMMP, which occurred on January 8, 2014.

This submittal is comprised of procedures, plans and the analytical laboratory statement of work used by Sandia personnel for air, surface soil, soil vapor, soil moisture, biota, and groundwater sampling and analysis at the Mixed Waste Landfill (MWL) (total of thirteen documents). The cited documents are described in the following appendices to the MWL LTMMP:

Appendix C – Air Sampling and Analysis Plan for the Mixed Waste Landfill
Appendix D – Soil-Vapor Sampling and Analysis Plan for the Mixed Waste Landfill
Appendix E – Soil-Moisture Monitoring Plan for the Mixed Waste Landfill
Appendix F – Groundwater Sampling and Analysis Plan for the Mixed Waste Landfill
Appendix G – Tritium and Biota Sampling and Analysis Plan for the Mixed Waste Landfill

If you have questions, please contact John Weckerle of my staff at (505) 845-6026.

Sincerely,

James W. Todd
Assistant Manager for
Engineering

Enclosure
See Page 2

cc w/enclosure:
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Amy Blumberg, SNL/NM, MS-0141
SNL Customer Funded Record Center, MS-0651 (**electronic copy only**)
SFO Legal File
SFO Waste Management File
John Weckerle, SFO/ENG, MS-0184
14-327-563197

Submittal of Cited Reference Documents
Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan

Sandia National Laboratories
Albuquerque, New Mexico
EPA ID No. NM5890110518

CERTIFICATION STATEMENT

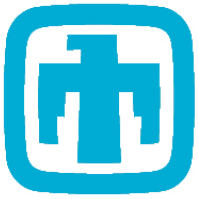
I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Michael W. Hazen, Vice-President
Sandia Corporation
Albuquerque, New Mexico
Operator

29 Jan 2014
Date signed

James W. Todd, Assistant Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Field Office
Owner

06 Mar 2014
Date signed



Sandia National Laboratories

Enclosure A

Reference Documents Cited in the Mixed Waste Landfill
Long-Term Monitoring and Maintenance Plan for
Sandia National Laboratories/New Mexico (SNL/NM)
Environmental Protection Agency
Identification Number NM5890110518

U.S. DEPARTMENT OF ENERGY

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000

Index of MWL Long-Term Monitoring and Maintenance Plan Documents

Document Number	Title	LTMMP Reference
AOP 00-03	Data Validation Procedure for Chemical and Radiochemical Data	Appendix D (Table D-1-1), Appendix F (Table F-1-1), Appendix G (Table G -3.1-1)
AOP 95-16	Sample Management and Custody	Appendix C (Table C-4.1-1), Appendix D (Table D-1-1), Appendix F (Table F-1-1), Appendix G (Table G -3.1-1)
FOP 05-01	Groundwater Monitoring Well Sampling and Field Analytical Measurements	Appendix F (Table F-1-1)
FOP 05-02	Groundwater Monitoring Equipment Field Check For Water Quality Measurements	Appendix F (Table F-1-1)
FOP 05-03	Groundwater Monitoring Equipment Decontamination	Appendix F (Table F-1-1)
FOP 05-04	Groundwater Monitoring Waste Management	Appendix F (Table F-1-1)
LOP 94-03	Sample Handling, Packaging, and Shipping	Appendix C (Table C-4.1-1), Appendix D (Table D-1-1), Appendix F (Table F-1-1), Appendix G (Table G -3.1-1)
PLA 05-09	Groundwater Monitoring Health and Safety Plan	Appendix F (Table F-1-1)
SMO 05-03	Procedure for Completing the Contract Verification Review	Appendix D (Table D-1-1), Appendix F (Table F-1-1), Appendix G (Table G -3.1-1)
FOP 08-22	Soil Vapor Sampling	Appendix D (Table D-1-1)
NA	SNL/NM Statement of Work for Analytical Laboratories	Appendix D (Table D-1-1), Appendix F (Table F-1-1), Appendix G (Table G -3.1-1)
NA	Quality Assurance Project Plan for the Sample Management Office	Appendix D (Table D-1-1), Appendix F (Table F-1-1), Appendix G (Table G -3.1-1)
FOP 10-07	Field Operation Procedure for Soil Moisture Determination at the Mixed Waste Landfill Utilizing Neutron Logging	Appendix E (Table E-4-1)

Notes:
Appendix C = Air SAP for the Mixed Waste Landfill
Appendix D = Soil-Vapor SAP for the Mixed Waste Landfill
Appendix E = Soil-Moisture Monitoring Plan for the Mixed Waste Landfill
Appendix F = Groundwater SAP for the Mixed Waste Landfill
Appendix G = Tritium and Biota SAP for the Mixed Waste Landfill

Sandia National Laboratories/NM

Sample Management Office

DATA VALIDATION PROCEDURE FOR CHEMICAL AND RADIOCHEMICAL DATA

AOP 00-03

Revision 3

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Appendix G: Mass Spectra Acceptability

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Revision History

Revision	Review Date	Effective Date	Summary of Changes
0	12/21/1999	12/21/1999	New document
1	12/08/2003	12/08/2003	Update to reflect current administrative changes
2	07/16/2007	07/16/2007	Update to reflect current administrative changes
3	05/12/2011	05/16/2011	EPA method updates and references. Process changes for the automatic upload of the data validation qualifiers and the necessary QC steps associated with the new data processing procedure.

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1.0 PURPOSE

The purpose of data validation is to identify, through the evaluation of supporting documentation, those data that do not meet the expected precision and accuracy of an analytical method. This procedure presents the guidelines used to evaluate chemical (organic and inorganic) and/or radiochemical analytical data acquired in support of environmental and waste management activities. The purpose of the procedure is to consistently qualify data using defined criteria; however, it is not intended to eliminate the need for professional judgment in evaluating the data quality. The data validator may be more or less stringent in evaluating the results based on experience and familiarity with the analytical techniques, historical data, sample matrices, or intended use of the data. The product of this procedure is a data validation report that includes information regarding the overall quality of the data and the resulting data qualifiers. When variations in the application of data qualifiers are warranted, the justification and rationale will be explained in the data validation report.

2.0 SCOPE AND OWNERSHIP

2.1 Scope

This procedure specifically covers the validation of chemical or radiochemical analytical results from environmental methods required for Sandia National Laboratories/New Mexico (SNL/NM) Sample Management Office (SMO) decisions but may be used by other organizations as appropriate. The format is based on analytical techniques, standard reporting protocols used by the laboratories, and the general format followed by the Environmental Protection Agency (EPA) functional guidelines. Additions and modifications were made to address analyses requested by the SNL/NM SMO customers. Any apparent redundancies between sections, is stylistically intentional for the sake of completeness and accuracy. Qualification of data performed under this procedure does not replace any data usability review for specific project use.

2.2 Ownership

The SNL/NM SMO owns this operating procedure (OP). The SMO is responsible for maintaining and revising this OP as necessary. Any comments or suggestions for improvement should be forwarded to the SMO.

3.0 RESPONSIBLE INDIVIDUALS AND ORGANIZATIONS

This section describes the responsibilities of SNL/NM personnel and contractors regarding this OP.

3.1 SMO Task Leader

The SMO Task Leader is responsible for:

- Ensuring this OP is implemented for review and validation of analytical data provided by the contract laboratories when data validation is requested.
- Providing oversight of the data review and validation process.
- Managing the validation contract, acting as the Sandia Delegated Representative

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- Developing and maintaining processes that ensure the necessary documentation, to perform data review and validation, is made available to the data validator.
- Ensuring nonconformances are documented and corrective actions are initiated and closed.
- Managing a process for complete analytical data package archival to the Records Center

3.2 SMO Technical Data Support Staff

The SMO technical data support staff is responsible for:

- Completing the Contract Verification Review (CVR) form on analytical data packages from the contract analytical laboratories pursuant to "Procedure for Completing the Contract Verification Review," (SMO-05-03).
- Transmitting and tracking electronically the complete analytical data package (which includes the CVR form, analytical data, sampling documentation, supporting documentation, and if applicable laboratory Electronic Data Deliverable (EDD) to the data validation coordinator.
- Implementing and follow-up of all nonconformances and corrective actions with the contract laboratories and data validator.
- Processing the EDD that includes the data validation qualifiers, into the Environmental Data Management System (EDMS), pursuant to "Procedure for Electronic Data Deliverable (EDD) Processing," (SMO-05-04).
- Performing QC checks on all data validation results by reviewing the report and comparing the results to the DV qualifiers captured on the EDD.
- Transmitting the complete analytical data package to the data administrator for final archiving.

3.3 SMO Data Administrator

The SMO data administrator is responsible for:

- Tracking analytical data delivered electronically from the contract analytical laboratories pursuant to "Procedure for Electronic Data Deliverable (EDD) Processing," (SMO-05-04).
- Forwarding the complete and final analytical data package and electronic data to the SNL/NM Records Center for archiving.

3.4 Data Validation Coordinator

The data validation coordinator is responsible for:

- Receiving, tracking, and distributing analytical data packages to data validators.
- Requesting data corrections or additional information needed from the analytical laboratories, notifying SMO of the request, and forwarding these to the data validator upon receipt from the laboratory.
- Notifying the SMO of nonconformances noted during the review process, and ensuring that nonconformances (e.g., incorrect or missing analytical information) are adequately addressed.
- Communicating with the SMO customer or designated representative when data review and validation is complete and sending the completed data validation report to the customer.

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- Compiling the data validation report and checklists with the CVR form, analytical data package, sampling documentation, and if applicable validation EDD files (see Section 5.1 below), and returning the complete package to the SMO technical data support staff.

3.5 Data Validator

The data validator is responsible for:

- Reviewing the CVR form, analytical data, sampling documentation, and supporting documentation as described in this OP.
- Notifying the data validation coordinator and the SMO of all data determined as rejected (R coded) according to this OP.
- Notifying the data validation coordinator of any corrections or additional information required from the analytical laboratory.
- Completing the data validation report including checklist(s) and if applicable generating validation EDD files (see Section 5.1 below), and returning the data package and report to the data validation coordinator.

4.0 PROCEDURE

Data are evaluated using common quality parameters from quality control (QC) measurements specified in the methods and applicable contract statement of work (SOW). These parameters are compared to statistically derived or regulatory method criteria to estimate the quality of the results. The quality parameters are measures of the analytical precision and accuracy, potential contamination both from the field and from the laboratory, sample matrix effects, and sample inhomogeneity. The laboratory may define the acceptance criteria as long as they meet or exceed those specifically defined within the method or contract. The appropriateness of acceptance criteria generated by the laboratory should be evaluated periodically by the SMO.

Qualification is based on minimal reporting requirements and does not address method or contract compliance requirements, except within the context of QC data. Complete method and contract compliance cannot generally be performed using only the laboratory data package and should be done during on-site assessments at the laboratory where all supporting documentation is available.

If any QC element for a method is not provided, the data validation report must document that the QC data are missing and any qualification is at the discretion of the data validator. A QC failure for an analyte that results in "R" coded (unusable) data due to matrix problems (e.g., matrix interference that cannot be alleviated by acceptable clean-up procedures) brings the appropriateness of the analytical method into question. As a result, the data validation report must document that analysis by another acceptable method or modification of the existing method may be necessary.

4.1 General

This section provides the portions of the method for reviewing QC data that are pertinent to both chemical (organic and inorganic) and radiochemical analytical data.

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4.1.1 Contract Verification Review (CVR)

The SMO is responsible for conducting a CVR of analytical data packages delivered from the contract analytical laboratories using the SMO "Procedure for Completing the Contract Verification Review," (SMO-05-03).

Criteria: A CVR form shall be included with the analytical data package that specifically addresses the Analytical Request/Chain of Custody (AR/COC), receipt of samples by the laboratory, and the technical, QC, and reporting requirements imposed upon the analytical laboratory through the SMO contract SOW.

Evaluation	Action
The CVR form should be checked to confirm: AR/COC and laboratory login information have been reviewed, missing samples and sample container irregularities are discussed, preservation and hold time deficiencies are indicated, appropriate target analyte lists (TALs) and contract-required laboratory qualifiers are used, results are reported, in correct units, for all analytes requested, all radiochemistry results include the calculated total propagated uncertainty (TPU), the required detection limits are reported and clearly defined or an explanation of why they were not met is given, all outstanding reporting issues are resolved, any request for an amended report from the laboratory has been received, and signatures and dates are present indicating CVR was completed.	Report any discrepancies and/or anomalies associated with the CVR form to SMO.

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4.1.2 Quality Control (QC) Exemptions

Various filter materials may be submitted for analysis. Matrix spike (MS) and replicate sample analysis requirements shall not apply to filter materials because representative splits of these samples are generally not obtainable. All other QC criteria shall apply to the analysis of filters.

The requirements for reanalysis for QC failures are waived when insufficient sample remains. A detailed discussion of that condition shall be included in the laboratory case narrative when it is encountered.

Acidity, alkalinity, biological oxygen demand (BOD), color, corrosivity, dissolved oxygen (DO), gravimetric oil and grease, hardness, ignitability, pH, titrimetric sulfide, conductivity, all of the solids methods, and turbidity analyses are generally exempt from the general inorganic QC requirements.

Criteria: The analyses referenced directly above shall be controlled according to the method QC and/or the laboratory's QC policies. In general, one or more of the following should be included:

- Blank; result less than (<) the method detection limit (MDL).
- Laboratory control sample (LCS); measured value within plus or minus (±) 20 percent (%) of known value.
- Duplicate; relative percent difference (RPD) <25%.
- Independent calibration check standard; result within ± 10% of true value.

Note: Blanks (MB/FB/EB) are not applicable for acidity by titration, alkalinity, conductivity, flash point, pH, and specific gravity. In the Blanks section of the data validation report document that the blank result was reported, but not assessed for data validation.

Evaluation	Action
If there are any QC failures for any of the analyses listed above,	qualify sample results associated with QC failures according to the appropriate requirements in Section 4.6, Procedure for Inorganic Data Validation. **Note**: Sample results shall not be qualified due to the lack of QC data. QC exemptions shall be discussed in the data validation report.

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4.1.3 Holding Times

Samples must be extracted and analyzed within EPA-specified holding times for results to be considered reflective of total concentrations. Analytical data generated outside of the specified holding time criteria must be considered to be suspect. Holding times must be evaluated to ascertain the validity of results based on the holding time of the sample from time of collection to time of analysis.

Solid materials, such as soils, that are being analyzed for radioisotopes or metals are generally exempt from qualification for exceeded holding times. The reviewer should evaluate the stability of the analyte and half-life, if applicable, and qualify based on professional judgment.

In the case of organic analyses, regulatory holding times are set by analytical method and do not address the stability of individual compounds; however, studies have been conducted to determine the stability of many of the commonly requested volatile compounds in preserved water. In some special cases, water samples for the analysis of volatile organic compounds (VOCs) are from sampling events that cannot be resampled, and rejecting non-detects may be very detrimental to the program. In these special cases, the holding time qualification guidelines given in Appendix C may be used, but the data validation report must clearly state that the evaluation and qualification were not performed using regulatory holding time guidelines.

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Criteria: All samples will be extracted and analyzed within specified holding times, per Appendix B.

Evaluation	Action
If a holding time infraction is <5% of the holding time criteria,	sample results may be accepted without qualification based on professional judgment. Note: Consideration should be given to the relevant holding time requirement; for example, "days" versus "hours."
If holding times are exceeded and preservation requirements are not met (see Section 4.1.4),	qualify all associated detects as "J" and all associated non-detects as "R."
If samples were analyzed after their holding time had expired but within 2 times (X) the specified holding time,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If samples were analyzed beyond 2X the specified holding time,	qualify all associated detects as "J" and all associated non-detects as "R."
If samples were analyzed within holding time and reanalyzed out of holding time due to a QC failure and…	
the original and reanalysis calibration, sample, and QC data are provided and the sample results are similar,	accept the results of the reanalysis without holding time qualification.
the original or reanalysis calibration, sample, and QC data are not provided, or the sample results of the original analysis and the reanalysis are not similar,	qualify all associated detects as "J" and all associated non-detects as "UJ."

4.1.4 Preservation (chemical and temperature)

Samples must be preserved according to EPA-specified criteria for results to be considered reflective of total concentrations. Analytical data generated outside of the specified preservation criteria must be considered to be suspect. The data validation report shall include a discussion of any preservation violations and a discussion supporting any qualifications.

Many organic compounds and most metals and radioisotopes are not affected by temperature variations up to ambient temperature and are generally not qualified. VOCs and mercury are subject to analyte loss at elevated temperatures.

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Criteria: All samples shall be preserved and shipped under conditions specified in Appendix B.

Samples for metals or radiochemical analysis that were received without the required chemical preservation but that were preserved by the laboratory after receipt generally do not require qualification if the samples were allowed to equilibrate at least 16 hours before a sample aliquot is taken.

Evaluation	Action
If samples were received outside the temperature criteria,	all associated detects may be qualified as "J" and all associated non-detects may be qualified as "UJ" or "R" using professional judgment (see below).
If temperature violations occur for VOCs and/or mercury,	qualify all associated detects as "J" and all associated non-detects as "UJ." Non-detects for VOCs may be qualified as "R" if extreme temperature violations occur.
If samples preserved by the laboratory upon receipt were not allowed to equilibrate after laboratory preservation or if no documentation shows the samples were allowed to equilibrate,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If samples were received without the required preservation and were not preserved by the laboratory after receipt,	qualify all associated detects as "J" and all associated non-detects as "R."

4.1.5 Calibration Points

Generally, it is not acceptable to remove points from the calibration curve unless the points are at the high or low ends of the curve. For the purpose of meeting calibration criteria, if a point is removed from the low end, the practical quantitation limit (PQL) must be adjusted accordingly. If a point is removed from the high end, the linear calibration range must be adjusted accordingly. Whenever a point is removed, it must be clearly documented in the instrument log. All initial calibration points must be analyzed without any changes to instrument conditions, and all points must be analyzed within 24 hours.

The laboratory may remove ICAL data points that are not the low or high points of the average or linear/quadratic curve, if the reason can be clearly documented. Acceptable reasons include misinjection of the standard or minor instrument failure for the particular data point. Notify the laboratory project manager if no such documentation is present.

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4.1.6 Calibration for QC samples

If any QC samples are analyzed using a different initial calibration than that of the field samples, the laboratory must include a calibration report from the calibration affecting the QC samples. This calibration data shall only be used to evaluate the QC samples, and only if the QC samples fail to meet recovery or RPD acceptance criteria. The laboratory is not required to report calibration data associated with QC samples from another Sample Delivery Group (SDG).

4.1.7 Blank Hierarchy

The general hierarchy for application of qualifiers due to blank contamination is 1) instrument blank, 2) preparation blank or method blank (MB), and 3) field blank (FB), equipment blank (EB), or trip blank (TB). As a general guideline, if the instrument blank is contaminated, then associated detected results in field samples, MB, FBs, EBs, and TBs that are analyzed in the same analytical run may be qualified. If the preparation blank is contaminated, all associated detected results in samples prepared with that blank may be qualified even if the samples are analyzed in different runs. If an FB or EB is contaminated, all associated detected results in samples collected during the same sampling event may be qualified. If a TB is contaminated, all associated detected results in samples transported in the same container (cooler) may be qualified. Professional judgment must be employed to determine the effect of multiple blank contaminations upon the quality of field sample data.

4.1.8 Blank Normalization

Because sample aliquot values (masses or volumes) seldom vary significantly within a batch, the laboratory generally assigns a representative aliquot value to the MB. When a sample has a significantly different aliquot size than that of the MB, a detected MB result needs to be normalized to the detected sample result before a comparison can be performed for blank assessment. The blank data are normalized to the sample results using the following equation:

Normalized blank concentration = (blank concentration) X (blank aliquot value/sample aliquot value)

It should be noted that the blank analyses might not involve the same weights, volumes, and/or dilution factors as the associated samples. These factors must be taken into consideration when applying the 5X and 10X criteria, such that the total amount of contamination is actually compared.

4.1.9 Field Duplicates

Field duplicate samples may be collected and analyzed as an indication of overall precision. These analyses measure both field and laboratory precision; therefore, the results may have more variability than laboratory duplicates which measure only laboratory performance. It is expected that solid or waste duplicate results will have a greater variance than water matrices due to inhomogeneity.

If samples are identified as field duplicates, document the occurrence in the data validation report and state that there are no “required” review criteria for field duplicate analyses comparability.

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4.1.10 Sample-Specific External Standard Recovery

In lieu of an internal standard (IS) addition, an addition of a known quantity of material to a second sample aliquot may be used to calculate sample results. To evaluate external standard recovery (standard addition), the spike amount and spike recovery must be reported.

Criteria: Recovery guidelines for external standard recovery shall be 50% to 105%. The quantity of external standard used should be adequate to provide a reasonable confidence level in the measured recovery; that is, the spike level should be greater than (>) the indigenous level.

Note: For samples that require dilution the evaluation uses the concentration of the diluted result not the corrected result.

Evaluation	Action
If the measured sample result is >2X the external standard spike added,	qualify all associated results as "J."
If the measured sample result is >4X the external standard spike added,	qualify all associated results as "R."
If the recovery is >105% but less than or equal to (≤) 125%,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
If the recovery is >125%,	qualify all associated non-detects as "R." Associated detects may be qualified "J-" or "R" based on professional judgment.
If the recovery is <50% but greater than or equal to (≥) 20%,	qualify all associated detects as "J+."
If the recovery is <20%,	qualify all associated non-detects as "R."

4.1.11 Rounding Rules and Significant Figures

If the figure is ≥5, round up; otherwise, round down. For example, 11.443 is rounded down to 11.44, and 11.455 is rounded up to 11.46. If a series of multiple operations is to be performed (i.e., add, subtract, divide, and/or multiply), all figures are carried through the calculations. The final answer is rounded to the proper number of significant figures. Before evaluating a number for being in control or out of control of a certain limit, the number evaluated shall be rounded using these rounding rules to the significance reported for that limit. For example, if the acceptance limit is ±10% of the true value, then a calculated percent recovery (%R) of 110.46 shall be reported as 110%, which is within the acceptance limits of 90% to 110%. On the other hand, a calculated %R of 110.50 shall be reported as 111%, which is not within the 90% to 110% acceptance limits.

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Blank qualifications with an associated numerical value should be recorded with no more than three significant figures for values ≥100, and no more than two significant figures for values <100 in the DVR; for example, 125U, 18U, 9.9U, 0.32U or 0.032U.

4.1.12 Special Laboratory Flags

4.1.12.1 "X" Flags

Criteria: The laboratory or analyst may have reason to believe that the result for a specific analysis has a high probability of being a false positive due to interferences. In this case, the laboratory shall qualify the result as "X" and narrate the justification for the flag. Generally, use of the "X" flag is restricted to use in conjunction with additional data such as spectral matching or results from another analytical technique. The raw data and case narrative should be reviewed to determine if they agree with the identification of a false positive.

Evaluation	Action
When evaluating the "X" qualifier, if it is determined that the interference is the most significant source of the instrument response (i.e., if the detect is primarily a false positive or if it is a detect with a very high bias),	qualify detects determined to be primarily false positives as "R" and detects determined to have very high bias as "NJ+." Include a thorough discussion supporting the qualification in the data validation report.

4.1.13 Analytical Methods

The laboratory shall follow the requirements specified in the analytical methods and those specified in the SNL/NM SMO contract SOW. When these requirements are not met, reanalysis is required. In those cases where reanalysis cannot occur, the failure to reanalyze will be discussed in the case narrative. This discussion should also be included in the data validation report.

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4.1.14 Calculations

Criteria: Laboratories will generally use commercial software whenever possible. Spreadsheets and laboratory developed software are required to be verified and uniquely identified, and shall include a revision number (i.e., be under version control). Reverification of commercial software and other software is not routinely required. Hand-calculated data or data calculated from a spreadsheet or other software not under version control must be verified by the random recalculation of some of the results. Hand calculated results and spreadsheets should have all required formulas and data included in the package. In addition, any spreadsheet that is not under version control should be brought to the attention of the SMO.

Evaluation	Action
If results cannot be regenerated using the reported data,	require a formal corrective action by the laboratory.
If results are verified by recalculation using reported data,	discuss the recalculation in the data validation report.

Criteria: Laboratories are required to calculate the RPD between the MS and matrix spike duplicate (MSD) using the actual results (Solid Waste [SW]-846 method 8000B). Contract Laboratory Program (CLP) and some other programs use calculation routines, which calculate the RPD using the %Rs.

$$RPD = (MS\ \%R - MSD\ \%R)/[(MS\ \%R + MSD\ \%R)/2]$$

This does not give an equivalent result as that obtained using the SW-846 formula (see Section 6.3 below) when the sample contains indigenous analyte. When the RPD is calculated using %Rs, the results will need to be recalculated before the evaluation is performed.

Evaluation	Action
If results are recalculated using the correct data,	discuss the recalculation in the data validation report.

4.1.15 Reanalysis

The laboratory may perform a reanalysis on one or more samples because of QC failures. This may occur because of MS failures, or it may occur because a small subset such as the acid fraction in semivolatile organic compound (SVOC) analysis had QC failures for the first analysis and the second analysis was performed outside the method-specific holding time. Based on professional judgment the laboratory is to report only the best data set on the certificate of analysis (COA). All supporting

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documentation concerning a reanalysis will be provided in the miscellaneous data section of the analytical data package.

4.1.16 Manual Integration

Manual integration review (MIR) is typically outside the scope of routine validation. When MIR is required by the program, it must be performed in accordance with standard operating procedures.

Manual integration is used to correct improper integration performed by the instrument software, not for the purpose of meeting QC criteria. While MIR is not normally required for data validation, manually integrated peaks may be reviewed based on professional judgment or whenever QC problems indicate it may be necessary

Evaluation	Action
If a manual integration was not documented correctly or was performed incorrectly or does not meet one or more of the criteria given,	request confirmation from the laboratory of the need for regeneration of data. Data may be qualified as "J" or "R" based on professional judgment.

4.1.17 Failed Batch QC

Occasionally the batch QC sample (i.e., MS, LCS, blank, etc.) will fail and the individual QC sample will also fail sample-specific QC parameters (i.e., ISs, surrogates, etc.) The usefulness of the QC data from these batch QC samples is based on professional judgment for minor excursions. However, significant failures where the QC sample fails both sample parameters (i.e., surrogates, etc.) and batch parameters (e.g., analyte) require that the batch QC data be rejected and the batch be treated as if it did not include the batch QC sample. That is, the samples are qualified as if no QC sample was run with the batch.

4.1.18 MS/MSD, LCS/LCSD and Replicates

Occasionally the laboratory may analyze for replicates, matrix spike/matrix spike duplicate (MS/MSD) pairs, and/or laboratory control sample/ laboratory control sample duplicate (LCS/LCSD) pairs, presenting more than one measure of precision. If the sample has little or no indigenous analyte, the MS/MSD RPD is the best indicator of precision. If the sample has significant indigenous analyte, the replicate is the best indicator of precision. As a general rule, the replicate precision is used if the indigenous analyte is >2X or 3X the MS spike concentration. The LCS/LCSD RPD should only be used as a measure of precision in the absence of both MS/MSD and replicate analyses.

More than one measurement of precision is not assessed for the same sample/analyte. The data validation report should include a discussion on which measure of precision was used for assessment and why.

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4.1.19 MS/MSD

Occasionally the laboratory may dilute before spiking or may run the MS/MSD pairs at a reduced volume. For example, the sample aliquot will be 1000 milliliters (ml) while the MS aliquot is 500 ml. In this case, if the extract volume is the same for both the sample aliquot and the MS aliquot, the RPD is still a good measure of precision, but the %R is not a good measure of accuracy and matrix effect. At a minimum, this issue should be noted in the data validation report. If the final volume of the MS aliquot was adjusted for sample size (in this case, adjusted to half the sample extract volume), it should be noted that the laboratory may have adjusted the extract volume to account for a smaller sample aliquot. In this case, the MS %R is a good measure of accuracy and matrix effect.

MS samples that require dilution due to matrix should not be used to evaluate associated sample data unless the relative dilution factor between the MS and the field samples is ≤5, in which case there is still significant sample matrix similarity between the MS and field samples. If the MS sample is not used to evaluate sample data, the sample results should be qualified for lack of accuracy and/or precision data, as applicable, if specified by the program.

Evaluation	Action
If the MS/MSD relative dilution factor is >5 compared to the samples,	qualify all associated detects as "J" and all associated non-detects as "UJ."

4.1.20 MS/MSD with Elevated Analyte Concentration Requirements

When the sample used for the MS/MSD has an analyte concentration >4X the analyte spike concentration and the MS and/or MSD %R is out of limits, sample results should be qualified due to a lack of matrix-specific accuracy data. Matrix-specific precision can still be assessed using the MS/MSD RPD. If a post-digestion spike is also performed, it can be used to assess matrix-specific accuracy data for the analytes not evaluated using the MS/MSD. The 4X rule also applies to the post-digestion spike; however, its analyte spike concentration may be higher than that of the MS/MSD. The post-digestion spike recovery limits are usually narrower than the MS recovery limits. The MS and MSD results may be used in conjunction with other QC results to determine the need for qualification of the data.

Evaluation	Action
If the sample used for MS/MSD has an analyte concentration >4X the analyte spike concentration and the MS and/or MSD %R for that analyte is out of limits,	qualify all associated detects as "J" and all associated non-detects as "UJ."

4.1.21 Blank Qualification with QC Failures

Data may be qualified as a non-detect (U) based on blank contamination and have other QC failures. While the general approach is to qualify the sample result as a non-detect with no further qualification,

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other quality issues should be considered to determine if additional qualification is warranted. For example, if the LCS had very low recovery, the actual sample result may be below the blank result because of poor recovery, not just because of blank contamination. In this case, the result may be qualified "UJ" rather than "U." In general, samples with results that are qualified "U" or "UJ" due to blank contamination are not rejected. Justification for additional qualification must be explained in the data validation report.

4.1.22 Initial Dilutions

Initial dilutions may be required due to high indigenous analyte concentrations. For multi-analyte determinations where initial dilutions are required to keep from saturating the detector, the detection limits and reporting limits must be adjusted for the initial dilution. In addition, the matrix effect of the over-range analyte on the other analytes being measured cannot be determined.

Evaluation	Action
If all target analytes are reported from the same diluted run,	all associated detects may be qualified as "J" and all associated non-detects may be qualified as "UJ" based on professional judgment.

4.1.23 Reporting Limit Verification

Data from independent reporting limit verification standards may be used to additionally evaluate the intercept. Acceptable reporting limit verifications may be used to minimize qualification based on professional judgment. An acceptable curve with a low standard at the reporting limit does not meet this requirement. The reporting limit verification must be the measurement of an independent standard.

4.1.24 Filtered Samples

Water samples may be submitted as both field filtered and unfiltered aliquots. When it is evident that both a filtered and an unfiltered sample are submitted, both results will be reviewed. The analyte concentrations for the filtered portion should be ≤ the unfiltered portion.

Evaluation	Action
If the analyte concentrations of the filtered portion are generally > that of the unfiltered portion,	contact the laboratory to determine if a sample mix-up has occurred.
If the analyte concentrations of the filtered portion are generally > that of the unfiltered portion and the reason cannot be identified,	document the problem and contact the technical data support for further direction.

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4.1.25 Sample Contamination

There may be instances where little or no contamination is present in the associated blank, but qualification of the sample due to contamination is deemed necessary. Contamination introduced in a diluent is one example. Although it is not always possible to determine, evidence of this occurrence can be identified when contaminants are found in the diluted sample result but are absent in the undiluted sample.

Evaluation	Action
If it is determined that the sample contamination is from a source not identified in the blank,	qualify the results for that analyte as "R" and discuss such circumstances in the data validation report.

4.2 Procedure for Gas Chromatography/Mass Spectrometry (GC/MS) Validation

The requirements addressed within this section are applicable to all GC/MS analytical techniques.

4.2.1 Instrument Tuning for GC/MS

Tuning and performance criteria are established to ensure mass resolution, identification; and, to some degree, sensitivity. These criteria are not sample-specific. Conformance is determined using standard materials. Therefore, these criteria should be met in all circumstances.

Criteria: The GC/MS tune shall be evaluated daily. The relative abundance criteria listed in the appropriate method must be met.

Evaluation	Action
If tunes are not run daily or if all abundance criteria are not met,	contact the laboratory for immediate corrective action and use professional judgment to determine which data should be used. The following actions are suggested: qualify all associated detects as "J" and all associated non-detects as "UJ."
If multiple QC failures also occurred,	qualify all results as "R."

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4.2.2 Calibration

Initial Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for compounds on the TAL. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run and of producing a linear curve. In the absence of, or in addition to, method-specific calibration acceptance criteria, the following general calibration acceptance criteria should be applied.

The laboratory may establish a calibration curve using either the linear regression (linear curve) approach or the average response factor (RF) approach. If both approaches are used to quantify and report target analytes within the same data package, calibration is to be assessed on an analyte-by-analyte basis.

Criteria: GC/MS instrument calibration shall be performed using a minimum of five calibration standards unless otherwise specified by the method. If calibration curves are used, five standards are required for a linear (first-order) calibration model, six standards are required for a quadratic (second-order) model, and seven standards are required for a third-order polynomial. Higher order curves (second order and higher) should not normally be used. If the laboratory uses a higher-order equation to establish a calibration curve, it should be evaluated for appropriate application.

Evaluation	Action
If an insufficient number of calibration standards was used,	qualify all associated detects as "J" and all associated non-detects as "UJ."

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RFs

Criteria: RFs are a measure of the slope of the calibration relationship and assumes that the curve passes through the origin. Under ideal conditions, the factors will not vary with the concentration of the standard that is injected into the instrument. In practice, some variation is to be expected.

When the variation, measured as the percent relative standard deviation (%RSD), is ≤15%, the use of the linear model is appropriate and the calibration curve can be assumed to be linear and to pass through the origin. This criterion is derived from SW-846 GC/MS Methods 8260B and 8270C.

As a general rule, the amount of IS should produce an instrument response (e.g., area counts) that is no more than 100X that produced by the lowest concentration of the least responsive target compound associated with the IS. This should result in a minimum RF of no <0.01 for the least responsive target compound.

The %RSD for the RFs obtained from the five initial calibration standards must be ≤15% and the average RF shall be ≥ the method-specified minimum RF for each compound. The minimum RFs for the system performance check compounds per method SW-846 8260B (VOC) are:

- Bromoform 0.10
- Chlorobenzene 0.30
- Chloromethane 0.10
- 1,1-Dichloroethane 0.10
- 1,1,2,2-Tetrachloroethane 0.30

Compounds (VOC and SVOC) without specified minimum RFs will be >0.05.

Evaluation	**Action**
If the average RF for any target compound is < the specified minimum RF, or <0.05 if no minimum is specified,	qualify all associated detects as "J" and all associated non-detects as "UJ" if the average RF is ≥0.01 and as "R" if the average RF is <0.01.
If the %RSD for any target compound is...	
>15% but ≤40%,	qualify all associated detects as "J" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
>40% but ≤60%,	qualify all associated detects as "J" and all associated non-detects as "UJ."
>60%,	qualify all associated detects as "J" and all associated non-detects as "R."

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Linear Curves

Criteria: The coefficient of determination (r^2) of the initial calibration curve shall be ≥0.99 and have a slope ≥ the method-specified minimum RF for each compound. Compounds without method-specified minimum RFs shall have a slope ≥0.05. The absolute value of the intercept shall be ≤3X the MDL.

Note: The sample results may be reported with non-detects at the MDL or at the PQL value. See below for appropriate evaluation.

Note: The intercept reported in the instrument calibration report may not be in appropriate units. When the intercept is not in appropriate units, the instrument conversion routine may be needed to evaluate the intercept.

For calibrations using the Target software the intercept in concentration units is:

Concentration Intercept = (b)(CIS)

Where:

b = reported intercept

CIS = concentration of IS (on-column conc. on quant. report)

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Evaluation	**Action**
If the slope for any target compound is < the minimum RF, or <0.05 if no minimum is specified,	qualify all associated detects as "J" and all associated non-detects as "UJ" if the slope is ≥0.01 and as "R" if the slope is <0.01.
If the r^2 for any target compound is...	
<0.99 but ≥0.90,	qualify all associated detects as "J" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
<0.90 but ≥0.80,	qualify all associated detects as "J" and all associated non-detects as "UJ."
<0.80,	qualify all associated detects as "J" and all associated non-detects as "R."
If the intercept for any target compound is positive and > the MDL,	qualify all associated detects <3X the intercept as "J+."
When results are reported at the MDL: If the intercept for any target compound is negative with an absolute value…	
> the MDL but ≤3X the MDL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "UJ."
>3X the MDL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "R."
When results are reported at the PQL: If the intercept for any target compound is negative with an absolute value...	
> the MDL but ≤2X the PQL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "UJ."
>2X the PQL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "R."

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4.2.3 Calibration Verification

Compliance requirements for satisfactory initial and continuing instrument calibration verification are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for compounds on the TAL. Initial calibration verification (ICV) independently verifies the calibration and continuing calibration verification (CCV) establishes the 12-hour relative RFs on which the quantitations are based and checks satisfactory performance of the instrument on a day-to-day basis.

Criteria: An ICV standard must be analyzed immediately following an initial calibration.

The ICV standard analysis results are not required to be reported in the data package unless the samples in the SDG were analyzed after the initial calibration standard but before a CCV standard analysis was performed. In this case, the ICV percent difference (%D) is assessed according to the calibration verification criteria described below for the associated samples. If a CCV is analyzed prior to samples and ICV data are also reported in the package, both the ICV %D and the appropriate CCV %D are to be assessed as described below. If both ICV %D and CCV %D infractions occur, the worst infraction should be evaluated for result qualification.

A CCV standard must be analyzed:

(1) if analysis continues for longer than 12 hours, and

(2) at the beginning of each additional 12-hour period.

The laboratory is allowed to perform corrective action and reanalyze the CCV once after a failure. If more than two CCVs were analyzed to obtain a passing CCV, then the calibration was not verified and the calibration verification frequency criteria was not met.

Evaluation	Action
If the ICV and CCV standards were not analyzed at the proper frequency, or if either a required ICV or CCV was not analyzed, or if all target compounds were not present in any ICV or CCV standard,	qualify all associated detects as “J” and all associated non-detects as “UJ.”
If all required ICVs and CCVs were not analyzed,	qualify all associated detects as “J” and all associated non-detects as “R.”

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RFs

Criteria: The %D between the ICV and/or CCV RFs and the average RFs obtained from the initial calibration shall be calculated according to the formula in Section 5.3 and must be ≤20%.

Evaluation	**Action**
If the %D was reported with the wrong sign (e.g., + %D for a negative bias),	document the occurrence in the data validation report and assess any infractions using the correct sign.
If the %D between an initial calibration RF and an ICV or CCV RF for any target compound is...	
>20% and positive (high bias),	qualify all associated detects as "J+."
>20% but ≤40% and negative (low bias),	qualify all associated detects as "J-" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
>40% but ≤60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
>60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "R."

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Linear Curves

Criteria: The %D (see Section 6.3) between the ICV and/or CCV standard concentrations and their true values must be ≤ 20%.

Evaluation	Action
If the %D was reported with the wrong sign (e.g., +%D for negative bias),	document the occurrence in the data validation report and assess any infractions using the correct sign.
If the %D between the measured ICV and/or CCV concentrations and their true values for any target compound is... >20% and positive (high bias), >20% but ≤40% and negative (low bias),	 qualify all associated detects as "J+." qualify all associated detects as "J-" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ.
>40% but ≤60% and negative, >60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "UJ." qualify all associated detects as "J-" and all associated non-detects as "R."

4.2.4 Blanks

The purpose of laboratory (or field) blank analysis is to determine the essence and magnitude of contamination resulting from laboratory (or field) activities.

The criteria for evaluation of blanks apply to any blank associated with the samples and include MBs, and, if submitted, EBs, FBs, and TBs. Action in the case of unsuitable blank results depends on the circumstances and origin of the blank. In instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of a contaminant. For purposes of evaluating multiple blanks, each preparation batch may be considered an independent event in evaluating MBs, and each sampling event may be considered an independent event for evaluating EBs, FBs, and TBs.

The result for any compound detected in the sample (other than those listed below), that was also detected in any associated blank, must be qualified when the sample concentration is <5X the blank concentration. For the following compounds, the results are qualified when the sample concentration is <10X the blank concentration.

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Common laboratory contaminants:

- Methylene chloride
- Acetone
- Toluene
- 2-butanone
- Common phthalate esters (e.g., bis(2-ethylhexyl)phthalate, di-n-octyl phthalate)

Criteria: The concentration of each target analyte found in the blank must be < the associated MDL. The sample results must not be corrected by subtracting any blank value. If QC problems with any blank exist, all data associated with the case must be carefully evaluated to determine whether there is an inherent variability in the data for the case, or if the problem is an isolated occurrence not affecting other data.

Evaluation	**Action**
If a compound detected in a blank is also detected in a field sample,	qualify the sample result for that compound in accordance with the scenarios given below.
If gross contamination (e.g.., saturated peaks by GC/MS) exists,	qualify results for all affected compounds as "R" due to interference.
If inordinate numbers of target compounds are found at low levels in the blank(s),	Discuss the presence of these compounds in the data validation report as it may be indicative of a problem at the laboratory. **Note:** Similar consideration should be given to tentatively identified compounds (TICs) that are found in both the sample and its associated blank(s) (see Section 4.2.13).

The following are examples of application of the blank qualification guidelines. Certain circumstances may warrant deviations from these guidelines.

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Scenario

The sample result is > the PQL but is <5X or 10X the blank result.

Qualification

Rule	10X	5X
Blank Result	7	7
PQL	5	5
Sample Result	30	30
Qualified Sample Result	30U	30U

In the example for the 10X rule, qualify sample results <70 (or 10 X 7) as a non-detect ("U") at the reported value. In the case of the 5X rule, qualify sample results <35 (or 5 X 7) as a non-detect ("U") at the reported value.

Scenario

The sample result is < the PQL, and is also <5X or 10X the blank result.

Qualification

Rule	10X	5X
Blank Result	6	6
PQL	5	5
Sample Result	4J	4J
Qualified Sample Result	5U	5U

In the example for the 10X rule, qualify sample results <60 (or 10 X 6) as a non-detect ("U") at the PQL. In the case of the 5X rule, qualify sample results <30 (or 5 X 6) as a non-detect ("U") at the PQL.

Note: Data are not reported as 4U, as this would be reported as a detection limit below the PQL.

The PQL may not be reported and it may not be possible to determine the PQL from the data. In these cases, qualify the contaminated sample result as "U" at 5X (or 10X) the blank concentration.

Note: In some instances, the laboratory may adjust their MDLs to account for low-level common laboratory contaminants. In these cases, it may be possible to have a low level detection in a blank that would be considered a non-detect when compared to the adjusted MDL, resulting in the blank data being reported as a non-detect (PQL U). This may result in sample results that are above the MDL but <5X or 10X the actual blank concentration not being qualified. In instances where it is believed that there is low-level contamination of common laboratory contaminants that are not

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identified in the blank, the sample results may be qualified as "NJ" based on professional judgment and discussed in the data validation report.

Scenario

The sample result is > the PQL, and is also >5X or 10X the blank result.

Qualification

Rule	10X	5X
Blank Result	10	10
PQL	5	5
Sample Result	120	120
Unqualified Sample Result	120	120

For both the 10X and 5X rules, the sample result exceeded the adjusted blank result of 100 (or 10 X 10) and 50 (or 5 X 10), respectively. Therefore, this sample result is not qualified.

4.2.5 Surrogate Recovery

Laboratory performance for individual samples is evaluated by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interference and high concentrations of analytes. Because the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the review and validation of data based on specific surrogate results is frequently subjective and demands analytical experience and professional judgment. In addition, surrogate recoveries can be influenced by the success in recoveries of the ISs. The evaluation of surrogate recoveries and ISs should be done concurrently. Accordingly, this section consists primarily of guidelines, in some cases with several optional approaches suggested.

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Criteria: Sample and blank surrogate recoveries must be within limits specified by the laboratory. Surrogate compound recoveries shall be calculated using the procedure described in SW-846 method 8000B. Reported recoveries shall be accompanied by the applicable acceptance limits. No qualification with respect to surrogate recovery is placed on data unless one or more of the following occurs:

1) at least two surrogates are out of specification in the base/neutral fraction or acid fraction (SVOC analysis),

2) one surrogate is out of specification in the volatile fraction (VOC analysis), or

3) any surrogate has < 10 %R.

Under these three conditions, there should be a reanalysis.

Note: The common acid fraction analytes (SVOC) are all phenols; all cresols; benzoic acid; dichlorophenoxyacetic acid; dinoseb; and hexachlorophene.

Note: When there are unacceptable surrogate recoveries followed by successful reanalysis, the laboratories are required to report only the successful run.

See Appendix E for general guidelines for surrogate recovery limits.

Note: Results from spiked or replicate QC samples that have surrogate recoveries < 10% cannot be used to evaluate associated sample results. Sample results should be qualified for lack of accuracy and/or precision data, as applicable, if specified by the program.

Evaluation	**Action**
If surrogate recovery acceptance criteria were not reported in the data package,	request amended data from the laboratory.
If, based on professional judgment, the laboratory's internal acceptance criteria are excessively wide or biased,	notify the program manager.
If an initial dilution was performed on any sample and at least one surrogate recovery is < the lower acceptance limit but ≥10%, or all surrogate recoveries are <10% and the results for one or more compounds are ≥ the PQL,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
If an initial dilution was performed on any sample, all surrogate recoveries are <10%, and all results are non-detect,	qualify all associated sample results as "R."

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If there are two or more analyses for a particular fraction at the same dilution,	determine which analysis contains the best data to report using the considerations below, qualify all data from the rejected analysis as "R," and document the reason for rejecting data from one analysis in the data validation report. Considerations should include: 1. surrogate recovery (marginal vs. gross deviation); 2. holding times; 3. comparison of the values of the target analytes reported in each fraction; and 4. performance of ISs.
For surrogate recoveries out of specification, the following approaches are suggested based on a review of all data from the batch, especially considering the apparent complexity of the sample matrix:	
if at least two surrogates in the base/neutral fraction or the acid fraction, or one surrogate in the volatile fraction, are out of specification low but have recoveries ≥ 10%,	qualify all detects for that fraction as "J-" and all non-detects for that fraction as "UJ."
if any surrogate recovery in a fraction is <10%,	qualify all detects for that fraction as "J-" and all non-detects for that fraction as "R."
if at least two surrogates in the base/neutral or the acid fraction, or one surrogate in the volatile fraction, are out of specification high,	qualify all detects for that fraction as "J+."

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Criteria: In the case of a blank analysis with surrogates out of specification, special consideration must be given to the validity of associated sample data. The basic concern is whether the blank problems represent an isolated problem with the blank alone or whether there is a fundamental problem with the analytical process.

If one or more samples in the batch show acceptable surrogate recoveries, the blank problem may be considered an isolated occurrence. However, even if this judgment allows some use of the affected data, analytical problems remain that must be corrected by the laboratory.

Evaluation	Action
If surrogate recovery in the blank does not meet acceptance criteria,	all detects < the PQL in all samples associated with the blank may be qualified as "J" and all non-detects in all samples associated with the blank may be qualified as "UJ."

4.2.6 Internal Standard Performance

Internal standard (IS) criteria ensure that GC/MS sensitivity and response are stable and acceptable during each analysis.

Criteria: Sample and blank IS results must be within limits given in the specific SW-846 method.

IS area counts must not vary by more than a factor of two (50% to 200%) from the average of those obtained from the calibration standards.

The retention time (RT) of the IS must not vary more than ±30 seconds from that of the associated calibration standard.

When qualification of sample results is warranted due to failure of an IS to meet RT or area count acceptance criteria, results of all target compounds associated with that IS are qualified.

Refer to Appendix D for IS/target compound correlation guidelines.

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Evaluation	Action
If there are two analyses for a particular fraction,	determine which analysis contains the best data to report using the considerations below, qualify all data from the rejected analysis as "R," and document the reason for rejecting the data from one analysis in the data validation report. Considerations should include: 1. magnitude of the RT shift; 2. holding times; 3. comparison of the values of the target compounds reported in each fraction; and 4. surrogate recovery.
If any IS area count is <50% of the average of that obtained from the calibration standards,	qualify all associated detects as "J+" and all associated non-detects as "UJ." Non-detects may be qualified as "R" based on professional judgment if the internal standard area counts are <25% of that of the average obtained from the calibration standards. **Note:** If extremely low area counts are reported, or if performance exhibits a major abrupt drop-off, then a severe loss of sensitivity is indicated.
If the IS area count is >200% of the average of that obtained from the calibration standards,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
If the IS RT varies by more than ±30 seconds from that of the associated CCV standard,	qualify all associated detects as "N" or "R" and all associated non-detects as "R."

4.2.7 MS/MSD

Data for MS/MSD are generated to determine long-term precision and accuracy of the analytical method on samples of various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis.

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Criteria: The MS/MSD data shall not be used to qualify field sample results unless the MS/MSD sample was from the same client and of similar matrix.

An MS and MSD sample shall be analyzed at a frequency of once per data package, once per 20 samples of similar matrix, or once per sample matrix, whichever is more frequent.

The laboratory shall not use FBs, EBs, or TBs to satisfy these requirements, if the laboratory can identify these blanks.

Unless otherwise stated in the specific method, the MS and MSD accuracy and precision acceptance criteria shall be those calculated by the laboratory using the procedure given in SW-846 Method 8000B. If the acceptance criteria are not given, recovery limits of 70% to 130% and ±30% RPD should be used as

the criteria. It may be appropriate to use wider default recovery acceptance criteria for SVOC analysis based on professional judgment. For solid and waste samples, it may be appropriate to accept up to a 40% RPD based on the professional judgment. The MS and MSD %R must be within the acceptance limits, unless the sample concentration is > 4X the spike concentration (see Section 4.1.20).

The MS and MSD analyses must meet all sample analysis acceptance criteria. An effort to determine to what extent the results of the MS/MSD affect the associated data should be made. This determination should be made considering the MS/MSD sample matrix, the surrogate recoveries, and the LCS results.

Professional judgment should be used to determine if MS/MSD failure warrants qualification of only the results for the failed compounds, or if results for all the compounds associated with the failed MS compound and its associated IS are affected. Generally, unless evidence exists to warrant qualification of other compounds, only the compounds in the MS spiking mixture shall be qualified.

For programs that require application of one final qualifier to sample results, if a recovery (accuracy) infraction is identified in one or both of the MS samples

along with an RPD (precision) infraction between the MS and MSD, the sample is qualified for the accuracy infraction. For example, if a compound has low MS recovery and the RPD is not within criteria, the data are qualified as "J-."

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Evaluation	Action
If the MS/MSD analysis was from another client or of a dissimilar matrix; if the frequency of the MS/MSD did not meet specified criteria; if no MS/MSD was analyzed; or if FB, EB, or TB samples were used for MS/MSD purposes,	qualify all detects as "J" and all non-detects as "UJ."
If no other measure of precision (i.e., LCSD or replicate) is available,	qualify all detects as "J" and all non-detects as "UJ."
If the surrogate, IS, and LCS %Rs are within the required acceptance criteria and…	
either the MS or MSD %R for any target compound is > the upper acceptance limit,	qualify all associated detects as "J+."
either the MS or MSD %R for any target compound is < the lower acceptance limit,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the recovery is ≥10% and as "R" if the recovery is <10%.
If the RPD for any target compound does not meet the acceptance criteria or %Rs fail both high and low,	qualify all associated detects for that compound as "J" and all associated non-detects as "UJ."

Note: The laboratory may analyze TBs in a separate batch than that of soil samples due to differences in sample matrices. In this situation, the laboratory may not analyze an MS/MSD for the batch associated with the TBs. The TB results should then be assessed for accuracy and precision using an LCS/LCSD.

4.2.8 Replicate

Replicate analyses are indicators of laboratory precision based on each sample matrix. If a replicate was performed instead of an MSD, the following criteria are applied. If insufficient sample was submitted to analyze an MS/MSD or replicate, the laboratory may run a laboratory control sample duplicate (LCSD) to measure precision. LCSD precision shall be assessed as described in Section 4.2.7.

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Criteria: A replicate sample shall be analyzed at a frequency of once per data package, once per 20 samples of similar matrix, or once per sample matrix, whichever is more frequent. All sample acceptance criteria must be met in the replicate analysis.

Samples identified as FBs, EBs, or TBs should not be used for replicate sample analysis.

Unless otherwise stated in the specific method, the replicate precision acceptance criteria shall be those calculated by the laboratory using the procedure given in SW-846 Method 8000B. When no laboratory-derived control limits are reported, a control limit of 30% for the RPD shall be used for sample values $\geq$5X the PQL. For solid and waste samples, it may be appropriate to accept up to a 40% RPD based on the professional judgment.

A control limit of ± the PQL shall be used for sample values < 5X the PQL, including the case when only one of the replicate sample values is <5X the PQL.

No precision criteria apply when both replicate sample values are < the PQL.

Evaluation	**Action**
If no replicate sample, no MSD, and no LCSD were analyzed for each matrix or for each data package,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."
If an FB, EB, or TB was used for the replicate analysis and no MSD or LCSD was run,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."
If the original result and replicate result for target compound are both $\geq$5X the PQL, and the RPD exceeds the appropriate control limit,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."
If the original and/or replicate result for any target compound is <5X the PQL (including non-detects) and the difference between the original result and replicate result is > the PQL,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."

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4.2.9 LCS

Data for LCSs are generated to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation.

Criteria: An LCS should be analyzed for all methods at a frequency of once per data package, once per matrix, or once per 20 analytical samples, whichever is most frequent. The LCS should have recoveries for all target analytes; however, for very large analyte lists or for known poor performers, the laboratory may have received an exemption for one or more analytes.

The LCS must meet all sample acceptance criteria. If surrogate and IS acceptance criteria are not met in the LCS analysis, the LCS must be reanalyzed. The LCS should meet all method-specific LCS requirements and acceptance criteria. If the recovery acceptance criteria are not reported, the reviewer should use the criteria in Appendix F, or 70% to 130% as the criteria.

If the laboratory analyzed an LCS/LCSD as a measure of precision both the LCS and LCSD must meet recovery acceptance criteria.

General laboratory precision and accuracy can be evaluated using the LCS acceptance criteria and the interlaboratory comparison data given in Appendix F. Individual LCS recoveries may be evaluated against the criteria in Appendix F if the laboratory's criteria are significantly different from those in the tables.

For volatile organics in an aqueous matrix, a successful **second source** CCV meets the LCS requirements.

Evaluation	**Action**
If, based on professional judgment, the laboratory's internal acceptance criteria are excessively wide or acceptable recoveries are significantly biased,	notify the program manager.
If the frequency of the LCS did not meet the specified criteria,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If results are reported for target compounds that are not in the LCS,	detects for those compounds may be qualified as "J" and non-detects for those compounds may be qualified as "UJ" based on professional judgment. Compounds missing under an exemption may be qualified based on professional judgment.

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If the LCS criteria were not met and reanalysis was not performed, then the laboratory performance and method accuracy are in question. Professional judgment should be used to determine if data should be qualified for all target compounds or just those compounds associated with the failed LCS compound and its associated IS. The following may be used as guidance in qualifying data.

If a full or large TAL LCS is analyzed, the following criteria may be used for LCS %Rs which fall outside reported acceptance criteria but are >10%:

70 to 74 compounds	≤ 5 LCS fall outside acceptance criteria - no qualification
60 to 69 compounds	≤ 4 LCS fall outside acceptance criteria - no qualification
50 to 59 compounds	≤ 3 LCS fall outside acceptance criteria - no qualification
40 to 49 compounds	≤ 2 LCS fall outside acceptance criteria - no qualification
30 to 39 compounds	≤ 1 LCS fall outside acceptance criteria - no qualification
< 30 compounds	No LCS fall outside acceptance criteria - no qualification

Evaluation	**Action**
If the LCS %R is > the upper acceptance limit,	qualify all associated detects as "J+."
If the LCS %R is < the lower acceptance limit,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the %R is ≥10% and as "R" if %R is <10%.
If %Rs for more than half of the compounds in the LCS analysis are below the acceptance range,	qualify all detects as "J-" and all non-detects as "UJ" if the failures are marginally low and as "R" if %Rs are significantly below acceptance limits. **Note**: If recoveries of more than half of the compounds in the LCS analysis are below the acceptance range, the laboratory has not shown that it can actually meet program required detection limits.
If %Rs for more than half of the compounds in the LCS analysis are above the acceptance range,	qualify all detects as "J+."
If %Rs for more than half of the compounds in the LCS analysis are outside the acceptance range, both above and below, or if an LCS/LCSD pair was analyzed and recoveries of any target compound are both above and below acceptance criteria,	qualify all detects in all associated samples as "J" and all non-detects in all associated samples as "UJ."

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4.2.10 Sample Carry-over

Sample carry-over may occur when a high-concentration sample is analyzed immediately prior to another field sample. Steps must be taken to avoid introduction of false positive results in the second sample analysis due to instrument contamination.

Criteria: The absence of sample carry-over must be determined and verified. If examination of the run logs indicates that any samples in the analytical run of interest required dilution, and there is no documentation of a rinse or blank analysis immediately following the original undiluted analysis then sample carry-over may be suspected in the subsequent sample.

Evaluation	Action
If any target compound found in the sample requiring dilution exceeded the high calibration standard and was also found in the following sample at a concentration <5X the PQL,	qualify the result for that compound in the second sample as "R" or "NJ" based on professional judgment.
If no data are available for the sample that required dilution and the laboratory has not documented that carry-over was evaluated, and the compound was also found in the following sample at a concentration <5X the PQL,	qualify the results for that compound in the second sample as "N."

4.2.11 Dilutions

Criteria: The PQLs must be adjusted to reflect all sample dilutions, concentrations, splits, clean-up activities, and dry weight factors that are not accounted for by the method.

Samples must be diluted and reanalyzed when any analytes exceed the calibration range.

Data from original samples should be included when any sample requires dilution due to one or more compounds exceeding the calibration range.

The original undiluted results document the actual MDLs for non-detects.

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Evaluation	Action
If the PQLs have not been properly adjusted,	request an amended report from the laboratory.
In some cases, initial dilutions are required because of expected high concentrations of non-target analytes or because one or more target analyte is expected to greatly exceed the instrument working range. In these instances, the laboratory may not be able to analyze the undiluted sample.	note the dilution and elevated MDLs in the data validation report.
If any target compound exceeds the calibration range and…	
the original undiluted sample result was reported,	qualify all detects from the undiluted analysis that exceeded the calibration range as "J."
the sample was diluted and reanalyzed, and the diluted sample data were reported,	qualify all non-detects from the diluted analysis as "UJ."
the original undiluted sample data were not provided,	request this information from the laboratory.
If data from the original sample run are unavailable,	refer to Section 4.2.5 for assessment of initially diluted samples with low surrogate recovery.

Criteria: The laboratory shall strive to make dilutions in such a way that the final concentration is measured in the mid-range of the calibration curve and that results are not reported from measurements below the lowest concentration standard.

Evaluation	Action
If the instrument response (reported result / dilution factor) from a diluted sample is < that of the lowest concentration standard,	qualify all associated detects from the diluted analysis as "J."

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Criteria: The extraction efficiency for extremely high concentrations of analytes has generally not been determined for most methods. If the analysis requires an extraction and dilutions of >100,000:1 the efficiency of the extraction may be suspect.

Evaluation	Action
If dilutions of >100,000:1 was required,	qualify all associated detects as "J-."

4.2.12 Mass Spectra Acceptability

Mass spectra review is typically outside the scope of routine data validation. When mass spectra review is required by the program, it must be performed by a validator experienced in the interpretation of mass spectra.

The laboratory is to identify mass spectra using either the National Bureau of Standards (NBS) /EPA/Mass Spectrometry Data Centre (MSDC) library or the National Institute of Standards and Technology (NIST)/EPA/National Institutes of Health (NIH) library. The laboratory must identity and document peaks and reference spectra for all target compounds with concentrations above the MDL. While it is not the function of the validator to determine if the analyst correctly identified a compound, an evaluation of how well the analyte peak matches the reference spectra may be requested. To evaluate analyte spectra, the guidelines in Appendix G shall be used.

Evaluation	Action
If the sample spectrum does not match the reference spectrum, the EICP RT or RRT does not meet criteria, or several guideline failures were observed,	qualify all associated results as "R."
If the analyte is not identifiable due to gross interference or apparent instrument instability,	qualify all associated results as "R."
If the analyte was misidentified by the laboratory,	request an amended report from the laboratory.
If identification of the analyte was hampered by interferences such that it is not certain that a positive identification could be made,	qualify all associated results as "N" based on professional judgment or request additional data from the laboratory.

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4.2.13 Tentatively Identified Compounds (TICs)

Chromatographic peaks that are not target analytes, surrogates, or ISs are potential TICs.

Criteria: For each sample, the laboratory may be requested to conduct a mass spectral search of either the NBS/EPA/MSDC library or the NIST/EPA/NIH library. The laboratory may report the possible identity for up to 20 of the largest VOC fraction peaks and the 20 largest SVOC fraction peaks which are not surrogate, IS, or target compounds, but which have an area/height >10% of the size of the area/height of the nearest IS.

It should be noted that common laboratory artifacts/contaminants and their sources (i.e., aldol products, solvent preservatives/reagent contaminants, etc.) may be present in blanks and not reported as sample TICs.

Examples:

- Common laboratory contaminants: CO_2 (m/e 44), siloxanes (m/e73), diethyl ether, hexane, certain freons (1,1,2-trichloro-1,2,2-trifluoroethane or fluoro-trichloromethane), phthalates at levels < 100 micrograms per liter (ug/L) or 4,000 micrograms per kilogram (ug/kg).
- Solvent preservatives: cyclohexene is a methylene chloride preservative. Related by-products include cyclohexanone, cyclohexenone, cyclohexanol, cyclohexenol, chlorocyclohexene, chlorocyclohexanol.
- Aldo reaction products of acetone include 4-hydroxy-4-methyl-2-pentanone, 4-methyl-2-penten-2-one, 5,5-dimethyl-2(5H)-furanone.

Evaluation	**Action**
If a low-level non-target compound that is a common artifact or laboratory contaminant is detected in a sample,	verify that TIC peaks present in samples are not found in blanks. Blank chromatograms should be examined for peaks that are <10% of the IS height but are present in the sample chromatogram at similar relative retention time (RRT).
If sample TIC results are not sufficiently above the level in the blank and the results are reported,	the results may be qualified as "R" (dilutions and sample size must be taken into account when comparing the amounts present in blanks and samples).

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If a result is identified as a TIC, If a compound is not found in any blanks, but is a suspected artifact or common laboratory contaminant,	qualify that result as "NJ." identify the compound as such in the data validation report. Compounds that are suspected artifacts or common laboratory contaminants result may be qualified as "R" based on professional judgment.

It should be noted that common laboratory calibration practices, along with limitations of some commercial software could result in compounds being detected and not reported in either the Form I or the TIC Summary Report. Review all quantitation reports to verify that all detected compounds are reported whenever a TIC Summary is included.

Evaluation	**Action**
If a compound is identified on the quantitation report but are not reported as target detect or as a TIC,	request a corrected report from the laboratory.

4.2.14 Method-specific Analytical Requirements–Organic GC/MS

The additional analytical requirements addressed below are organized by SW-846 method. These requirements should be checked if the level of deliverable (level III or level IV) allows.

4.2.14.1 Method 8260B, VOC Analysis by GC/MS

Criteria: The analysis of 2-chloroethyl vinyl ether in water must be performed on an unacidified sample.

Evaluation	**Action**
If 2-chloroethyl vinyl ether was reported for an acidified water sample,	qualify all associated detects as "NJ-" and all associated non-detects as "R."

4.2.14.2 Method 8270C, SVOC Analysis by GC/MS

Criteria: Gel permeation chromatography (GPC) cleanup shall be used as necessary to eliminate interferences. In addition, all water samples containing high molecular weight compounds that interfere with the analysis of the target compounds must also undergo GPC cleanup.

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Evaluation	Action
If the runlog notations, spectral data, IS %Rs, or surrogate %Rs indicate potential interferences,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If appropriate extract cleanup was not performed,	note this on the data validation report.

4.2.14.3 Method 8280A, Polychlorinated Dioxins and Furans by GC/MS

Sample analysis shall be performed according to the requirements listed in SW-846 Method 8280A. Evaluation of tuning reports is not required for this method.

Criteria: Initial calibration shall be performed using the five calibration solutions listed in Table 1 of the method. The %RSD for the ISs and the target compounds for the five calibration standards must be <15%.

Calibration verification shall be performed using the standards solution given in Table 4 of the method. The calibration verification analysis must meet the criteria given in Section 7.13.3.6 of the method.

Evaluation	Action
If the %RSD is >15% for any internal standard or target compound,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If the CCV acceptance criteria were not met for any target compound,	qualify all associated detects as "J" and all associated non-detects as "UJ."

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Sample Analysis

Criteria: For identification of any compound, the ion abundance ratios must be within the limits specified in Table 9 of the method.

For 2,3,7,8-substituted compounds that have an isotopically labeled internal standard or recovery standard present in the sample extract, the RT must be −1 to +3 seconds of the isotopically labeled standard. For 2,3,7,8-subtituted compounds that do not have an isotopically labeled internal standard or recovery standard present in the sample extract, the RT must fall within 0.005 RRT units of the RRT measured in the continuing calibration.

For non-2,3,7,8-substituted compounds, the RT must be within the corresponding homologous RT windows established by analyzing the column performance check solution.

Evaluation	Action
If ion abundance ratio criteria were not met for any compound,	qualify all associated results as "R."
If the RT of any compound is outside of the RT window,	qualify all associated results as "R."

Criteria: IS %R for analytical samples must be ≥25% and ≤150%. IS recovery guidelines are discussed in Section 7.15.5 of the method.

The LCS shall contain all of the target compounds at concentrations near the midpoint of the calibration range.

Evaluation	Action
If the recovery of any internal standard solution compound is >150%,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
If the recovery of any internal standard solution compound is <25%,	qualify all associated detects as "J+" and all associated non-detects as "UJ" if the recovery is ≥10% and as "R" if the recovery is <10%
If results are reported for target compounds that are not in the LCS,	qualify all associated detects as "J" and all associated non-detects as "UJ."

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GC Column Performance

Criteria: The GC column performance solution is used for defining the homologous GC RT windows and to document the chromatographic resolution. Column performance must be evaluated at the beginning of each 12-hour analytical period and must meet method acceptance criteria (see Section 7.12 of the method) before sample analysis may begin.

Evaluation	Action
If GC column performance was not evaluated at the required frequency or if method criteria were not met,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Confirmation of 2,3,7,8-TCDF Detects

Criteria: The DB-5 GC column generally used for polychlorinated dibenzodioxin (PCDD) and polychlorinated dibenzofuran (PCDF) analyses does not adequately separate 2,3,7,8-

TCDF from its closest eluting isomer. If 2,3,7,8-TCDF is detected in a sample, the result must be confirmed on a second column capable of separating 2,3,7,8-TCDF from all other TCDF homologues (as proven by successful analysis of the GC column performance mix with <25% valley between 2,3,7,8-TCDF and its closest eluting isomer).

Evaluation	Action
If 2,3,7,8-TCDF was detected in a sample and the result was not confirmed on a second column with successful analysis of the GC column performance mix,	qualify all associated detects as "NJ."

4.2.14.4 Method 8290, Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans by HRGC/HRMS

Initial Calibration

Criteria: A 5-point calibration is prepared for each labeled and unlabeled compound. The relative response factor (RRF) %RSD for the unlabeled standards must be ≤20%. For the labeled compounds, the %RSD must be ≤30%. Ion abundance ratios must meet the criteria listed in Table 8 of the method.

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Evaluation	Action
If the %RSD is: >20% for any unlabeled calibration standard or >30% for any labeled calibration standard, but ≤ 40%, >40% but ≤60% for either a labeled or unlabeled calibration standard, >60% for either a labeled or unlabeled calibration standard,	 qualify all associated detects as "J" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ." qualify all associated detects as "J" and all associated non-detects as "UJ." qualify all associated detects as "J" and all associated non-detects as "R."
If the ion abundance criteria is not met for any compound,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Continuing Calibration

Criteria: Calibration must be verified for both unlabeled and labeled compounds at the beginning and end of each 12-hour shift during which analysis is performed.

The measured RFs must be ≤20% of the mean values established during initial calibration for unlabeled compounds and ≤30% of the mean values established during initial calibration for labeled compounds. The ion abundance must be within the limits in Table 8 of the method.

For the calibration verification analyzed at the beginning of a 12-hour shift, the effect on data quality of a standard that does not meet criteria must be assessed using professional judgment. Guidance is provided in Section 7.7.4.4 of the method. For the calibration verification analyzed at the end of a 12-hour shift, a %D of 25% for unlabeled compounds and 35% for labeled compounds is acceptable; however, in this instance, the mean RFs from the beginning and ending daily calibration runs are used to calculate analyte concentrations instead of the RFs obtained from the initial calibration. If the %D of the ending

calibration is >25% for any unlabeled compound and/or >35% for any labeled compound, then successful performance of another initial calibration must be analyzed within two hours of sample analysis for the data to be acceptable. In this case, the mean RFs from the beginning and ending daily calibration runs are still used to calculate analyte concentrations.

Evaluation	Action
If the ion abundance ratio for any compound is outside of the method limits,	qualify all associated detects as "J" and all associated non-detects as "UJ."

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If the %D criteria is not met for any CCV compound at the beginning of a 12-hour shift, and… the %D is positive, the %D is negative,	 qualify all associated detects as "J+." . qualify all associated detects as "J-" and if any other calibration criteria have been exceeded for that compound, qualify all associated as "UJ."
If the %D criteria were <u>not</u> met for any compound at the end of a 12-hour shift, a new initial calibration was analyzed within two hours of sample analysis, and… the %D is positive, the %D is negative,	 qualify all associated detects as "J+." qualify all associated detects as "J-" if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
If the %D criteria were not met for any compound at the end of a 12-hour shift and a new initial calibration was <u>not</u> analyzed within two hours of sample analysis,	qualify all sample data analyzed during that 12-hour shift as "R."

Sample Preparation

Criteria: Extract cleanup shall be performed to eliminate interferences. The laboratory shall first partition the sample extract, followed by silica/alumina column cleanup and carbon column cleanup.

Evaluation	**Action**
If the documentation on the run log, spectra data, and/or IS or labeled compound %Rs indicate interferences and extract cleanup was not performed,	qualify all associated detects as "J" and all associated non-detects as "UJ."

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Sample Analysis

Criteria: For identification of any compound, the ion abundance ratios must be within the limits specified in Table 8 of the method.

For 2,3,7,8-substituted compounds which have an isotopically labeled IS or recovery standard present in the sample extract, the RT must be -1 to +3 seconds of the isotopically labeled standard. For 2,3,7,8-substituted compounds that do not have an isotopically labeled IS or recovery standard present in the sample extract, the RT must fall within 0.005 RRT units of the RRT measured in the continuing calibration.

For non-2,3,7,8-substituted compounds, the RT must be within the corresponding homologous RT windows established by analyzing the column performance check solution.

Evaluation	Action
If ion abundance ratio criteria are not met for any compound,	qualify all associated results as "R."
If the RT of any compound is outside of the RT window,	qualify all associated results as "R."

Mass Spectrometer Performance Criteria

Criteria: Performance criteria are established to ensure mass resolution, identification and, to some degree, sensitivity. These criteria are not sample specific.

Conformance is determined using standard materials. These criteria should be met in all circumstances. Mass spectrometer performance must be checked at the beginning and end of each analytical period in accordance with the method criteria (see Section 8.2 of the method).

Evaluation	Action
If mass spectrometer performance was not checked at the required frequency or if method criteria were not met,	qualify all associated detects as "R" and all associated non-detects as "UJ."

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Replicate Samples

Criteria: A replicate sample should be extracted and analyzed with each batch of samples. The RPDs between results (i.e., between the recoveries for the labeled 2,3,7,8-substituted compounds and between the concentrations for the non-labeled 2,3,7,8-substituted compounds) should be ≤25%.

Evaluation	Action
If a replicate sample, MSD, or LCSD were not analyzed for each matrix or for each data package,	qualify all detects of the same matrix as "J" and all non-detects of the same matrix as "UJ."
If the RPD between the sample (or MS or LCS) and its replicate (or MSD or LCSD) for any compound falls outside the appropriate control window,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."

Internal Standards

Criteria: The laboratory must spike all samples with the sample fortification solution and all sample extracts with recovery standard solution. The %R of each compound must be within 40% to 135%.

Evaluation	Action
If the %R for any sample fortification solution compound is <40%,,	qualify all detects for that sample fraction as "J+" and all non-detects for that sample fraction as "UJ" if the %R is ≥10% and as "R" if the %R is <10%.
If the %R for any sample fortification solution compound is >135%,	qualify all detects for that sample fraction as "J-" and all non-detects for that sample fraction as "UJ."

Gas Chromatography Column Performance

Criteria: The GC column performance solution is used for defining the homologous GC RT windows and to document the chromatographic resolution. Column performance must be checked at the beginning of each analytical analysis period and must meet method acceptance criteria (see Section 8.2 of the method) before sample analysis may begin.

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Evaluation	Action
If GC column performance is not checked at the required frequency or if method criteria is not met,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Confirmation of 2,3,7,8-TCDF Detects

Criteria: The DB-5 GC column generally used for PCDD and PCDF analyses does not adequately separate 2,3,7,8-TCDF from its closest eluting isomer. If 2,3,7,8-TCDF is detected in a sample, the result must be confirmed on a second column capable of separating 2,3,7,8-TCDF from all other TCDF homologues (as proven by successful analysis of the GC column performance column mix with <25% valley between 2,3,7,8-TCDF and its closest eluting isomer).

Evaluation	Action
If 2,3,7,8-TCDF was detected in a sample and the result was not confirmed on a second column with successful analysis of the GC column performance mix,	qualify all associated detects as "NJ."

4.2.14.5 Method TO-14, VOCs in Ambient Air using GC/MS

Analysis shall be performed according to the requirements specified in EPA Method TO-14A, "Determination of VOCs in Ambient Air Using SUMMA® Passivated Canister Sampling and Gas Chromatographic Analysis," Revision 1.0. In general, validate this analysis according to the Section 4.2. Also, this section provides some guidance that applies to TO-15.

Surrogates, an MS/MSD, and TICs are not required for this method.

MDLs are not used for TO-15, detects are only reported above the PQL.

Instrument Tuning for GC/MS

See Section 4.2.1 for tuning and performance criteria.

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Initial Calibration

Criteria: Instrument calibration shall be performed using at least three standard concentration levels (five standards for TO-15) and a humid zero air standard (not required for TO-15). In addition, a zero air certification for the sampling apparatus is to be provided.

Evaluation	Action
If an insufficient number of standards were used,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If a zero air certification is not provided,	document the occurrence in the data validation report

RFs

Criteria: The %RSD for the RFs must be ≤30% and the average RF shall be ≥ the method-specified minimum RF for each compound. Compounds without specified minimum RFs will be >0.05.

Evaluation	Action
If the average RF for any target compound is < the specified minimum RF, or <0.05 if no minimum is specified,	qualify all associated detects as "J" and all associated non-detects as "UJ" if the average RF is ≥0.01 and as "R" if the average RF is <0.01.
If the %RSD for any target compound is...	
≤30%,	qualify all associated detects as "J" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
>45% but ≤60%,	qualify all associated detects as "J" and all associated non-detects as "UJ."
>60%,	qualify all associated detects as "J" and all associated non-detects as "R."

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Calibration Verification

Criteria: Prior to analysis of samples, a calibration standard must be analyzed immediately following an initial calibration to ensure that the instrument continues to remain under control.

A calibration standard must be analyzed:

(1) daily and

(2) contain all target compounds.

The laboratory is allowed to perform corrective action and reanalyze once after a failure. If more than two calibration standards were analyzed to obtain a passing calibration standard, then the calibration was not verified and the calibration verification frequency criteria was not met.

Evaluation	Action
If the calibration standard was not analyzed at the proper frequency, or if all target compounds were not present in any calibration standard,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If the required calibration standard was not analyzed,	qualify all associated detects as "J" and all associated non-detects as "R."

RFs

Criteria: The %D between RFs and the average RFs obtained from the initial calibration shall be calculated according to the formula in Section 5.3 and must be ≤30%.

Evaluation	Action
If the %D was reported with the wrong sign (e.g., + %D for a negative bias),	document the occurrence in the data validation report and assess any infractions using the correct sign.
If the %D between an initial calibration RF and continuing calibration RF for any target compound is...	
>30% and positive (high bias),	qualify all associated detects as "J+."
>30% but ≤45% and negative (low bias),	qualify all associated detects as "J-" and, if any other calibration criteria have been

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	exceeded for that compound, qualify all associated non-detects as "UJ."
>45% but ≤60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
>60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "R."

Blanks

Criteria: A daily humid zero air instrument blank (not required for TO-15) shall be analyzed immediately prior to and after instrument calibration. These instrument blank results must be <0.2 parts per billion by volume (ppbv) in all target analytes before analysis may proceed.

Evaluation	Action
If a humid zero air instrument blank was not analyzed at the required frequency,	qualify all associated detects <5X the PQL as "J."
If any target compound was detected in the instrument blank at a level ≥ the MDL but <0.2 ppbv,	qualify all results as discussed in Section 4.2.4.

Internal Standard Performance

Criteria: IS area counts must not vary by more than ±40% from the average of those obtained from the calibration standards.

The retention time (RT) of the IS must not vary more than ±0.33 minutes (20 sec.) from that of the associated calibration standard.

When qualification of sample results is warranted due to failure of an IS to meet RT or area count acceptance criteria, results of all target compounds associated with that IS are qualified.

Refer to Appendix D for IS/target compound correlation guidelines.

Evaluating previous CCV IS areas are not required for this method.

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Evaluation	**Action**
If there are two analyses for a particular fraction,	determine which analysis contains the best data to report using the considerations below, qualify all data from the rejected analysis as "R," and document the reason for rejecting the data from one analysis in the data validation report. Considerations should include: 1. magnitude of the RT shift; 2. holding times; 3. comparison of the values of the target compounds reported in each fraction.
If any IS area count is <40% of the average of that obtained from the calibration standards,	qualify all associated detects as "J+" and all associated non-detects as "UJ." Non-detects may be qualified as "R" based on professional judgment if the internal standard area counts are <20% of that of the average obtained from the calibration standards. **Note:** If extremely low area counts are reported, or if performance exhibits a major abrupt drop-off, then a severe loss of sensitivity is indicated.
If the IS area count is >140% of the average of that obtained from the calibration standards,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
If the IS RT varies by more than ±0.33 minutes from that of the associated calibration standard,	qualify all associated detects as "N" or "R" and all associated non-detects as "R."

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LCS/LCSD

See Section 4.2.9 for LCS/LCSD criteria.

4.2.14.6 Method 1668A, Chlorinated Biphenyl Congeners

Initial Calibration

Criteria: Isotope dilution shall be used for calibration of the toxics and beginning and ending level of chlorination (LOC) chlorinated biphenyls (CBs). A 5- or 6-point calibration is prepared for each native congener. The RRF %RSD for any native toxics/LOC CBs must be <20%. If a linear curve is used for initial calibration, the r^2 of the curve must be >0.99.

Evaluation	Action
If the %RSD for any target compound is…	
>20% but ≤40%,	qualify all associated detects as "J" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
>40% but ≤60%,	qualify all associated detects as "J" and all associated non-detects as "UJ."
>60%,	qualify all associated detects as "J" and all associated non-detects as "R."
If the r^2 for any target compound is…	
<0.99 but ≥0.90,	qualify all associated detects as "J" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
<0.90 but ≥0.80,	qualify all associated detects as "J" and all associated non-detects as "UJ."
<0.80,	qualify all associated detects as "J" and all associated non-detects as "R."

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Criteria: Calibration using ISs is used for determination of native CBs for which a labeled compound is not available. For these CBs, calibration is performed at a single point. Compounds should be quantitated using the appropriate reference IS listed in Table 2 of the method. Ion abundance ratios must meet the criteria in Table 8 of the method or must be within 15% of the theoretical ratio of the ion monitored.

Evaluation	Action
If the ion abundance criteria were not met for any calibration compound,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Continuing Calibration

Criteria: At the beginning of each 12-hour shift during which analyses are performed, calibration is verified for all native CBs and labeled compounds. The ion abundance ratios for all CBs must be within the limits in Table 8 and all compounds must meet the calibration verification recovery limits listed in Table 6 of the method.

RRTs of native CBs and labeled compounds in the calibration verification must be within ± 0.5% of the mean RRT determined in the ICAL or most recent calibration verification standard . The diluted combined 209-congener solution must be analyzed as a final step in the calibration verification and must meet minimum analysis and resolution specifications of the method.

Evaluation	Action
If the ion abundance ratio for any compound is outside of the method limits,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If the verification limits are not met for any calibration verification compound and…	
the %R is above the verification limits,	qualify all associated detects as "J+."
the %R is below the verification limits,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the recovery is ≥10% and as "R" if the recovery is <10%.
If the RRT of any compound is outside of the RRT window,	qualify all associated results as "R."

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RT Calibration

Criteria: The absolute RT of CB 209 must be ≥55 minutes if the SPB-octyl column is used. If a GC column or column system alternate to the SPB-octyl column is used, the absolute RT of CB 209 must be ≥ the laboratory-established minimum RT for CB 209. If the laboratory has not established a minimum RT value for CB 209, the RT for CB 209 must be ≥55 minutes.

Evaluation	Action
If an SPB-octyl column was used, and the absolute RT of CB 209 is <55 minutes,	qualify all associated results as "R."
If a GC column or column system alternate to the SPB-octyl column was used and the absolute RT is < the laboratory-established minimum RT for CB 209, or <55 minutes if the laboratory has not established a minimum RT,	qualify all associated results as "R."

Ongoing Precision and Recovery (OPR)

Criteria: OPR must be established for every batch of samples extracted and analyzed and must meet the recovery and %RSD limits listed in Table 6 of the method. If the OPR criteria are not met and reanalysis was not performed, then the laboratory performance and method accuracy are in question.

Evaluation	Action
If the frequency of the OPR did not meet the specified criteria,	note the deficiency in the data validation report.
If the OPR %R is > the upper acceptance limit,	qualify all associated detects as "J+."
If the OPR %R is < the lower acceptance limit,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the %R is ≥ 10% and as "R" if the %R is < 10%.

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If %Rs for more than half of the compounds in the OPR analysis are below the acceptance range,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the failures are marginally low and as "R" if %Rs are significantly below acceptance limits. **Note**: If recoveries for more than half of the compounds in the OPR analysis are below the acceptance range, the laboratory has not shown that it can actually meet program required detection limits.
If %Rs for more than half of the compounds in the OPR analysis are above the acceptance range,	qualify all associated detects as "J+."
If %Rs for more than half of the compounds in the OPR analysis are outside the acceptance range, both above and below,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Sample Preparation

Criteria: CBs may be bound to suspended particles in aqueous samples; therefore, the preparation of aqueous samples is dependent upon the solids content of the sample. A direct extraction is used for aqueous samples containing <1% solids. For aqueous samples containing >1% solids, the sample is agitated, allowed to settle and the liquid is decanted and discarded prior to extraction of the solids. The particle size for all solid samples should be determined prior to preparation. Particle size must be 1 mm or less prior to sample preparation.

Evaluation	**Action**
If % solids and particle size were not determined prior to sample preparation or if the proper preparation method was not performed,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Criteria: Extract cleanup shall be used as necessary to eliminate interferences. The laboratory may employ GPC, acid, neutral, or base silica gel; florisil; carbopak/celite; or HPLC cleanup methods or anthropogenic isolation column for lipids (tissue extracts only).

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Evaluation	Action
If the documentation on the run log, spectra data, and/or IS or labeled compound recoveries indicate interferences and applicable cleanup was not performed,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Sample Analysis

Criteria: For identification of any CB or labeled compound, the ion abundance ratios must be within the limits specified in Table 8 of the method or ±15% of the calibration verification standard. The RRT of each CB must be within ±0.5% of the mean RRT determined in the initial calibration or ±0.5% of the RRT from the most recent calibration verification standard.

Evaluation	Action
If ion abundance ratio criteria are not met for any compound,	qualify all associated results as "R."
If the RRT of any CB is outside of the RRT window,	qualify all associated results as "R."

Mass Spectrometer Performance Criteria

Criteria: Performance criteria are established to ensure mass resolution, identification, and, to some degree, sensitivity. These criteria are not sample specific. Conformance is determined using standard materials. These criteria should be met in all circumstances.

Evaluation	Action
If mass spectrometer performance was not checked at the required frequency or if method criteria were not met,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Labeled Compounds

Criteria: To assess method performance on the sample matrix, the laboratory must spike all samples with the labeled toxics/LOC/window defining standard spiking solution and all sample extracts with the labeled cleanup standard spiking solution. The recovery of each labeled compound must be within the limits listed in Table 6 of the method.

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Evaluation	Action
If the %R for any labeled toxics/LOC/window defining standard compound is below acceptance limits,	qualify all detects for that sample fraction as "J+" and all non-detects for that sample fraction as UJ" if the recovery is ≥10% and as "R if the recovery is <10%.
If the %R for any labeled toxics/LOC/window defining standard compound is above acceptance limits,	qualify all detects for that sample fraction as "J-" and all non-detects for that sample fraction as "UJ."
If the %R for any labeled cleanup standard compound is below acceptance limits,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the recovery is ≥10% and as "R" if the recovery is <10%.
If the %R for any labeled cleanup standard compound are above acceptance limits,	qualify all associated detects as "J+."

4.2.14.7 California Environmental Protection Agency Air Resources Board; Method 428, PCDD, PCDF, and PCB Emissions from Stationary Sources

Initial Calibration

Criteria: A 5-point calibration is prepared for each compound (see Tables 3, 5, and 10 of the method for standard concentrations). The RRF RSD for any compound must be ≤15%.

Evaluation	Action
If the %RSD for any compound is…	
>15% but ≤40%,	qualify all associated detects as "J" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
>40% but ≤60%,	qualify all associated detects as "J" and all associated non-detects as "UJ."
>60%,	qualify all associated detects as "J" and all associated non-detects as "R."

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Continuing Calibration

Criteria: At the beginning and end of each 12-hour shift during which analyses are performed, calibration is verified for all compounds. The measured RFs must be ≤30% of the mean values established during initial calibration. The relative abundance must meet the requirements specified in Tables 7 and 13 of the method.

Evaluation	Action
If the mass ratio for any compound is outside of the method limits,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If the %D criteria were not met for any compound and…	
the %D is positive,	qualify all associated detects for that compound as "J+."
the %D is negative,	qualify all associated detects as "J-" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."

GC Column Performance

Criteria: The GC column performance solution is used for defining the homologous GC RT windows, to document the chromatographic resolution, and to check relative ion abundance criteria. Column performance must be checked at the beginning and end of each 12-hour analysis period and must meet method acceptance criteria (see Sections 5.3.5 and 6.3.5 of the method). If the laboratory operates during consecutive 12-hour shifts, analysis of the performance check solution at the beginning of each 12-hour period and at the end of the final 12-hour period is sufficient.

Evaluation	Action
If GC column performance was not checked at the required frequency or if method criteria is not met,	qualify all associated detects as "J" and all associated non-detects as "UJ."

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Sample Preparation

Criteria: Extract cleanup shall be performed to eliminate interferences. The laboratory shall first partition the sample extract and then follow with an appropriate cleanup procedure.

Evaluation	Action
If sample spectra and/or IS and/or surrogate recoveries indicate interferences and documentation of extract cleanup was not provided,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Sample Analysis

Criteria: For identification of any compound, the mass ratios must be within ±15% of the mass ratios listed in Tables 7 and 13 of the method. The RRT of each compound must be within ±0.006 RRT units of the standard RRT.

Evaluation	Action
If mass ratio criteria are not met for any compound,	qualify all associated results as "R."
If the RRT of any compound is outside of the RRT window,	qualify all associated results as "R."

Internal Standards

Criteria: To assess method performance on the sample matrix, the laboratory must spike all samples with known concentrations of stable isotopically labeled ISs prior to extraction.

The laboratory must spike all samples with known concentrations of recovery ISs prior to injection. The %R of each IS must be within 40% to 120% of the known value and the absolute RTs must be within ±10 seconds of those measured during the last previous continuing calibration check.

If IS %Rs are outside of the acceptable limits, the signal to noise ratio of the IS must be $\geq$10.

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Evaluation	Action
If the %R for any IS compound is below acceptance limits,	qualify all associated detects for that sample fraction as "J+" and all associated non-detects for that sample fraction as "UJ" if the recovery is ≥10% and as "R" if the recovery is <10%.
If the %R for any IS compound is above acceptance limits,	qualify all associated detects for that sample fraction as "J-" and all associated non-detects for that sample fraction as "UJ."

Matrix Blank

Criteria: Portions of the sample matrix (resin and filter) shall be analyzed at a frequency of every extraction set of 20 or fewer samples. All samples must be associated with an uncontaminated matrix blank. An uncontaminated matrix blank is defined as not having any compounds detected at a concentration ≥ the MDL. The sample results must not be corrected by subtracting blank values.

Matrix blanks should be evaluated in the same manner as an MB. Blank qualification guidelines are discussed in Section 4.2.4.

Blank Sampling Train

Criteria: There shall be a least one blank train submitted to the laboratory for each series of three or fewer test runs. For sources with air pollution control devices, there shall be at least one blank train assembled at the inlet, and one at the outlet of the air pollution control devices for each set of three or fewer runs at each location. All samples must be associated with an uncontaminated blank train. An uncontaminated blank train is defined as not having any compound detected at a concentration ≥ the MDL. The sample results must not be corrected by subtracting blank values.

Blank sampling trains should be evaluated in the same manner as an MB. Blank qualification guidelines are discussed in Section 4.2.4.

LCS

Criteria: A LCS must be extracted and analyzed with every batch of 20 samples or less and it must contain at least one representative of each chlorinated class of compounds to be determined in the samples. Accuracy is considered acceptable if the %R is within 60% to 140%.

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Note: If the LCS criteria are not met and reanalysis was not performed, then the lab performance and method accuracy are in question.

Evaluation	**Action**
If the frequency of the LCS did not meet the specified criteria,	note the deficiency in the data validation report.
If there was not at least one compound associated with each chlorinated class of compounds,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If the %R for an LCS compound is >140%,	qualify all associated detects as "J+."
If the %R for an LCS compound is <60%,	qualify all associated detects as "J-", and all associated non-detects as "UJ" if the %R is ≥10% and as "R" if the %R is <10%.
If %Rs for more than half of the compounds in the LCS analysis are below the acceptance range,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the failures are marginally low and as "R" if %Rs are significantly below acceptance limits. **Note**: If %Rs for more than half of the compounds in the LCS analysis are below the acceptance range, the laboratory has not shown that it can actually meet program required detection limits.
If %Rs for more than half of the compounds in the LCS analysis are above the acceptance range,	qualify all associated detects as "J+."
If %Rs for more than half of the compounds in the LCS analysis are outside the acceptance range, both above and below,	qualify all associated detects as "J" and all associated non-detects as "UJ."

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Mass Spectrometer Performance Criteria

Performance criteria are established to ensure mass resolution, identification and, to some degree, sensitivity. These criteria are not sample specific. Conformance is determined using standard materials. These criteria should be met in all circumstances.

Criteria: Mass spectrometer performance must be checked every 12 hours of analysis in accordance with the method criteria. All compounds in all initial calibration and continuing calibration standards must be within the QC limits listed in Tables 7 and 13 of the method for their respective isotopic ratios.

Evaluation	Action
If mass spectrometer performance was not checked at the required frequency or if method criteria are not met,	qualify all associated detects as "R" and all associated non-detects as "UJ."

QC Check Sample

Criteria: A QC check sample must be extracted and analyzed with every batch of 20 samples or less. Accuracy is considered acceptable if the %R is within 60% to 140% and precision is acceptable if the RPD is ≤30%.

Note: If the QC check sample criteria are not met and reanalysis was not performed, then the lab performance and method accuracy are in question.

Evaluation	Action
If the frequency of the QC check sample did not meet the specified criteria,	note the deficiency in the data validation report.
If any QC check sample RPD is > 30%,	qualify all associated detects of the same matrix as "J" and all associated non-detects as "UJ."
If the QC check sample %R is >140%,	qualify all associated detects as "J+."
If the QC check sample %R is <60%,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the %R is ≥10% and as "R" if the %R is <10%.
If %Rs for more than half of the compounds in the QC check sample analysis are below the acceptance range,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the failures are marginally low and as "R" if

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	%Rs are significantly below acceptance limits. **Note**: If %Rs for more than half of the compounds in the QC check sample analysis are below the acceptance range, the laboratory has not shown that it can actually meet program required detection limits.
If %Rs for more than half of the compounds in the QC check sample analysis are above the acceptance range,	qualify all associated detects as "J+."
If %Rs for more than half of the compounds in the QC check sample analysis are outside the acceptance range, both above and below,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Spiked Sampling Trains

Criteria: Surrogate standards must be spiked into each sampling train as a means of estimating the precision and accuracy of the sampling train for collecting and recovering PCDDs, PCDFs, and PCBs in the stack gas sample. Surrogate recovery is considered acceptable if the %R is within 60% to 140%.

Evaluation	**Action**
If the surrogate %R is >140%,	qualify all associated detects as "J+."
If the surrogate %R is <60%,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the %R is ≥10% and as "R" if the %R is <10%.

4.2.14.8 Method 1613B, Tetra- through Octa-Chlorinated Dioxins and Furans by HRGC/HRMS

NOTE: MS/MSD analysis is not required for this method.

Initial Calibration

Criteria: A combined 5-point calibration is prepared for the 2,3,7,8-substituted PCDDs and PCDFs for which labeled compounds are added to the samples (isotope dilution) and

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for 1,2,3,7,8,9-HxCDD, OCDF, and any non-2,3,7,8-substituted compounds (internal standards). The RRF %RSD for the compounds calibrated using isotope dilution must be ≤20%. For the compounds calibrated using internal standards, the %RSD must be ≤35%. Ion abundance ratios must meet the criteria listed in Table 9 of the method.

The laboratory may use alternative ions for quantitation to eliminate interferences. In this case, the ion abundance ratios must meet the criteria set by the laboratory.

Evaluation	**Action**
If the %RSD is...	
>20% for any compound calibrated by isotope dilution, or >35% for any compound calibrated by internal standard, but ≤40%,	qualify all associated detects as "J" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
>40% but ≤60% for any compound,	qualify all associated detects as "J" and all associated non-detects as "UJ."
>60% for any compound,	qualify all associated detects as "J" and all associated non-detects as "R."
If the ion abundance criteria were not met for any compound,	qualify all associated results as "R."

Continuing Calibration

Criteria: At the beginning of each 12-hour period during which analysis is performed, calibration is verified for all compounds. The measured concentration of each compound must be within the limits set in Table 6 of the method. The ion abundance must be within the limits in Table 9 of the method.

The absolute RTs of the ^{13}C-1,2,3,4-TCDD and ^{13}C-1,2,3,7,8,9-HxCDD internal standards must be within ±15 seconds of the RTs obtained during the initial calibration. The RRTs of the PCDDs/PCDFs and labeled compounds must be within the limits given in Table 2 of the method.

The evaluation of RTs and subsequent qualification of sample data requires professional judgment. If RRT criteria have not been met but absolute RTs between the CCV and the initial calibration and between the CCV and the sample meet criteria, qualification of data may not be necessary. If RRT criteria and absolute RT criteria are not met, this may be an indication of instrument instability warranting qualification of sample data.

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Evaluation	Action
If the ion abundance ratio criteria were not met for any compound,	qualify all associated detects as "J."
If the measured concentration criteria were not met for any compound at the beginning of a 12 hour period and...	
the measured concentration is > the upper acceptance limit,	qualify all associated detects as "J+."
the measured concentration is < the lower acceptance limit,	qualify all associated detects as "J-" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."

Sample Preparation

Criteria: The cleanup standard $^{37}Cl_4$-2,3,7,8-TCDD shall be added to all extracts prior to cleanup to measure the efficiency of the cleanup process. The recovery of the cleanup standard shall be within the limits set in Table 7 of the method.

Evaluation	Action
If the cleanup standard was not added to a sample, MB, or QC sample extract,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If the recovery of the cleanup standard is > the upper acceptance limit,	qualify all associated detects as "J."
If the recovery of the cleanup standard is < the lower acceptance limit,	qualify all associated detects as "J" and all associated non-detects as "UJ."

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Sample Analysis

Criteria: For identification of any compound, the ion abundance ratios must be within the limits specified in Table 9 of the method.

The recoveries of the labeled compounds must be within the limits specified in Table 7 of the method.

The RRTs of the PCDDs/PCDFs and labeled compounds must be within the limits specified in Table 2 of the method.

Evaluation	Action
If the ion abundance ratio criteria were not met for any compound,	qualify all associated results as "R."
If the recovery of any labeled compound is > the upper acceptance limit,	qualify all detects for the corresponding unlabeled compound as "J."
If the recovery of any labeled compound is < the lower acceptance limit,	qualify all detects for the corresponding unlabeled compound as "J" and all non-detects for the corresponding unlabeled compound as "UJ".
If the RT of any compound is outside of the RT window,	qualify all associated results as "R."

Mass Spectrometer Performance Criteria

Criteria: Performance criteria are established to ensure mass resolution; identification; and, to some degree, sensitivity. These criteria are not sample specific. Conformance is determined using standard materials. These criteria should be met in all circumstances. System performance must be evaluated at the beginning of each 12-hour period in which analysis is performed.

Evaluation	Action
If mass spectrometer performance was not evaluated at the required frequency or if method criteria were not met,	qualify all associated detects as "R" and all associated non-detects as "UJ."

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GC Column Performance Mix

Criteria: The GC column performance solution is used for defining the homologous GC RT windows and to document the chromatographic resolution. Column performance must be evaluated at the beginning of each 12-hour analytical period and must meet method acceptance criteria (see Section 15.4 of the method) before sample analysis may begin.

Evaluation	Action
If GC column performance was not evaluated at the required frequency or if method criteria were not met,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Confirmation of 2,3,7,8-TCDF detects

Criteria: The DB-5 GC column generally used for PCDD and PCDF analyses does not adequately separate 2,3,7,8-TCDF from its closest eluting isomer. If 2,3,7,8-TCDF is detected in a sample, the result must be confirmed on a second column capable of separating 2,3,7,8-TCDF from all other TCDF homologues (as proven by successful analysis of the GC column performance column mix with <25% valley between 2,3,7,8-TCDF and its closest eluting isomer).

Evaluation	Action
If 2,3,7,8-TCDF is detected in a sample and the result is not confirmed on a second column with successful analysis of the GC column performance mix,	qualify all associated detects as "NJ."

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4.3 Procedure for GC and High-Performance Liquid Chromatography (HPLC) Validation

The requirements covered within this section are applicable to all GC and HPLC analytical techniques, including SW-846 Methods 8081A, 8082, and 8330.

4.3.1 Calibration

Initial Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for compounds on the TAL. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve.

When methods require confirmation of target analytes on a second, fully-calibrated column, the calibrations of both columns must be assessed.

The laboratory may establish a calibration curve using either the linear regression (linear curve) approach or the calibration factor (CF) approach. If both approaches are used to quantify and report target analytes within the same data package, calibration is to be assessed on an analyte-by-analyte basis.

Criteria: GC and HPLC instrument calibration shall be performed using a minimum of five calibration standards unless otherwise specified by the method. If calibration curves are used, five standards are required for a linear (first-order) calibration model, six standards are required for a quadratic (second-order) model, and seven standards are required for a third-order polynomial. Higher-order curves should not normally be used. If the laboratory uses a higher order equation to establish a calibration curve, it should be evaluated for appropriate application.

ISs shall not be used for quantitation.

Evaluation	Action
If an insufficient number of calibration standards were used,	qualify all associated detects as "J" and all associated non-detects as "UJ."

CFs

Criteria: In the absence of or in addition to, method-specific calibration acceptance criteria, the following general calibration acceptance criteria should be applied.

The %RSD for the CFs obtained from the five initial calibration standards must be ≤20%.

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Evaluation	Action
If any target compound has a %RSD:	
>20% but ≤40%,	qualify all associated detects as "J" and, all associated non-detects as "UJ" if any other calibration criteria have been exceeded for that compound.
>40% but ≤60%,	qualify all associated detects as "J" and all associated non-detects as "UJ."
> 60%,	qualify all associated detects as "J" and all associated non-detects as "R."

Linear Curves

Criteria: **The r^2 of the initial calibration curve shall be ≥0.99. The absolute value of the intercept shall be ≤3X the MDL.**

NOTE: The sample results may be reported with non-detects at the MDL or at the PQL value. See below for appropriate evaluation.

Evaluation	Action
If any target compound has a r^2:	
<0.99 but ≥0.90,	qualify all associated detects as "J" and, all associated non-detects as "UJ" if any other calibration criteria have been exceeded for that compound.
<0.90 but ≥0.80,	qualify all associated detects as "J" and all associated non-detects as "UJ."
<0.80,	qualify all associated detects as "J" and all associated non-detects as "R."
When results are reported at the MDL:	
If the intercept for any target compound is negative with an absolute value…	
> the MDL but ≤3X the MDL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and

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>3X the MDL,	all associated non-detects as "UJ." qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "R."
When results are reported at the PQL: If the intercept for any target compound is negative with an absolute value...	
> the MDL but ≤2X the PQL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "UJ."
>2X the PQL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "R."
If the intercept for any compound is positive and > the MDL,	qualify all associated detects <3X the intercept as "J+."

4.3.2 Calibration Verification

Compliance requirements for satisfactory initial and continuing instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for compounds on the TAL. The ICV independently verifies the calibration, and the CCV establishes the relative CFs on which the quantitations are based and checks satisfactory performance of the instrument on a day-to-day basis.

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Criteria: An ICV must be run immediately following an initial calibration. The ICV standard analysis results are not required to be reported in the data package unless the samples in the SDG were analyzed after the initial calibration standards but before a CCV standard analysis was performed. In this case, the ICV %D is assessed according to the calibration verification criteria described below for the associated samples. If a CCV is analyzed prior to samples and ICV data are also reported in the package, both the ICV %D and the appropriate CCV %D are to be assessed as described below. If both ICV %D and CCV %D infractions occur, the worst infraction should be evaluated for result qualification.

A CCV must be run:

(1) at the beginning of each analytical run,

(2) at least once every 20 samples (preferably every 10), and

(3) at the end of each analytical run.

The laboratory is allowed to perform corrective action and reanalyze the CCV once after a failure. If multiple CCVs were analyzed (more than two) to obtain a passing CCV, then the calibration was not verified and the calibration verification frequency was not met. This is applicable to both CFs and linear curves.

The evaluation of CCV data applies to all CCVs that bracket samples of interest.

A closing CCV is not required for toxaphene or chlordane if these compounds are non-detect in all samples.

Evaluation	**Action**
If the ICV/CCV standards were not analyzed at the proper frequency, or if either a required ICV or CCV was not analyzed, or if all target compounds were not present in any ICV or CCV standard,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If all required ICVs and CCVs were not analyzed,	qualify all associated detects as "J" and all associated non-detects as "R."

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CFs

Criteria: The %D (see Section 6.3) between the ICV and/or the daily or continuing calibration standard CFs and the average CFs obtained from the initial calibration must be ≤15%.

Evaluation	Action
If the %D was reported with the wrong sign (e.g., +%D for negative bias),	document the occurrence in the data validation report and assess any infractions using the correct sign.
If the %D between ICV and/or CCV CF and the average CF obtained from the initial calibration is…	
>15% and positive (high bias),	qualify all associated detects as "J+."
>15% but ≤40% and negative (low bias),	qualify all associated detects as "J-." May qualify all associated non-detects as "UJ" if any other calibration criteria have been exceeded for that compound.
>40% but ≤60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
>60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "R."

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Linear Curves

Criteria: The %D (see Section 6.3) between the daily or continuing calibration standard concentrations and their true values must be ≤15%.

The %D shall be calculated according to the formula in Section 6.3.

Evaluation	Action
If the %D was reported with the wrong sign (e.g., +%D for negative bias),	document the occurrence in the data validation report and assess any infractions using the correct sign.
If the %D between a measured ICV and/or CCV concentration and its true value is…	
>15% and positive (high bias),	qualify all associated detects as "J+."
>15% but ≤40% and negative (low bias),	qualify all associated detects as "J-." May qualify all associated non-detects for that compound as "UJ" if any other calibration criteria have been exceeded for that compound.
>40% but ≤60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
>60% and negative,	qualify non-detects for that compound as "R."

4.3.3 Blanks

The purpose of laboratory (or field) blank analysis is to determine the essence and magnitude of contamination resulting from laboratory (or field) activities.

The criteria for evaluation of blanks apply to any blank associated with the samples and include MBs, and, if submitted, EBs, and FBs. Action in the case of unsuitable blank results depends on the circumstances and origin of the blank. In instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of a contaminant. For purposes of evaluating multiple blanks, each preparation batch may be considered an independent event in evaluating MBs, and each sampling event may be considered an independent event for evaluating FBs and EBs.

The result of any compound detected in the sample, which was also detected in any associated blank, must be qualified when the sample concentration is <5X the blank concentration

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Criteria: The concentration of each target analyte found in the blank must be < the associated MDL. The sample results must not be corrected by subtracting any blank value. If QC problems exist with any blank, all data associated with the case must be carefully evaluated to determine whether there is an inherent variability in the data for the case, or if the problem is an isolated occurrence not affecting other data.

Evaluation	**Action**
If a compound found in a blank is also found a sample,	qualify the sample result for that compound in accordance with the scenarios given below.
If gross contamination exists,	qualify results for all compounds affected as "R" due to interference.
If inordinate numbers of other target compounds are found at low levels in the blank(s),	discuss the presence of these compounds in the data validation report as it may be indicative of a problem at the laboratory.

The following are examples of application of the blank qualification guidelines. Certain circumstances may warrant deviations from these guidelines.

Scenario

If the sample result is > the PQL but is <5X the blank result.

Qualification

Blank Result	7
PQL	5
Sample Result	30
Qualified Sample Result	30U

Qualify sample result <35 (or 5 X 7) as non-detect ("U") at the reported value.

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Scenario

If the sample result is < the PQL and is also <5X the blank result.

Qualification

Blank Result	6
PQL	5
Sample Result	4J
Qualified Sample Result	5U

Qualify sample result <30 (or 5 X 6) as non-detect ("U") at the PQL.

Note 1: Data are not reported as 4U, as this would be reported as a detection limit below the PQL.

The PQL may not be reported and it may not be possible to determine the PQL from the data. In these cases, qualify the contaminated sample result as "U" at 5X the blank concentration. If an MDL is reported, the PQL may be 5X the MDL.

Scenario

If the sample result is > the PQL and is also >5X the blank result.

Qualification

Blank Result	10
PQL	5
Sample Result	60
Unqualified Sample Result	60

Sample result exceeded the adjusted blank result of 50 (or 5 X 10). Thus, this sample result is not qualified.

4.3.4 Surrogate Recovery

Laboratory performance for individual samples is established by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interference and high concentrations of analytes. Because the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the review and validation of data based on specific surrogate results is frequently subjective and demands analytical experience and professional judgment.

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Criteria: Sample and blank surrogate recoveries must be within limits specified by the laboratory. Surrogate compound recoveries shall be calculated using the procedure described in SW-846 Method 8000. Reported recoveries shall be accompanied by the applicable acceptance limits.

Note: Results from spiked or replicate QC samples that have surrogate %Rs <10% cannot be used to qualify sample results. Samples should be qualified for lack of accuracy and/or precision data, as applicable, if specified by the program.

Evaluation	**Action**
If surrogate recovery acceptance criteria are not reported in the packages,	request amended data from the laboratory.
If, based on professional judgment, the laboratory's internal acceptance criteria are excessively wide or biased,	notify the program manager.
If an initial dilution was performed on any sample and at least one surrogate has %R < the lower acceptance limit but ≥10%, or all surrogates have <10 %R and the results for one or more compounds were ≥ the PQL,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
If an initial dilution was performed on any sample, all surrogate %Rs are <10%, and all results are < the PQL,	qualify all associated sample results as "R."
If there are two or more analyses for a particular fraction at the same dilution,	determine which analysis contains the best data to report using the considerations below, qualify all data from the rejected analysis as "R," and document the reason for rejecting data from one analysis in the data validation report. Considerations should include: 1. surrogate recovery (marginal vs. gross deviation); 2. holding times; and 3. comparison of the values of the TALs reported in each fraction.
For surrogate recoveries out of	

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specification, the following approaches are suggested based on a review of all data from the case, especially considering the apparent complexity of the sample matrix. If any surrogate %R is out of specification low,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the recovery is ≥10% and as "R" if the recovery is <10%.
If a surrogate %R is out of specification high,	qualify all associated detects as "J+."

Criteria: In the case of a blank analysis with surrogates out of specification, special consideration must be given to the validity of associated sample data. The basic concern is whether the blank problems represent an isolated problem with the blank alone or whether there is a fundamental problem with the analytical process.

If one or more samples in the batch show acceptable surrogate recoveries, the blank problem may be considered to be an isolated occurrence. However, even if this judgment allows some use of the affected data, analytical problems remain that must be corrected by the laboratory.

Evaluation	**Action**
If surrogate recovery in the blank does not meet acceptance criteria,	all detects < the PQL in all samples associated with the blank may be qualified as "J" and all non-detects in all samples associated with the blank may be qualified as "UJ."

4.3.5 MS/MSD

Data for MS/MSD are generated to determine long-term precision and accuracy of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis.

Criteria: The MS/MSD data shall not be used to evaluate field sample results unless the MS/MSD sample was from the same client and of similar matrix.

An MS and MSD sample shall be analyzed at a frequency of once per data package, once per 20 samples of similar matrix, or once per sample matrix, whichever is more frequent. The MS must have recoveries calculated for all single-component target compounds. The presence of multi-component target

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compounds in the spiking solution is recommended but not required.

The laboratory shall not use FBs or EBs to satisfy this requirement if the laboratory can identify these blanks.

Unless otherwise stated in the specific method, the MS and MSD accuracy and precision acceptance criteria shall be those calculated by the laboratory using the procedure given in SW-846 Method 8000B. If the acceptance criteria are not given, recovery limits 70% to 130% and ±30% RPD should be used as the criteria. For solid and waste samples, it may be appropriate to accept up to a 40% RPD, based on the professional judgment.

The MS %Rs must be within the limits, unless the sample concentration is >4X the spike concentration (see Section 4.1.20).

The MS and MSD analyses must meet all sample analysis acceptance criteria. The MS and MSD results may be used in conjunction with other QC results to determine the need for qualification of the data. An effort to determine to what extent the results of the MS/MSD affect the associated data should first be made. This determination should be made considering the MS/MSD sample matrix, the surrogate recoveries, and the LCS results.

Professional judgment should be used to determine if MS/MSD failure warrants qualification of only the results for the failed compounds, or if results for all the compounds associated with the failed MS compound are affected. Generally, unless evidence exists to warrant qualification of other compounds, only the compounds in the MS spiking mixture shall be qualified.

For programs that require application of one final qualifier to sample results, if a recovery (accuracy) infraction is identified in one or both of the MS samples along with an RPD (precision) infraction between the MS and MSD, the sample is qualified for the accuracy infraction. For example, if a compound has a low MS recovery and the RPD is not within criteria, the data are qualified as "J-."

Evaluation	**Action**
If the program requires MS/MSD analysis for all matrices and all target compounds and the MS/MSD sample was from another client or of a dissimilar matrix; the frequency of the MS/MSD did not meet specified criteria; no MS/MSD was analyzed or an FB- or EB was used for MS/MSD analysis,	qualify all detects as "J" and all non-detects as "UJ."
If no other measure of precision(i.e., LCSD or replicate) is available,	qualify all detects as "J" and all non-detects as "UJ."

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If results are reported for single-component target compounds that are not in the MS,	all associated detects may be qualified as "J" and all associated non-detects may be qualified as "UJ" based on professional judgment.
If any multi-component target compound is missing from the MS,	note the discrepancy in the data validation report.
If the surrogate and LCS recoveries are within the required acceptance criteria and… either MS or MSD %R for any target compound is > the upper acceptance limit, either MS or MSD %R for any target compound is < the lower acceptance limit,	 qualify all associated detects as "J+." qualify all associated detects as "J-" and all associated non-detects as "UJ" if the recovery is ≥10% and as "R" if the recovery is <10%.
If the RPD for any target compound does not meet the acceptance criteria or %Rs fail both high and low,	qualify all associated detects f as "J" and all associated non-detects as "UJ."

4.3.6 Replicate

Replicate analyses are indicators of laboratory precision based on each sample matrix. If a replicate was performed instead of an MSD, the following criteria are applied. If insufficient sample was submitted to analyze an MS/MSD or replicate, the laboratory may run an LCS/LCSD to measure precision. LCSD precision will be assessed as described in Section 3.3.5.

Criteria: Replicate samples shall be analyzed at a frequency of once per data package, once per 20 samples of similar matrix, or once per sample matrix, whichever is more frequent. All sample acceptance criteria must be met in the replicate analysis.

Samples identified as FBs or EBs shall not be used for replicate sample analysis.

Unless otherwise stated in the specific method, the replicate precision acceptance criteria shall be those calculated by the laboratory using the procedure given in SW-846 Method 8000B. When no laboratory-derived control limits are reported, a control limit of 30% for the RPD shall be used for sample values >5X the PQL. For solid and waste samples, it may be appropriate to accept up to a 40% RPD, based on the professional judgment.

A control limit of ± PQL shall be used for sample values <5X the PQL, including the case when only one of the replicate sample values is <5X the PQL.

No precision criteria apply when both replicate sample values are < the PQL.

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Evaluation	Action
If no replicate sample, no MSD, and no LCS/LCSD was analyzed for each matrix or for each data package,	qualify all associated detects of the same matrix as "J" and all associated non-detects as "UJ."
If an FB or EB was used for the replicate analysis and no MSD or LCSD was run,	qualify all associated detects of the same matrix as "J" and all associated non-detects as "UJ."
If the original result and replicate result are both >5X the PQL, and the RPD falls outside of appropriate control limits,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."
If the original and/or replicate result is <5X the PQL (including non-detects) and the difference between the original result and replicate result is > the PQL,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."

4.3.7 LCS

Data for LCSs are generated to provide information on the accuracy of the analytical method and on laboratory performance, including sample preparation.

Criteria: An LCS should be analyzed for all methods at a frequency of once per data package, once per matrix, or once per 20 analytical samples, whichever is most frequent.

The LCS must have recovery calculated for all single-component compounds or at least one multi-component compound, if applicable. For very large analyte lists or for known poor performers, the laboratory may have received an exemption for one or more analytes. Analytes with exemptions will be identified in the case narrative.

The LCS must meet all sample acceptance criteria. If surrogate acceptance criteria are not met in the LCS analysis, the LCS must be reanalyzed. The LCS should meet all method-specific LCS requirements and acceptance criteria. f the recovery acceptance criteria are not reported, the criteria in Appendix F or 70% to 130% should be used as the criteria.

If the laboratory analyzed an LCS/LCSD as a measure of precision, both the LCS and LCSD must meet the acceptance criteria.

General laboratory precision and accuracy can be evaluated using the LCS acceptance criteria and the interlaboratory comparison data given in Appendix F. Individual LCS recoveries may be evaluated against the criteria in Appendix F if the laboratory's criteria are significantly different from those in the tables.

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Evaluation	Action
If, based on professional judgment, the laboratory's internal acceptance criteria are excessively wide or acceptable recoveries are significantly biased,	notify the program manager.
If the frequency of the LCS did not meet the specified criteria,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If results are reported for target compounds that are not in the LCS,	may qualify detects for these compounds as "J" and non-detects as "UJ" based on professional judgment. Compounds missing under an exemption may be qualified based on professional judgment.

If the LCS criteria are not met and reanalysis was not performed, then the laboratory performance and method accuracy are in question. Professional judgment should be used to determine if data should be qualified for all target compounds or just those compounds associated with the failed LCS compound. The following may be used as guidance in qualifying data.

Evaluation	Action
If the LCS %R is > the upper acceptance limit,	qualify all associated detects as "J+."
If the LCS %R is < the lower acceptance limit,	qualify all associated detects for that compound as "J-" and all associated non-detects as "UJ" if the %R is ≥10% and as "R" if the %R is <10%.
If %Rs for more than half of the compounds in the LCS analysis are below the acceptance range,	qualify all associated detects as "J-", and all associated non-detects as "UJ" if the failures are marginally low and as "R" if %Rs are significantly below acceptance limits. **Note**: If %Rs for more than half of the compounds in the LCS analysis are below the acceptance range, the laboratory has not shown that it can actually meet program required detection limits.

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If %Rs for more than half of the compounds in the LCS analysis are above the acceptance range,	qualify all associated detects as "J+."
If %Rs for more than half of the compounds in the LCS analysis are outside the acceptance range, both above and below,	qualify all associated detects as "J" and all associated non-detects as "UJ."

4.3.8 TAL Compound Identification

These criteria are established to ensure that adequate chromatographic resolution and instrument sensitivity is achieved by the chromatographic system.

Criteria: The laboratory must report RT window data for each GC column used to analyze samples. The RT of the ICV (or the first CCV of the day) should fall within the RT window established by the initial calibration. RTs of subsequent CCVs should fall within the RT window established by the ICV or the first CCV of the day.

Evaluation	**Action**
If RT windows were not reported,	request an amended report from the laboratory.
If RT windows are not available, or if an RT for a standard exceeds the associated windows,	qualify all associated detects as "NJ" and all associated non-detects as "R." Emphasize the possibility of either false negatives or false positives, as appropriate, in the data validation report.

4.3.9 Sample Carry-over

Sample carry-over may occur when a high-concentration sample is analyzed immediately prior to another field sample. Steps must be taken to avoid introduction of false positive results in the second sample analysis due to instrument contamination.

Criteria: The absence of sample carry-over must be determined and verified. If examination of the run logs indicates that any samples in the analytical run of interest required dilution, and there is no documentation of a rinse or blank analysis immediately following the original undiluted analysis then sample carry-over may be suspected in the subsequent sample.

Evaluation	**Action**
If any target compound found in the	qualify the results for that compound in

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sample requiring dilution exceeded the high calibration standard and was also found in the following sample at a concentration <5X the PQL,	the second sample as "R" or "NJ", based on professional judgment.
If no data are available for the sample that required dilution and the laboratory has not documented that carry-over was evaluated, and the compound(s) was (were) also found in the following sample at concentrations <5X the PQL,	qualify the results for that compound in the second sample as "N."

4.3.10 Dilutions

Criteria: The PQLs must be adjusted to reflect all sample dilutions, concentrations, splits, clean-up activities, and dry weight factors that are not accounted for by the method.

Samples must be diluted and reanalyzed when any analytes exceed the calibration range. Data from original sample runs should be included when any sample requires dilution due to one or more compounds exceeding the calibration range.

The original undiluted results document the actual MDLs for non-detects.

Evaluation	**Action**
If the PQLs have not been properly adjusted,	request an amended report from the laboratory.
If an initial dilution was required because of expected high concentrations of non-target analytes or because one or more target analyte were expected to greatly exceed the instrument working range and the laboratory was not able to analyze the undiluted sample,	note the dilution and elevated MDLs in the data validation report.
If any target compound exceeded the calibration range and… the original undiluted sample result was reported, the original undiluted sample run were not provided,	 qualify all detects which exceeded the calibration range as "J." request this information from the laboratory.
the sample was diluted and reanalyzed and	qualify all non-detects from the diluted

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the diluted sample data were reported,	analysis as "UJ."
If data from the original sample run are unavailable,	refer to Section 4.3.4 for assessment of initially diluted samples with low surrogate recovery.

Criteria: The laboratory shall strive to make dilutions in such a way that the final concentration is measured in the mid-range of the calibration curve, and that results are not reported from measurements below the lowest concentration standard.

Evaluation	**Action**
If the instrument response (reported result / dilution factor) of any detect from diluted samples is < that of the lowest concentration standard,	qualify all associated detects from the diluted analysis as "J."

Criteria: The extraction efficiency for extremely high concentrations of analytes has generally not been determined for most methods. If the analysis requires an extraction and dilutions of > 100,000:1 the efficiency of the extraction may be suspect.

Evaluation	**Action**
If dilutions of > 100,000:1 was required,	qualify all associated detects as "J-."

4.3.11 Quantification and Confirmation

Criteria: Detected compound results must be confirmed using a second GC/HPLC column. The laboratory shall report RPDs between the results obtained from the two GC/HPLC columns. RPDs are not evaluated if the analyte is not detected on the primary column. (see note below)

Evaluation	**Action**
If the results from the second column confirmation are not reported,	qualify all detects as "NJ."
If the RPD between detects for a particular analyte from two analytical columns is >40% and ≤ 75%…	

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for PCB, pesticide, and herbicide analyses,	qualify the reported result as "J."
for high explosive (HE) analysis,	report the result from the C-18 column and qualify it as "J."

An RPD between results for a particular analyte from two analytical columns that is >75% may indicate that there is a significant coelution or interference problem. As applied here, a coelution is two target analytes, or one target and one non-target analyte, that have peaks at the same RT, and an interference is a non-target analyte with a peak at a target analyte RT. That is, a coelution is a quantity that cannot be verified, and an interference is a result that is a false positive.

A general review of the actual spectra may be required to determine the best qualification. If the spectrum includes a significant number of extraneous peaks outside of the target analyte RT windows, interferences are likely on one or both of the columns. Non-symmetrical peak shape is indicative of coelution, and shifts in RTs may indicate either coelution or interference. A review of the beginning and ending CCV RTs will give the reviewer an indication of instrument stability during the analysis.

If one of the results is < the PQL and the other is much > the PQL, suspect interference or a false positive. Values around the PQL should be evaluated using both RPD and absolute differences. For example, results of 1 ug/L and 5 ug/L have an RPD of 133% but would not be significantly different from each other for analyses with a PQL of 5 ug/L. An attempt should be made to determine if the peak is primarily due to interference or if the peak has a significant contribution from the target analyte.

Note: It is not uncommon to find MDLs for GC/HPLC methods as determined using 40 CFR 136 to be artificially low, which may result in false positives due to random instrument noise for concentrations below the PQL.

In general, rejection of data with results much > the PQL will require additional supporting analytical information such as GC/MS or diode array spectral matching (see Appendix G).

Evaluation	**Action**
If the RPD is >75% and…	
one result is <5X the PQL and the other result is > the PQL and >10X the first result,	qualify the reported result as "R."
both results are <5X the PQL…	
for PCB, pesticide, and herbicide analyses,	qualify the reported result as "NJ."
for HE analysis,	report the result from the C-18 column and qualify it as "NJ."

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both results are much > the PQL, one or both peaks may have contribution due to coelution, and…	
it is apparent that the peak is primarily due to the target analyte,	qualify the reported result as "J+."
it is not apparent that the peak is primarily due to the target analyte,	qualify the reported result as "NJ+."
If rejecting data where both results are much > the PQL,	include a complete description of the justification and supporting data used in the data validation report.

In waste-type samples, the separation techniques may not completely isolate the analytes of concern from other compounds and the spectra may contain multiple extraneous peaks. The more peaks there are in the spectra, the more likely it is that false positives will be reported.

Evaluation	**Action**
If a large number of unidentified peaks are seen in the spectra or if several additional peaks are located near a reported analyte RT in both spectra,	results may be qualified as "N" using professional judgment.

Criteria: Although confirmation is not required for non-detects it is a common laboratory practice to use a dual column system and perform the confirmation analysis on all samples. Occasionally, there may be QC failures that occur on one of the columns that are acceptable on the other column. Laboratories may choose to report the analytes with acceptable results from one column and the remaining analytes from the other column. The following guidelines should be used when this occurs.

This practice may only be used for reporting non-detects from both columns.

All QC elements must be reported for both columns.

This can only be used when no primary column is specified, such as in SW-846 Method 8082. When a primary column is specified, such as in SW-846 Method 8330, all QC for the primary column must be acceptable.

The QC must be completely acceptable for each analyte on one or the other column. That is, the laboratory cannot use an acceptable LCS for an analyte on one column and an acceptable CCV for that analyte on the other column to justify acceptable performance.

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Evaluation	Action
If both results are reported and qualification is required,	use the results from the column with the best performance.

4.3.12 Method-specific Analytical Requirements–Organic GC and HPLC

The additional analytical requirements given below are organized by SW-846 method. These requirements should be checked if the level of deliverable (level III or level IV) allows.

4.3.12.1 Method 8081A, Organochlorine Pesticide by GC

If discussion of water sample clean-up procedures was not included in the data package, it can be assumed that clean-up was not necessary and no discussion is required in the data validation report. For soil analysis, Florisil clean-up is required for all sample extracts.

Criteria: The laboratory must include a discussion of any clean-up procedures performed on the samples.

An instrument blank consisting of clean solvent containing only the surrogate compounds shall be analyzed at the beginning and end of each analytical run, and once every 20 analytical samples.

Evaluation	Action
If discussion of sample clean-up procedures is missing or incorrect,	notify the laboratory and note the discrepancy in the data validation report.
If clean-up procedures were documented in the data package,	discuss the clean-up procedures used in the data validation report.
If no instrument blank was run, or if frequency criteria were not met,	may qualify detects <5X the MDL as "J" based on professional judgment.

Criteria: The total % breakdown for both DDT and endrin must each be ≤15%.

Evaluation	Action
If DDT breakdown is > 15%,	beginning with the samples following the last *in-control* standard, qualify all detects for DDT as "J" and all detects for DDD and DDE as "NJ."
If DDT breakdown is >15% and DDT was	qualify the result for DDT in the sample

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not detected in any sample analyzed after the last in-control standard but DDD and DDE were detected in any of those samples,	with DDD and DDE detects as "R."
If endrin breakdown is >15%,	beginning with the samples following the last *in-control* standard, qualify all detects for endrin as "J" and detects for endrin ketone and endrin aldehyde as "NJ."
If endrin breakdown is >15% and endrin was not detected in any sample analyzed after the last in-control standard, but endrin aldehyde and endrin ketone were detected in any of those samples,	qualify the result for endrin in the sample with the endrin aldehyde and endrin ketone detects as "R."

Note: A closing CCV is not required for toxaphene or chlordane if these compounds are non-detect in all samples.

4.3.12.2 Method 8082, PCB Aroclors by GC

Criteria: PCB analysis shall be performed according to the requirements listed in SW-846 Method 8082.

The laboratory must include a discussion of any clean-up procedures performed on the samples. If discussion of sample clean-up procedures was not included in the data package, it can be assumed that clean-up was not necessary and no discussion is required in the data validation report. The laboratory case narrative shall include a thorough discussion of any problems encountered regarding target compound recognition and/or quantitation and especially addressing suspected environmental degradation of compounds. Reported results shall be justified with such discussion and supporting documentation.

PCBs reported as total PCBs or as individual congeners are qualified in accordance with the Section 4.2.14.6.

Evaluation	**Action**
If clean-up procedures were documented in the data package,	discuss the clean-up procedures used in the data validation report.
If the discussion does not appear to justify the results reported by the laboratory,	notify the laboratory; more supporting documentation may be required from the laboratory.
If the laboratory identifies any aroclors as degraded,	qualify all associated detects as "J."

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4.3.12.3 Method 8151A, Chlorinated Herbicides by GC

Criteria: Chlorinated herbicide analysis shall be performed according to the requirements listed in the SW-846 Method 8151A.

The LCS shall contain each of the specified target chlorinated herbicides at concentrations near the midpoint of the calibration range.

Evaluation	Action
If results are reported for target compounds that are not in the LCS,	may qualify all associated detects as "J" based on professional judgment.
If LCS analytes are not at concentrations near the midpoint of the calibration range,	note the finding in the data validation report and notify the laboratory.

4.3.12.4 Confirmation of PAH by Method 8310

The primary analysis should be done by HPLC on a C18 column using a diode array detector. Confirmation is done qualitatively using spectral matching and/or quantitatively using a fluorescence detector. This method presupposes a high expectation of detecting the compounds. When used as a screening tool both confirmation methods should be employed. If a co-eluting compound is present that is detected by both the diode array detector and the fluorescence detector, the primary method of determining if interference is present is the spectral match from the diode array detector.

An effort to determine if the peak is primarily from the target compound or due to interference should be made. This is determined by comparison of the sample diode array spectra to the reference spectra in accordance with Appendix G.

Evaluation	Action
If the diode array spectra were used for confirmation and no diode array spectra were included in the data package,	qualify the result as "NJ."
If the sample absorption spectra does not match the standard absorption spectra or the percent difference spectra does not exhibit a relatively straight line,	qualify the result as "R."
If the analyte was misidentified by the laboratory,	request an amended report from the laboratory.
If identification of the analyte was hampered by interferences such that it is not certain that a positive identification could be made or that the quantification may be biased high,	qualify all associated results as "N" or "NJ" based on professional judgment or request additional data from the laboratory.

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The second evaluation compares the calculated values from the two detectors when a two-detector system is used. When one of the results is < the PQL and the other is much > the PQL (i.e., near or above the mid-point in the calibration curve), suspect interference or a false positive. Values around the PQL should be evaluated using both the RPDs and absolute differences. For example, results of 1 ug/L and 5 ug/L have an RPD of 133% but would not be significantly different from each other for analyses with a PQL of 5 ug/L.

Evaluation	**Action**
If results from the second column confirmation were not reported,	qualify all detects as "NJ."
If the RPD between detects for a particular analyte from two analytical columns is >40% and ≤75%,	report the result from the diode array detector and qualify it as "J."
If the RPD is > 75% and…	**Note**: If the RPD is >75%, one or both peaks may be due to coelution.
one result is <5X the PQL and the other result is > the first result,	qualify the result as "R."
both results are <5X the PQL,	qualify the result as "NJ."
both results are >5X the PQL and it appears that the peak is primarily due to the target analyte (spectral match),	qualify the result as "J+."
both results are >5X the PQL and it is not apparent that the peak is primarily due to the target analyte,	qualify the result as "NJ+."
If rejecting data where both results are much > the PQL,	include a complete description of the justification for the rejection and supporting data used in the data validation report. **Note**: In general, rejection of data with results >5X the PQL will require additional supporting analytical information such as GC/MS spectral matching.

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4.3.12.5 Method 8015B, Non-halogenated Organics Using GC/Flame Ionization Detector (Gasoline Range Organics/Diesel Range Organics)

Confirmation on a second column is not typically required for gasoline range organics (GRO) and diesel range organics (DRO) reported by this method.

GRO and DRO results represent all peaks detected over a designated RT range on the chromatogram. The RT assessment is performed as described in Section 4.3.8 for all reported RT markers.

Evaluation	Action
If RT windows are exceeded,	qualify all associated detects as "J" and all associated non-detects as "UJ."

4.4 Procedure for Liquid Chromatography/Mass Spectrometry/Mass Spectrometry (LC/MS/MS) Validation

The requirements addressed within this section are applicable to all LC/MS/MS analytical techniques. LC/MS/MS is a highly selective analysis that utilizes four means of compound discrimination: chromatographic separation, negative ion generations (where applicable), mass selection, and daughter fragmentation. It is theoretically possible that two different compounds could have the same RT and generate the same ion, but it is highly unlikely that these two compounds would fragment to the same daughter ion.

4.4.1 Instrument Calibration for LC/MS/MS

Initial Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for compounds on the TAL. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run and of producing a linear curve. In the absence of or in addition to, method-specific calibration acceptance criteria, the following general calibration acceptance criteria should be applied.

If an internal standard is used to calculate analytical results, the slope or RF values are evaluated as directed below. If the analysis does not use an internal standard to quantitate analytical results, the value of the slope or CF is not evaluated.

The laboratory may establish a calibration curve using either the linear regression (linear curve) approach or the RF approach. If both approaches are used to quantify and report target analytes within the same data package, calibration is to be assessed on an analyte-by-analyte basis.

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Criteria: LC/MS/MS instrument calibration shall be performed using a minimum of five calibration standards. The lowest point of the curve must be at or below the PQL.

If calibration curves are used, five standards are required for a linear (first-order) calibration model, six standards are required for quadratic (second-order) model , and seven standards are required for third-order polynomial . Higher order curves should not normally be used. If the laboratory uses a higher-order equation to establish a calibration curve, it should be evaluated for appropriate application.

Daily instrument calibration is required for perchlorate analysis.

Evaluation	Action
If an insufficient number of calibration standards were used, the PQLs were incorrect or all points were not analyzed within a 24-hour period:	qualify all associated detects as "J" and all associated non-detects as "UJ."
If the instrument for perchlorate analysis was not calibrated daily,	qualify all associated detects as "J" and all associated non-detects as "UJ."

RFs

Criteria: The %RSD for the RFs obtained from the five initial calibration standards must be ≤20%.

Evaluation	Action
For analyses using an internal standard for analyte quantitation, if the average RF for any target analyte is < the specified minimum RF, or <0.05 if no minimum is specified,	qualify all associated detects as "J" and all associated non-detects as "UJ" if the RF is ≥0.01 and as "R" if the RF is <0.01.
If any target compound has a %RSD…	
>20% but ≤40%,	qualify all associated detects as "J" and, may qualify all associated non-detects as "UJ" if any other calibration criteria have been exceeded for that compound.
>40% but ≤60%,	qualify all associated detects as "J" and all associated non-detects as "UJ."
> 60%,	qualify all associated detects as "J" and all associated non-detects as "R."

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Linear Curves

Criteria: The r^2 of the initial calibration curve shall be ≥0.99 and have a slope ≥0.05 for each compound. The absolute value of the intercept shall be ≤3X the MDL.

Note: The sample results may be reported with non-detects at the MDL or at the PQL value. See below for appropriate evaluation.

For perchlorate, forcing the calibration curve through a zero intercept is an acceptable practice and usually results in more accurate quantitation for low level results.

Evaluation	Action
For analyses using an internal standard for analyte quantitation, if the slope for any target analyte is < the specified minimum RF, or <0.05 if no minimum RF is specified,	qualify all associated detects as "J" all associated non-detects as "UJ" if the slope is ≥0.01 and as "R" if the slope is < 0.01.
If any target compound has a r^2:	
<0.99 but ≥0.90,	qualify all associated detects as "J" and may qualify all associated non-detects as "UJ" if any other calibration criteria have been exceeded for that compound.
<0.90 but ≥0.80,	qualify all associated detects as "J" and all associated non-detects as "UJ."
< 0.80,	qualify all associated detects as "J" and all associated non-detects as "R."
If the intercept for any target analyte is positive and > the MDL,	qualify all associated detects <3X the intercept as "J+."
When results are reported at the MDL: If the intercept for any target compound is negative with an absolute value... > the MDL but ≤3X the MDL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "UJ."

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>3X the MDL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "R."
When results are reported at the PQL: If the intercept for any target compound is negative with an absolute value...	
> the MDL but ≤2X the PQL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "UJ."
>2X the PQL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "R."

4.4.2 Calibration Verification

Compliance requirements for satisfactory initial and continuing instrument calibration verification are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for target compounds. The ICV independently verifies the calibration, and CCV establishes the 12-hour relative RFs on which the quantitations are based and checks satisfactory performance of the instrument on a day-to-day basis.

The evaluation of CCV data applies to all CCVs that bracket samples of interest.

Criteria: An ICV standard is analyzed immediately following an initial calibration. For perchlorate analysis, the ICV is always evaluated for %D criteria. For HE analysis, the ICV standard analysis results are not required to be reported in the data package unless the samples in the SDG were analyzed after the initial calibration but before a CCV standard analysis was performed. In this case, the ICV %D is assessed according to the calibration verification criteria described

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below for the associated samples. If a CCV is analyzed prior to samples and ICV data are also reported in the package, both the ICV %D and the appropriate CCV %D are to be assessed as described below. If both ICV %D and CCV %D infractions occur, the worst infraction should be evaluated for result qualification.

A CCV standard must be analyzed:

1) at the beginning of each analytical run;
2) at least once every 10 samples; and
3) and at the end of each analytical run.

If multiple CCVs were analyzed to obtain a passing CCV, the calibration is not verified and the calibration frequency is not met.

Evaluation	**Action**
If the ICV/CCV standards were not analyzed at the proper frequency, or if either a required ICV or CCV was not analyzed, or if all target compounds were not present in any ICV or CCV standard,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If all required ICVs and CCVs were not analyzed,	qualify all associated detects as "J" and all associated non-detects as "R."

RFs

Criteria: The %D between the ICV and/or CCV RFs and the average RF obtained from the initial calibration shall be calculated according to the formula in Section 6.3 and must be $\leq$20% for HE and $\leq$15% for perchlorate. The evaluation of CCV data applies to all CCVs that bracket samples of interest.

Evaluation	**Action**
If the %D was reported with the wrong sign (e.g., +%D for a negative bias),	document the occurrence in the data validation report and assess any infractions using the correct sign.
If the %D between an initial calibration RF or CF and an ICV or CCV RF or CF for any target analyte is... >20% for HE or >15% for perchlorate and positive (high bias),	qualify all associated detects as "J+."

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>20% for HE or >15% for perchlorate but ≤40% and negative (low bias),	qualify all associated detects as "J-" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
>40% but ≤60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
>60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "R."

Linear Curves

Criteria: The %D between the ICV or CCV standard concentrations and their true values shall be calculated according to the formula in Section 6.3 and must be ≤20% for HE and ≤15% for perchlorate. The evaluation of CCV data applies to all CCVs that bracket samples of interest.

Evaluation	**Action**
If the %D was reported with the wrong sign (e.g., +%D for negative bias),	document the occurrence in the data validation report and assess any infractions using the correct sign.
If the %D between a measured ICV and/or CCV concentration and its true value for any analyte is...	
>20% for HE or >15% for perchlorate and positive (high bias),	qualify all associated detects as "J+."
>20% for HE or >15% for perchlorate but ≤40% and negative (low bias),	qualify all associated detects as "J-" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
>40% but ≤60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
>60% and is negative,	qualify all associated detects as "J-" and all associated non-detects as "R."

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4.4.3 Reporting Limit Verification

A reporting limit verification standard (i.e., CRI), of the same origin as the calibration standard must be analyzed at the beginning and end of each perchlorate analysis run and at the beginning only of each HE analytical run as a measure of accuracy near the PQL. This analysis may be referred to as a post-digestion spike. Analysis of a CRI is required for both HE and perchlorate methods. CRI standard concentrations are at 2X the MDLs for perchlorate analysis, and at no more than 2X the PQL for HE analysis.

The laboratory may run more than the required CRIs in a batch. In this case, the bracketing CRIs for perchlorate and the CRI immediately preceding the samples for HE will be used for the CRI evaluation.

Criteria: The advisory recovery acceptance criteria for perchlorate analysis are 70% to 130%. For HE analysis, recoveries must be within limits specified by the laboratory. If recovery acceptance criteria are not reported, the recovery acceptance range shall be 70% to 130%.

Evaluation	Action
If frequency criteria are not met,	qualify all detects <5X the PQL as "J" and all non-detects as "UJ."
If the %R is >130%,	qualify all associated detects <5X the PQL as "J+."
If the %R is <70% but ≥30%,	qualify all associated detects <5X the PQL as "J-" and all associated non-detects as "UJ."
If the %R is <30%,	qualify all associated detects <5X the PQL as "J-" and all associated non-detects as "R."

4.4.4 Blanks

For perchlorate analysis, refer to Section 4.5.3 for assessment of blanks.

The following applies for HE analysis.

The preparation batch consists of a group of no more than 20 samples of the same matrix processed on the same day. All samples in a batch must be initiated on the same day. Each batch must contain a MB.

An initial calibration blank (ICB) must be analyzed to verify the baseline immediately following calibration and prior to analytical sample analysis. A continuing calibration blank (CCB) must be

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analyzed after each CCV and at the end of every analytical sequence in order to bracket all sample analyses. All CCBs that bracket samples of interest shall be reported and assessed. If a bracket has an ICB and no CCB, then the ICB should be treated as a CCB for validation purposes.

The purpose of laboratory (or field) blank analysis is to determine the essence and magnitude of contamination resulting from laboratory (or field) activities.

The criteria for evaluation of blanks apply to any blank associated with the samples and include MBs and, if submitted, EBs and FBs. Action in the case of unsuitable blank results depends on the circumstances and origin of the blank. In instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of a contaminant. For purposes of evaluating multiple blanks, each preparation batch may be considered an independent event in evaluating preparation blanks, and each 12-hour run sequence may be considered an independent event for evaluating FBs and EBs.

The result of any compound detected in the sample, which was also detected in any associated blank, must be qualified when the sample concentration is <5X the blank concentration.

Criteria: The concentration of each target analyte found in the blank must be < the associated MDL. The sample results must not be corrected by subtracting any blank value. If QC problems exist with any blank, all data associated with the case must be carefully evaluated to determine whether there is an inherent variability in the data for the case, or if the problem is an isolated occurrence not affecting other data.

Evaluation	**Action**
If a compound found in a blank is also found in the field sample,	qualify the sample result for that compound in accordance with the scenarios given below.
If gross contamination exists,	qualify results for all compounds affected as “R” due to interference.
If inordinate numbers of other target compounds are found at low levels in the blank(s)	discuss the presence of those compounds in the data validation report as it may be indicative of a problem at the laboratory.

The following are examples of application of the blank qualification guidelines. Certain circumstances may warrant deviations from these guidelines.

Scenario

Sample result is > the PQL but is <5X the blank result.

Qualification

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Blank Result	7
PQL	5
Sample Result	30
Qualified Sample Result	30U

Sample results <35 (or 5 X 7) would be qualified as non-detects ("U") at the reported value.

Scenario

The sample result is < PQL and is also <5X the blank result.

Qualification

Blank Result	6
PQL	5
Sample Result	4J
Qualified Sample Result	5U

Qualify sample results <30 (or 5 X 6) as non-detect ("U") at the PQL.

Note: Data are not reported as 4U, as this would be reporting a detection limit below the PQL.

The PQL may not be reported and it may not be possible to determine the PQL from the data. In these cases, qualify the contaminated sample result as "U" at 5X the blank concentration.

Scenario

The sample result is > the PQL and is also >5X the blank result.

Qualification

Blank Result	10
PQL	5
Sample Result	60
Unqualified Sample Result	60

Sample result exceeded the adjusted blank result of 50 (or 5 X 10). Thus, this sample result is not qualified.

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4.4.5 Surrogate Recovery – HE analysis only

Laboratory performance on individual samples is established by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interference and high concentrations of analytes. Because the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the review and validation of data based on specific sample results is frequently subjective and demands analytical experience and professional judgment. The evaluation of surrogate recoveries and internal standards should be performed concurrently. Accordingly, this section consists primarily of guidelines, in some cases with several optional approaches suggested.

Criteria: Sample and blank surrogate recoveries must be within limits specified by the laboratory. Surrogate compound recoveries shall be calculated using the procedure described in SW-846 Method 8000B. Reported recoveries shall be accompanied by the applicable acceptance limits.

Results from spiked or replicate QC samples that have surrogate %Rs < 10% cannot be used to evaluate associated sample results. Associated samples should be qualified for lack of accuracy and/or precision data as applicable.

Evaluation	Action
If the surrogate recovery acceptance criteria were not reported in the data package,	request amended data from the laboratory.
If, based on professional judgment, the laboratory's internal acceptance criteria are excessively wide or biased,	notify the program manager.
If an initial dilution was performed on any sample and at least one surrogate recovery is < the lower acceptance limit but ≥10%, or all surrogate recoveries are <10% and the results for one or more compounds are > the PQL,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
If an initial dilution was performed on any sample, any surrogate %R is <10%, and all results are non-detect,	qualify all sample results as "R."
If there are two or more analyses for a particular fraction at the same dilution,	determine which contains the best data to report using the considerations below, qualify all data from the rejected analysis as "R" and document the reason for rejecting data from one analysis in the data validation report.

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	Considerations should include: 1. surrogate recovery (marginal vs. gross deviation); 2. holding times; 3. comparison of the values of the target analytes reported in each fraction; and 4. performance of ISs.
For surrogate spike recoveries out of specification, the following approaches are suggested based on a review of all data from the batch, especially considering the apparent complexity of the sample matrix.	
If the surrogate is out of specification low,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the recovery is ≥10% and as "R" if the recovery is <10%.
If the surrogate is out of specification high,	qualify all detects as "J+."

Criteria: In the case of a blank analysis with surrogate out of specification, special consideration must be given to the validity of associated sample data. The basic concern is whether the blank problems represent an isolated problem with the blank alone or whether there is a fundamental problem with the analytical process.

If one or more samples in the batch show acceptable surrogate recovery, r the blank problem may be considered to be an isolated occurrence. However, even if this judgment allows some use of the affected data, analytical problems remain that must be corrected by the laboratory.

Evaluation	**Action**
If surrogate recovery in the blank does not meet acceptance criteria,	may qualify all detects < the PQL in all samples associated with the blank as "J" and all non-detects in all samples associated with the blank as "UJ."

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4.4.6 Internal Standard Performance

IS criteria ensure that instrument sensitivity and response are stable and acceptable during each analysis.

Criteria: The laboratory may use an IS to calculate the result ,or it may use the IS as a RT check only (perchlorate). If the IS is used for quantification, the internal standard area counts must not vary by more than 70% to 130% and the RT of the internal standard must not vary by more than ±30 seconds from the average of those obtained from the calibration standards or from the mid-level calibration standard.

If the internal standard is only used as an RT check, the RRT of the internal standard must fall within the acceptance range of 0.98 to 1.02, and the internal standard recovery should be evaluated using the surrogate criteria. If recovery acceptance limits are not reported in the data package, recovery should be evaluated based on reported MS acceptance limits.

Evaluation	**Action**
If there are two analyses for a particular sample,	determine which contains the best data to report based on the considerations below, qualify all data from the rejected analysis as "R" and document the reason for rejecting data from one analysis in the data validation report. Considerations should include: 1. magnitude of the RT shift; 2. holding times; 3. comparison of the values of the target compounds reported in each sample; and. 4. surrogate recovery.
If the IS was used for quantification and... its area count is >130% of the average of that obtained from the calibration standards, its area count is <70% of the average of that obtained from the calibration standards,	 qualify all associated detects as "J-" and all associated non-detects as "UJ." qualify all associated detects as "J+" and all associated non-detects as "UJ" if the area count is ≥25% and as "R" if the area count is <25%.

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its RT varies by more than ±30 seconds,	**Note:** If extremely low area counts are reported, or if performance exhibits a major abrupt drop-off, then a severe loss of sensitivity is indicated. qualify all associated detects as "N" or "R" and all associated non-detects as "R."
If the IS was used as an RT check and the RRT does not fall within the acceptance range,	qualify all associated detects as "N" or "R" and all associated non-detects as "R."
If the IS was used as an RT check,	evaluate the internal standard area counts according to Section 4.4.5.

4.4.7 MS/MSD

Data for MS/MSD pairs are generated to determine long-term precision and accuracy of the analytical method on samples various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis.

Criteria: The MS/MSD data shall not be used to evaluate associated field sample results unless the MS/MSD sample was from the same client and of similar matrix.

An MS and MSD sample shall be analyzed at a frequency of once per data package, once per 20 samples of similar matrix, or once per sample matrix, whichever is more frequent.

The laboratory shall not use FBs or EBs to satisfy these requirements if the laboratory can identify these blanks.

For HE, the MS and MSD accuracy and precision acceptance criteria shall be those calculated by the laboratory using the procedure given in SW-846 Method 8000B. If the recovery acceptance criteria are not given, recovery limits of 70% to 130% and 30% RPD should be used as the criteria. For solid and waste samples, it may be appropriate to accept up to a 40% RPD, based on the professional judgment of the reviewer.

For perchlorate, the MS/MSD recovery acceptance criteria are 75% to 125% and 20% RPD. For solid and waste samples, it may be appropriate to accept up to a 30% RPD, based on the professional judgment.

The MS and MSD %R must be within the limits, unless the sample concentration is >4X the spike concentration (see Section 4.1.20).

The MS and MSD analyses must meet all sample analysis acceptance criteria.

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The MS and MSD may be used results in conjunction with other QC results to determine the need for qualification of the data. An effort to determine to what extent the results of the MS/MSD affect the associated data should first be made. This determination should be made considering the MS/MSD sample matrix, the surrogate and IS %Rs, and the LCS results.

Professional judgment should be used to determine if MS/MSD failure warrants qualification of only the results for the failed compounds or if results for all the compounds associated with the failed MS compound and its associated IS are affected. Generally, unless evidence exists to warrant qualification of other compounds, only the compounds in the MS spiking mixture shall be qualified.

For programs that require application of one final qualifier to sample results, if a recovery (accuracy) infraction is identified in one or both of the MS samples along with an RPD (precision) infraction between the MS and MSD, the sample is qualified for the accuracy infraction. For example, if an analyte has low MS recovery and the RPD is not within criteria, the data are qualified as "J-."

Evaluation	**Action**
If the MS/MSD sample was from another client or of a dissimilar matrix; the frequency of the MS/MSD did not meet specified criteria; no MS/MSD was analyzed; an FB or EBs was used for MS/MSD purposes.	qualify all detects as "J" and all non-detects as "UJ."
If no other measure of precision (i.e., LCSD or replicate) is available,	qualify all detects as "J" and all non-detects as "UJ."
If the surrogate, IS and LCS %Rs are within the required acceptance criteria and…	
either %R for any target compound is > the upper acceptance limit,	qualify all associated detects as "J+."
either %R for any target compound is < the lower acceptance limit, and ≥ 10%,	qualify all associated detects as "J-" and all associated non-detects as UJ" if the recovery is ≥10% and as "R" if the recovery is <10%.
If the RPD for any target compound does not meet the acceptance criteria or %Rs fail both high and low,	qualify all associated detects as "J" and all associated non-detects as "UJ."

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4.4.8 Replicate

Replicate analyses are indicators of laboratory precision based on each sample matrix. If a replicate was performed instead of a MSD, the following criteria are applied. If insufficient sample was submitted to analyze a MS/MSD or replicate, the laboratory may run an LCSD to measure precision.

Criteria: A replicate sample shall be analyzed at a frequency of once per data package, once per 20 samples of similar matrix, or once per sample matrix, whichever is more frequent. All sample acceptance criteria must be met in the replicate analysis.

Samples identified as FBs or EBs should not be used for replicate sample analysis.

For HE values ≥5X the PQL, the replicate precision acceptance criteria shall be that calculated by the laboratory using the procedure given in SW-846 Method 8000B. If the acceptance criteria are not given, an RPD of ≤30% should be used as the acceptance criteria. For solid and waste samples, it may be appropriate to accept up to a 40% RPD, based on the professional judgment.

For perchlorate, the replicate precision acceptance criteria is 20% RPD for sample values ≥5X the PQL. For solid and waste samples, it may be appropriate to accept up to a 30% RPD, based on the professional judgment.

For both HE and perchlorate analysis, a control limit of ± the PQL shall be used for sample values > the PQL but <5X the PQL, including the case when only one of the replicate sample values is > the PQL but <5X the PQL.

No precision criteria apply when both replicate sample values are < PQL.

Evaluation	Action
If a replicate sample, MSD, and LCS/LCSD were not analyzed for each matrix or for each data package,	qualify all detects of the same matrix as "J" and all non-detects of the same matrix as "UJ."
If an FB or EB was used for the replicate analysis and no MSD or LCSD was run,	qualify all detects of the same matrix as "J" and all non-detects of the same matrix as "UJ."
If the original result and replicate result for any target compound are both ≥5X the PQL, and the RPD exceeds the appropriate control limit,	qualify all associated detects of the same matrix as "J" and all associated non-detects all associated as "UJ."
If the original and/or replicate result for any target compound is > the PQL but <5X the PQL (including non-detects) and the difference between the original result and replicate result is > the PQL,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."

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4.4.9 LCS

Data for LCSs are generated to provide information on the accuracy of the analytical method and on laboratory performance including sample preparation.

Criteria: An LCS should be analyzed for all methods at a frequency of once per data package, once per matrix, or once per 20 analytical samples, whichever is most frequent.

The LCS must meet all sample acceptance criteria and all method-specific LCS requirements. The LCS for HE must meet laboratory-derived acceptance criteria. If surrogate and IS recovery acceptance criteria are not met for the LCS analysis, the LCS must be reanalyzed. If the recovery acceptance criteria are not reported, the criteria in Appendix F or 70% to 130% should be used as the criteria.

The recovery acceptance limits for perchlorate are 85% to 115%.

If the laboratory analyzed an LCS/LCSD as a measure of precision, both the LCS and LCSD must meet the acceptance criteria.

Evaluation	Action
If, based on professional judgment, the laboratory's internal acceptance criteria are excessively wide or acceptable recoveries are significantly biased,	notify the program manager.
If the frequency of the LCS did not meet the specified criteria,	qualify all detects as "J" and all non-detects as "UJ."
If results are reported for target compounds that are not in the LCS,	may qualify detects for those compounds as "J" and non-detects for those compounds may be qualified as "UJ" based on professional judgment.

If the LCS criteria are not met and reanalysis was not performed, then the laboratory performance and method accuracy are in question. The following may be used as guidance in qualifying data.

Evaluation	Action
If the LCS %R is > the upper acceptance limit,	qualify all associated detects as "J+."
If the LCS %R is < the lower acceptance limit,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the %R is ≥ 10% and as "R" if %R is < 10%.

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For HE analysis, if %Rs for more than half of the compounds in the LCS analysis are below the acceptance range,	qualify all detects as "J-" and all non-detects as "UJ" if the %Rs are marginally low and as "R" if %Rs are significantly below acceptance limits.
For HE analysis, if %Rs for more than half of the compounds in the LCS analysis are above the acceptance range,	qualify all detects as "J+."
For HE analysis, if %Rs for more than half of the compounds in the LCS analysis are outside the acceptance range, both above and below, or if an LCS/LCSD pair was analyzed and the recoveries of any target analyte are both above and below acceptance criteria,	qualify all detects as "J" and non-detects as "UJ."

4.4.10 Sample Carry-over

Sample carry-over may occur when a high-concentration sample is analyzed immediately prior to another field sample. Steps must be taken to avoid introduction of false positive results in the second sample analysis due to instrument contamination.

Criteria: The absence of sample carry-over must be determined and verified. If examination of the run logs indicates that any samples in the analytical run of interest required dilution and there is no documentation of a rinse or blank analysis immediately following the original undiluted analysis then sample carry-over may be suspected.

Evaluation	**Action**
If any compound found in the sample requiring dilution exceeds the high calibration standard and was also found in the following sample at concentration <5X the PQL,	qualify the results for that compound in the second sample as "R."
If no data are available for the sample that required dilution and the laboratory has not documented that carry-over was evaluated, and any compound was also found in the following sample at concentration <5X the PQL,	qualify the results for that compound in the second sample as "N."

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4.4.11 Dilutions

Criteria: The PQLs must be adjusted to reflect all sample dilutions, concentrations, splits, clean-up activities, and dry weight factors that are not accounted for by the method.

Samples must be diluted and reanalyzed when any analyte exceeds the calibration range.

Original sample runs should be included when any sample requires dilution due to one or more compounds exceeding the calibration range.

The original undiluted results document the actual MDLs for non-detects.

Evaluation	Action
If the PQLs have not been properly adjusted,	request an amended report from the laboratory.
If an initial dilutions was required because of expected high concentrations of non-target analytes or because one or more target analytes were expected to greatly exceed the instrument working range and the laboratory was not be able to analyze the undiluted sample.	note the dilution and evaluated MDLs in the data validation report.
If any target compound exceeds the calibration range and…	
the original undiluted sample result was reported,	qualify all detects from the undiluted analysis that exceed the calibration range as "J."
the sample is diluted and reanalyzed, and the diluted sample data were reported,	qualify all non-detects from the diluted analysis as "UJ."
the original undiluted sample data was not provided,	request this information from the laboratory.
If data from the original sample run are unavailable,	refer to Section 4.2.5 for assessment of initially diluted samples with low surrogate recovery.

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Criteria: The laboratory shall strive to make dilutions in such a way that the final concentration is measured in the mid-range of the calibration curve, and that results are not reported from measurements below the lowest concentration standard.

Evaluation	Action
If the instrument response (reported result / dilution factor) from diluted sample is < that of the lowest concentration standard,	qualify all detects from the diluted analysis as "J."

4.4.12 Perchlorate Chlorine Ratios

Criteria: The natural isotopic abundances for the chlorine isotopes give a $^{35}Cl/^{37}Cl$ ratio of approximately 3.08. Laboratories must statistically derive isotope ratio acceptance criteria to be used as an additional confirmation of analyte identity.

When the laboratory does not specify acceptance criteria the mean of the ratio population shall not deviate by more than 10% from the 3.07 theoretical value, and the standard deviation shall not significantly exceed 0.2. Between the MDL and the PQL, the individual sample isotope ratio control limits shall be near the population mean ±20% (approximately 3σ). Above the PQL, the individual sample isotope ratio control limits shall be near the population mean ±15% (approximately 2σ).

When isotope ratio acceptance criteria are not met, the laboratory must provide supporting data and explanatory case narrative comments in the data package.

Evaluation	Action
If the isotope ratios were not reported,	calculate the ratio if the raw data were supplied or request an amended report from the laboratory if the raw data were not supplied.
If the isotope ratios are outside acceptance limits,	qualify detects as "NJ" or "R" based on professional judgment.
If supporting data and explanation were not provided,	request an amended report from the laboratory.

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4.4.13 Perchlorate Interference Check Standard

Criteria: The laboratory shall analyze an interference check standard (ICS) from a matrix containing 500 ppm each of chloride, sulfate, carbonate, and bicarbonate in every batch. The concentration of this standard will be at the PQL. To demonstrate that perchlorate is adequately isolated and recovered under the specific conditions used, this standard should recover within ±20% of the known value.

Evaluation	Action
If frequency criteria were not met,	note the deficiency in the data validation report.
If the recovery is not within ±20% of the known value,	note the deficiency in the data validation report.

4.5 Validation Guidelines for Confirmation by LC/MS/MS

These guidelines are for qualification of the original data based on the confirmation data obtained by LC/MS/MS and apply to HE by SW-846 Method 8330 and perchlorate by EPA Method 314. It should be noted that no confirmation LC/MS/MS results are qualified. If the original sample result is a detect, and the corresponding LC/MS/MS result is a detect, the original result is considered to be confirmed, although confirmation qualifiers may be applied. As with all validation guidelines, professional judgment is the final criteria.

4.5.1 Required LC/MS/MS Data

The laboratory is expected to include all calibration and QC data normally supplied in a level 4 data package; however, only the following information is necessary to evaluate the confirmation.

1) Form I Sample Results
2) CRI Summary
3) CCV %D Summary
4) IS Recovery
5) MB results

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4.5.2 LC/MS/MS QC are Acceptable

The laboratory is expected to meet all QC acceptance criteria when performing confirmation by LC/MS/MS. **Note:** Multiple QC failures should result in "NJ" or no qualification to original results.

If all LC/MS/MS QC acceptance criteria are met:

Evaluation	**Action**
If the original result is ≥ the PQL and the LC/MS/MS result is non-detect, If the original result is < the PQL and the LC/MS/MS result is non-detect,	qualify the original result as "R." qualify the original result as "R."
If the original result and the LC/MS/MS result are > the PQL, and… the %D is >40%,	 qualify the original result as "J."
If the original result is ≥ the PQL and the LC/MS/MS result is < the PQL, If the original result is < the PQL and the LC/MS/MS result is ≥ the PQL,	qualify the original result as "NJ+." qualify the original result as "J-."

4.5.3 Method Blank

The MB performed on LC/MS/MS should be < the MDL.

Evaluation	**Action**
If the LC/MS/MS MB concentration is ≥ the MDL and… the original result is > the PQL, but <5X the MB concentration,	 qualify the original result as "R."
the original result is < the PQL and <5X the MB concentration,	qualify the original result as "NJ+."

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4.5.4 Continuing Calibration

If the original result is a detect and the LC/MS/MS result is a non-detect and the LC/MS/MS CCV is outside acceptance criteria:

Evaluation	Action
If the CCV %D is positive (high bias), >20% and…	
the original result is ≥ the PQL,	qualify the original result as "R."
the original result is < the PQL,	qualify the original result as "R."
If the CCV %D is negative (low bias), >20% and…	
the original result is ≥ the PQL,	qualify the original result as "R."
the original result is < the PQL,	qualify the original result as "NJ."

4.5.5 Post Digestion Spike/CRI

If the original result is a detect, the LC/MS/MS result is a non-detect, and the LC/MS/MS post digestion spike/CRI are outside acceptance criteria:

Evaluation	Action
If the spike %R is > the upper limit and…	
the original result is ≥ PQL,	qualify the original result as "R."
the original result is < PQL,	qualify the original result as "R."
If the spike %R is < the lower limit and…	
the original result is ≥ the PQL,	qualify the original result as "R."
the original result is < the PQL,	qualify the original result as "NJ."

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4.5.6 Internal Standard Performance

In the case of confirmation analysis, IS performance is assessed only as it reflects instrument sensitivity, not calculated bias; and only applies if the IS is used for quantification.

If the original result is a detect; the LC/MS/MS result is a non-detect; and the IS is outside acceptance criteria:

Evaluation	**Action**
If the IS %R is > the upper limit and…	
the original result is ≥ the PQL,	qualify the original result as "R."
the original result is < the PQL,	qualify the original result as "R."
If the IS %R is < the lower limit and…	
the original result is ≥ the PQL,	qualify the original result as "R."
the original result is < the PQL,	qualify the original result as "NJ."

4.6 Procedure for Inorganic Data Validation

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for target analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run, and CCV documents that the initial calibration is still valid.

4.6.1 Initial Calibration

Criteria: Instruments used for all analyses except ion chromatography (IC) must be calibrated daily and each time the instrument is set up as noted below. **Inductively coupled plasma (ICP)-atomic emission spectroscopy (AES) radial-viewing analysis:** A blank and at least one standard must be used in establishing the analytical curve. **ICP-AES axial-viewing analysis:** A blank and at least three standards must be used in establishing the analytical curve.

This requirement specifically addresses the trace analysis of arsenic, cadmium, lead, antimony, selenium, and thallium using axial-viewing ICP-AES instead of graphite furnace atomic absorption (GFAA) for samples with analyte concentrations below 500 parts per billion (ppb).

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ICP-MS analysis: A blank and at least one standard must be used in establishing the analytical curve.

Mercury analysis by cold vapor atomic absorption (CVAA): A blank and at least four standards must be used in establishing the analytical curve.

Cyanide analysis: A blank and at least three standards, one of which must be at the PQL, must be used in establishing the analytical curve.

IC analysis: A blank and at least three standards, one of which must be at the PQL, must be used in establishing the analytical curve. Daily calibration is not required if acceptable calibration verification is performed prior to the analytical run.

Flow Injection and Colorimetric analysis: A blank and at least three standards, one of which must be at the PQL, must be used in establishing the analytical curve.

Evaluation	Action
If the minimum number of standards was not used for initial calibration,	qualify all detects as "J" and all non-detects as "UJ."
If the instrument was not calibrated at the proper frequency,	qualify all sample results as "R."
If only one standard was used for trace axial view ICP-AES,	notify the laboratory and the program that the laboratory was not compliant with the SOW.

Criteria: The correlation coefficient (r) of the initial calibration curve shall be ≥0.995, and the absolute value of the intercept shall be ≤3X the MDL.

Note: The sample results may be reported with non-detects at the MDL or at the PQL value. See below for appropriate evaluation.

The r assessment need only be performed on those curves established using at least three standards and a blank (four-point curve).

The intercept shall be assessed for all inorganic calibration curves, with the following exception: The laboratory may report two calibration lines for some inorganic analytes. In this case, qualifiers should be applied if the r criteria are not met for either reported calibration. The intercepts for these curves should not be evaluated.

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Evaluation	**Action**
If any compound has a r: <0.995 but ≥0.90, <0.90 but ≥0.80, <0.80,	 qualify all associated detects as "J" and all associated non-detects may be qualified as "UJ" if any other calibration criteria have been exceeded for that analyte. qualify all associated detects as "J" and all associated non-detects as "UJ." qualify all associated detects as "J" and all associated non-detects as "R."
When results are reported at the MDL: If the intercept for any target compound is negative with an absolute value... > the MDL but ≤3X the MDL, >3X the MDL,	 qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "UJ." qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "R."
When results are reported at the PQL: If the intercept for any target compound is negative with an absolute value... > the MDL but ≤2X the PQL, >2X the PQL,	 qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "UJ." qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "R."
If any compound has an intercept that is positive and > the MDL,	qualify all associated detects <3X the intercept as "J+."

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4.6.2 CCV

Criteria: ICV and CCV: An ICV standard must be analyzed after instrument calibration and prior to sample analysis. A CCV standard must be analyzed once every 10 injections or every two hours, whichever is more frequent. The evaluation of CCV data applies to all CCVs that bracket samples of interest.

ICV and CCV analysis results must be within the recovery acceptance criteria of 90% to 110% of the true value for all analytes except mercury and cyanide.

ICV and CCV analysis results for mercury must fall within the recovery acceptance criteria of 80% to 120% of the true value.

ICV and CCV analysis results for cyanide must fall within the recovery acceptance criteria 85% to 115% of the true value.

Evaluation	**Action**
If the ICV and CCV standards were not analyzed at the proper frequency, or if either a required ICV or CCV was not analyzed, or if all target compounds were not present in any ICV or CCV standard,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If all required ICVs and CCVs were not analyzed,	qualify all associated detects as "J" and all associated non-detects as "R."
If the ICV or CCV %R is…	
<90% but ≥75% (mercury: <80% but ≥65% and cyanide: <85% but ≥70%),	qualify all associated detects as "J-" and all associated non-detects as "UJ."
>110% but ≤125% (mercury: >120% but ≤135%, cyanide: >115% but ≤130%),	qualify all associated detects as "J+."
<75% (mercury: <65%, cyanide: <70%),	qualify all associated detects "J-" and all associated non-detects as "R."
>125% (mercury: >135%, cyanide: >130%),	qualify all associated detects as "R."

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4.6.3 Blanks

Blank analysis results are assessed to determine the existence of contamination problems. The criteria for evaluation of blanks apply to any laboratory blank associated with the samples. See Section 4.1.2 for general chemistry QC exemptions.

Criteria: An ICB must be analyzed to verify the baseline immediately following calibration and prior to analytical sample analysis. A CCB must be analyzed after each CCV and at the end of every analytical sequence in order to bracket all sample runs. All CCBs that bracket samples of interest shall be reported and assessed.

A minimum of one MB (or preparation blank) should be analyzed for every 20 samples. The same reagents used for the sample digestion must be used to prepare the MB. In those cases for which reagents are automatically added to all samples by an autoanalyzer, the ICB is equivalent to a preparation blank. FBs and EBs are treated as preparation blanks.

If any QC problems exist with any blank, all data associated with the batch must be evaluated to determine whether there is an inherent variability in the data for the batch, or if the problem is an anomaly not affecting other data.

If the absolute value of the ICB or CCB result is > the PQL, the analysis should have been terminated and the problem corrected by the laboratory. If any analyte concentration in the blank is > the PQL, the lowest reported concentration in the associated samples must be $\geq$10X the concentration in the blank. Samples having analyte concentrations <10X that of the blank but > the PQL shall be re-digested and/or reanalyzed.

No contaminants $\geq$ MDL should be present in the blanks.

When there is blank contamination and reanalysis is not possible, the data may need to be qualified. Use the blank (ICB, CCB, MB, FB, or EB) with the highest concentration associated with the samples of interest to qualify data. If a CCB is used to qualify data, it must bracket the sample of interest.

The effect of MB values versus ICB/CCB values on sample results is not straightforward and will vary depending on analytical method. Professional judgment is required to properly assess the affect of blank data on sample results. As a general guideline, in the case of conflicting positive and negative MB and ICB/CCB values, the MB values will take precedence over ICB/CCB values when applying qualifications to associated sample results.

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Evaluation	**Action**
If blank frequency criteria were not met,	note the deficiency in the data validation report.
If any associated blank value is positive and is ≥ the MDL but ≤ the PQL,	qualify all associated detects ≥ the MDL but <5X blank value as "U" at 5X the blank value. All associated detects >5X blank may be qualified "J+" based on professional judgment.
If any ICB/CCB value is positive and > the PQL,	qualify all associated sample results < the PQL as "U" at the PQL and all associated detects > the PQL but <5X the blank value as "UJ" at 5X the blank value or as "R" based on professional judgment. All associated detects >5X blank value may be qualified "J+" or "R" based on professional judgment.
If any MB, FB, or EB value is positive and > the PQL,	qualify all associated detects <5X the blank value and all associated non-detects as "UJ" at 5X the blank value. All associated detects >5X the blank value may be qualified "J+" or "R" based on professional judgment.
If the absolute value of the negative blank is > the MDL but ≤ the PQL,	qualify all associated detects <5X the MDL as "NJ-" and all associated non-detects as "UJ."
If the absolute value of a negative ICB/CCB value is > the PQL, and the analysis was not terminated by the laboratory,	notify the laboratory and qualify all associated detects <10X the PQL as "NJ-" or "R" and all associated non-detects as "R."
If the absolute value of the negative MB, FB, or EB value is > the PQL, and the analysis was not terminated by the laboratory,	notify the laboratory and qualify all associated detects <5X the blank value as "UJ" or "R" based on professional judgment and all associated non-detects as "R." Sample results >5X the blank value may be qualified as "J-" or "R" based on professional judgment.

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4.6.4 MS

The MS sample analysis is performed as a measure of the ability to recover analytes in a particular matrix.

Criteria: The MS data shall not be used to evaluate data unless the MS sample was from the same client and of similar matrix.

An MS sample shall be analyzed at a frequency of once per data package, once per 20 samples of similar matrix, or once per sample matrix, whichever is more frequent.

Samples identified as FBs and EBs cannot be used for MS analysis.

Spiking levels shall be approximately at the mid-point of the calibration range.

The MS recovery acceptance criteria are 75% to 125%, unless the sample concentration is >4X the spike concentration (see Section 4.1.20).

MS analysis shall be performed for all analytes other than sodium, potassium, magnesium, and calcium.

For methods, which require a digestion, post-digestion spikes (PS) are occasionally performed. The recovery acceptance criteria on a PS are 85% to 115%. For methods which do not require digestion (i.e. IC, ion-specific electrode, and colorimetric techniques), MSs shall be analyzed. These spikes may be referred to as a post spikes or analytical spikes. These should be evaluated using the recovery acceptance criteria of a MS, 75% to 125%.

Evaluation	**Action**
If the MS sample was from another client or of a dissimilar matrix, the frequency of the MS did not meet specified criteria, an MS was not analyzed, or an FB or EB was used for MS analysis,	qualify all detects as "J" and all non-detects as "UJ."
If an MS %R is…	
>125%,	qualify all associated detects as "J+."
<75% but ≥30%,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
<30%,	qualify all associated detects as "J-" and all associated non-detects as "R."
If an MS/MSD pair was analyzed and recoveries of any target analyte are both	qualify all detects as "J" and all non-detects as "UJ."

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above and below acceptance criteria,	
If the post-digestion spike %R is… >115%,	 qualify all associated detects as "J+."
If the post-digestion spike %R is < the acceptance criteria,	qualify all associated detects as "J-" and all associated non-detects as UJ" if the recovery is ≥10% and as "R" if the recovery is <10%.

4.6.5 Replicate

Replicate analyses are indicators of laboratory precision based on each sample matrix.

Criteria: One replicate must be analyzed for each matrix or each batch, with a minimum frequency of one per 20 samples.

Samples identified as FBs or EBs should not be used for replicate or MSD analysis.

An acceptance limit of 20% for the RPD shall be used for sample values ≥5X the PQL. For solid and waste samples, it may be appropriate to accept an RPD of up to 35% based on professional judgment.

A control limit of ± the PQL shall be used for sample values > the PQL but <5X the PQL, including the case when only one of the replicate sample values is > the PQL but <5X the PQL.

No precision criteria apply when both replicate sample values are < the PQL.

When a replicate was not performed but an MSD was analyzed, the MS/MSD RPDs are evaluated as specified in Section 4.3.5. If neither a replicate nor an MS/MSD were analyzed, the laboratory may run an LCSD to measure precision. LCS/LCSD RPDs are evaluated as specified in Section 4.3.5.

Evaluation	**Action**
If no replicate sample, MSD, or LCSD were analyzed for each matrix or for each data package, or if an FB or EB was used for the replicate analysis,	qualify all detects of the same matrix as "J" and all non-detects of the same matrix as "UJ."
If the original result and replicate result are both ≥5X the PQL and the RPD exceeds the appropriate control limit,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."

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If the original and/or replicate result is > the PQL but <5X the PQL (including non-detects) and the difference between the original result and replicate result is > the PQL,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."

4.6.6 LCS

Data for LCSs are generated to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation.

Criteria: LCSs shall be analyzed using the same sample preparation and analysis methods used for samples, with one LCS analyzed with each batch of up to 20 samples. Multiple LCS analyses may not be used to meet acceptance criteria; that is, if multiple LCSs are analyzed for a batch and any failures occur, the failed LCS will be used to qualify the data.

For all aqueous LCS results, the recovery acceptance criteria are 80% to 120%, except antimony and silver. The recovery acceptance criteria for silver and antimony are laboratory-specified. LCS failures for silver and antimony shall be discussed in the data validation report but shall not be subject to the reanalysis requirement.

For all solid LCS results, the recovery acceptance criteria are established by the agency that prepared the reference material or statistically-derived criteria developed by the laboratory. The laboratory should report these acceptance criteria on the LCS reporting form. If solid LCS acceptance criteria are not provided, then 30% to 150% should be used to assess soil results. If this situation occurs, it should be noted in the data validation report. A solid LCS should be analyzed for mercury in solid analyses.

An aqueous LCS is not required for mercury or cyanide analyses. Since the ICV is always digested/distilled for these analyses, it is equivalent to an LCS.

Evaluation	**Action**
If an LCS was not analyzed,	qualify all detects as "J" and all non-detects as "UJ."
<u>Aqueous LCS</u> If the LCS %R is…	
>120%,	qualify all associated detects as "J+."
<80% but ≥50%,	qualify all associated detects as "J-" and all associated non-detects "UJ."
<50%,	qualify all associated detects as "J-" and

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	all associated non-detects as "R."
Solid LCS If the LCS %R is…	
> the upper control limit,	qualify all associated detects as "J+."
≥30% but < the lower control limit,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
<30%,	qualify all associated detects as "J-" and all associated non-detects as "R."
If an LCS/LCSD pair was analyzed and recoveries for any target analyte are both above and below acceptance criteria,	qualify all detects as "J" and all non-detects as "UJ."
If an aqueous LCS was analyzed for soil matrices,	qualify all detects as "J" and all non-detects as "UJ."

4.6.7 Reporting Limit Verification

Criteria: Reporting limit verification (i.e., CRA [AA], CRDL [cyanide], and CRI [ICP-AES, ICP-MS, and LC/MS/MS]) standards are analyzed at the beginning of each analytical run as a measure of accuracy near the reporting limit. CRA and CRDL standards are prepared with concentrations at the PQLs, and CRI standards are prepared with concentrations at twice the PQLs.

The advisory recovery acceptance criterion for these analyses is 70% - 130%.

Evaluation	**Action**
If the reporting limit verification recovery is…	
>130%,	qualify all associated detects <5X the PQL as "J+."
<70% but ≥30%,	qualify all associated detects <5X the PQL as "J-" and all associated non-detects as "UJ."
<30%,	qualify all associated detects <5X the PQL as "J-" and all associated non-detects as "R."

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4.6.8 Method-specific analytical requirements (inorganic)

4.6.8.1 ICP-AES and ICP-MS Methods

ICS

The ICP-AES and ICP-MS ICSs (ICS A and ICS AB) verify the instrument's interelement and background correction factors.

Criteria: An ICS A must be analyzed at the beginning of each sample analysis run.

Absolute values for all ICS A target analytes, except those in the ICS A solution, must be ≤ the MDL.

Evaluation	Action
If the ICS A sample was not analyzed at the required frequency,	note the deficiency in the data validation report.
If the sample concentrations of aluminum, calcium, iron, and/or magnesium are < their respective concentrations in the ICS A solution,	accept the sample results without qualification.
If the sample concentrations of aluminum, calcium, iron, and/or magnesium are comparable to or > their respective concentrations in the ICS A solution, and the ICS A result for a non-spiked analyte is...	
positive and ≥ the MDL,	qualify all associated sample detects < 50X the ICS A result as "J+."
negative and the absolute value of the result is > the MDL but ≤2X the MDL,	qualify all associated detects <50X the absolute value of the ICS A result as "J-" and all associated non-detects as "UJ."
negative and the absolute value of the result is >2X the MDL,	qualify all associated detects <50X the absolute value of the ICS A result as "J-" and all associated non-detects as "R."

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Criteria: An ICS AB must be analyzed at the beginning of each sample analytical run.

ICS AB results for the target analytes in the ICS AB solution must be within 80% to 120% of the true value.

If the recovery criteria are not met, the analyst may either terminate the analysis or continue and re-analyze the failed constituents at a later time.

Evaluation	**Action**
If the ICS AB was not analyzed at the required frequency,	note the deficiency in the data validation report.
If the concentrations of aluminum, calcium, iron, and magnesium in the sample are < their respective concentrations in the ICS AB solution,	accept the sample results without qualification.
If the sample concentrations of aluminum, calcium, iron, and magnesium are comparable to or > their respective concentrations in the ICS AB solution and the ICS AB recovery for an analyte is...	
>120%,	qualify all associated detects as "J+."
<80% but ≥50%,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
<50%,	qualify all associated detects as "J-" and all associated non-detects as "R."

ICP Serial Dilution

The ICP serial dilution monitors physical or chemical interferences that may exist in each sample matrix.

Criteria: A serial dilution must be analyzed for each matrix in an analytical run. If the undiluted results for the sample used for serial dilution are ≥50X the MDL, then the %D between a 5X dilution result and the original result must agree within 10%.

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Samples with elevated concentrations that require dilutions >50X or that require multiple dilutions must also meet these requirements. However, care should be used in evaluating the result from the undiluted sample since it may be above the linear range of the instrument and would not apply.

No acceptance criterion applies when the undiluted sample result is <50X the MDL.

Evaluation	Action
If frequency requirements are not met,	qualify all detects ≥50X the MDL as "J."
If the result for any analyte in the sample used for serial dilution analysis is ≥50X the MDL and the %D is >10%,	qualify detects for all samples of the same matrix in the batch as "J" and non-detects all samples of the same matrix in the batch as "UJ."

Instrument Tuning for ICP-MS

Tuning and performance criteria are established to ensure mass resolution and identification. These criteria are not sample specific. Conformance is determined using standards. Therefore, these criteria should be met in all circumstances.

Criteria: The ICP-MS tune shall be evaluated daily. The tuning solution must contain elements representing all of the regions of interest. The mass calibration must be within 0.1 atomic mass units (amu) of the true value. The resolution must be verified to be <0.9 amu full width at 10% peak height.

Evaluation	Action
If tunes were not run daily or if all mass calibration and resolution criteria were not met,	use professional judgment to determine which data should be used. It is suggested that all associated detects should be qualified as "J" and all associated non-detects should be qualified as "UJ."
If multiple QC failures also occurred,	qualify all results as "R."

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Internal Standard (IS) Performance for ICP-MS

IS criteria ensure that ICP-MS sensitivity and response are stable and acceptable during each analysis. They also allow for monitoring of indigenous quantities of the ISs.

Criteria: The intensity of the IS in the samples must fall within 60% to 125% of the intensity of the IS in the initial calibration standard. The intensity of the IS in the bracketing CCVs and CCBs must fall within 80% to 120% of the intensity of the IS in the initial calibration standard.

Evaluation	Action
If no IS was used,	qualify all results as "R."
If the IS intensity for a sample is… ≥30% but <60% of the intensity of the IS in the calibration standard, >125% but ≤160% of the intensity of the IS in the calibration standard, <30% or >160 % of the intensity of the IS in the calibration standard,	 qualify all associated detects as "J+" and all associated non-detects as "UJ." qualify all associated detects as "J-" and all associated non-detects as "UJ." qualify all associated results as "R."
If both the CCV and CCB have IS intensities outside of the recovery limits,	all associated sample results may be qualified as "J/UJ" due to instrument drift based on professional judgment.

4.6.8.2 Total Organic Carbon (TOC) by SW-846 Method 9060

Criteria: Quadruplicate analyses are required. The average is to be reported.

Evaluation	Action
If quadruplicate analyses were not run,	qualify all detects as "J" and all non-detects as "R."

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4.6.8.3 Total Cyanide and Cyanide Amenable to Chlorination

After evaluation of total cyanide data (and application of appropriate qualifiers) using sections 4.6.1 through 4.6.7, proceed to the following guidance for further evaluation of analytical data for total and amenable cyanide,

Criteria: Sample preparation includes distillation of the samples. In addition to the field samples, the QC samples and one standard and the ICV must be distilled. The LCS meets the requirement for distillation of one standard if the concentrations of the LCS and ICV are different.

Evaluation	Action
If the samples, appropriate QC samples, and appropriate standards were not distilled,	qualify all results as "R."
If the field samples were distilled but the QC samples and/or standards were not distilled,	qualify all associated detects as "J" and all associated non-detects as "UJ."

The remainder of this section is provided as guidance for the assessment of data for cyanide amenable to chlorination. Total cyanide data are to be reviewed according to the guidance in Sections 4.6.1 through 4.6.6.

Cyanide amenable to chlorination (decomposed by chlorination) is derived by measuring the total cyanide and the cyanide remaining after chlorination. The amenable cyanide is calculated as the difference between the total and chlorinated. Biases in the cyanide after chlorination will result in a bias in the opposite direction for the calculated amenable result.

The actual analysis of the sample is the same for the total and the chlorinated analysis; only the sample preparation is different. The laboratory will generally run the total and the chlorinated samples together in the same batch and will use the same calibration and calibration checks for both the total and chlorinated cyanide samples. The laboratory should identify which sample is the total sample and which sample is the chlorinated sample.

LCS and MS solutions are generally of the form that will not decompose with chlorination giving a %R of zero for chlorinated cyanide. When the chlorinated cyanide recovery is 0%, the reported amenable cyanide recovery is equal to the total cyanide recovery. Alternatively, the LCS and MS solutions may not decompose with chlorination and will give a recovery of 0% for amenable cyanide. The laboratory should discuss in the case narrative the form of solution that was used for LCS and MS analyses. The chlorinated cyanide LCS and MS recoveries may not be reported. In this case, the chlorinated cyanide LCS and MS recoveries can be determined from the raw data. The amenable cyanide LCS and MS data should be evaluated using the criteria given for total cyanide.

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When total and amenable cyanide are analyzed together in the same run, all initial and continuing calibration qualification applied to the total cyanide results should also be applied to the amenable cyanide results. When total and chlorinated cyanide are not analyzed in the same run, qualifications applied to the total and chlorinated cyanide results should also be applied to the amenable cyanide results. Signed qualification for chlorinated cyanide results should be reversed for amenable cyanide results; that is, a "J+" for chlorinated cyanide results would be a "J-" for the associated amenable cyanide.

Major differences in total and chlorinated results are generally attributed to incomplete destruction of cyanide complexes such as thiocyanide. Non-detects for total cyanide with significant cyanide results for chlorinated cyanide (negative amenable cyanide) may indicate a significant presence of thiocyanide or other cyanide complexes in the sample.

Criteria: A CCV standard must be analyzed once every 10 injections or every two hours, whichever is more frequent. The evaluation of CCV data applies to all CCVs that bracket samples of interest.

The recovery acceptance criteria for CCV analysis results must be within 85% to 115%.

Evaluation	**Action**
If a chlorinated cyanide CCV %R is…	
<85% but ≥70%,	qualify all associated detects for amenable cyanide as "J+."
>115% but ≤130% and the amenable cyanide result is < the total cyanide result,	qualify all associated detects for amenable cyanide as "J-" and all associated non-detects for amenable cyanide as "UJ."
<70%,	qualify all associated detects for amenable cyanide as "R."
>130% and the amenable cyanide result is < the total cyanide result,	qualify both detects and non-detects for amenable cyanide as "R."

Criteria: A minimum of one MB should be analyzed for every 20 samples. The same reagents used for the sample must be used to prepare the MB. A CCB must be analyzed after each CCV and at the end of every analytical sequence. All CCBs that bracket samples of interest shall be reported and assessed.

If cyanide is detected in an MB or CCB, the chlorinated sample results must be assessed to determine the impact on amenable cyanide results.

No contaminants ≥ the MDL should be present in the blanks.

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Evaluation	Action
If a chlorinated cyanide MB or CCB value is positive and ≥ the MDL and the chlorinated sample result is a detect <5X the MB/CCB value,	qualify all associated detects for amenable cyanide as "J-"and, if the total cyanide result is > the MDL, qualify all associated non-detects for amenable cyanide as "UJ."
If the absolute value of the negative chlorinated cyanide MB or CCB value is > the MDL and the chlorinated sample result is < 5X the MDL or non-detect,	qualify all associated detects for amenable cyanide <5X the MDL as "J+."

Criteria: The absolute value of a negative amenable cyanide result must be <3X the MDL.

Note: Laboratories will generally report the amenable cyanide as non-detect when the chlorinated result is > the total cyanide result. The raw data may need to be reviewed to determine the actual negative amenable cyanide result.

Evaluation	Action
If the absolute value of a negative amenable cyanide result is >3X the MDL and the total cyanide is a non-detect,	note in the data validation report but do not qualify any results.
If the absolute value of a negative amenable cyanide result is >3X the MDL and the total cyanide is a detect,	qualify the amenable cyanide result as "UJ" if the absolute value of the amenable cyanide result is >3X but ≤10X the MDL and as "R" if the absolute value of the amenable cyanide result is >10X the MDL.

4.6.8.4 Total/Partial Inorganic Analyte Results

Several inorganic analytes are analyzed and reported as total and partial results, (i.e. total chromium/hexavalent chromium, TKN/ ammonia, hardness/calcium and magnesium, total alkalinity/carbonate and bicarbonate, total cyanide/amenable cyanide, and total phosphorus/phosphate. In these cases, it is expected that the partial value will be ≤ the total value. These reported values may or may not be obtained from the same analytical method. When the reported result for the partial analyte is > the result for the total analyte, one or both results are suspect. The extent the quality of the data is affected must be determined. The following criteria should be used for guidance.

Note: Comparisons are made at the elemental level, that is, total nitrogen should be > the nitrogen in ammonia not > the ammonia.

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Criteria: When both a partial and a total result are reported, the result for the partial analyte must be ≤ the result for the total analyte.

If the partial result is > the total result, the laboratory should be contacted for further information. If the laboratory cannot be contacted or cannot provide sufficient explanation, the following criteria apply.

If the partial result is > the total result and both results are ≥5X the PQL, then the RPD between the two values should be ≤20%.

If the partial result is > the total result and one or both results are <5X the PQL, then the difference between the two values should be ≤ the partial analyte's PQL.

Evaluation	Action
If the partial result is > the total result, and…	
both the total and partial results are ≥5X the PQL and the RPD is >20%,	may qualify one or both results as "R" or "J" based on professional judgment.
one or both results are <5X the PQL and the difference between the two results is > the partial analyte's PQL,	may qualify one or both results as "R" or may qualify all associated detects as "J" (with or without bias) or may qualify all associated non-detects as "UJ" based on professional judgment.

Partial Analyte Conversions

To Convert	To	Multiply By
O-phosphate	Phosphorus	0.326
Ammonia	Nitrogen	0.824
Ca Mg	Hardness Hardness (total hardness is the sum of the calculated Ca and Mg hardness results)	2.497 (2.5, if titrated) 4.118 (4.12, if titrated)

Alkalinity Relationships

The results obtained from the phenolphthalein and total alkalinity determinations offer a mean for stoichiometric classification of the three principal forms of alkalinity present in many waters.

- Carbonate alkalinity is present when the phenolphthalein alkalinity is not zero and is not < the total alkalinity.
- Hydroxide alkalinity is present if the phenolphthalein alkalinity is > half the total alkalinity.

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- Bicarbonate alkalinity is present if the phenolphthalein alkalinity is < half the total alkalinity.

Result of Titration	Hydroxide Alkalinity as $CaCO_3$	Carbonate Alkalinity as $CaCO_3$	Bicarbonate Alkalinity as $CaCO_3$
P=0	0	0	T
P< ½ T	0	2P	T-2P
P= ½ T	0	2P	0
P> ½ T	2P-T	2(T-P)	0
P=T	T	0	0

P- phenolphthalein alkalinity; T- total alkalinity

Phenolphthalein alkalinity is the term traditionally used for the quantity measured by titration to pH 8.3. It is not routinely reported by the laboratories but could be calculated using the amount of titrant used to reach pH 8.3. There is usually a column on the alkalinity worksheet that contains this information. Since total alkalinity is reported, it should be verified that the carbonate, bicarbonate, and hydroxide values do not exceed the total.

No conversion is required to compare hexavalent chromium to total chromium.

The calculation for amenable cyanide is detailed in Section 4.6.8.3.

4.6.8.5 Data Validation for Analyses by NIOSH Method 7300

This procedure is for the analysis of elements capable of detection by ICP-AES analysis, including Be, in air samples. The samples are collected onto filters at a flow rate of 1 to 4 L/min. The working range of this method is 0.005 to 2.0mg/m^3 (2.5-1000ug/sample) for each element in a 500-L air sample.

The laboratory must follow the requirements specified in NIOSH 7300 as well as any requirements specified in the AHIA Accreditation Requirements. Compliance requirements for satisfactory data reporting include:

- Case narrative
- Initial calibration data
- Continuing calibration data
- Media blanks, FBs, and preparation blank data
- LCS/LCSDs
- Sample results
- Instrument run logs

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Initial Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analysis run, and CCV documents that the initial calibration is still valid.

Criteria: Calibrate the spectrometer according to the manufacturer's recommendations. Typically, an acid blank and a 10µg/mL multi-element***** working standard is used.

*****refer to method for chemically compatible combinations of elements

Evaluation	**Action**
If the minimum number of standards as defined in the criteria section was not used for initial calibration,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If the instrument was not calibrated as required,	qualify all associated detects and all associated non-detects as "R."

Calibration Verification

Criteria: A CCV standard must be analyzed for every 10 samples. The recovery acceptance criteria for analysis results must be within the 90% to 110% of the true value for all analytes.

Evaluation	**Action**
If the CCV frequency criteria were not met	qualify all associated detects as "J" and all associated non-detects as "R."
If the ICV or CCV %R is…	
≥75% but <90%,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
≥110% but <125%,	qualify all associated detects as "J+."
If the ICV or CCV %R is…	
<75%,	qualify all associated detects as "J-" and all associated non-detects as "R."
>125%,	qualify all associated detects as "R."

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Blanks

Blank analysis results are assessed to determine the existence of contamination. During sampling, two to ten FBs are collected per sample set. During sample preparation a reagent blank (MB) and media blanks are included with the samples during the digestion process. The average media blank result (μg/mL) is subtracted from the sample result (μg/mL) in the final calculation. In instances where more than one blank (FB or MB) associated with a given sample is ≥ the MDL, qualification is to be performed using the associated blank with the highest concentration of contaminant.

Criteria: The same reagents used for the sample digestion must be used to prepare the MB. No contaminants > the MDL may be present in the blanks.

Evaluation	Action
If the frequency criteria were not met,	note the deficiency in the data validation report.
If problems with any blank exist,	all data associated with the batch must be evaluated to determine whether there is an inherent variability in the data for the batch or if the problem is an anomaly not affecting other data.
If any analyte concentration in the blank is in excess of the PQL,	the lowest reported concentration in the associated samples must be > 10X the concentration in the blank or results must be qualified or rejected.
If a blank value is ≥ the MDL,	qualify all associated detects <5X the blank concentration as "J."

LCS/LCSD

The LCS/LCSD serves as a measure of the overall performance of all steps in the analysis, including sample preparation.

Criteria: The LCS/LCSD must be analyzed using the same preparation and analysis methods used for samples, with one LCS/LCSD analyzed for each batch of up to 10 samples.

All LCS/LCSD results for air filters must fall within the recovery and RPD control limits established by the agency that prepared the reference material or by statistically-derived limits developed by the laboratory. The laboratory is to include these limits on the LCS/LCSD reporting form.

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Professional judgment may be used to determine the need for qualification of sample results based on whether or not the LCS, LCSD, or both meet QC acceptance criteria.

Evaluation	Action
If the LCS/LCSD was not analyzed,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If the %R is…	
> upper control limit,	qualify all associated detects as "J+."
>30% and < the lower control limit,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
<30%,	qualify all associated detects as "J-" and all associated non-detects as "R."
If RPD criteria were not met,	qualify detects for associated compounds as "J" and non-detects as "UJ."

Dilutions

The PQLs must be adjusted to reflect all sample dilutions. Original undiluted results document the actual MDLs for non-detected compounds.

Criteria: It must be determined that the laboratory strove to make dilutions in such a way that the final concentration was measured in the mid-range of the calibration curve, and that the laboratory did not report results from measurements above the highest concentration standard.

Evaluation	Action
If any samples required dilution because one or more analytes exceeded the calibration range, and…	
the original undiluted results were reported,	qualify all associated detects > the high standard as "J."
only the diluted results were reported,	qualify all associated non-detects as "UJ."

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4.7 Procedure for Radiochemical Analyses Validation

4.7.1 Quantification

Criteria: Radiochemical analytical results shall be reported as measured and shall include the TPU at the 95% confidence level (2-sigma).

Note: Some programs may request the result be reported with the 1-sigma uncertainty. When this is the case the reported uncertainty must be multiplied by two for evaluation of quantitation and RER.

The laboratory shall report all results regardless of concentration or sign and shall not report any result as "less than."

The laboratory shall include a sample minimum detectable activity (MDA) calculated using sample-specific parameters.

For programs that require application of one final qualifier to sample results, if the "BD" qualifier is applied to a sample result, the result shall not be further qualified as "J" due to other QC failures.

Note: Some programs may request the "U" qualifier instead of the "BD" qualifier.

Extremely large errors/uncertainties may indicate inappropriate error calculation. If large errors/uncertainties are reported with the results, the laboratory should verify the calculations.

Evaluation	**Action**
If the sample result is < the 2-sigma TPU,	qualify the result as "BD."
If the sample result is < the MDA,	qualify the result as "BD."
If the sample result is ≥ the MDA but <3X the MDA,	qualify the result as "J."
If the absolute value of a negative result is > the MDA,	qualify the result as "R." **Note:** This action is not applied to gamma spectroscopy data.
If the absolute value of a negative sample result for gamma spectroscopy is >2X the MDA,	qualify the result as "R."

If the "BD" qualifier is applied to a sample result, the result shall not be further qualified as "J" due to other QC failures.

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4.7.2 Blanks

Blank analysis results are assessed to identify contamination. The criteria for evaluation of blanks apply to all blanks associated with the samples.

Criteria: One MB (or preparation blank) must be analyzed for each matrix and each batch, or for every 20 samples, whichever is most frequent.

MB analysis is required for all analyses requiring sample preparation.

Samples associated with any preparation blank result that is ≥ the MDA shall be redigested and reanalyzed. Exceptions to this requirement are samples for which the measured sample concentration is ≥10X the preparation blank value.

Evaluation	**Action**
If the prep blank was not analyzed at the proper frequency and there are sample concentrations ≥ the MDA but <5X the MDA,	qualify those results as "J."
If the blank result is positive and is statistically >0.0 (i.e., > the 2-sigma TPU and ≥ the MDA),	qualify all associated sample results ≥ the MDA but <5X the blank value as "NJ+."
If the absolute value of a negative blank result is > the MDA,	qualify all associated detects ≥ the MDA but <5X the MDA as "NJ-." The program may require results < the MDA to be qualified "UJ."
If the absolute value of a negative blank result is >5X the MDA,	notify the laboratory and qualify all associated sample results as "R."
If the absolute value of the negative blank result is > 5X the MDA for liquid scintillation analyses such as tritium, where the calibration blank is subtracted from the result,	notify the laboratory and qualify all sample results <5X the MDA as "R."

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4.7.3 Sample-Specific Chemical/Tracer Recovery

An addition of a known quantity of radioactive or chemically similar material to a sample prior to chemical separation is used to determine the amount of the analyte recovered.

Criteria: Recovery guidelines for tracer and carrier results shall be 50% to 105%. Optionally, low tracer recoveries may be evaluated from the total area counts. Samples with low recoveries but with tracer area counts >400 counts may or may not be qualified based on professional judgment.

The quantity of tracer material used should be adequate to provide a maximum of 10% uncertainty at the 95% confidence level in the measured recovery.

Evaluation	**Action**
If a recovery for a chemical carrier or tracer isotope is...	
>105% but ≤125%,	qualify all associated results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."
If a recovery for a chemical carrier or tracer isotope is...	
>125%,	qualify all associated results as "R."
If a recovery for a chemical carrier is...	
<50% but ≥20%,	qualify all associated results ≥ the MDA as "J+."
<20%,	qualify all associated results ≥ the MDA as "J+" and all associated results < the MDA as "R."
If a recovery for a tracer isotope is...	
≥10% but <50%,	qualify all associated results ≥ the MDA as "J+."
<10%,	qualify all associated results ≥ the MDA as "J+" and all associated results < the MDA as "R."

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4.7.4 MS

MS analyses are performed on field samples, except as noted below, as a measure of the ability to recover the analyte from a particular matrix.

Criteria: The MS data shall not be used to evaluate sample data unless the MS sample was from the same client and of similar matrix.

The recovery acceptance criteria for MS results must be within 75% to 125% unless the sample result is >4X the spike added (see Section 4.1.20).

One MS sample shall be analyzed from each batch, with a minimum frequency of one per 20 samples.

Samples identified as FBs or EBs shall not be used to satisfy the spike analysis requirement.

If an MS result fails to meet recovery criteria, all associated samples shall be redigested and reanalyzed. Unfiltered water samples and unprepared solid samples are exempt from the reanalysis requirement. Results for unfiltered water samples and unprepared solid samples for which the MS failed the acceptance criteria may be reported and qualified without reanalysis.

MSs are not required for gamma spectroscopy, radon-222, or any analyses utilizing standard addition spike or a tracer or carrier that is chemically identical to the analyte. In addition, radium-226 analyses that employ a barium-133 tracer are exempt from the MS requirements. For radium-228 analysis, an MS is required if the final actinium separation, which is not traced by barium-133, does not incorporate a carrier recovery.

Evaluation	**Action**
If the MS sample was from another client or of a dissimilar matrix, the frequency criteria of the MS was not met, no MS was analyzed, or an FB or EB was used for the MS,	qualify all results ≥ the MDA as "J." The program may require results < the MDA to be qualified "UJ."
If an MS %R is…	
<25%,	qualify all associated results ≥ the MDA as "J-" and all associated results < the MDA as "R."
<75% but ≥25%,	qualify all associated results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."

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>125% but ≤150%,	qualify all associated results ≥ the MDA as "J+."
>150%,	qualify all associated results as "R."

4.7.5 Replicate

Replicate analyses indicate laboratory precision based on each sample matrix.

If an MS/MSD was analyzed in place of a replicate, the following criteria are applied to the MS/MSD results. If insufficient sample was submitted to analyze a replicate or MS/MSD, the laboratory may analyze an LCS/LCSD to measure precision using the following criteria for evaluation.

Criteria: One replicate sample shall be analyzed from each batch with a minimum frequency of one per 20 samples. The replicate data shall not be used to evaluate associated sample data unless the replicate sample was from the same client and of similar matrix.

The RER calculated using the 2-sigma TPU is used to determine replicate precision for radiochemical results.

The radiochemical replicate determinations shall agree when the 95% confidence level uncertainties are considered. That is, the RER shall be <1.0.

Samples identified as FBs or EBs shall not be used to satisfy the replicate analysis requirement.

No precision criteria applies to samples with activities < the MDA, including those where one result is > the MDA and one result is < the MDA.

Replicate analyses may not be possible in tritium analyses when the moisture content is too low or the sample size is too small. A discussion of this problem shall be included in the laboratory case narrative, with no qualifiers applied.

Evaluation	**Action**
If no replicate sample, no MSD, and no LCSD was analyzed for each matrix or for each data package,	qualify all results ≥ the MDA of the same matrix as "J." The program may require results < the MDA to be qualified "UJ."
If frequency criteria are not met, or if an FB or EB was used for the replicate,	qualify all results ≥ the MDA as "J." The program may require results < the MDA to be qualified "UJ." **Note**: Some programs may not require replicate evaluation on non-client

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	samples. For these programs, note this in the data validation report, with no qualifications applied.
If the RER is >1.0 and ≤3.0,	qualify all associated results ≥ the MDA as "J." The program may require results < the MDA to be qualified "UJ."
If the RER is >3.0,	qualify all associated results for that analyte as "R." **Note:** Tritium in soils are not qualified "R" when the RER is >3.0.

4.7.6 LCS

The LCS serves as a measure of the overall performance of all steps in the analysis, including sample preparation.

Criteria: One LCS shall be analyzed for each batch up to 20 samples.

For aqueous LCS analytical results, the recovery acceptance criteria shall be within 80% to 120% of the true value. For solid LCS results, the recovery acceptance criteria shall be within the control limits specified by the agency that prepared the reference material or statistically-derived limits developed by the laboratory. The laboratory shall report the control limits in the QC portion of the deliverable. Multiple LCS analyses may not be used to meet acceptance criteria; that is, if multiple LCSs are analyzed for a batch and any failures occur, the failed LCS will be used to qualify the data.

Evaluation	**Action**
If LCS frequency criteria are not met,	note the deficiency in the data validation report.
If the LCS %R for any analyte is…	
<30% or >150%,	qualify all associated sample results as "R."
< the lower control limit but ≥30%,	qualify all associated sample results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."

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> the upper control limit but ≤150%,	qualify all associated sample results ≥ the MDA as "J+."
If an LCS/LCSD pair was analyzed and recoveries of any target analyte were both above and below acceptance criteria,	qualify all results ≥ the MDA as "J."
If an aqueous LCS was used for solid matrices,	qualify all associated results≥ the MDA as "J." The program may require results < the MDA to be qualified "UJ."

4.7.7 Instrument Control Charts

In general, there are four types of control charts used to monitor radiochemistry instrumentation performance: efficiency, resolution, centroid, and background.

Efficiency Control Charts: Used for all instrumentation. A radioactive control source (that does not have to match the counting geometry of the samples) is counted and decay-corrected counts, count rate, activity or efficiency of the source is plotted. Displayed on the same plot are the average, ±2-sigma control limits, and ±3-sigma control limits, or just simply upper and lower control limits. Since the frequency of instrument calibration typically ranges from monthly to annually, a control source is counted to show that the instrument response is stable and that the efficiency calibration is valid for the sample count.

Resolution Control Charts: Used for instrumentation that utilize multi-channel analyzers to create spectra (with the exception of liquid scintillation counters). The full-width half-maximum (FWHM) of one or multiple peaks of the control source are plotted. Displayed on the same plot are the upper and lower FWHM control limits. This plot shows that there is no increase in instrument noise to negatively impact spectral resolution for the sample count.

Centroid Control Charts: Used for instrumentation that use multi-channel analyzers to create spectra (with the exception of liquid scintillation counters). The centroid of one or multiple peaks of the control source is plotted. Displayed on the same plot are the upper and lower centroid control limits. This plot shows that the instrument gain is stable and that drift that could lead to poor peak integration or misidentification of peaks has not occurred.

Background Control Charts: Used for most instrumentation, though has limited value for data validation. An instrument background is performed and the counts or count rate is plotted. Displayed on the same plot are the average, ±2-sigma limit, and ±3-sigma control limits, or just simply upper and lower control limits. This plot shows that the detector has not become contaminated with radioactivity or that the instrument noise has not increased to the point to cause unwanted counts.

For evaluation, a data point outside the control limit means outside the ±3-sigma control limit when the laboratory provides sigma-type control charts.

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Instead of control charts, the laboratory may provide control summaries that provide control data of multiple detectors and/or types of charts. This is acceptable as long as all the information needed to evaluate instrument control is provided in the summary.

4.7.7.1 All Radiochemistry Instrumentation

Criteria: The instrument raw data will clearly contain the detector ID and count start date and time for all samples. The control charts will list the detector IDs and list the range of dates plotted. The date range must be current up to the count start date of the sample. For controls that are counted daily or before use, the charts must be updated to the actual date of sample count. For controls that are counted weekly/monthly, the charts must be updated to within a week/month of the sample count. See the specific instrumentation criteria below for control count frequency requirements.

In general, only the control chart data point appropriate for the sample count start date is evaluated. If the next control chart data point is plotted and shows an extreme outlier, the stability of the counter during the time of the sample count may need to be investigated. The laboratory should have made an attempt to recount the sample (if possible) and verify the original count results. Professional judgment is needed in this situation, especially if the sample result looks suspect.

Evaluation	**Action**
If the control chart is missing from the data package or not updated,	request an amended report from the laboratory.
If instrument control frequency was not met for the sample count,	note the deficiency in the data validation report.

4.7.7.2 Gas Proportional Instrumentation

Criteria: Alpha and beta control sources will be counted daily or before counter use and plotted using efficiency control charts. A background will be counted daily or before counter use and plotted using alpha and beta background control charts.

If the sample analyte is an alpha-emitter, only the alpha control charts are evaluated. If the sample analyte is a beta-emitter, only the beta control charts are evaluated.

Evaluation	**Action**
If the efficiency control point is…	
above the upper control limit,	qualify all associated results ≥ the MDA as "J+"

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below the lower control limit,	qualify all associated results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."
If the background control point is…	
above the upper control limit,	qualify all associated results ≥ the MDA but <3X the MDA as "J+."
below the lower control limit,	qualify all associated results ≥ the MDA but <3X the MDA as "J-." The program may require results < the MDA to be qualified "UJ."

4.7.7.3 Liquid Scintillation Instrumentation

Criteria: Vendor supplied, unquenched H-3, C-14, and blank control sources will be counted daily or before counter use and plotted using efficiency and background control charts.

For low-energy beta analysis, (such as H-3, Ni-63 or Pu-241) only the H-3 efficiency and background control charts are evaluated. For mid- to high-energy beta analysis, (such as C-14, Cl-36, Sr-90 or Tc-99) only the C-14 efficiency and background control charts are evaluated.

Evaluation	**Action**
If the efficiency control point is…	
above the upper control limit,	qualify all associated results ≥ the MDA as "J+."
below the lower control limit,	qualify all associated results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."
If the background control point is…	
above the upper control limit,	qualify all associated results ≥ the MDA but < 3X the MDA as "J+."
below the lower control limit,	qualify all associated results ≥ the MDA but <3X the MDA as "J-." The program may require results < the MDA to be qualified "UJ."

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4.7.7.4 Lucas Cell Instrumentation

Criteria: A control source will be counted daily or before counter use and plotted using efficiency control charts.

Evaluation	Action
If the efficiency control point is…	
above the upper control limit,	qualify all associated results ≥ the MDA as "J+."
below the lower control limit,	qualify all associated results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."

4.7.7.5 Alpha Spectrometer Instrumentation

Criteria: If calibrated monthly, the calibration standard can also be used as the control source for generating efficiency control chart data. If a semi-annual or annual calibration is performed, a control source will be counted at least monthly and plotted using efficiency control charts. Only one peak is necessary to control chart. The laboratory should perform pulser control checks at least weekly (preferably daily or before use). The pulser checks will confirm that the instrument gain and resolution are stable. Backgrounds will be counted at least weekly and monitored by the laboratory for contamination. Pulser check results and background control charts do not have to be included or evaluated in the data package.

Evaluation	Action
If the efficiency control point is outside of the control limits and the tracer is measured simultaneously with the analyte,	note the deficiency in the data validation report. **Note:** Although the analyte results will not be biased, the reported tracer yield may be biased.
If an efficiency control point is above the upper control limit and a tracer is not measured simultaneously with the analyte (Ba-133, Np-239 or Th-234),	qualify all associated results ≥ the MDA as "J+."
If an efficiency control point is below the	qualify all associated results ≥ the MDA

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lower control limit and a tracer is not measured simultaneously with the analyte (barium-133, neptunium-239, or thorium-234),	as "J-." The program may require results < the MDA to be qualified "UJ."
If the detector background was not counted within one week of the sample count start date,	note the deficiency in the data validation report.

4.7.7.6 Gamma Spectroscopy Instrumentation

Criteria: A source will be counted daily or before counter use and plotted using efficiency control charts. At a minimum, two peaks need to be control charted for efficiency, resolution (FWHM), and centroid. These peaks are a low-energy peak (< 100 kilo electron volts) and a high-energy peak (> 1000 kilo electron volts). Backgrounds will be counted at least weekly and monitored by the laboratory for contamination; however, background control charts do not have to be included or evaluated in the data package.

If the low-energy efficiency control point is outside control limits and the high-energy control point is within limits, technically only the low-energy gamma emitting target analytes need qualification. Since the determination of what energy range requires qualification is not straightforward and requires professional judgment, it is acceptable to qualify all target analytes in this situation.

Evaluation	**Action**
If the efficiency control point is…	
above the upper control limit,	qualify all associated results≥ the MDA as "J+."
below the lower control limit,	qualify all associated results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."
If the resolution control point is outside (above or below) of the control limits,	notify the laboratory and qualify all associated sample results as "R."
If the centroid control point is outside (above or below) of the control limits,	note the deficiency in the data validation report.

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If the detector background was not counted within one week of the sample count start date,	note the deficiency in the data validation report.

4.7.8 Method-Specific Analytical Requirements – Radiochemical

4.7.8.1 Gamma Spectroscopy

The laboratory may rejection of a specific gamma spectroscopy analyte result due to various analytical quality issues (e.g., interference, low abundance, no valid peak, or uncertain identification). This data shall be assessed based on professional judgment.

Criteria: The laboratory qualifiers shall be reviewed for "X"- qualified data.

Evaluation	Action
If the result is recommended for rejection by the laboratory,	may qualify the result as "R" based on professional judgment.

4.7.8.2 Gross Alpha Beta

The flaming of planchets in the gross alpha beta method may result in the loss of beta emitters. The omission of the flaming step may result in the interference of alpha particle transmission.

Criteria: The sample preparation documentation shall be examined to determine whether the planchets were flamed.

Evaluation	Action
If the planchets were flamed prior to counting for gross beta,	qualify all beta results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."
If the planchets were not flamed,	qualify all alpha results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."

4.7.8.3 Total/Partial Radiochemical Results

Occasionally radiochemical analytes are analyzed and reported as total and partial results, for example, total radium by gross alpha and radium-226 by radon emanation. These reported values are necessarily not obtained from the same analytical method. The following criteria should be used for guidance.

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Criteria: When both a partial and a total result are reported, the result for the partial analyte must be ≤ the result for the total analyte. If the reported result for the partial analyte is > the result for the total analyte, one or both results are suspect.

The extent the quality of the data is affected must be determined.

Evaluation	Action
If the partial result is > the total result,	the laboratory should be contacted for further information.
If the laboratory cannot be contacted or cannot provide sufficient explanation, the following criteria apply:	
If the total result is ≤ the MDA and the partial result is > MDA but < 2X MDA,	no qualification (other than "BD" or "J" due to quantification) of either result is warranted as the results are statistically similar enough.
If the total result is ≤ the MDA and the partial result is > 2X MDA,	qualify the total result as "NJ-" due to a suspected false negative.
If both results are > MDA and the total result is < the partial, and the RER between the two results is >1.0,	qualify the total result as "J-."

5.0 DATA VALIDATION REPORTS

A data validation report shall be produced to discuss the data review and validation; and to document, based on instrumentation and methodology, the QC elements examined. The SMO or Program Manager uses the data validation report to evaluate and determine if nonconformance, corrective actions, or penalties should be pursued. If this procedure is modified based on the professional judgment of the data validator, the data validation report must document the adjustments. Any method-specific QC requirements not addressed in this document must be documented by the data validator in the data validation report or included as an addendum to the procedure. The database administrator submits the data validation report to the SNL/NM Customer Funded Record Center for archiving. The data validation report shall include the following (as appropriate):

5.1 Sample Findings Summary and Validation EDD Files

A data table or spreadsheet summarizing flagged data resulting from the data review and validation. The sample findings summary is to be used by database personnel to facilitate the data entry of data validation qualifiers to the electronic database. However, when laboratory EDD files are available the SNL/NM

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Validation EDD Generator is used to produce a sample findings summary and validation EDD file. The validation EDD file is subsequently used for electronic data entry of data validation qualifiers to the database. The sample findings summary and validation EDD file shall include the following:

- The site name
- AR/COC number
- Sample number(s)
- Analysis or individual analytes
- Data validation qualifiers
- Any relevant comments

5.2 Data Validation Narrative (format may vary by project)

A summary of samples and all qualifiers applied to the data as a result of the validation process. The narrative shall include the following:

- The date issued
- The names of those to whom the report is issued
- The validator's name
- The laboratory name and SDG identifier
- AR/COC number
- Type of analysis addressed in the report
- Sample/analyte qualification and a general description of why qualification was applied
- Data validation procedure and revision used
- Any relevant comments

5.3 Data Qualification Summary

A summary of the process used for review and validation. The data qualification summary includes the following sections **(as appropriate)**:

- Sample Shipping/Receiving (refer to Section 4.1.1). Are all shipping/receiving and AR/COC issues that could affect data quality and defensibility discussed, and qualifications properly applied?
- Holding Times and Preservation (refer to Section 4.1.1). Are all holding time and preservation issues that could affect data quality discussed, and qualifications properly applied?
- Calibration. Are all calibration (initial and/or continuing/verification) issues that could affect data quality discussed, and qualifications properly applied?
- Tuning. Are all tuning issues that could affect data quality discussed, and qualifications properly applied?
- IS. Are all IS issues that could affect data quality discussed, and qualifications properly applied?
- Isotope Ratios. Are all isotope abundance issues that could affect data quality discussed, and

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qualifications properly applied?

- Surrogates. Are all surrogate issues that could affect data quality discussed, and qualifications properly applied?
- Tentatively Identified Compounds (TICs). If required, are the identification and qualification of TICs discussed?
- Confirmation. Was second-column analysis discussed, and were qualifications properly applied?
- Reporting Limit Verification (RLV, CRI/CRA). Are all RLV and CRI/CRA issues that could affect data quality discussed, and qualifications properly applied?
- ICP ICS. Are all ICS issues that could affect data quality discussed, and qualifications properly applied?
- ICP Serial Dilution (SD). Are all SD issues that could affect data quality discussed, and qualifications properly applied?
- Tracer/Carrier. Are all tracer and/or carrier issues that could affect data quality discussed, and qualifications properly applied?
- Blanks. Are all detections of target analytes in all applicable blanks discussed, and qualifications properly applied?
- Laboratory Control Sample (LCS). Are all LCS issues that could affect data quality discussed, and qualifications properly applied?
- Matrix Spikes (MS). Are all MS issues that could affect data quality discussed, and qualifications properly applied?
- Laboratory Replicates. Are all the laboratory replicate issues that could affect data quality discussed, and qualifications properly applied?
- Detection Limits/Dilutions. Is the appropriateness of the reported detection limits discussed? Are sample dilutions discussed?
- Other QC. Are all QC issues that could affect data quality, other than those previously addressed, discussed? Include a brief description of any laboratory nonconformance reports (NCRs) that directly impacted data quality.
- Corrective Action Reports (CARs). Discuss or attach laboratory correspondence covering any corrective action, clarification, or modification to the report that was required to complete the validation process.

5.4 Validation Notes/Worksheets <u>(as appropriate)</u>

The validation notes/worksheets document results of the review and data validation by methodology and show QC results that do not meet acceptance criteria (that is, failures). These notes/worksheets identify data for which holding time/preservation requirements and calibration acceptance criteria were not met; laboratory blanks, FBs, EBs, or TBs were contaminated; surrogate recovery criteria were exceeded; MS/MSDs exceeded limits; and LCS %Rs and replicate RPDs or RERs exceeded acceptance limits. In addition, the validation notes/worksheet identify the validator and the laboratory; include the validator's comments and notes; and include AR/COC numbers, SDG number, types and number of samples analyzed, and sample numbers.

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5.5 CVR and AR/COC

The CVR and AR/COC records also are pertinent to data review and validation. These records are supplied by the SMO and the laboratory and are copied and attached to the data validation report.

6.0 DEFINITIONS

6.1 Data Qualifier Definitions

Data qualifiers are commonly used during the validation process to classify sample data as to their conformance to QC requirements. For the purposes of this procedure, the following code letters and associated definitions are provided:

BD	(below detection limit) - Used in radiochemistry to identify results that are not statistically different from zero.
J	The associated value is an estimated quantity.
J+	The associated numerical value is an estimated quantity with a suspected positive bias.
J-	The associated numerical value is an estimated quantity with a suspected negative bias.
N	Presumptive evidence of the presence of the material.
NJ	Presumptive evidence of the presence of the material at an estimated quantity.
NJ+	Presumptive evidence of the presence of the material at an estimated quantity with a suspected positive bias.
NJ-	Presumptive evidence of the presence of the material at an estimated quantity with a suspected negative bias.
R	The data are unusable (compound may or may not be present). Resampling and reanalysis are necessary for verification.
U	The analyte was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.
UJ	The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

Datum is unqualified if the quality parameters indicate the method was appropriate and that the reported result reflects the true value within the expected analytical uncertainty.

Datum is qualified as estimated (J) if the reported result can be used to infer an estimate of the true value (with a suspected positive or negative bias, as may be indicated), but the quality parameters indicate an uncertainty in the result that is > the expected analytical uncertainty.

Datum is qualified as presumptive (N) if there is question as to whether the analyte is indigenous to the sample or if there is question regarding the identity of the analyte.

Datum is qualified as presumptive and estimated (NJ) when there is evidence of the presence of the material at an estimated quantity (with a suspected positive or negative bias, as may be indicated).

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Datum is qualified as unusable (R) if the quality parameters do not support the reported result as a valid indicator of the true value.

Datum is qualified as estimated non-detects (UJ) for results reported as < the detection limit and for which some other quality concerns exist.

6.2 Sample Quantification Limits

For purposes of this procedure, the following definitions are provided:

MDA Minimum detectable activity. A radiological detection limit. A sample with activity concentration at the minimum detectable concentration (MDC) has a 95% probability of being measured above the decision level, which is the lowest threshold used to distinguish a positive result (i.e., a detect). For the purposes of data validation, the MDC equals the minimum detectable activity.

MDL Method detection limit. The minimum concentration of a substance that can be measured (quantified) and reported with 99% confidence that the analyte concentration is > zero. This measure of instrument sensitivity takes into account all solutions that have been subjected to all sample preparation steps for the method. In data packages the MDL may be referred to as the detection limit (DL). For organic data, the MDL will be one-fifth the PQL, and the value associated with the "U" qualifier or the value of the low standard will be used as the PQL.

PQL Practical quantitation limit. The lowest concentration of analytes in a sample that can be reliably determined and quantified within specified limits of precision and accuracy by the indicated methods under routine laboratory operating conditions. For the purposes of this procedure, the PQL is considered to be 5X the value of the MDL if not defined by the laboratory. In data packages the PQL may be referred to as the contract-required detection limit (CRDL) or reporting limit (RL). For inorganic data, the PQL will be 5X the MDL, and the value associated with the "U" qualifier will be used as the MDL.

6.3 Formulas

The % Difference (%D) for LCSs, standards, and serial dilution is calculated as follows:

$$\%D = \frac{[M - T]}{T} \times 100$$

where,

%D	=	percent difference
M	=	measured value
T	=	true value or sample value for serial dilution

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The RPD for replicate samples is calculated as follows:

$$RPD = \frac{[S - R]}{(S + R)/2} \times 100$$

where, RPD = relative percent difference
S = sample value (original)
R = replicate sample value

The RPD for MS/MSD samples is calculated as follows:

$$RPD = \frac{MS - MSD}{(MS+MSD)/2} \times 100$$

where, RPD = relative percent difference
MS = MS value
R = MSD value

The %R for spiked samples is calculated as follows:

$$\%R = \frac{SSR-SR}{SA} \times 100$$

where, SSR = spiked sample result
SR = sample result
SA = spike added

The Replicate Error Ratio (RER) is used to determine replicate precision for radiochemical results. The RER is given by:

$$RER = \frac{[S - R]}{F_{95S} + F_{95R}}$$

where, RER = replicate error ratio
S = sample value (original)
R = replicate sample value
F_{95S} = sample uncertainty (95% or 2 sigma)
F_{95R} = replicate uncertainty (95% or 2 sigma)

The linear curve equation is given by:

$$y = mx + b$$

where, y = instrument response (peak area or height)

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m = slope of the line (also called the coefficient of x)
x = concentration of the calibration standard
b = the intercept

The %RSD is calculated as follows:

$$\%RSD = \frac{SD}{RF} \times 100\%$$

where, SD = standard deviation
RF = mean RF for each compound from the initial calibration

7.0 ACRONYMS

SNL acronyms that do not need to be defined in SNL Memos

AA	Atomic Absorption
AR	Analysis Request
BNA	Base/Neutral/Acid (Compounds)
BOD	Biological Oxygen Demand
CAR	Corrective Action Report
CAS	Chemical Abstract Service
CB	Chlorinated Biphenyl
CCB	Continuing Calibration Blank
CCV	Continuing Calibration Verification
CF	Calibration Factor
CLP	Contract Laboratory Program
CRA	Reporting Limit Verification for AA Methods
CRDL	Contract-Required Detection Limit
COC	Chain of Custody
CRI	Reporting Limit Verification for ICP-AES and ICP-MS Methods
CVR	Contract Verification Review
CVAA	Cold Vapor Atomic Absorption
DL	Detection Limit
DO	Dissolved Oxygen
DOE	Department of Energy
DRO	Diesel Range Organics
EB	Equipment Blank
EDD	Electronic Data Deliverable
EICP	Extracted Ion Current Profile
EPA	U.S. Environmental Protection Agency

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FB	Field Blank
FWHM	Full-width Half-maximum
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
GFAA	Graphite Furnace Atomic Absorption
GPC	Gel Permeation Chromatography
GRO	Gasoline Range Organics
HE	High Explosive
HPLC	High-Performance Liquid Chromatography
HRGC	High Resolution Gas Chromatography
HRMS	High Resolution Mass Spectrometry
HT	Holding Time
IC	Ion Chromatography
ICAL	Initial Calibration
ICB	Initial Calibration Blank
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
ICS	Interference Check Sample
ICS A	Interference Check Sample Solution A
ICS AB	Interference Check Sample Solution AB
ICV	Initial Calibration Verification
IDL	Instrument Detection Limit
IS	Internal Standard
LAL	Lower Acceptance Limit
LC/MS/MS	Liquid Chromatography/Mass Spectrometry/Mass Spectrometry
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOC	Level of Chlorination
MB	Method Blank
MDA	Minimum Detectable Activity
MDC	Minimum Detectable Concentration
MDL	Method Detection Limit
MIR	Manual Integration Review
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MSDC	Mass Spectrometry Data Centre
NBS	National Bureau of Standards
NCR	Nonconformance Report
ND	Not Detected/Non-detect

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NIH	National Institute of Health
NIST	National Institute of Standards and Technology
OP	Operating Procedure
OPR	Ongoing Precision and Recovery
PAH	Polyaromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCDD	Polychlorinated Dibenzodioxin
PCDF	Polychlorinated Dibenzofuran
PQL	Practical Quantitation Limit
PS	Post-digestion spike
QC	Quality Control
RER	Replicate Error Ratio
RF	Response Factor
RL	Reporting Limit
RLV	Reporting Limit Verification
RPD	Relative Percent Difference
RRF	Relative Response Factor
RRT	Relative Retention Time
RSD	Relative Standard Deviation
RT	Retention Time
SDG	Sample Delivery Group
SMO	Sample Management Office
SNL/NM	Sandia National Laboratories/New Mexico
SOW	Statement of Work
SVOC	Semivolatile Organic Compound
SW	Solid Waste (EPA procedure number)
TAL	Target Analyte List
TB	Trip Blank
TCDF	Tetrachlorodibenzofuran
TCLP	Toxicity Characteristic Leaching Procedure
TIC	Tentatively Identified Compound
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
TPU	Total Propagated Uncertainty
UAL	Upper Acceptance Limit
VOC	Volatile Organic Compound

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Measurements and Symbols

<	less than
≤	less than or equal to
>	greater than
≥	greater than or equal to
±	plus or minus
X	times
m	milli (1/1000)
%	percent
°C	degrees Centigrade
g	gram
ppb	parts per billion
ppbv	parts per billion by volume
k	Kilo
L	Liter
%D	percent difference
%R	percent recovery
%RSD	percent relative standard deviation
r	correlation coefficient
r^2	coefficient of determination
µ	micro (1/1000,000)
amu	atomic mass units

8.0 GLOSSARY OF TERMS

2-Sigma error: The error reported at the 95% confidence interval.

Acceptance limits: Ranges of acceptable results for each type of QC measurement. They may be defined on a program-specific basis, or they may be derived internally at a laboratory from historic QC performance data. May also be referred to as control limits.

Accuracy: The closeness of agreement between an observed value and the true value. "Precision" is a measure of the reproducibility of a value, without knowledge of the true value. The classic example used to illustrate these terms is a dartboard example: The placement of four darts thrown at a dartboard is considered accurate if the darts are each close to the bull's-eye (regardless of their proximity to one another). Hence, to be both accurate and precise the four darts would need to be grouped closely together and be close to the bull's-eye.

Analyte: That which is analyzed for. This can be chemical (chromium, benzene), biological (fecal coliform bacteria), mineral (asbestos fibers), or radiological (alpha and beta emissions).

Analytical run: The interval (i.e., period of time or series of measurements) within which the accuracy and precision of the measuring system is expected to be stable. Within the analytical run, controls are often analyzed to confirm stability.

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Batch: A group of samples which behave similarly with respect to the sampling or the testing procedures being employed and which are processed as a unit. For QC purposes, if the number of samples in a group is > 20, then each group of 20 samples or less will all be handled as a separate batch.

Bias: The difference between the reported result and the true result. Bias may be introduced through field or laboratory variability and error or due to substances in the sample that interfere with the analytical system's ability to provide an accurate measurement. Because the true concentration of an analyte in an environmental sample is generally never known, bias is estimated by using surrogates, MSs, LCSs, and other indicators of analytical accuracy.

Calibration: The process of correlating instrument signal response with analyte concentration. An instrument must be properly calibrated in order to produce accurate results.

Chemical carrier: An identical or similar carrier material used to infer the degree to which the separation processes were effective in separating the analyte from the matrix. Measured gravimetrically or chemically.

Congener: A congener refers to any one particular compound of the same chemical family. For example, there are 209 congeners of Chlorinated Biphenyls (CBs).

Contamination: A component of a sample from an extract that is not representative of the environmental source of the sample. Contamination may stem from other samples, sampling equipment, while in transit, from laboratory reagents, laboratory environment, or analytical instruments. Blanks (instrument blanks, MBs, preparation blanks, TBs, EBs, and FBs) may be used to assess contamination.

Control sample: A QC sample introduced into a process to monitor the performance of the system.

Correlation coefficient (r) or coefficient of determination (r^2): A statistical evaluation of the linearity of a calibration curve, i.e. "goodness of fit."

Detect: Sample result ≥the MDL.

Duplicate: A second aliquot of a sample that is treated the same as the original aliquot of sample. (See definitions for field duplicate and replicate.)

Environmental sample: A sample taken unaltered (as much as possible) from the environment (as opposed to a blank, performance evaluation sample, MS sample, etc.). Environmental sample may be referred to as "field sample."

Equipment blank (EB): A sample of analyte-free media (for example, clean water poured over a bailer) that has been used to rinse the sampling equipment. The EB is collected after completion of decontamination and prior to collection of environmental samples. This blank is useful in documenting adequate decontamination of sampling equipment. An EB also may be referred to as a "rinsate blank."

Field blank (FB): A sample containing an analyte-free matrix that is collected and processed in exactly the same manner as an equivalent environmental sample (for example, clean water is poured into a sample

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container in the same physical location where the environmental sample is collected and is subsequently handled, processed, and analyzed exactly as an equivalent environmental sample). The FB is used to identify contamination resulting from field sample collection techniques.

Field duplicate: A duplicate sample generated in the field used to determine sampling and analytical precision.

Holding time: The period between collection of samples by the samplers and preparation and/or analysis of samples by the laboratory (see Appendix B for required hold times). If the method specifies a holding time to extraction and a holding time to analysis then two holding times are evaluated. If no holding time to extraction is specified then the listed holding time is the holding time to analysis. That is, the laboratory cannot extract a sample and store the extract in order to meet holding time. However, professional judgment may be applied here. If the sample preparation includes MS and LCS samples and both of these pass it may be inferred that the stability of the extract has been verified.

Instrument blank: A blank designed to determine the level of contamination associated with the analytical instruments.

Internal standard (IS): A chemical compound added to every blank, sample, and standard extract at a known concentration that is used to (1) compensate for analyte concentration changes that might occur during storage of the extract, and (2) compensate for quantification variations that can occur during analysis. ISs are used as the basis for quantifying target analytes.

Isomer: A chemical species with the same number and types of atoms as another chemical species, but possessing different properties. For example, 2,3,7,8-TCDD refers to only one of the 22 possible TCDD isomers; that isomer which is chlorinated in the 2,3,7,8-position of the dibenzo-p-dioxin ring structure.

Isotope dilution: A means of determining a naturally occurring (native) compound by reference to the same compound in which one or more atoms has been isotopically enriched.

Laboratory control sample (LCS): A known matrix that is spiked with compounds representative of the target analytes at known concentrations. The spiking occurs prior to sample preparation and analysis. An LCS is used to document laboratory overall performance.

Matrix: The substrate that contains the analyte of interest (for example, surface water, drinking water, air, soil, tissue, etc.).

Matrix interference: Bias introduced because something in the sample interferes with the analytical system's ability to provide an accurate measurement. The interference may be physical (turbidity in stormwater runoff may block light transmission in an analysis based on ultraviolet absorbance) or chemical (a chemical similar to the analyte of interest may increase the response of the instrument, resulting in a positive bias).

Matrix spike (MS): A measured amount of sample spiked with a known concentration of target analyte(s). The spiking occurs prior to sample preparation and analysis. An MS is used to assess the bias of a method in a given sample matrix.

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Matrix spike duplicate (MSD): Intralaboratory (within the same laboratory) split-samples spiked with identical concentrations of target analyte(s). The spiking occurs prior to sample preparation and analysis. MSDs are used to assess the precision and bias of a method in a given sample matrix.

Method blank (MB): An analyte-free matrix that is prepared and processed at the laboratory in exactly the same manner as an equivalent environmental sample (that is, all reagents are added in the same volumes or proportions as used in sample processing). The MB is used to document contamination resulting from the analytical process.

Non-detect: Sample result < the MDL.

Ongoing Precision and Recovery (OPR): A MB spiked with known quantities of analytes and analyzed as a sample. Its purpose is to assure that results produced by the laboratory remain within the limits specified in EPA Method 1668 for precision and recovery.

Precision: The proximity to one another of the results for multiple measurements on the same sample (i.e., a measure of the repeatability of a measurement process). This does not address proximity to a true value; it is possible for multiple results to show very high precision and yet be completely incorrect by comparison with a true value. Precision is quantified, for example, by calculating the RPD between the result obtained for a sample and that obtained from an associated duplicate or replicate sample. As with accuracy, there is an assumed correlation between quantitative precision as determined via QC analyses and the inferred precision in measurements of unknowns.

Quality control (QC): The system of routine technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users. In other words, QC activities are the tactics used to measure and control quality.

Radioactive tracer: A radioactive isotope of the analyte that is added to the sample to correct for any losses of the analyte during the chemical separations or other processes employed in the analysis.

Relative dilution factor: The dilution factor ratio (value ≥1) of two samples. For example, if one sample has a dilution factor of 2 and another sample has a dilution factor of 10, the relative dilution factor is 5.

Relative response factor (RRF): A measure of the relative mass spectral response of an analyte compared to its IS. RRFs are determined by analysis of standards and are used in the calculation of concentrations of analytes in samples.

Relative retention time (RRT): The ratio of the RT of a compound to that of a standard (such as an IS).

Replicate (also may be called "sample duplicate"): A duplicate sample generated in the laboratory used to determine analytical precision.

Reporting limit verification: A low-level verification standard of the same origin as the calibration standard run as a measure of accuracy near the PQL. The reporting limit verification is known as the CRI

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for ICP-AES and ICP-MS methods, CRA for AA methods, and CRDL for cyanide methods.

Response (also may be called "instrument response"): The signal output of an analytical instrument in which the intensity of the signal is proportionate to the concentration detected. Response is measured by peak area or peak height.

Retention time (RT): The time a target analyte is retained on a chromatography column before elution. The identification of a target analyte is dependent on a target compound's RT falling within the specified RT window established for that compound. RT is dependent on the nature of the column's stationary phase, column diameter, temperature, flow rate, and other parameters.

Sample delivery group (SDG): A group of samples that are processed together by the laboratory. Ideally, all the samples in a batch will be similar enough that matrix QC measurements performed with the batch will be representative of all the samples in the batch.

Spike: A known amount of analyte that is introduced purposely into a sample (either an environmental sample or a blank) for the purpose of determining whether the analytical system can accurately measure the analyte.

Surrogate: A chemical that is similar to the target analyte(s) in chemical composition and behavior in the analytical process but that is not expected to be present in the sample. Surrogates are added to all the environmental samples, blanks, and QC samples in the analytical batch during the preparation stage of the analysis. Surrogates are used to monitor the performance of the analytical process. An example would be the use of fluorinated organic compounds in an analysis that looks for chlorinated and brominated organic compounds. Surrogates also may be called "system monitoring compounds" (SMCs).

Target analyte: A chemical that is being looked for in an analysis.

Tentatively identified compound (TIC): A compound that is outside the standard list of analytes in a GC/MS method but that is reported based on a tentative match between the instrument response and the instrument's computer library. The identification and quantitation of these compounds is tentative.

Trip blank (TB): A sample of analyte-free media (such as distilled/deionized water) taken from the laboratory to the sampling site and returned to the laboratory unopened. A TB is used to document contamination attributable to shipping and field handling procedures. This type of blank is useful in documenting contamination of volatile organic samples.

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9.0 REASON CODES

Programs may require that general validation codes be included in their computer databases or EDDs. The following codes are the default codes used when this is required.

H1 - Holding time exceeded for sample analysis
H2 - Holding time exceeded for sample extraction
H3 - Holding time exceeded by >2X the specified holding time

TP1 - Sample improperly preserved
TP2 - Sample not preserved
TP3 - Sample not maintained at required temperature
TP4 - Required sample or extract clean up not performed
TP5 - Sample received unpreserved and preserved at the laboratory

I1 - Initial calibration not reported
I2 - Initial calibration not independently verified
I3 - Slope r^2 or RF %RSD criteria not met
I4 - Minimum RF / Slope not met
I5 - Intercept too large
I6 - Insufficient number of calibration standards used

C1 - Continuing calibration frequency not met
C2 - Continuing calibration %D failed high
C3 - Continuing calibration %D failed low

B - MB contamination at concentration >MDL
B1 - TB contamination at concentration >MDL
B2 - FB/EB contamination at concentration >MDL
B3 - Calibration blank contamination at concentration >MDL
B4 - Negative value for calibration blank - absolute value >the MDL
B5 - Negative value for MB - absolute value >the MDL
B6 - Negative value for FB/EB/TB - absolute value >the MDL
B7 - MB contamination at activity ≥the MDA
B8 - MB frequency not met
B9 - Instrument or calibration blank frequency not met

IS1 - Internal standard / tracer recovery failed high
IS2 - Internal standard / tracer recovery failed low but ≥10%
IS3 - Internal standard / tracer recovery failed low and <10%

S1 - Surrogate(s) failed high
S2 - Surrogate(s) failed low
S3 - Multiple random surrogate failures

FR1 - Result exceeds calibration range
FR2 - No result reported - sample lost or damaged
FR3 - Result is less than the MDA / MDL or < the 2-sigma TPU
FR4 - Negative result - absolute value >2X the MDA/MDL

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FR5 - Retention time criteria not met
FR6 - Ion mass ratio criteria not met
FR7 – Result is ≥ the MDA and <3X the MDA

MS1 - MS not analyzed or not applicable
MS2 - MS analyte(s) recovery failed high
MS3 - MS analyte(s) recovery failed low
MS4 - MS analytes recovery failed both high and low
MS5 - MS/MSD RPD failed

RP1 - Replicate not analyzed or not applicable
RP2 - Replicate RPD failed

L1 - LCS frequency not met
L2 - LCS analyte(s) recovery failed high
L3 - LCS analyte(s) recovery failed low
L4 - LCS analytes recovery failed both high and low
L5 - LCS/LCSD RPD failed

DL1 - Reporting limit verification frequency not met[1]
DL2 - Reporting limit verification percent recovery failed high[1]
DL3 - Reporting limit verification percent recovery failed low[1]

CK1 - ICS frequency not met
CK2 - ICS analyte(s) failed high
CK3 - ICS analyte(s) failed low

D1 - Serial dilution failed %D
D2 - Inappropriate initial dilution

V1 - Conformation analysis not done
V2 - Conformation RPD exceeds criteria
V3 - Confirmation analysis by second method did not confirm original result (LCMSMS)

X1 - Non-specified data quality concern – see validation report
X2 - Analysis failed to meet method requirements - see validation report
X3 - Required QC documentation missing

Z1 - Spectral identification criteria not met[2]
Z2 - Minimum peak criteria not met[3]

1: refers to QC for CRA/CRDL/CRI analyses.
2: used when rejecting results that have been X qualified by the lab for interference or short half-life, and also for failed organic spectral matching (GC/MS, diode array, HPLC, etc.).
3: used when rejecting results that have been X qualified by the lab for low abundance, no valid peak, or peak not meeting identification criteria.

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10.0 REFERENCES

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Model Statement of Work for Analytical Laboratories (prepared for the DOE National Nuclear Security Administration Service Center)

U.S. Department of Energy NNSA Service Center Model Data Validation Procedure

USEPA Contract Laboratory Program National Functional Guidelines

40 CFR 136, Protection of Environment: Guidelines Establishing Test Procedures for the Analysis of Pollutants

EPA Method 314, *Determination of Perchlorate in Drinking Water by Ion Chromatography*

EPA Method 1613B, *Tetra-thru-Octa (CDDs) Chlorinated Dioxins and Furans (CDFs)*

EPA Method 1668A, *Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by HRGC/HRMS*

SW-846 Method 428, *Determination of Polychlorinated Dibenzo-p-dioxin (PCDD), Polychlorinated dibenzofuran (PCDF), and Polychlorinated Biphenyl Emissions from Stationary Sources*

SW-846 Method 8000B, *Determinative Chromatographic Separations*

SW-846 Method 8015B, *Nonhalogenated Organics Using GC/FID*

SW-846 Method 8081A, *Organochlorine Pesticides by Gas Chromatography*

SW-846 Method 8082, *Polychlorinated Biphenyls (PCBs) by Gas Chromatography*

SW-846 Method 8151A, *Chlorinated Herbicides by GC Using Methylation or Pentafluorobenzylation Derivatization*

SW-846 Method 8260B, *Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry*

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(GC/MS)

SW-846 Method 8270C, *Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)*

SW-846 Method 8280A, *The Analysis of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans by High Resolution Gas Chromatography/Low Resolution Mass Spectrometry (HRGC/LRMS)*

SW-846 Method 8290, *Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)*

SW-846 Method 8310, *Polynuclear Aromatic Hydrocarbons*

SW-846 Method 8330, *Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC)*

SW-846 Method TO-14 (Rev. 1), *Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using Specially Prepared Canisters with Subsequent Analysis by Gas Chromatography*

NIOSH 7300, Elements by ICP (Nitric/Perchloric Acid Ashing)

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Appendix A

Data Reporting Requirements

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NOTE: If any QC samples are analyzed using a different initial calibration than that of the field samples, the laboratory must include a calibration report for the calibration affecting the QC samples. This calibration data shall only be used to evaluate the QC samples, and only if the QC samples fail to meet recovery or RPD acceptance criteria. The laboratory is not required to report calibration data associated with QC samples from another sample delivery group (SDG).

If required data is not present contact the laboratory to request an amended report. Documentation may include the following, as appropriate.

Gas Chromatography/Mass Spectrometry (GC/MS)

- Case narrative
- Instrument tuning data
- Initial calibration data
- Applicable calibration verification data
- Continuing calibration check data
- Instrument and preparation blank data
- Surrogate data
- IS performance data
- MS/MSD data
- LCS data
- Sample results and analytical data for the requested target analytes, including results from dilutions, if analyzed
- Identification and data for any sample TICs
- Instrument run logs
- AR/COC and shipping documents
- Login worksheet
- Laboratory replicate data, if analyzed

Dioxins and Furans by HRGC/HRMS

- Case narrative
- Column performance check data
- Initial calibration data
- Applicable calibration verification data
- Continuing calibration check data
- Preparation blank data
- Labeled compound data
- OPR data
- Ion abundance ratio data
- Sample results and analytical data for the requested target analytes, including results from dilutions, if analyzed
- Instrument run logs
- AR/COC and shipping documents

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- Login worksheet
- Laboratory replicate data, if analyzed

Gas Chromatography (GC) and High-Performance Liquid Chromatography (HPLC)

- Case narrative
- Initial calibration data, including secondary column, if appropriate
- Applicable calibration verification data
- Continuing calibration check data
- Instrument and preparation blank data
- Surrogate data
- MS/MSD data
- LCS data
- Sample results and analytical data for the target analytes, including data from dilutions, if analyzed
- Confirmation data and RPD between the results
- Instrument run logs
- AR/COC and shipping documents
- Login worksheet
- Laboratory replicate data, if analyzed

Polychlorinated Biphenyl (PCB) Congeners, EPA Method 1668A

- Case Narrative
- Initial calibration data, including RRT windows
- Calibration verification data including ion abundance ratios and RRTs
- Preparation blank data
- OPR data
- Clean-up standard data
- Labeled compound data
- Sample results and analytical data for the requested target analytes, including results from dilutions, if analyzed
- Ion abundance ratio for all detected sample results, labeled compounds, and clean-up standards
- RRTs for all detected sample results, labeled compounds, and clean-up standards
- Instrument run logs
- Sample preparation data
- Lipid data (tissue samples only)
- AR/COC and shipping documents
- Login worksheet

High Explosives (HE) and Perchlorate by Liquid Chromatography/Mass Spectrometry/Mass Spectrometry (LC/MS/MS)

- Case narrative
- Initial calibration data

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- Applicable calibration verification data
- ICB data
- Continuing calibration check data
- CCB data
- Low level calibration verification (CRI) [1] data
- Instrument and preparation blank data
- Surrogate data (HE only)
- IS or Method of Standard Addition performance data
- MS/MSD data
- LCS data
- RT data
- Isotope Ratio data (perchlorate only)
- Sample results and analytical data for the requested target analytes, including results from dilutions, if analyzed
- Instrument run logs
- AR/COC and shipping documents
- Login worksheet
- Laboratory replicate data, if analyzed

Inorganic

- Case narrative
- Initial calibration data
- Applicable calibration verification data
- ICB data
- Continuing calibration data
- CCB data
- Instrument tuning data
- Instrument and preparation blank data
- MS data
- LCS data
- Laboratory replicate data
- ICP-AES and ICP-MS interference check sample (ICS) data
- ICP serial dilution data
- PQL verification (CRA/CRI/contract-required detection limit [CRDL])[2]
- Sample results and analytical data, including data from dilutions, if analyzed
- Instrument run logs
- AR/COC and shipping documents

[1] CRI = reporting limit verification for LC/MS/MS, ICP-AES and ICP-MS methods.

[2] CRA = reporting limit verification for atomic absorption (AA) methods.
CRI = reporting limit verification for LC/MS/MS, ICP-AES, and ICP-MS methods.
CRDL = reporting limit verification for cyanide methods.

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- Login worksheet

Radiochemistry

- Case narrative
- Instrument and preparation blank data
- Applicable calibration verification data
- MS data
- LCS data
- Laboratory replicate data
- Sample results
- Carrier or chemical tracer data
- Instrument run logs
- AR/COC and shipping documents
- Login worksheet
- Control Charts

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Appendix B

Sample Preservation and Holding Times

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Sample Preservation Techniques and Holding Times

Method	Parameters	Matrix	Volume/Container	Preservation	Holding Times Sample	Holding Times Extract
305.1,310 2320B	Acidity, Alkalinity Bicarbonate	Water	500 mL Plastic or Glass	4 °C	14 Days	NA
300.0, 320.1, 325, 340, 375, 9056	Bromide, Chloride Fluoride, Sulfate	Water	1 L Plastic	4 °C	28 Days	NA
405.1	BOD	Water	1 L Plastic	4 °C	48 Hours	NA
9010B, 9012A,	Total Cyanide	Water	1 L Plastic	4 °C; NaOH; pH > 12	14 Days	NA
9013, 9014, 335.1, 335.3	Amenable Cyanide	Solid/Other	125 mL Glass Jar	4 °C	14 Days	NA
415, 9060	DOC, TOC	Water	250 mL Amber Glass	4 °C; H_2SO_4; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	4 °C	28 Days	NA
200.7, 200.8,	All metals except Cr(VI) and Hg	Water	500 mL Plastic	HNO_3 ; pH < 2	180 Days	NA
6010B, 6020,		Solid/Other	250 mL Glass Jar		180 Days	NA
7196A, 7197	Cr(VI)	Water	500 mL Plastic	4 °C	24 Hours	NA
218.6	Cr(VI)	Water	500 mL Plastic	4 °C, pH 9.3-9.7	28 days	NA
3060A,		Solid/Other	250 mL Glass Jar	4 °C	30 Days	7 days
245.1, 7470A	Hg	Water	500 mL Plastic	HNO_3 ; pH < 2	28 Days	NA
7471A		Solid/Other	250 mL Glass Jar	4 °C	28 Days	NA
130.1, 2340B	Hardness	Water		HNO_3 ; pH < 2 4 °C	180 Days	NA
345.1	Iodide	Water	500 mL Plastic or Glass	4 °C	24 Hours	NA
353, 351,	Ammonium, Nitrate + Nitrite	Water	1 L Plastic	4 °C; H_2SO_4; pH < 2	28 Days	NA
365.4, 350	Total Phosphorus, TKN			4 °C; not acidified	24 hours	NA
300.0	Nitrate, Nitrite,	Water	500 mL Plastic	4 °C	48 Hours	NA

Note: 40 mL vials require caps with Teflon lined septum. All other containers require Teflon lined screw cap lids to minimize container contamination and loss of analyte.
*If samples are shipped to the laboratory in EnCore™ samplers, samples must be extruded and placed in sample containers within 48 hours of sample collection.

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Sample Preservation Techniques and Holding Times

Method	Parameters	Matrix	Volume/Container	Preservation	Holding Times Sample	Extract
354.1	Ortho Phosphorus					
365	Ortho Phosphorus	Water	500 mL Plastic	4 °C; H_2SO_4; pH < 2	48 Hours	NA
9210/9211,	Nitrate	Water	1 L Plastic	4 °C; 1M Boric Acid	48 Hours	NA
9056		Solid/Other	250 mL Glass Jar	4 °C	48 Hours	NA
314.0, 9058	Perchlorate	Water	250 mL Plastic or Glass	4 °C	28 Days	NA
6850 (modified)	Perchlorate by LC/MS/MS	Water/Solid	250 mL Plastic or Glass	4 °C	28 Days	NA
		Solid	4 oz. Wide-mouth jar	4 °C	28 Days	NA
410	Chemical Oxygen Demand (COD)	Water	250 mL Glass	4 °C; H_2SO_4; pH < 2	28 Days	NA
1664	Total Recoverable oil and Grease	Water	1 L Glass	4 °C; H_2SO_4 or HCl; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	4 °C	28 Days	NA
9070/9071A	Total Recoverable Oil and Grease	Water	1 L Glass	4 °C; HCl; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	4 °C	28 Days	NA
ASTM D-854	Specific Gravity					
376/9030B/9031	Sulfide	Water	1 L Glass	4 °C; NaOH; Zinc acetate; pH > 9	7 Days	NA
		Solid/Other	125 mL Glass Jar	4 °C	7 Days	NA
160	TDS, TSS, TS	Water	1 L Plastic	4 °C	7 Days	NA
160.4	Volatile solids (volatile residue)	Water	plastic or glass	4 °C	7 Day	NA
9020B	TOX	Water	1 L Amber Glass	4 °C; H_2SO_4; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	4 °C	28 Days	NA
9060	TOC	Water	Glass	4 °C; H_2SO_4 or HCL; pH < 2 if analyzed >2 hours after collection	2 hours, unless acidified	N/A

Note: 40 mL vials require caps with Teflon lined septum. All other containers require Teflon lined screw cap lids to minimize container contamination and loss of analyte.
*If samples are shipped to the laboratory in EnCore™ samplers, samples must be extruded and placed in sample containers within 48 hours of sample collection.

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Sample Preservation Techniques and Holding Times

Method	Parameters	Matrix	Volume/Container	Preservation	Holding Times Sample	Holding Times Extract
418.1	TPH	Water	1 L Amber Glass	4 °C; HCl; pH < 2	28 Days	NA
1664	TPH	Water	1 L Amber Glass	4 °C; H_2SO_4 or HCl; pH < 2	28 Days	NA
8440	TPH	Solid/Other	125 mL Glass Jar	4 °C	28 Days	NA
9065, 9066, 420	Total Recoverable Phenols	Water	1 L Glass	4 °C; H_2SO_4; pH < 4	28 Days	NA
		Solid	125 mL Glass Jar	4 °C	28 Days	NA
150.1, 9040B	pH	Water	125 mL Plastic	4 °C	24 Hours	NA
110, 180.1	Color, Turbidity	Water	500 mL Plastic	4 °C	48 Hours	NA
120.1, 9050	Specific Conductance	Water	125 mL Plastic	4 °C	28 Days	NA
All radiochemical parameters except Rn-222 and tritium		Water	1 L Plastic (2 x 2 L Preferred)	HNO_3 ; pH < 2	180 Days	NA
		Solid/Other	250 mL Glass Jar		180 Days	NA
913.0	Radon 222	Water	125 mL Glass	None	72 Hours	NA
906.0	Tritium	Water	1 L Glass		180 Days	NA
		Solid/Other	Sample size will vary with moisture content		180 Days	NA
8015 (Modified)	Petroleum Hydrocarbons (Diesel Range Organics)	Water	2 x 1 L Amber Glass Bottle	4 °C	7 Days	40 Days
		Soil/Other	250 mL Glass Jar	4 °C	14 Days	40 Days
	Petroleum Hydrocarbons (Gasoline Range Organics)	Water	3 x 40 mL Glass Vial	4 °C; HCl; pH < 2	14 Days	NA
		Soil/Other	125 mL Glass Jar	4 °C	14 Days	NA
5035/8015 (Modified)	Petroleum Hydrocarbons (Gasoline Range Organics)	Soil	4 x 40 mL Glass Vial	4 °C, 2 Vials $NaHSO_4$ 1 Vial CH_3OH, 1 Vial No Preservative	*14 days	NA

Note: 40 mL vials require caps with Teflon lined septum. All other containers require Teflon lined screw cap lids to minimize container contamination and loss of analyte.
*If samples are shipped to the laboratory in EnCore™ samplers, samples must be extruded and placed in sample containers within 48 hours of sample collection.

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Sample Preservation Techniques and Holding Times

Method	Parameters	Matrix	Volume/Container	Preservation	Holding Times Sample	Extract
8021B	Halogenated Volatile Organics	Water	3 x 40 mL Glass Vial	4 °C; HCl; pH < 2	14 Days	NA
		Soil/Other	125 mL Glass Jar	4 °C	14 Days	NA
5035/8021B	Halogenated Volatile Organics	Soil	4 x 40 mL Glass Vial	4 °C, 2 Vials $NaHSO_4$ 1 Vial CH_3OH, 1 Vial No Preservative	*14 days	NA
8081A,	Organochlorine Pesticides	Water	4 L Amber Glass Bottle	4 °C	7 Days	40 Days
		Soil/Other	250 Glass Jar	4 °C	14 Days	40 Days
8082	PCBs	Water	4 L Amber Glass Bottle	4 °C	1 Year	1 Year
		Soil/Other	250 ml Glass Jar	4 °C	1 Year	1 Year
8141A	Organophosphorous Compounds	Water	4 L Amber Glass Bottle	4 °C; NaOH or H_2SO_4; pH 5-8	7 Days	40 Days
		Soil/Other	250 Glass Jar	4 °C	14 Days	40 Days
8151A	Chlorinated Herbicides	Water	4 L Amber Glass Bottle	4 °C;	7 Days	40 Days
		Soil/Other	250 Glass Jar	4 °C	14 Days	40 Days
8260B (modified)	Volatile Organics by GC-MS	Water	3 x 40 mL Glass Vial	4 °C; HCl; pH < 2	14 Days	NA
				4 °C; not acidified	7 days	NA
		Soil/Other	125 ml Glass Jar	4 °C	14 Days	NA 5035/8260B
	Volatile Organics by GC-MS	Soil	4 x 40 mL Glass Vial	4 °C, 2 Vials $NaHSO_4$ 1 Vial CH_3OH, 1 Vial No Preservative	*14 days	NA
8270C, 625	Semi-volatile Organics by GC-MS	Water	4 L Amber Glass Bottle	4 °C	7 Days	40 Days
		Soil/Other	250 mL Glass Jar	4 °C	14 Days	40 Days
8280A	Polychlorinated Dioxins and Furans by GC/MS	Water	4 L Amber Glass Bottle	4 °C	30 Days (1yr)	45 Days
		Soil/Other	250 mL Glass Jar	4 °C	30 Days (1yr)	45 Days
8318	N-Methylcarbamate Pesticides by HPLC	Water	4 L Amber Glass Bottle	4 °C; 0.1 N $ClCH_2CO_2H$, pH 4 - 5	7 Days	40 Days
		Soil/Other	250 mL Glass Jar	4 °C	7 Days	40 Days
8330	Nitroaromatics and Nitramines by	Water	4 L Amber Glass Bottle	4 °C	7 Days (1yr)	40 Days

Note: 40 mL vials require caps with Teflon lined septum. All other containers require Teflon lined screw cap lids to minimize container contamination and loss of analyte.
*If samples are shipped to the laboratory in EnCore™ samplers, samples must be extruded and placed in sample containers within 48 hours of sample collection.

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Sample Preservation Techniques and Holding Times

Method	Parameters	Matrix	Volume/Container	Preservation	Holding Times Sample	Extract
	HPLC	Soil/Other	250 mL Glass Jar	4 °C	14 Days (1yr)	40 Days
TO-13A	PAHs in Filter Cartridges	PUF, Tenax, or XAD-2 Filter Cartridge		4 °C	7 Days (1yr)	40 Days
TO-14A	VOC in Air	SUMMA® Canister			28 Days (by consensus)	
8321A (modified)	High Explosives by LC/MS/MS	Water	Amber Glass/Teflon lined cap	4 °C,	7 Days	40 Days
		Solid	Amber Glass/Teflon lined cap	4 °C,	14 Days	40 Days

Note: 40 mL vials require caps with Teflon lined septum. All other containers require Teflon lined screw cap lids to minimize container contamination and loss of analyte.
*If samples are shipped to the laboratory in EnCore™ samplers, samples must be extruded and placed in sample containers within 48 hours of sample collection.

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Appendix C

Volatile Organic Holding Times

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Volatile Organic Compounds
Maximum Holding Times
Non-detects in Water

Compound	CAS #	15 - 60 days	60 - 120 days
1,1-dichloroethene	75-35-4	UJ	R
2-butanone	78-93-3	UJ	R
Acrolein	107-02-8	UJ	R
Allyl chloride	107-05-1	UJ	R
Bromomethane	74-83-9	UJ	R
Carbon tetrachloride	56-23-5	UJ	R
Chloromethane	74-87-3	UJ	R
Dibromochloromethane	124-48-1	UJ	R
Ethyl benzene	100-41-4	UJ	R
m&p xylene	Na	UJ	R
Methyl methacrylate	80-62-6	UJ	R
o xylene	95-47-6	UJ	R
Vinyl chloride	75-01-4	UJ	R
1,1,1 trichloroethane	75-55-6	Not Qualified	UJ
1,1 dichloropropene	563-58-6	Not Qualified	UJ
1,2,4 trichlorobenzene	120-82-1	Not Qualified	UJ
1,2,4 trimethylbenzene	95-63-6	Not Qualified	UJ
1,2 dibromo-3-chloropropane	96-12-8	Not Qualified	UJ
1,2 dichlorobenzene	95-50-1	Not Qualified	UJ
1,3,5 trimethylbenzene	108-67-8	Not Qualified	UJ
1,3 dichlorobenzene	541-73-1	Not Qualified	UJ
1,4 dichlorobenzene	106-46-7	Not Qualified	UJ
4-methyl-2-pentanone	108-10-1	Not Qualified	UJ
Bromodichloromethane	75-27-4	Not Qualified	UJ
Chlorobenzene	108-90-7	Not Qualified	UJ
Chloroethane	75-00-3	Not Qualified	UJ
Ethyl methacrylate	97-63-2	Not Qualified	UJ
Hexachlorobutadiene	87-68-3	Not Qualified	UJ
Isopropylbenzene	98-82-8	Not Qualified	UJ
Naphthalene	91-20-3	Not Qualified	UJ
n-propylbenzene	103-65-1	Not Qualified	UJ
2-chlorotoluene	95-49-8	Not Qualified	UJ
4-chlorotoluene	106-43-4	Not Qualified	UJ
4-isopropyltoluene	99-87-6	Not Qualified	UJ
Tetrachloroethene	127-18-4	Not Qualified	UJ
Trichloroethene	79-01-6	Not Qualified	UJ

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Volatile Organic Compounds (cont.)
Maximum Holding Times
Non-detects in Water

Compound	CAS #	60-120 days	120 - 240 days
1,1,1,2 tetrachloroethane	630-20-6	Not Qualified	UJ
1,1,2,2 tetrachloroethane	79-34-5	Not Qualified	UJ
1,1,2 trichloroethane	79-00-5	Not Qualified	UJ
1,1 dichloroethane	75-35-4	Not Qualified	UJ
1,2,3 trichlorobenzene	87-61-6	Not Qualified	UJ
1,2 dibromomethane	106-93-4	Not Qualified	UJ
1,2 dichloroethane	107-06-2	Not Qualified	UJ
1,2 dichloropropane	78-87-5	Not Qualified	UJ
1,3 dichloropropane	142-28-9	Not Qualified	UJ
Acetone	67-64-1	Not Qualified	UJ
Acrylonitrile	75-05-8	Not Qualified	UJ
Benzene	71-43-2	Not Qualified	UJ
Bromobenzene	108-86-1	Not Qualified	UJ
Bromochloromethane	74-97-5	Not Qualified	UJ
Bromoform	75-25-2	Not Qualified	UJ
Chloroform	67-66-3	Not Qualified	UJ
cis-1,2 dichloroethene	156-59-2	Not Qualified	UJ
Dibromomethane	106-93-4	Not Qualified	UJ
Dichlorodifluoromethane	75-71-8	Not Qualified	UJ
Methyl acrylonitrile	126-98-7	Not Qualified	UJ
Methylene chloride	75-09-2	Not Qualified	UJ
n-butylbenzene	104-51-8	Not Qualified	UJ
sec-butyl benzene	135-98-8	Not Qualified	UJ
tert-butyl benzene	98-06-6	Not Qualified	UJ
Toluene	108-88-3	Not Qualified	UJ

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Appendix D

GC/MS Internal Standards

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Laboratories may vary the compounds calculated off of any IS and should identify within the report which compounds were calculated from each IS. If this information is not readily available the following tables may be used as guidelines.

GC/MS VOA Internal Standard Tables

Fluorobenzene

Chloromethane	Vinyl Chloride	Bromomethane	Chloroethane
Acetone	1,1-Dichloroethene	Methylene Chloride	Carbon Disulfide
1,1-Dichloroethane	Trans-1,2-Dichloroethene	2-Butanone	2,2-Dichloropropane
Cis-1,2-Dichloroethene	Chloroform	Bromochloromethane	1,1,1-Trichloroethane
1,1-Dichloropropene	Carbon Tetrachloride	1,2-Dichloroethane	Benzene
Trichloroethene	1,2-Dichloropropane	Bromodichloromethane	Dibromomethane
4-Methyl-2-pentanone	Cis-1,3-Dichloropropene	Trichlorofluoromethane	Acetonitrile
Acrolein	Acrylonitrile	n-Butyl alcohol	2-Chloro-1,3-butadiene
Dichlorodifluoromethane	1,4-Dioxane	Ethyl acetate	Iodomethane
Isobutyl alcohol	Methacrylonitrile	Methyl methacryalate	Methyl isobutyl ketone
Propionitrile	Trichlorofluoromethane		

Chlorobenzene-d5

Toluene	Trans-1,3-Dichloropropene	1,1,2-Trichloroethane	2-Hexanone
1,3-Dichloropropane	Tetrachloroethene	Chlorodibromomethane	1,2-Dibromoethane
Chlorobenzene	1,1,1,2-tetrachloroethane	Ethylbenzene	m,p-Xylenes
o-Xylene	Styrene	Bromoform	1,1,2,2-Tetrachloroethane
Ethyl methacrylate			

1,4-Dichlorobenzene-d4

1,2,3-Trichloropropane	Bromobenzene	1,2-Dibromo-3-chloropropane	1,2-Dichlorobenzene
1,3-Dichlorobenzene	1,4-Dichlorobenzene	Hexachlorobutadiene	Napthalene
Pentachloroethane	1,2,4-Trichlorobenzene		

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GC/MS SVOA Internal Standard Tables

1,4-Dichlorobenzene-d4

2-Fluorophenol	Phenol-d5	2-Chlorophenol-d4	1,2-Dichlorobenzene-d4
Phenol	Bis (2-Chloroethyl) ether	2-Chlorophenol	1,3-Dichlorobenzene
1,4-Dichlorobenzene	1,2-Dichlorobenzene	2-Methylphenol	2,2'-oxybis(2-Chloropropane
4-Methylphenol	N-Nitroso-di-n-propylamine	Hexachloroethane	Pyridine
Acetophenone	Aniline	Methyl metanesulfonate	N-Nitrosodiethylamine
N-Nitrosodimethylamine	N-Nitrosomethylethylamine	N-Nitrosomorpholine	N-Nitrosopiperidine
N-Nitrosopyrrolidine			

Naphthalene-d8

Nitrobenzene-d5	Nitrobenzene	Isophorone	2-Nitrophenol
2,4-Dimethylphenol	Bis (2-Chloroethoxy) methane	2,4-Dichlorophenol	1,2,4-Trichlorobenzene
Naphthalene	4-Chloroaniline	Hexachlorobutadiene	4-Chloro-3-methylphenol
2-Methylnaphthalene	Benzoic Acid	2.6-Dichlorophenol	Hexachloropropene
N-Nitrosodi-n-butylamine	Safrole		

Acenaphthene-d10

2,4,6-Tribromophenol	2-Fluorobiphenyl	Hexachlorocyclopentadiene	2,4,6-Trichlorophenol
2,4,5-Trichlorophenol	2-Chloronaphthalene	2-Nitroaniline	Dimethylphthalate
Acenaphthylene	2,6-Dinitrotoluene	3-Nitroaniline	Acenaphthene
2,4-Dinitrophenol	4-Nitrophenol	Dibenzofuran	2,4-Dinitrotoluene
Diethylphthalate	4-Chlorophenyl phenyl ether	Fluorene	4-Nitroaniline
2-sec-Butyl-2,6-dinitrophenol	Isosafrole	N-Nitro-o-toluidine	Pentachlorophenol
1,2,4,5-Tetrachlorobenzene	2,3,4,6-Tetrachlorophenol		

Phenanthrene-d10

2,4-Dinitro-2-methylphenol	N-Nitrosodiphenylamine	4-Bromophenyl phenyl ether	Hexachlorobenzene
Pentachlorophenol	Phenanthrene	Anthracene	Carbazole
Di-n-butylphthalate	Fluoranthene	Methapyrilene	Pentachloronitrobenzene
Phenacetin	Pronamide		

Chrysene-d12

Pyrene	Butylbenzylphthalate	3,3'-Dichlorobenzidine	Benzo(a)anthracene
Chrysene	Bis(2-Ethylhexl)phthalate	2-Acethylaminofluorene	Chlorobenzilate

Perlene-d12

Di-n-octylphthalate	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene	Dibenz(a,h)anthracene	Benzo(g,h,i)perylene	Hexachlorophene

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3-Methylcholanthrene			

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Appendix E

Surrogate Recovery Limits

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Guidelines for Surrogate Recovery Limits

Volatile Organics – Water	**Mean**	**Lower Limit**	**Upper Limit**
1,2-Dichloroethane-d4	95	72	119
4-bromofluorobenzene	98	76	119
Dibromofluoromethane	100	85	115
Toluene-d8	102	83	120
Volatile Organics – Solid			
4-bromofluorobenzene	101	84	118
Toluene-d8	100	84	116
Semi-volatile Organics – Water			
2-fluorobiphenyl	79	48	112
Terphenyl-d14	92	51	135
2,4,6-Tribromophenol	82	42	124
2-Fluorophenol	63	19	108
Nitrobenzene-d5	76	41	111
Semi-volatile Organics – Solid			
2-fluorobiphenyl	72	43	103
Terphenyl-d14	78	32	125
2,4,6-Tribromophenol	80	36	126
2-Fluorophenol	70	37	104
Phenol-d5/d6	71	40	102
Nitrobenzene-d5	69	37	102
Pesticides – Water			
Decachlorobiphenyl	83	32	135
TCMX	81	25	138
Pesticides – Solid			
Decachlorobiphenyl	94	56	132
TCMX	97	69	124
PCB – Water			
Decachlorobiphenyl	88	42	133
PCB – Solid			
Decachlorobiphenyl	91	58	125
HE – Water			
3,4-Dinitrotoluene	86	33	139
2-Methyl-4-nitroaniline	86	33	139
1,4-Dintrobenzene	86	33	139
1,2-Dintrobenzene	86	33	139
HE – Solid			
3,4-Dinitrotoluene	98	56	140
2-Methyl-4-nitroaniline	98	56	140

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1,4-Dintrobenzene	98	56	140
1,2-Dintrobenzene	98	56	140

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Appendix F

Laboratory Control Limits

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Organic LCS Criteria Guidelines (Volatile Compounds)

Volatile Compound	CAS #	Water			Solid		
		Ave	Low	High	Ave	Low	High
Acetone	67-64-1	91	39	142	88	19	158
Benzene	71-43-2	102	81	122	99	73	126
Bromobenzene	108-86-1	100	76	124	93	66	121
Bromochloromethane	74-97-5	97	65	129	99	71	127
Bromodichloromethane	75-27-4	98	76	121	100	72	128
Bromoform	75-25-2	99	69	128	96	56	137
Bromomethane	74-83-9	88	30	146	95	31	159
2-Butanone	78-93-3	91	32	150	94	29	159
n-Butylbenzene	104-51-8	103	69	137	101	65	138
sec-Butylbenzene	135-98-8	100	72	127	97	63	132
tert-Butylbenzene	98-06-6	99	70	129	99	65	132
Carbon disulfide	75-15-0	100	37	162	103	47	159
Carbon tetrachloride	56-23-5	102	66	138	100	67	133
Chlorobenzene	108-90-7	102	81	122	99	75	123
Chloroethane	75-00-3	99	62	135	98	39	157
Chloroform	67-66-3	100	63	136	98	72	124
Chloromethane	74-87-3	83	39	127	90	51	129
2-Chlorotoluene	95-49-8	100	73	126	98	69	128
4-Chlorotoluene	106-43-4	101	74	128	100	73	126
Dibromochloromethane	124-48-1	96	58	133	98	66	130
1,2-Dibromo-3-chloropropane	96-12-8	91	50	132	87	40	135
1,2-Dibromoethane	106-93-4	100	80	121	97	70	124
Dibromomethane	74-95-3	101	76	125	100	73	128
1,2-Dichlorobenzene	95-50-1	96	71	122	97	74	119
1,3-Dichlorobenzene	541-73-1	100	75	124	98	72	124
1,4-Dichlorobenzene	106-46-7	99	74	123	98	72	125
Dichlorodifluoromethane	75-71-8	93	31	155	85	34	136
1,1-Dichloroethane	75-34-3	101	69	133	99	73	125
1,2-Dichloroethane	107-06-2	100	69	132	104	72	137
1,1-Dichloroethene	75-35-4	99	68	130	100	65	136
cis-1,2-Dichloroethene	156-59-2	99	72	126	96	67	125
trans -1,2-Dichloroethene	156-60-5	99	60	139	100	66	134
1,2-Dichloropropane	78-87-5	100	75	125	95	71	119
1,3-Dichloropropane	142-28-9	100	73	126	100	76	123
2,2-Dichloropropane	594-20-7	103	69	137	101	67	134
1,1-Dichloropropene	563-58-6	102	73	132	102	70	135
cis-1,3-Dichloropropene	10061-01-5	100	69	131	99	72	126
trans-1,3-Dichloropropene	10061-02-6	98	53	142	96	65	127
Ethylbenzene	100-41-4	100	73	127	101	74	127
Hexachlorobutadiene	87-68-3	97	51	142	98	53	142
2-Hexanone	591-78-6	92	56	128	97	47	146

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Volatile Compound	CAS #	Water			Solid		
		Ave	Low	High	Ave	Low	High
Isopropylbenzene	98-82-8	101	75	127	103	77	129
4-Isopropyltoluene	99-87-6	102	73	131	104	75	133
Methylene chloride	75-09-2	96	53	140	97	54	141
4-Methyl-2-pentanone	108-10-1	96	58	134	97	47	147
Naphthalene	91-20-3	96	54	138	84	40	127
n-Propylbenzene	103-65-1	101	72	129	99	63	135
Styrene	100-42-5	100	65	134	101	74	128
1,1,1,2-Tetrachloroethane	630-20-6	105	81	129	100	74	125
1,1,2,2-Tetrachloroethane	79-34-5	96	63	128	93	54	131
Tetrachloroethene	127-18-4	96	44	149	103	67	139
Toluene	108-88-3	100	77	122	99	71	127
1,2,3-Trichlorobenzene	87-61-6	99	57	142	97	62	133
1,2,4-Trichlorobenzene	120-82-1	100	66	134	98	65	131
1,1,1-Trichloroethane	71-55-6	100	67	132	101	68	133
1,1,2-Trichloroethane	79-00-5	100	75	125	95	62	127
Trichloroethene	79-01-6	96	44	149	103	67	139
1,2,3-Trichloropropane	96-18-4	98	73	124	97	63	130
1,2,4-Trimethylbenzene	95-63-6	103	74	132	98	65	131
1,3,5-Trimethylbenzene	108-67-8	102	74	131	99	65	133
Vinyl chloride	75-01-4	99	50	147	92	58	126
o-Xylene	95-47-6	100	80	121	101	77	125

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Organic LCS Criteria Guidelines (Semi-Volatile Compounds)

Semi-Volatile Compound	CAS #	Water			Solid		
		Ave	Low	High	Ave	Low	High
Polynuclear Aromatics							
2-Methynaphthalene	91-57-6	75	46	104	77	47	107
Acenaphthene	83-32-9	78	47	108	77	46	108
Acenaphthylene	208-96-8	79	50	107	76	44	107
Anthracene	120-12-7	83	54	112	80	53	107
Benz(a)anthracene	56-55-3	83	56	109	82	52	111
Benzo(b)fluoranthene	205-99-2	82	45	118	80	45	114
Benzo(k)fluoranthene	207-08-9	85	45	124	84	45	123
Benzo(g,h,i)perylene	191- 24-2	81	38	123	82	38	126
Benzo(a)pyrene	50-32-8	81	53	110	81	50	111
Chrysene	218-01-9	82	55	109	83	53	112
Dibenz(a,h)anthracene	53-70-3	85	42	127	83	41	125
Fluoranthene	206-44-0	85	54	116	84	54	114
Fluorene	86-73-7	81	50	112	78	49	108
Indeno(1,2,3-cd)pyrene	193-39-5	84	43	125	80	38	121
Naphthalene	91-20-3	71	39	102	73	40	107
Phenanthrene	85-01-8	84	51	117	80	50	110
Pyrene	129-00-0	89	49	128	84	46	123
Phenolic/Acidic							
2,4-Dichlorophenol	120-83-2	76	48	105	77	45	110
2, 4-Dimethylphenol	105-67-9	69	28	109	67	32	103
2,4-Dinitrophenol	51-28-5	76	14	138	73	13	132
2-Chlorophenol	95-57-8	71	37	106	75	44	106
2-Methylphenol	95-48-7	73	38	109	72	40	104
3-Methylphenol	108-39-4	71	32	110	74	41	107
4-Methylphenol	106-44-5	71	32	110	74	41	107
2-Nitrophenol	88-75-5	76	39	113	76	42	111
4,6-Dinitro-2-methylphenol	534-52-1	85	40	130	83	29	137
4-Chloro-3-methylphenol	59-50-7	79	47	111	80	46	113
Pentachlorophenol	87-86-5	78	38	117	72	25	119
4-Nitrophenol	100-02-7				77	17	138
Phenol	108-95-2				70	39	100
Basic							
3,3'-Dichlorobenzidine	91-94-1	65	19	111			
4-Chloroaniline	106-47-8	62	15	109			
Phthalate Esters							
Bis(2-ethylhexyl) phthalate	117-81-7	84	42	126	87	47	127
Butyl benzyl phthalate	85-68-7	81	46	116	86	49	123
Di-n-butyl phthalate	84-74-2	85	54	116	83	56	110
Di-n-octyl phthalate	117-84-0	87	37	137	86	41	132
Diethyl phthalate	84-66-2	79	41	118	82	50	114

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Semi-Volatile Compound	CAS #	Water			Solid		
		Ave	Low	High	Ave	Low	High
Dimethyl phthalate	131-11-3	76	25	127	80	49	110
Nitrosoamines							
N-Nitrosodimethylamine	62-75-9	68	26	110	66	18	114
N-Nitrosodiphenylamine	86-30-6	80	48	111	82	49	116
N-Nitroso-di-n-propylamine	621-64-7	81	34	128	77	40	114
Chlorinated Aliphatics							
Bis(2-chloroethoxy) methane	111-91-1	76	46	107	76	43	108
Bis(2-chloroethyl) ether	111-44-4	73	37	110	71	38	105
Bis(2-chloroisopropyl) ether	108-60-1	78	26	131	68	21	115
Hexachlorobutadiene	87-68-3	65	27	103	78	40	117
Hexachloroethane	67-72-1	61	28	94	72	37	110
Halogenated Aromatics							
1,2,4-Trichlorobenzene	120-82-1	72	37	107	77	44	111
1,2-Dichlorobenzene	95-50-1	67	33	102	71	45	97
1,3-Dichlorobenzene	541-73-1	65	32	98	70	39	100
1,4-Dichlorobenzene	106-46-7	65	32	98	69	35	103
2-Chloronaphthalene	91-58-7	77	49	104	75	45	105
4-Bromophenyl phenyl ether	101-55-3	83	52	113	82	46	117
4-Chlorophenyl phenyl ether	7005-72-3	81	50	111	80	47	112
Hexachlorobenzene	118-74-1	82	52	112	83	47	118
Nitroaromatics							
2,4-Dinitrotoluene	121-14-2	84	51	118	82	48	116
2,6-Dinitrotoluene	606-20-2	83	49	117	80	48	112
2-Nitroaniline	88-74-4	82	48	115	81	44	118
3-Nitroaniline	99-09-2	73	19	126	69	27	110
4-Nitroaniline	100-01-6	77	36	118	74	34	113
Nitrobenzene	98-95-3	77	44	109	77	41	113
Neutral Aromatics							
Carbazole	86-74-8	83	48	117	80	44	117
Dibenzofuran	132-64-9	80	54	107	77	51	103
Others							
Benzyl alcohol	100-51-6	71	30	112	71	19	123
Isophorone	78-59-1	81	50	112	77	43	111

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Organic LCS Criteria Guidelines (Pesticides and PCB)

Pesticide	CAS #	Water			Solid		
		Ave	Low	High	Ave	Low	High
Aldrin	309-00-2	83	27	138	93	47	140
α-BHC	319-84-6	94	60	128	93	62	125
β-BHC	319-85-7	96	66	126	95	62	127
δ-BHC	319-86-8	91	46	136	94	57	130
γ-BHC (Lindane)	58-89-9	82	27	137	91	59	123
α-Chlordane	5103-71-9	93	63	123	92	63	121
4,4'-DDD	72-54-8	88	27	149	81	28	135
4,4'-DDE	72-55-9	87	33	140	97	68	126
4,4'-DDT	50-29-3	92	47	138	92	45	140
Dieldrin	60-57-1	95	62	129	96	67	125
Endosulfan I	959-98-8	80	49	111	74	14	133
Endosulfan II	33213-65-9	79	28	130	89	37	141
Endosulfan sulfate	1031-07-8	96	54	137	99	62	135
Endrin	72-20-8	95	56	134	97	61	133
Endrin aldehyde	7421-93-4	96	56	137	92	37	147
Endrin ketone	53494-70-5	102	77	127	100	66	134
Heptachlor	76-44-8	87	42	131	96	51	140
Heptachlor epoxide	1024-57-3	96	62	131	98	66	130
4,4'-Methoxychlor	72-43-5	103	56	150	100	57	143
PCB							
Aroclor – 1016	12674-11-2	85	25	144	90	41	138
Aroclor – 1260	11096-82-5	87	30	146	96	61	131

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Organic LCS Criteria Guidelines

Nitroaromatics and Nitramines	CAS #	Water			Solid		
		Ave	Low	High	Ave	Low	High
2-Amino-4,6-Dinitrotoluene (2-Am-DNT)	355-72-78-2	87	59	115	102	80	124
4-Amino-2,6-Dinitrotoluene (4-Am-DNT)	1946-51-0	96	56	137	101	79	124
1,3-Dinitrobenzene (DNB)	99-65-0				101	79	124
2,4-Dinitrotoluene (24DNT)	121-14-2	83	12	154	98	36	161
2,6-Dinitrotoluene (26DNT)	606-20-2				100	77	122
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	88	40	136	103	72	134
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	85	17	153			
Nitrobenzene (NB)	98-95-3				96	39	154
2-Nitrotoluene (2NT)	88-72-2				97	39	156
3-Nitrotoluene (3NT)	99-08-1	80	15	146	95	32	159
4-Nitrotoluene (4NT)	99-99-0	80	16	144	101	77	124
Pentaerythritol tetranitrate (PETN)							
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	89	47	131	100	74	126
Trinitrobenzene (135TNB)	99-35-4				95	34	156
2,4,6-Trinitrotoluene (TNT)	118-96-7				95	17	173

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Appendix G

Mass Spectra Acceptability

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Mass Spectra Acceptability

Ideal spectral identification of a target analyte by a mass spectrometer data system is performed by comparing three characteristic ions (i.e., a primary or quantitation ion, a secondary ion, and a tertiary ion) from one mass spectrum to the same characteristic ions in the reference mass spectrum. The three characteristic ions from the mass spectrum are defined as the three ions of greatest relative intensity or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum. In most cases, ions with the greatest abundance are used for evaluation; however, if target analytes suffer from coelution, interferences may dictate the use of less abundant ions for evaluation. Some analytes generate a mass spectrum that is of such a simple nature that a tertiary ion is not sufficiently abundant (e.g., low molecular weight analytes and analytes that do not fragment sufficiently upon electron impact ionization). In this case, two ions are used for identification.

For evaluation of analyte spectra, all of the following factors should be considered before an acceptability judgment is made.

RTs

The intensities of the primary, secondary, and, if applicable, tertiary ions at the established RT of the target analyte are shown in the extracted ion current profiles (EICPs). The RTs for the secondary and tertiary ion profiles should be the same as the primary ion. Depending on peak shape and chromatographic interferences, the RTs could differ by a few hundredths of a minute; however, the RTs between primary and secondary ions should not vary by more than 0.03 minutes.

RRTs

The RRT of the target analyte in the sample should agree to within 0.06 RRT units of the same analyte in the reference standard (either the midpoint standard of the initial calibration or the daily CCV).

Ion Ratios

The most intense ion in a spectrum is assigned a relative abundance of 100 and is known as the base peak. The intensities of all other ions in the spectrum are compared to the intensity of the base peak to obtain an intensity ratio (or ion ratio). The ion ratios for the three characteristic ions from the sample spectrum are compared to the ion ratios for the same ions from the reference spectrum. Relative intensities should agree to within ±30%. For example, an ion that has an abundance of 50% when compared to the base peak in the reference spectrum will have a range of 20-80% as its acceptance criteria for that same ion in the sample spectrum.

Ion ratio evaluation is performed by the laboratory. GC/MS data systems using Target software automatically flag target analytes with a "Q" on the quantitation report when ratio comparison criteria are exceeded. Because interferences and varying instrument conditions can affect relative abundances, the presence of a Q flag does not necessarily indicate an invalid identification; however, a Q flag in addition to other guideline failures may result in the need for additional data in order to make an acceptability judgment.

Visual Comparison of Mass Spectra

The sample spectrum should be visually compared to the reference spectrum for pattern similarity. When a peak elutes in a discrete manner and the reference spectrum was obtained under similar conditions as the sample spectrum, the mass spectral pattern from the sample will be similar to the mass spectral pattern of the reference

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spectrum. If coelution occurs or a high level of background is present, the partial or total spectral pattern from the reference spectrum should be visible within the spectral pattern of the sample spectrum, with sample ion ratios emulating the reference ion ratios, depending on the inherent complexity of the analyte spectrum.

Identification of Target Analytes Present in Samples at Low Levels

Spectra from target analytes that are detected at levels around the established MDL should be examined carefully for the presence of secondary and, if applicable, tertiary ions. For a qualitative identification to be made, all ions used by the instrument method should be present. Because background noise, column bleed, and interferences can hamper identification, correct subtraction is important to identification. Supplemental data may be required from the laboratory in order to properly separate chromatographic interferences. These data may include a library search with listed spectral fit (or match) quality (i.e., a "Q report") or additional EICPs displaying interfering ions for RT comparison.

Interferences

Identification of target analytes is hampered when sample components are not resolved chromatographically (i.e., there is co-elution of non-target and/or target analytes) and produce mass spectra containing ions from more than one analyte. When GC peaks, EICPs, or spectra show evidence of interference (e.g., GC or EICP peak appears broadened with shoulders, obviously overlapping peaks are present, or extraneous ions are present in the spectrum), supplemental data may be required from the laboratory in order to properly evaluate analyte spectra. These data may include a Q report or additional EICPs displaying interfering ions for RT comparison.

Guidelines for Use of Supplemental Data

Q Report

If a target analyte is detected by the mass spectrometer data system and its identification is questionable, the mass spectrum for that analyte may be subjected to a computer comparison against a library of established mass spectra (i.e., a "library search"). This search generates a Q report that shows the mass spectrum being searched, the compounds in the library whose spectra most closely matches the mass spectrum being searched, and a Chemical Abstract Services (CAS) number and a match quality rating from 1-100 (with 100 being a perfect match fit) for each of those compounds. A Q report obtained for a spectrum at the RT of the analyte in question can sometimes help identify that analyte. Ideally, if a data system identifies a target analyte using the identification parameters discussed (i.e., RT, RRT, and major ion intensity ratios), a library search of the analyte should yield concurrent results with a match rating of >75. The following variables affect match quality ratings:

The Analyte Concentration

For identification of an analyte of low concentration (i.e., detections at or just above the MDL), ions of >50% relative intensity in library spectrum should be present in sample spectrum. If minor ions in the analyte spectrum are absent due to low concentration, the match quality rating may be low.

The Nature of the Spectrum

If the spectrum of the analyte in question is relatively complex (i.e., the spectrum contains multiple ions of >50% relative intensity), match quality ratings will generally be higher. If the spectrum of the peak in question only yields two or three ions within scanning range, separation from interferences and background is sometimes not

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possible, making match quality ratings lower. Also, if the spectrum of the analyte in question has one or more ions common to known contaminants, misidentification will be more common (e.g., acetone with its primary ion of 43 is sometimes hard to distinguish from early eluting, low molecular weight hydrocarbons that have the same ion as their primary ions).

The presence of one or more interferences can affect match quality ratings. One dominant interference can yield spectral match quality ratings that are high but whose best match is primarily due to the interfering non-target analyte, not the analyte in question. Multiple interferences will usually yield match quality ratings that are low due to the inability of the software to make a match without a dominant pattern.

The Conditions Under Which the Library Spectrum is Obtained

If spectral quality matches are low, especially for the target analyte in question, the library spectra for the analyte in question should be considered suspect. Mass spectra in established libraries are normally generated under wider scan ranges than are dictated in methods. Low molecular weight analytes in the library may have one or more characteristic ions below the scanning range of the environmental analytical method, rendering the spectra in the low molecular weight range only partially comparable. If it is obvious that the library mass spectrum for an analyte was obtained under different scanning conditions as the sample spectrum, match quality ratings may be reduced.

Additional EICPs

The review of EICPs of all ions of >50% relative abundance, including the primary, secondary, and tertiary ions of the analyte in question as well as ions from interfering analytes, is one way to determine interference separability and abundance contribution. If some or all of the ions from an interfering analyte (i.e., those not contained in the target analyte in question) maximize at the same RT as the target analyte in question, it is possible that interfering ions are contributing abundance to the analyte in question. Also, if peak shape is variable, it is possible that two or more compounds are co-eluting and are contributing a range of ions and overlapping chromatographic peak shapes. If EICPs show that the characteristic ions from the analyte in question elute at the same RT and that RT differs from the EICPs of the ions from interfering compounds, then it is possible that the target analyte in question is present.

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Document Title: Data Validation Procedure for Chemical and Radiochemical Data

Document Number: AOP 00-03 **Revision: 3**

By my signature below, I affirm that I have read and understand this SMO Procedure, and all references called out in procedural steps, and I agree to operate within the stated constraints.

Name (printed)	Signature	Dept./Company	Date

SANDIA NATIONAL LABORATORIES
LONG TERM STEWARDSHIP DEPARTMENT (ORG 4142)

SAMPLE MANAGEMENT AND CUSTODY ADMINISTRATIVE OPERATING PROCEDURE

AOP 95-16
Revision 05

Prepared By: 11-05-2013
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Author: *How frequently does this document need to be reviewed and/or revised?*	*Every 3 years*
Manager: *Does this document need to be tracked?*	*Yes*

EFFECTIVE DATE: 11/12/13

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LIST OF ATTACHMENTS

Attachment A: Clearance Radiological Process Knowledge Form
Attachment B: ARCOC
Attachment C: IH SARF
Attachment D: RPDP SARF
Attachment E: RPSD SARF
Attachment F: Sample Label
Attachment G: Holding Times and Sample Preservation
Attachment H: Radiological Survey Form

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Revision History

Revision	Effective Date	Summary of Changes
Rev 0	01/25/1995	New Document
Rev 1	04/08/1996	Administrative Updates
Rev 2	12/19/2003	Organization ownership change from Sandia ES&H to Environmental Restoration Project
Rev 3	03/28/2007	Changed revision cycle from 2 to 3 years. Organization ownership change from Sandia Environmental Restoration Project to Sandia ES&H Organization.
Rev 4	06/29/2011	Programmatic revisions include the addition of the Sample Management Analysis Request Tool (SMART) and the addition of Industrial Hygiene (IH) sampling. Other revisions are definition updates, sentence structure, grammar, and formatting. Additions include Revision History page, tracking box and footnote disclaimer
Rev 5	11/12/2013	Programmatic revisions include improvements to ARCOC processing, the addition of Bioassay sampling and changes to Industrial Hygiene (IH) sampling to include the use of the Radiological Process Knowledge Form (SF 6951-RRF). Chem101 and PKX050 were added to training requirements. The chemicals were removed from use in addition to removing the use of the fume hood. Added SMO QA Coordinator role. Other revisions include updating language to reflect current program elements and requirements.

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ACRONYMS AND ABBREVIATIONS

AOP	Administrative Operating Procedure
ARCOC	Analysis Request/Chain-of-Custody Record
COC	Chain-of-Custody
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
IATA	International Air Transport Association
IH	Industrial Hygiene
LOP	laboratory operating procedure
OP	operating procedure
PHS	Primary Hazard Screening
RCT	Radiation Control Technician
RMA	Radioactive Materials Area
RPDP	Radiation Protection Dosimetry Program
RPPM	Radiation Protection Procedures Manual
RPSD	Radiation Protection Sample Diagnostics
SALI	Sample Analysis Laboratory Information
SARF	Sample Analysis Request Form
SMART	Sample Management Analytical Request Tool
SMO	Sample Management Office
SMO-QAPP	Sample Management Office Quality Assurance Project Plan
SNL/NM	Sandia National Laboratories/New Mexico
SOW	Statement of Work

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1.0 PURPOSE, SCOPE, AND OWNERSHIP

1.1 Purpose

This administrative operating procedure (AOP) describes the handling of samples at Sandia National Laboratories/New Mexico (SNL/NM) Sample Management Office (SMO) and delineates requirements for the selection of sample containers, required sample volumes, holding times, preservation techniques and sample custody control and documentation. This procedure also contains basic requirements for packaging and shipping environmental, industrial hygiene, bioassay and waste samples. Refer to the Sample Handling, Packaging and Shipping Laboratory Operating Procedure, LOP 94-03 for more detailed sample packaging and shipping requirements. This procedure implements Section 3.3.3, Sampling Handling and Custody Requirements, of the Sample Management Office/Quality Assurance Project Plan (SMO-QAPP).

1.2 Scope

This document applies to SNL/NM sampling projects that use the services of the SMO. Projects that reference this procedure or process samples through the SMO shall comply with this procedure. Samples, forms, and data submitted to the SMO for processing shall conform to the requirements in this procedure.

1.3 Ownership

The SMO owns this document. The SMO is responsible for preparing, revising, and distributing this document as necessary.

2.0 RESPONSIBLE INDIVIDUALS AND ORGANIZATIONS

The **Department Manager** is responsible for the following:

- Providing programmatic guidance leading to the development of this AOP.
- Reviewing and approving the procedure.
- Acting as liaison to the U.S. Department of Energy (DOE) and National Nuclear Security Administration/Sandia Field Office (NNSA/SFO) regarding sample management issues.

The SMO **Technical Lead** is responsible for the following:

- Updating this procedure.
- Developing and maintaining the SNL/NM Sample Management Office (SMO) Contract Statement of Work for Analytical Laboratories (SMO-SOW).
- Managing contractor laboratory services including procurement, routine performance assessments and general laboratory oversight.

The SMO **QA Coordinator** is responsible for the following:

- Providing project data quality assurance guidance.

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- Ensuring that this procedure is distributed to the appropriate personnel for project/program use.
- Ensuring that sufficient quality checks are in place to maintain the integrity of the SMO sample information management and analytical result database.
- Documenting non-conformances and corrective actions in accordance with the applicable SMO-QAPP.
- Interfacing with the Records Management Coordinator for maintenance of project documentation and to resolve record management concerns for storage and maintenance of sampling and analysis records.

The **SMO Packaging Coordinator and Packaging support staff** are responsible for receiving and packaging samples shipped through the Receiving/Mail & Material Movement Organization (10263, "Shipping and Receiving") to the contracted laboratories for analysis. SMO Packaging Coordinator(s) and Support Staff responsibilities include but are not limited to the following:

- Overseeing the day-to-day operations of the SMO Sample Packaging Facility and support personnel.
- Verifying proper sample collection documentation from field sampling personnel.
- Ensuring that sample custody is properly maintained and documented in accordance with the most current SMO-QAPP.
- Ensuring all samples, with the exception of groundwater samples or known non-radiological samples with a Clearance-Radiological Process Knowledge Form SF 6951-RRF (Attachment A) on file, receive a radiological survey by a Health Physics Radiation Control Technician (RCT) prior to shipment to an analytical laboratory.
- Ensuring samples are properly stored and packaged for shipment to the analytical laboratories in accordance with the SMO-QAPP, DOE, U.S. Department of Transportation (DOT) and International Air Transportation Administration (IATA) regulations. (Refer to LOP 94-03.)
- Interfacing with SNL/NM Shipping, Radiation Protection Operations and other SNL/NM on-site organizations;
- Ensuring Samples are shipped in a timely manner giving laboratories sufficient time to analyze samples within holding times.

The **SMO Customer(s)/Sampling Personnel** are responsible for sampling and initiating chain-of-custody documentation. Sampling personnel are responsible for performing the applicable activities prescribed in this procedure, including but not limited to:

- Utilizing the Sample Management Analysis Request Tool (SMART) to initiate and submit bottle orders, to produce container labels and to produce and submit the Analytical Request Chain-of-custody (ARCOC) (Attachment B).
- Utilizing the Industrial Hygiene (IH) Sampling Analysis Request Form (SARF) chain-of-custody for industrial hygiene customers (Attachment C).
- Utilizing the Radiation Protection Dosimetry Program (RPDP) SARF chain-of-custody for RPDP customers (Attachment D).
- Providing the SMO with the Radiation Survey Documentation (Attachment H) for samples coming out of a Radioactive Material Area (RMA).
- Working with the Radiation Protection program, and providing the SMO with a copy of the Clearance-Radiological Process Knowledge Form, SF 6951-RRF (Attachment A), for non-

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radiological samples. This is not mandatory, but will help expedite sample processing for some sampling programs.
- Labeling and using the correct containers and preservatives for the materials to be analyzed.
- Documenting field parameters during the sampling event according to applicable sampling procedure(s).
- Collecting sufficient volumes of samples for all analyses, including quality control analyses.
- Delivering samples to the SMO Packaging Facility according to chain-of-custody requirements and in secure/safe condition according to SMO requirements as stated in the Sample Handling, Packaging and Shipping Laboratory Operating Procedure (LOP 94-03).
- Delivering samples to SMO in a timely manner and communicating with SMO staff about short holding times.

The **Analytical Laboratory** is responsible for following the applicable SMO-SOW. Requirements include, but are not limited to:
- Developing and maintaining quality assurance programs and procedures in accordance with the applicable SMO-SOW.
- Providing sampling kits that include coolers and certified sample containers to the SMO using appropriate cleaning methods and preservatives.
- Ensuring that sample custody is properly maintained and documented in accordance with the current SMO-QAPP and SMO-SOW.
- Immediately notifying the SMO of non-conformances such as broken sample custody seals, leaking sample containers, broken sample containers, incorrect sample containers and incorrect preservation (i.e., pH, temperature).
- Performing analyses in accordance with the applicable SMO-SOW.
- Analyzing samples within required holding times.
- Providing data in accordance with format requirements in the applicable SMO-SOW.
- Handling of samples from receipt at the laboratory through completion of analysis maintaining sample integrity.
- Returning sample control documentation and analytical reports to SMO in accordance with contract and project requirements.

3.0 TRAINING QUALIFICATIONS

Personnel shall be trained and qualified as necessary to perform their assigned work. The Sandia Education and Training Organization provides basic training and qualification guidance. Training requirements are presented in activity-specific operating procedures with specific requirements for the tasks performed. Personnel shall be trained according to established training cycles to maintain proficiency. Training shall be updated to meet required frequency schedules when specified. Details of corporate training are outlined in the SMO-QAPP and are referenced in the current Primary Hazard Screening (PHS) document, PHS 972834764, SMO Packaging Facility Operations and in LOP 94-03.

SMO personnel and customers are responsible for adherence to training requirements stipulated in this procedure and the current SMO-QAPP and the SMO Packaging Facility Operations PHS as it pertains to each individual.

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4.0 SAMPLE DOCUMENTATION AND MATERIALS

4.1 Bottle Order/Sample Request Form & Sample Containers

The Bottle Order/ Sample Request form is accessed through the SMART application. The completed and approved Bottle Order initiates the sampling process and is used to complete the ARCOC. The ARCOC may be obtained from the SMO home page, Electronic Forms link, or through the SMART application. Note that the SMART application is *not* used for the IH SARF or RPDP SARF chain-of-custody.

Recommended sample containers and chemical preservatives may be obtained by logging on to the SMO SMART application and completing the Bottle Order/Sample Request form. Most projects require that a bottle order be placed with the contract laboratory. (The IH and Bioassay projects do not utilize the SMO Bottle Order process.) It is recommended that bottle orders be submitted for approval to the SMO one to two weeks prior to sampling. The purpose of the bottle order is to:

- Initiate the sampling process.
- Notify the lab of the expected number of samples and analyses.
- Notify the lab of expected sampling dates.
- Obtain sample containers from certified suppliers with analytical method specified chemical preservatives. (Containers are inspected as covered in Part B, Section 3.3.8 of the SNL/NM SMO-QAPP.)

4.2 Analytical Request Chain-of-custody (ARCOC or COC, SARF) Forms

The COC provides an accurate and defensible written and/or computerized record to trace the possession and handling of a sample from collection to completion of all required analyses. COC records provide a record of sample history and are critical for data integrity. Four different COC forms may be submitted to the SMO:

- Contract Laboratory Analysis Request and Chain-of-custody (ARCOC) (Attachment B)
- Industrial Hygiene SARF (IH SARF)(Attachment C)
- Radiation Protection Dosimetry Program Sample Analysis Request Form (RPDP SARF) (Attachment D)
- Onsite Laboratory/Radiation Protection Sample Diagnostics (RPSD) Sample Analysis Request Form (RPSD SARF) (Attachment E)

4.3 Sample Label

An SMO SNL/NM sample label must be completed with indelible ink and affixed to each sample container prior to or during sampling. The label in Attachment F is required for all samples submitted on an ARCOC. The Sample Label is produced after completion of the SMART application ARCOC and using the label printer model Zebra LP 2844. It may also be produced using a spreadsheet and the Zebra

label printer. A label printer is available for customer use at the SMO Packaging Facility (Building 928) and at the Field Office (Building 9925). The Sample Label information shall match the information on the corresponding ARCOC. For samples not submitted under the ARCOC, the label information must match the information on the SARF. Each completed sample label submitted on an ARCOC includes the following:

- SMO SNL/NM Sample Identification Number (The first 5 digits of the Sample Number are controlled and obtained from the SMO. The Sample fraction designation is assigned by the sampler.)
- ARCOC Number
- Sample location
- Date and time of sample collection
- Sample matrix type
- Chemical Preservative
- Analysis
- Collector's name
- SNL/NM Thunderbird logo

Samples submitted on a SARF chain-of-custody will contain a SARF chain-of-custody number. and Sample Number.

4.4 Custody Seals

Sample custody seals are used to help determine unauthorized tampering of samples following collection until the time of sample preparation and analysis. SNL/NM uses adhesive backed seals with the SNL/NM Thunderbird logo. Custody seals may be obtained from an SMO Packaging Facility representative. Initialed and dated seals must be affixed to sample containers before the samples leave the custody of the sampling personnel. IH containers and Volatile Organic Compound containers are exempt from this requirement. The container(s) are placed in a sealed plastic bag and the bag, not the container(s), is secured with the custody tape.

- The custody seal is initialed and dated while the seal is affixed to the backing.
- The seal is then removed from the backing and affixed to the container in such a manner that it is necessary to break the seal in order to open the container.
- The custody seal may be removed by the person initiating or retaining custody of the sample (e.g., the sampling personnel or the analytical laboratory sample custodian).
- The integrity of the seal must be verified prior to its removal.
- A broken seal invalidates the sample and must be documented as a nonconformance.

4.5 SNL/NM "Shipper" Form and Shipper's Waybill

The SNL/NM electronic shipping form, Web Shipper, is required on all shipments leaving SNL/NM. The Web Shipper and the commercial shipper's waybill complete the sample custody documentation and show possession of the sample from shipment to arrival at a contract laboratory. A copy of the Web Shipper form and shipper's waybill (if applicable) under which the samples are shipped shall be retained to document shipment of the sample(s). The SMO Packaging Facility Personnel are responsible for completing all shipping documentation per the current version of LOP 94-03.

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5.0 SAMPLE MANAGEMENT PROCEDURES

5.1 Sampling Kit Procedure (Bottle Orders)

Required sample containers and chemical preservatives are obtained by logging on to the SMO SMART application and completing the Bottle Order/Sample Request form. Most projects require that a bottle order be placed with the contract laboratory. IH and RPDP Bioassay programs do not require a Bottle Order.

The Bottle Order initiates the sampling process for the projects that utilize the ARCOC. The customer shall submit a Bottle Order request to the SMO utilizing the SMART application. Upon receipt, the SMO reviews the Bottle Order and submits it to the contract laboratory. The contract laboratory provides sampling kits according to the Bottle Order specifications. The SMO shall ensure staff is trained in sampling kit requirements. It is recommended that bottle orders be submitted for approval to the SMO one to two weeks prior to sampling. IH and RPDP projects do not utilize the SMART application for sampling kits.

The SMO shall provide oversight and ensure that the laboratories follow the SMO-SOW as it pertains to providing sampling kits. The laboratories shall have applicable procedures and processes in place. The SMO shall inspect sampling kits to determine that they are intact, accurate, and meet any specific written requirements associated with the SMO-SOW. Any errors or damage to sampling kits will be addressed in accordance with the SMO-SOW and procurement policies.

5.2 Sampling Considerations

For sampling requirements, refer to Sample Containers and Preservatives, Holding Times and Sample Preservation (Attachment G).

Sample Volume**:** The volume of the sample collected should be sufficient to perform all the required analyses plus any additional volume needed to meet quality control requirements or repeat analyses. The minimum sample volume required for typical analytical procedures is listed in Attachment G, Holding Times and Sample Preservation. After the Bottle Order/Sample Request form is complete and approved, the required sample volumes will auto fill on the ARCOC when initiated. Laboratory-specific sample volume requirements may apply.

For the IH SARF chain-of-custody, the IH customer is responsible for meeting volume requirements.

Sample Preservation: Prior to sampling, the appropriate chemical preservative(s) is added to the sample bottles by the analytical laboratory. Due to the variety of chemical tests performed on samples, it may be impractical to chemically preserve samples during actual field collection. Following collection, most samples are cooled and maintained at <6˚C (i.e., stored in a cooler with ice or ice gel or in a refrigerator) to conform to temperature preservation requirements. Chemical and temperature Preservation requirements are listed in Attachment G and will auto fill on the Bottle Order and the ARCOC forms.

For the IH SARF COC, the IH customer is responsible for meeting sample preservation requirements.

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Holding Times: Holding time is the time interval between sample collection and sample preparation or analysis. Holding times are calculated in days or hours, according to the time units used in the U.S. Environmental Protection Agency (EPA) holding time requirements. That is, if the EPA-specified holding time is given in hours, then the analysis must be complete before the end of the last hour of the holding time when calculated from the sampling time. When the holding time is given in days, the analysis must be complete before the end of the day on which the holding time would expire as calculated from the sampling day. Recommended maximum holding times are listed in Attachment G and should be adhered to. Samples should be shipped to the laboratory at the completion of each day of sampling, or as soon as practical.

SMO will make every effort to notify the laboratory when samples having less than 72 hours of the holding time remaining are to be shipped.

Sample Storage: All samples shall be stored in a secured location when not in the immediate custody of an individual. The samples should be stored under physical and environmental conditions commensurate with the preservation requirements and intended analysis. Sample integrity must be maintained during sample storage through access controls and documentation. Samples shall be placed in a sample storage refrigerator and allowed to equilibrate to the required temperature prior to shipment to a contract laboratory.

Daily verification and documentation of storage temperature should be maintained when temperature is a preservation requirement. Additional measures must be taken to separate waste samples from non-waste samples in order to avoid cross-contamination. Trip blanks should be used as appropriate to determine sample contamination during sample storage and shipment.

5.3 Sample Custody Procedure

Custody procedures provide an accurate record of sample history and shall be followed by SMO, field (sampling) and laboratory personnel to provide an accurate record of sample history.

By definition, a sample is in custody if it is:

- In one's possession,
- In view,
- In a controlled access area
- In transit following proper chain-of-custody procedures.

Sampling Team Member (Customer) Custody Procedure

A Sample Team Member is responsible for the care and custody of samples collected until sample custody is properly transferred. The following procedure shall be used to ensure proper control of samples:

- For the ARCOC, a project team member must submit to the SMO a Bottle Order at least 7 days prior to the requested delivery date for containers. The Bottle Order is initiated using the SMART application found on the SMO homepage. Once the Bottle Order is submitted, it will go through an SMO approval process and will be submitted to the appropriate analytical laboratory. Upon approval, all project team members will be notified. The approved Bottle Order is used by the customer to

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complete the ARCOC. From the approved Bottle Order, the Sample Matrix, Container Type and Volume, Preservative, Analysis Parameter and Method will pre-fill the ARCOC. SMART application Bottle Orders are not submitted for the IH or RPDP Bioassay SARF COC or the Onsite Laboratory (RPSD) Sample Analysis Request Form (RPSD/SARF).

- For the ARCOC, the Sample Team Member documents sample collection information: *Sample-No.-Fraction, Sample ID or Sample Location Detail, Pump Depth, Date/Time Collected, Collection Method, Sample Type, Filtered/Unfiltered sample* (refer to LOP 94-03).
- For the IH SARF COC, the sample team member will provide a completely filled form to include *IH Survey ID number, Submitted by name, Submission date, Analysis Requested, IH Sample #, Col. Date, Turn-Around-Time, Matrix.* In the *Sample Comments* section, the IH sample team member or the SMO will assign a unique sample number and fraction for each *IH Sample #.* The IH SARF COC is 2 pages. The second page is the received/relinquished page. The corresponding second page must include the IH Survey ID number.
- If samples are destined for the on-sight Radiation Protection Sample Diagnostics (RPSD) laboratory for analysis (i.e., gamma spec, alpha, beta, etc.), the customer shall complete either the paper form RPSD/SARF COC (Attachment E) provided by the RPSD laboratory or submit an electronic version of the SARF through the Sample Analysis Laboratory Information (SALI) system.
- For the ARCOC, sample container labels (Attachment F) shall be affixed to sample containers, or in some cases, to the re-sealable bag, and shall match information on the associated ARCOC. Sample labels shall be legible and completed in indelible ink. (Refer to LOP 94-03). Blank Sample Labels may be obtained by contacting an SMO Packaging Facility representative or may be printed from the SMO SMART Application. (See Sample Labeling section.)
- All samples shall be accompanied with corresponding ARCOC, IH or RPDP SARF, COC, and/or RPSD SARF documentation.
- Samples shall be delivered to the SMO Packaging Facility for review of custody documentation prior to acceptance and transfer of custody to the SMO. (Refer to LOP 94-03).
- The SMO Packaging Facility shall process samples as required by LOP 94-03. Samples submitted by sampling team members to the SMO Packaging coordinator or support staff shall be clean, sealed, and intact. Sample container lids shall be secured with custody tape that has been initialed and dated. Glass containers are placed in re-sealable bubble bags and double bagged. If samples are from an area designated as a Radioactive Material Area (RMA), the sampling team member shall include the Radiation Survey Documentation (Attachment H) with the samples. (Refer to LOP 94-03).
- A sampling team member shall assist the Sample Packaging Facility representative verifying that all sample containers and request forms are correct and complete. (Refer to LOP 94-03).
- Upon complete verification, the sampling team member shall transfer custody of the samples to the SMO Packaging Facility representative by signing, dating and noting the time on the appropriate *Relinquished By* line on the ARCOC,IH or RPDP SARF, COC, and/or RPSD SARF. The SMO Packaging Facility representative shall then accept custody by signing, dating, and noting the time on the appropriate *Received By* line, below the *Relinquished By* signature.

Packaging Coordinator Procedure

- The SMO Packaging Facility representative shall relinquish samples to the contract laboratory by signing the *Relinquished By* line on the ARCOC, SARF, or COC. The chain-of-custody documentation is then put into a zip-lock bag and placed inside the shipping container/cooler. The shipping container/cooler is then closed and sealed with custody tape and delivered to SNL/NM Shipping and Receiving personnel for shipment to contract laboratories. Included with the shipping

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container is a completed Web Shipper. The SNL/NM Shipping and Receiving Department shall be responsible for assigning the shipment to the appropriate commercial carrier (overnight air shipment is preferred) and for final labeling of the container/cooler. Non-hazardous samples may be hand-delivered to local analytical laboratories by the SMO after meeting all other requirements for packaging and shipping. Refer to LOP 94-03 for detailed sample handling, packaging, and shipping requirements and instructions.

- The SNL/NM Shipping/Receiving Department is responsible for completing the shipping documentation, including the waybill. The SMO shall retain a copy of all sample custody documents including shipping documentation.

Analytical Laboratory Custody Procedure

Sample custody is transferred to the contract laboratory at the time of sample receipt, after which the contract laboratory is responsible for maintenance of unbroken chain-of-custody. The analytical laboratory shall maintain the sample custody records until sample analysis is complete. Sample receipt requirements for the analytical laboratory are:

- At the time of receipt, the subcontract laboratory sample custodian shall sign and date the ARCOC or SARF COC form in indelible ink to acknowledge sample receipt and to accept custody.
- The contract laboratory sample custodian receiving the samples shall verify that the information listed on the ARCOC or SARF COC form is correct and accurately describes the contents of the shipment.
- Maintain records to clearly document all internal transactions as well as the final disposition (e.g., destruction) of the sample.
- Retain samples for at least 60 days, or according to contract or project requirements, after the final analytical report is issued.
- Return custody documentation (original ARCOC, IH SARF, or RPDP SARF or applicable chain-of-custody) to SMO SNL/NM upon completion of analysis.
- Follow the current version of the SMO-SOW

Non-conformance and Corrective Action:

Any non-conformances and corrective actions related to processes described in this procedure and associated corrective actions will be documented, approved, and implemented in accordance with the requirements of the SMO-QAPP and the responsibilities identified in this procedure (Section 4.0). Non-conformances shall be identified by any personnel (e.g., SNL/NM staff; contractor; or contract analytical laboratory).

6.0 RECORDS MANAGEMENT

The SMO shall maintain records to document activities and to provide support for possible evidential proceedings. Records that provide documentary evidence of quality shall be specified, prepared and maintained in accordance with appropriate SNL/NM record-keeping procedures. SMO records shall be transferred to the customer as well as the Records Center for cataloging and storage in accordance with SNL/NM and DOE requirements. The following documentation required by this procedure should be submitted to the Project/Task Leader or SMO personnel for review, approval, and storage in the Records Center:

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- ARCOC, IH SARF COC, or RPDP SARF COC Record (hard copy to Records Center)
- Shipper form (hard copy to Records Center)
- Radiation Survey Documentation when applicable (hard copy to Records Center)
- Data package electronic file and EDD
- Nonconformance and corrective action records
- Pertinent correspondence

References

International Air Transport Association (IATA) Dangerous Goods Regulations, current edition, 52nd Edition (updated annually), International Air Transport Association (IATA), Montreal, Canada

National Nuclear Security Administration Service Center Model Statement of Work for Analytical Laboratories, current revision, National Nuclear Security Administration Service Center, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico Quality Assurance Project Plan for the SNL/NM Sample Management Office (SMO-QAPP), current revision, Sandia National Laboratories/New Mexico Sample Management Office, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico Sample Handling, Packaging and Shipping Laboratory Operating Procedure (LOP 94-03), current revision, Sandia National Laboratories/New Mexico Sample Management Office, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico Statement of Work for Analytical Laboratories, current revision, Sandia National Laboratories/New Mexico Sample Management Office, Albuquerque, NM

U.S. Environmental Protection Agency Code of Federal Regulations (CFR), CFR Title 49, Updated Quarterly as of October 1st, U.S. Environmental Protection Agency, Washington, DC

U.S. Occupational Safety and Health Administration Code of Federal Regulations (CFR), Title 29, Section 1910.1200, Updated Quarterly as of July1st, U.S. Occupational Safety and Health Administration Government Printing Office, Washington, D.C.

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ATTACHMENTS

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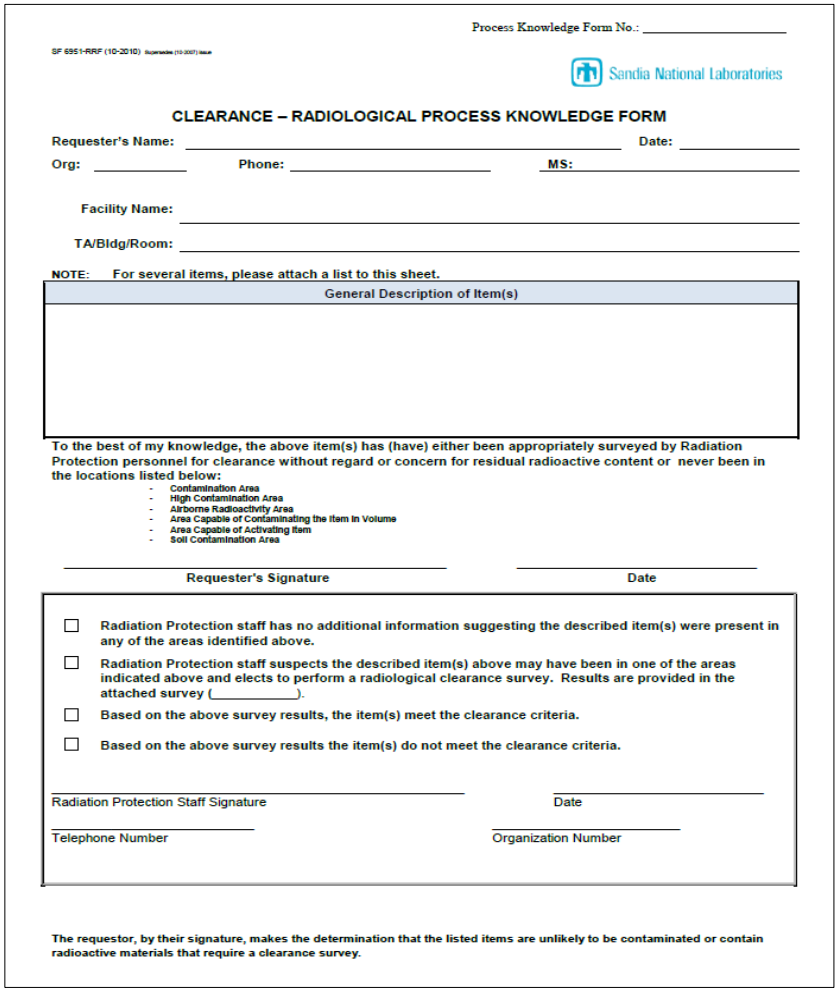
ATTACHMENT A: CLEARANCE RADIOLOGICAL PROCESS KNOWLEDGE FORM SF 6951-RRF



Process Knowledge Form No.: _____

SF 6951-RRF (10-2010) Supersedes (10-2007) Issue

Sandia National Laboratories

CLEARANCE – RADIOLOGICAL PROCESS KNOWLEDGE FORM

Requester's Name: _____ Date: _____

Org: _____ Phone: _____ MS: _____

Facility Name: _____

TA/Bldg/Room: _____

NOTE: For several items, please attach a list to this sheet.

General Description of Item(s)

To the best of my knowledge, the above item(s) has (have) either been appropriately surveyed by Radiation Protection personnel for clearance without regard or concern for residual radioactive content or never been in the locations listed below:

- Contamination Area
- High Contamination Area
- Airborne Radioactivity Area
- Area Capable of Contaminating the Item In Volume
- Area Capable of Activating Item
- Soil Contamination Area

_____ _____
Requester's Signature Date

☐ Radiation Protection staff has no additional information suggesting the described item(s) were present in any of the areas identified above.

☐ Radiation Protection staff suspects the described item(s) above may have been in one of the areas indicated above and elects to perform a radiological clearance survey. Results are provided in the attached survey (_____).

☐ Based on the above survey results, the item(s) meet the clearance criteria.

☐ Based on the above survey results the item(s) do not meet the clearance criteria.

_____ _____
Radiation Protection Staff Signature Date

_____ _____
Telephone Number Organization Number

The requestor, by their signature, makes the determination that the listed items are unlikely to be contaminated or contain radioactive materials that require a clearance survey.

ATTACHMENT B:
CONTRACT LABORATORY ANALYSIS REQUEST AND CHAIN-OF-CUSTODY
SMO 2012-ARCOC

SMO 2012-ARCOC (4-2012) — AOP 95-16

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY

Internal Lab — Page _1_ of __

Batch No. — SMO Use — AR/COC

Project Name:	Date Samples Shipped:	SMO Authorization:	☐ Waste Characterization ☐ RMMA ☐ Released by COC No.
Project/Task Manager:	Carrier/Waybill No.	SMO Contact Phone:	
Project/Task Number:	Lab Contact:		☐ 4° Celsius
Service Order:	Lab Destination:	Send Report to SMO:	Bill to: Sandia National Laboratories (Accounts Payable),
	Contract No.:	Rita Kavanaugh/505.284.2553	P.O. Box 5800, MS-0154
Tech Area:			Albuquerque, NM 87185-0154
Building: Room:	Operational Site:		

Sample No.	Fraction	Sample Location Detail	Depth (ft)	Date/Time Collected	Sample Matrix	Container Type	Container Volume	Preserv-ative	Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID

Last Chain: ☐ Yes	Sample Tracking — SMO Use	Special Instructions/QC Requirements:	Conditions on Receipt
Validation Req'd: ☐ Yes	Date Entered:	EDD ☐ Yes ☐ No	
Background: ☐ Yes	Entered by:	Turnaround Time ☐ 7 Day* ☐ 15 Day* ☐ 30 Day	
Confirmatory: ☐ Yes	QC inits.:	Negotiated TAT ☐	
		Sample Disposal ☐ Return to Client ☐ Disposal by Lab	
		Return Samples By:	
		Comments:	

Sample Team Members	Name	Signature	Init.	Company/Organization/Phone/Cell

1. Relinquished by	Org.	Date	Time	3. Relinquished by	Org.	Date	Time
1. Received by	Org.	Date	Time	3. Received by	Org.	Date	Time
2. Relinquished by	Org.	Date	Time	4. Relinquished by	Org.	Date	Time
2. Received by	Org.	Date	Time	4. Received by	Org.	Date	Time

*Prior confirmation with SMO required for 7 and 15 day TAT

This ARCOC is for example purposes only. The ARCOC currently in effect is posted on the 4100 Controlled Documents homepage (SMO 2012-ARCOC).

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ATTACHEMNT C: Industrial Hygiene (IH) SARF Chain-of-custody

SANDIA
SNL NM
SARF Chain of Custody Report

IH Survey ID: S01013 Lab Log Batch ID: Lab receiving sample
Sample location TA1 897 1300

Submitted By: CASTILLO,R Submission Date:
Charge code:

Send Report To: SNL NM Attention of: CASTILLOR
Address: Email:
Phone: Fax:

Analysis requested (please be specific if possible)
CADMIUM

General comments to lab personnel
Additional Potential Hazards, Name and phone/pager of a person knowledgeable about the sample origin and hazards

IH Sample #	Lab ID	Col. Date	Turn-Around-Time	Matrix	Sample Comments
12345678901		11/17/2010	NORMAL (15 DAYS)	SWIPE	088750-001
12345678902			NORMAL (15 DAYS)	SWIPE	088750-002
12345678903			NORMAL (15 DAYS)	SWIPE	088750-003

Samples Checked For
☐ Container Integrity
☐ Sample Size
☐ Sampling Label

Condition of Sample Receivec
☐ Acceptable
☐ Not Acceptable

Custody Seals
☐ Present
☐ Not Present

ATTACHMENT D:
RPDP SAMPLE ANALYSIS REQUEST FORM

RPDP SARF

SAMPLE ANALYSIS REQUEST FORM (SARF)
RADIATION PROTECTION DOSIMETRY PROGRAM (RPDP)

Page 1 of 1

RPDP BATCH NO. _____ RPSD LOG NO. _____

Customer Name: Goke, Sarah Hayes
Organization: 4121
MailStop: 0651
Phone: 845-DOSE / 284-5598
Email: dosimetry@sandia.gov
Prgm Name: Radiation Protection Dosimetry Program

Analytical Lab: _____
Lab Contact: _____
Contract No.: _____
Date Shipped: _____
Shipper No.: _____
RPDP Contact/Ph: Sarah Hayes Goke / 505.284.5598

Send Results to: RPDP
P.O. Box 5800, MS-0651
Albuquerque, NM 87185
Email: dosimetry@sandia.gov
FAX: 505.844.8313

Bill to: Sandia National Laboratories
Accounts Payable Department
P.O. Box 5800, MS-1383
Albuquerque, NM 87185-1383

Customer Sample ID	Lab Sample ID	Date Collected	Time Collected 0-24 HRS	TAT	Sample Matrix	Qty/Tot Volume Tare Wt	Rad Screen (cpm)	QC Set	EDD (Off-Site Labs) [ ] Yes [X] No: Parameter / Method Requested	Lab Notes

Turn Around Time(TAT) Instructions
ENTER DATE NEEDED BY: (applicable to all samples)

N - Normal, R - Rush, U - Urgent

Special Instructions/Hazards
Biological Sample - Treat With Caution
Contact: Sarah Hayes Goke, 284-5598, pager (800) 237-6849

Sample(s) Condition on Receipt
[ ] Normal
[ ] Abnormal
If abnormal, fill out the attached Sample Condition Upon receipt form and contact the customer about the sample condition before proceeding further.

1. Relinquished by	Org.	Date	1. Received by	Org.	Date
2. Relinquished by	Org.	Date	2. Received by	Org.	Date
3. Relinquished by	Org.	Date	3. Received by	Org.	Date
4. Relinquished by	Org.	Date	4. Received by	Org.	Date
5. Relinquished by	Org.	Date	5. Received by	Org.	Date
6. Relinquished by	Org.	Date	6. Received by	Org.	Date

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ATTACHMENT E: ONSITE LABORATORY (RPSD) SAMPLE ANALYSIS REQUEST

RPSD SARF

Sandia National Laboratories
Sample Analysis Programs

Sample Analysis Request Form
Page ____of ____

To be completed by Customer

Shaded areas are for Lab use

Customer Name: _____
Customer Email ID: _____
Organization: _____
Phone: Sample _____
Location (Bldg/Rm): _____
Date Results Needed: _____
Project/Task Number: _____

Hazards/Special Instructions:

☐ Provide EDD

Batch Log No: _____
Logged By: _____

o RPOP - Rad Protection Operation
o RPID - Dosimetry
o RPSD - Sample Diagnostics
o IH - Industrial Hygiene
o DND -DeconDecom
o EXT- External
o SND - Source & Device
o WM – Waste Management
o OTH - Other
o EM - Environment Monitoring
o EMAA - Ambient Air
o EMWW - Waste Water
o EMGW - Ground Water
o EMTS - Terrestrial surveill
o EMSW - Storm Water
o CMC – Coop Monitoring Ctr
o ER – Enviroment Restoration

Customer Sample ID	Sample Type	Date/Time Collected	Sample Amount or Flow Rate	Requested Analysis	Survey or COC#	Lab ID	Rad Screen(CPM)	Remarks/Aliquot Amount

Relinquished by _____ Date _____ Received by _____ Date_____

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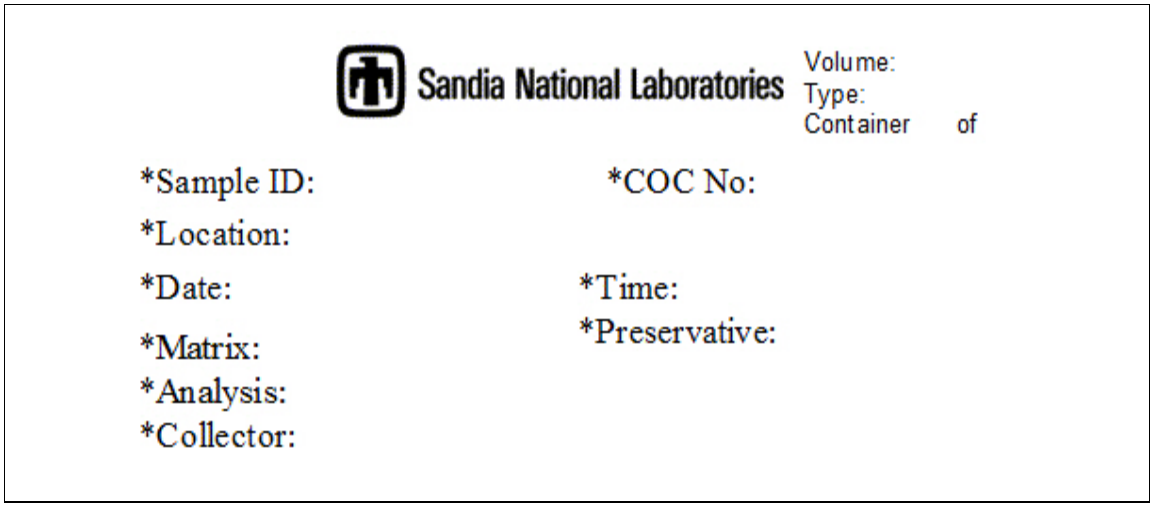
ATTACHMENT F
SAMPLE LABEL
http://info.sandia.gov/esh/smo/
https://info.sandia.gov/esh/smo_application



***Required fields**

ATTACHMENT G
SAMPLE CONTAINERS AND PRESERVATIVES
Holding Times and Sample Preservation

305.1,310.1	Acidity, Alkalinity	Water	Plastic or Glass	4 °C	14 Days	NA
300, 320.1, 325	Bromide, Chloride	Water	1 L Plastic	4 °C	28 Days	NA
340.2, 375.X	Fluoride, Sulfate	Solid/Other	125 mL Glass Jar	4 °C	28 Days	NA
405	BOD	Water	1 L Plastic	4 °C	48 Hours	NA
9010B, 9014	Total Cyanide	Water	1 L Plastic	4 °C; NaOH; pH > 12	14 Days	NA
		Solid/Other	125 mL Glass Jar	4 °C	14 Days	NA
415, 9060	DOC, TOC	Water	250 mL Amber Glass	4 °C; H_2SO_4; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	4 °C	28 Days	NA
200, 6010, 6020, 7000	All metals except Cr(VI) and Hg	Water	500 mL Plastic	HNO_3 ; pH < 2	180 Days	NA
		Solid/Other	250 mL Glass Jar		180 Days	NA
3060A, 7196A, 7197	Cr(VI)	Water	500 mL Plastic	4 °C	24 Hours	NA
		Solid/Other	250 mL Glass Jar	4 °C	30 Days	NA
245, 7470A, 7471A	Hg	Water	500 mL Plastic	HNO_3 ; pH < 2	28 Days	NA
		Solid/Other	250 mL Glass Jar	4 °C	28 Days	NA
130.1	Hardness	Water		HNO_3 ; pH < 2 4 °C	180 Days	NA
345.1	Iodide	Water		4 °C	24 Hours	NA
300, 353.1, 351, 365	Ammonium, Nitrate + Nitrite Total Phosphorus, TKN	Water	1 L Plastic	4 °C; H_2SO_4; pH < 2	28 Days	NA
		Solid/Other	250 mL Glass Jar	4 °C	28 Days	NA
300, 365, 9210	Nitrate, Nitrate + Nitrite, Nitrite, Ortho Phosphorus	Water	500 mL Plastic	4 °C	48 Hours	NA
		Solid/Other	250 mL Glass Jar	4 °C	48 Hours	NA

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1664, 9070	Total Recoverable oil and Grease	Water	1 L Glass	4 °C; H_2SO_4; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	4 °C	28 Days	NA
376	Sulfide	Water	1 L Glass	4 °C; NaOH; Zinc acetate; pH > 9	7 Days	NA
		Solid/Other	125 mL Glass Jar	4 °C	7 Days	NA
160	TDS, TSS, TS	Water	1 L Plastic	4 °C	7 Days	NA
9020B	TOX	Water	1 L Glass	4 °C; H_2SO_4; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	4 °C	28 Days	NA
418.1, 8440	TPH	Water	1 L Amber Glass	4 °C; H_2SO_4; pH < 2	28 Days	NA
1664		Solid/Other	125 mL Glass Jar	4 °C	28 Days	NA
9065, 9066	Total Recoverable Phenols	Water	1 L Glass	4 °C; H_2SO_4; pH < 2	28 Days	NA
		Solid	125 mL Glass Jar	4 °C	28 Days	NA
150, 9040B	pH	Water	125 mL Plastic	4 °C	24 Hours	NA
110, 180	Color, Turbidity	Water	500 mL Plastic	4 °C	48 Hours	NA
120, 9050	Specific Conductance	Water	125 mL Plastic	4 °C	28 Days	NA
All radiochemical parameters except Rn-222 and tritium		Water	1 L Plastic (2 x 2 L Preferred)	HNO_3 ; pH < 2	180 Days	NA
		Solid/Other	250 mL Glass Jar		180 Days	NA
Rn-222	Radon 222	Water	3 x 40 mL Amber Glass Vial	None	72 Hours	NA
Tritium	^3H	Water	1 L Glass		180 Days	NA
		Solid/Other	Required sample size will vary with solid moisture content			NA
8015	Petroleum Hydrocarbons	Water	2 x 1 L Amber Glass Bottle	4 °C	14 Days	40 Days
		Soil/Other	250 mL Glass Jar	4 °C	14 Days	40 Days

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8021B	Halogenated Volatile Organics	Water	3 x 40 mL Amber Glass Vial	4 °C; HCl; pH < 2	14 Days	NA
		Soil/Other	125 mL Glass Jar	4 °C	14 Days	NA
8081, 8082	Organochlorine Pesticides, PCBs	Water	4 L Amber Glass Bottle	4 °C	7 Days	40 Days
		Soil/Other	250 Glass Jar	4 °C	14 Days	40 Days
8141A	Organophosphorous Compounds	Water	4 L Amber Glass Bottle	4 °C; NaOH or H_2SO_4; pH 5-8	7 Days	40 Days
		Soil/Other	250 Glass Jar	4 °C	14 Days	40 Days
8151	Chlorinated Herbicides	Water	4 L Amber Glass Bottle	4 °C;	7 Days	40 Days
		Soil/Other	250 Glass Jar	4 °C	14 Days	40 Days
8260B (Modified)	Volatile Organics by GC-MS	Water	3 x 40 mL Amber Glass Vial	4 °C; HCl; pH < 2	14 Days	NA
		Soil/Other	125 mL Glass Jar	4 °C	14 Days	NA
8270C	Semi-volatile Organics by GC-MS	Water	4 L Amber Glass Bottle	4 °C	7 Days	40 Days
		Soil/Other	250 Glass Jar	4 °C	14 Days	40 Days
8280A	Polychlorinated Dioxins and Furans by GC/MS	Water	4 L Amber Glass Bottle	4 °C	30 Days	45 Days
		Soil/Other	250 Glass Jar	4 °C	30 Days	45 Days
8318	N-Methylcarbamate Pesticides by HPLC	Water	4 L Amber Glass Bottle	4 °C; 0.1 N $ClCH_2CO_2H$, pH 4 - 5	7 Days	40 Days
		Soil/Other	250 Glass Jar	4 °C	7 Days	40 Days
8330	Nitroaromatics and Nitramines by HPLC	Water	4 L Amber Glass Bottle	4 °C	7 Days	40 Days
		Soil/Other	250 Glass Jar	4 °C	14 Days	40 Days
TO-13	PAHs in Filter Cartridges	PUF, Tenax, or XAD-2 Filter Cartridge		4 °C	7 Days	40 Days
TO-14/ TO-15	VOC in Air	SUMMA® Canister			30 Days (by consensus)	
305.1,310.1	Acidity, Alkalinity	Water	Plastic or Glass	4 °C	14 Days	NA
300, 320.1, 325	Bromide, Chloride	Water	1 L Plastic	4 °C	28 Days	NA
340.2, 375.X	Fluoride, Sulfate	Solid/Other	125 mL Glass Jar	4 °C	28 Days	NA
405	BOD	Water	1 L Plastic	4 °C	48 Hours	NA

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9010B, 9014	Total Cyanide	Water	1 L Plastic	4 °C; NaOH; pH > 12	14 Days	NA
		Solid/Other	125 mL Glass Jar	4 °C	14 Days	NA
415, 9060	DOC, TOC	Water	250 mL Amber Glass	4 °C; H_2SO_4; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	4 °C	28 Days	NA
200, 6010, 6020, 7000	All metals except Cr(VI) and Hg	Water	500 mL Plastic	HNO_3 ; pH < 2	180 Days	NA
		Solid/Other	250 mL Glass Jar		180 Days	NA
3060A, 7196A, 7197	Cr(VI)	Water	500 mL Plastic	4 °C	24 Hours	NA
		Solid/Other	250 mL Glass Jar	4 °C	30 Days	NA
245, 7470A, 7471A	Hg	Water	500 mL Plastic	HNO_3 ; pH < 2	28 Days	NA
		Solid/Other	250 mL Glass Jar	4 °C	28 Days	NA
130.1	Hardness	Water		HNO_3 ; pH < 2 4 °C	180 Days	NA
345.1	Iodide	Water		4 °C	24 Hours	NA
300, 353.1, 351, 365	Ammonium, Nitrate + Nitrite Total Phosphorus, TKN	Water	1 L Plastic	4 °C; H_2SO_4; pH < 2	28 Days	NA
		Solid/Other	250 mL Glass Jar	4 °C	28 Days	NA
300, 365, 9210	Nitrate, Nitrate + Nitrite, Nitrite, Ortho Phosphorus	Water	500 mL Plastic	4 °C	48 Hours	NA
		Solid/Other	250 mL Glass Jar	4 °C	48 Hours	NA
1664, 9070	Total Recoverable oil and Grease	Water	1 L Glass	4 °C; H_2SO_4; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	4 °C	28 Days	NA
376	Sulfide	Water	1 L Glass	4 °C; NaOH; Zinc acetate; pH > 9	7 Days	NA
		Solid/Other	125 mL Glass Jar	4 °C	7 Days	NA
160	TDS, TSS, TS	Water	1 L Plastic	4 °C	7 Days	NA
9020B	TOX	Water	1 L Glass	4 °C; H_2SO_4; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	4 °C	28 Days	NA
418.1, 8440 1664	TPH	Water	1 L Amber Glass	4 °C; H_2SO_4; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	4 °C	28 Days	NA

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9065, 9066	Total Recoverable Phenols	Water	1 L Glass	4 °C; H_2SO_4; pH < 2	28 Days	NA
		Solid	125 mL Glass Jar	4 °C	28 Days	NA
150, 9040B	pH	Water	125 mL Plastic	4 °C	24 Hours	NA
110, 180	Color, Turbidity	Water	500 mL Plastic	4 °C	48 Hours	NA
120, 9050	Specific Conductance	Water	125 mL Plastic	4 °C	28 Days	NA
All radiochemical parameters except Rn-222 and tritium		Water	1 L Plastic (2 x 2 L Preferred)	HNO_3; pH < 2	180 Days	NA
		Solid/Other	250 mL Glass Jar		180 Days	NA
Rn-222	Radon 222	Water	3 x 40 mL Amber Glass Vial	None	72 Hours	NA
Tritium	^3H	Water	1 L Glass		180 Days	NA
		Solid/Other	Required sample size will vary with solid moisture content			NA
8015	Petroleum Hydrocarbons	Water	2 x 1 L Amber Glass Bottle	4 °C	14 Days	40 Days
		Soil/Other	250 mL Glass Jar	4 °C	14 Days	40 Days
8021B	Halogenated Volatile Organics	Water	3 x 40 mL Amber Glass Vial	4 °C; HCl; pH < 2	14 Days	NA
		Soil/Other	125 mL Glass Jar	4 °C	14 Days	NA
8081, 8082	Organochlorine Pesticides, PCBs	Water	4 L Amber Glass Bottle	4 °C	7 Days	40 Days
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8141A	Organophosphorous Compounds	Water	4 L Amber Glass Bottle	4 °C; NaOH or H_2SO_4; pH 5-8	7 Days	40 Days
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		Soil/Other	250 Glass Jar	4 °C	14 Days	40 Days
8260B (Modified)	Volatile Organics by GC-MS	Water	3 x 40 mL Amber Glass Vial	4 °C; HCl; pH < 2	14 Days	NA
		Soil/Other	125 mL Glass Jar	4 °C	14 Days	NA

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8270C	Semi-volatile Organics by GC-MS	Water	4 L Amber Glass Bottle	4 °C	7 Days	40 Days
		Soil/Other	250 Glass Jar	4 °C	14 Days	40 Days
8280A	Polychlorinated Dioxins and Furans by GC/MS	Water	4 L Amber Glass Bottle	4 °C	30 Days	45 Days
		Soil/Other	250 Glass Jar	4 °C	30 Days	45 Days
8318	N-Methylcarbamate Pesticides by HPLC	Water	4 L Amber Glass Bottle	4 °C; 0.1 N $ClCH_2CO_2H$, pH 4 - 5	7 Days	40 Days
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		Soil/Other	250 Glass Jar	4 °C	14 Days	40 Days
TO-13	PAHs in Filter Cartridges	PUF, Tenax, or XAD-2 Filter Cartridge		4 °C	7 Days	40 Days
TO-14						

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Attachment H: Radiological Survey Form

http://www-irn.sandia.gov/esh/radpro_procedures/forms/rsf.dot

Survey Number:

RADIOLOGICAL SURVEY FORM

Page: _____ of _____

Location:	Requester/Org.:	Date:	Time:
Purpose:	Request #:	RWP#:	

Instrument and Probe Type and Serial Number		Surveyor(s) Printed Name(s)	Surveyor(s) Signature/Date

#	Item Description/Location	BETA-GAMMA ACTIVITY Counting Data Attached: ☐ YES ☐NO % Eff.: [c] _____ Radionuclide: _____				ALPHA ACTIVITY Counting Data Attached: ☐ YES ☐NO % Eff.: [c] _____ Radionuclide: _____				RADIATION SURVEY Background: _____ mrem/hr Radiation Type: Gamma	
		cpm	Bkg. cpm	dpm[a, b] 100cm2	T/R/F[c]	cpm	Bkg. cpm	dpm[a, b] 100cm2	T/R/F[c]	mrem/hr	Distance from Source[d]

[a] ND = No detectable activity above background [b] If other than 100 cm², indicate area or record as 'dpm/probe' or 'dpm/LAW' (large area wipe). [c] T/R/F = Total/Removable/Fixed [d] OC or CT = On Contact [c] %Eff-Removable/Direct

Remarks:		
	Reviewed by:	Date:

Page _____ of _____

AUTHORIZED USERS LIST

Document Title: Sample Management and Custody

Administrative Operating Procedure

Document Number: AOP 95-16 **Revision:** 05

By my signature below, I affirm that I have read and understand this document, and all references called out in procedural steps, and I agree to operate within the stated constraints.

Name (printed)	Signature	Dept./Company	Date
Name (printed)	Signature	Dept./Company	Date
Name (printed)	Signature	Dept./Company	Date
Name (printed)	Signature	Dept./Company	Date
Name (printed)	Signature	Dept./Company	Date
Name (printed)	Signature	Dept./Company	Date
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SANDIA NATIONAL LABORATORIES
LONG-TERM STEWARDSHIP

FIELD OPERATING PROCEDURE

FOP 05-01

GROUNDWATER MONITORING WELL SAMPLING AND FIELD ANALYTICAL MEASUREMENTS

Author: Robert Ziock, Subject Matter Expert — **Date:** 1/10/12

Approved: Michael Skelly, Project Leader — **Date:** 10 Jan 12

Approved: Don Schofield, Field Support Operations Project Leader — **Date:** 1/10/12

Approved: Pamela Puissant, Department Manager — **Date:** 1/24/12

Author: *How frequently does this document need to be reviewed and/or revised?*	*Every three years or when activities change*	
Manager: *Does this document need to be tracked?*	(Yes)	*No*

EFFECTIVE DATE: 1/24/12

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Revision History

Revision	Review Date	Effective Date	Summary of Changes
1	9/29/2005	10/10/2005	New document
2	6/13/2007	8/16/2007	Formatting changes. Updated section 2, Roles and Responsibilities; section 3, Training Qualifications; section 9, References.
3	11/12/2009	11/12/2009	Formatting changes. Added work planning and control information to section 4.0, Health & Safety. Updated section 3, Training Qualifications; section 9, References.
4	1/10/2012	1/24/2012	Formatting changes. Revision history changed from 2 years to 3 years. Removal of some forms (attachments) and replaced with hyperlinks to where the forms can be found. Updated section 3, Training Qualifications; section 9, References.

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FORMS

ARCOC – Sample Management Office – Analysis Request and Chain of Custody Form
EP 2009-ALW – Environmental Planning – Activity Level Work Evaluation Form
EP 2009-AUL – Environmental Planning – Authorized Users List
EP 2009-OJT – Environmental Planning – On-the-Job Training
EP 2009-WRA – Environmental Planning – Work Resumption Authorization Form

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Acronyms & Abbreviations

AOP	administrative operating procedure
ARCOC	analysis request and chain of custody
DI	deionized
DO	dissolved oxygen
EDMS	Environmental Data Management System
ES&H	Environment, Safety and Health
FOP	field operating procedure
gal/ft^3	gallon(s)/cubic foot
ft	foot/feet
in	inch(es)
LOP	laboratory operating procedure
LTES	Long Term Environmental Stewardship
mL	milliliter(s)
min	minutes(s)
OJT	on-the-job training
ORP	oxidation/reduction potential
OSHA	Occupational Safety and Health Administration
pH	potential for hydrogen
PHS	primary hazard screening
PLA	plan
RCRA	Resource Conservation and Recovery Act
SAP	sampling and analysis plan
SC	specific conductance
SMO	Sample Management Office
SNL/NM	Sandia National Laboratories, New Mexico
THA	task hazard analysis
TOC	total organic carbon
VOC	volatile organic compound

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1.0 PURPOSE, SCOPE, AND OWNERSHIP

Purpose This field operating procedure (FOP) provides instruction on collecting a groundwater sample from a monitoring well that is representative of in situ groundwater conditions and is suitable for laboratory analysis. The sample must be conducted per regulatory requirements and established agency guidance to provide legally defensible analytical data for regulatory compliance.

Scope The scope of this procedure is limited to well purging, field analytical measurements, and the collection of samples from monitoring wells as part of Sandia National Laboratories, New Mexico (SNL/NM) groundwater monitoring activities.

Ownership The Long-Term Stewardship Department is responsible for development, approval, distribution, revision, and control of this document.

2.0 ROLES AND RESPONSIBILITIES

The **project leader** is responsible for the following:

- Reviewing and recommending approval of this procedure.
- Providing overall coordination and management of the project.
- Providing a sampling and analysis plan (SAP) that meets prescribed regulatory or programmatic requirements.
- Reviewing completed field forms and data pertaining to the sampling activities.
- Reporting all information as may be required by regulations or directives.

The **sampling coordinator** is responsible for the following:

- Generating a mini-SAP from the SAP. The mini-SAP is a field friendly version of the SAP. It details sampling activities for the field support operations project leader and field technicians. It summarizes sampling procedures, analytical parameters, field measured parameters, purge requirements, and waste management tasks. It also identifies monitoring well characteristics that may extend the sampling period (e.g., low yield wells, well construction issues, etc.).
- Coordinating sampling activities with the SNL/NM lead investigators, regulators, Kirtland Air Force Base and their environmental contractors, Sample Management Office (SMO), and field technicians.
- Providing the field support operations project leader with a copy of the mini-SAP.
- Coordinating sampling procedure variances with the project leader and the field support operations project leader.
- Reviewing completed field forms and data pertaining to the sampling activities.
- Ensuring that all data quality requirements are performed.
- Providing the project leader with a summary of field activities and sampling results.

- Reporting all information as may be required by regulations or directives.
- Submitting completed field forms to the Customer Funded Record Center and entry of relevant data to the Environmental Data Management System (EDMS) database.
- Managing, coordinating, and disposing of purge water and other waste generated from field operations in compliance with SNL/NM Corporate Policy ESH100 Environment Safety & Health, and FOP 05-04, *Groundwater Waste Management Plan.*
- Reviewing and providing recommendations for revisions to this procedure (if necessary).

The **field support operations project leader** is responsible for the following:

- Communicating with the sampling coordinator regarding sampling activities.
- Supervising the field technicians.
- Reviewing training requirements for field technicians.
- Providing for the on-the-job training (OJT) of new field technicians.
- Assigning field technicians (qualified by training and experience) to conduct the activities described in this procedure.
- Coordinating sampling activities with the sampling coordinator, SMO, and field technicians.
- Ensuring the materials and equipment necessary to perform the work are available.
- Providing the field technicians with a copy of the mini-SAP.
- Reviewing field documentation.
- Maintaining the calibration records.
- Maintenance of the training matrix for all field personnel.
- Maintaining, reviewing, and revising all technical work documents.
- Notifying the project leader and sampling coordinator of unusual field conditions, wells requiring maintenance, or breach of well security.
- Reviewing and providing recommendations for revisions to this procedure (if necessary).

The **field technician** is responsible for the following:

- Completing all necessary and required training as specified by the field support operations project leader.
- Maintaining and decontaminating equipment.
- Field checking instruments according to the manufacturer's instructions and this procedure.
- Purging the well in preparation for sample collection.
- Collecting and recording field measurements as required by this procedure and the mini-SAP.
- Collecting, preserving, and storing samples as specified in the mini-SAP and in accordance with administrative operating plan (AOP) AOP 95-16, *Sample Management and Custody*.
- Delivering samples to SMO packaging and shipping facility within the required holding times.
- Managing purge water and other generated waste.

- Securing wells.
- Informing the field support operations project leader of wells requiring maintenance or breach of well security.
- Completing and reviewing field documentation forms.
- Providing recommendations for revisions to this procedure (if necessary).

3.0 TRAINING QUALIFICATIONS

Personnel conducting field activities shall complete the following:

- Read applicable sections of SNL/NM Corporate Policy ESH100 Environment Safety & Health.
- Read primary hazard screening (PHS) SNL05A01241, *Long Term Environmental Stewardship (LTES) Groundwater Monitoring Activities.*
- OJT for new field personnel performing groundwater sampling activities. Document training by completing On-the-Job Training form (EP 2009-OJT).
- Read and sign AOP 95-16, *Sample Management and Custody*.
- Read and sign FOP 03-02, *LTES Groundwater Level Data Acquisition and Management*.
- Read and sign laboratory operating procedure (LOP) LOP 94-03, *Sample Handling, Packaging and Shipping*.
- Read and sign FOP 05-02, *Groundwater Monitoring Equipment Field Check.*
- Read and sign FOP 05-03, *Groundwater Sampling Equipment Decontamination.*
- Read and sign FOP 05-04, *Groundwater Waste Management Plan.*
- Read and sign Plan (PLA) PLA 05-09, *Groundwater Monitoring Health & Safety Plan.*
- Complete training courses listed in Table 1.
- Field personnel shall sign the Authorized Users List (EP 2009-AUL) to affirm they have read and understand this document, and agree to operate within the stated constraints.

Table 1. Training Course List

Course Code	Course Title
CHM100/103	Chemical Safety Training/Site-Specific Chemical Training
ELC105	Basic Electrical Safety (> 50 volts)
ELC901	Safe Switching Briefing
ENV100	OSHA Health & Safety Basic Training - General Worker (40 HR)
ENV103	OSHA Health & Safety Training Refresher (8 HR)
ENV112	Hazardous Waste & Environmental Management Training
ENV216	RCRA - Less Than 90-Day Area Accumulation Area for Owners & Emergency Coordinators
ENV316	RCRA - Less Than 90-Day Area Accumulation Area for Waste Workers
ENV416	RCRA - Less Than 90-Day Area Accumulation Area for Waste Workers - Site-Specific

Table 1. Training Course List (concluded)

Course Code	Course Title
ESH100	ES&H Awareness
FKL153	Forklift Operator and Hands-On Training
MCH200	Hand and Power Tool Safety
MED102	Standard First Aid
MED104	Heartsaver CPR
OTS101	Occupational Thermal Stress
PKX100	Basic Hazardous Material Transportation Training
PPE106	Personal Protective Equipment Training
PRS150	Pressure Safety Orientation
PRS250	Advanced Pressure Safety
RAD230	Radiological Worker II Training
RAD230R	Radiological Worker II Retraining
RGH100	Crane, Rigging, Hoisting, & Hands-on Training

CPR = Cardiopulmonary Resuscitation
ES&H = Environment, Safety and Health
HR = hour
OSHA = Occupational Safety and Health Administration
RCRA = Resource Conservation and Recovery Act

4.0 HEALTH AND SAFETY

A task hazard analysis (THA) has been performed on the activities described in this FOP as well as a hazard assessment survey performed by a SNL/NM industrial hygienist. They are detailed in the PLA 05-09, *Groundwater Sampling Health and Safety Plan*. The THA was performed in conjunction with PHS SNL05A01241, *LTES Groundwater Monitoring Activities*.

An Activity Level Work Evaluation Form (EP 2009-ALW) was completed and approved by the department manager as required by AOP 09-10, *Work Planning and Control*.

A field technician or the field support operations project leader shall conduct a tailgate safety meeting and fill out a Tailgate Safety Meeting Form prior to the start of groundwater sampling activities as described in PLA 05-09, *Groundwater Sampling Health and Safety Plan*.

In the event that work is stopped due to:

- Safety-related issues,
- an injury incurred while performing the tasks identified in this procedure, or
- as the result of an audit,

the field technicians shall immediately notify the field support operations project leader, the project leader, and the department manager. The field technicians shall seek the assistance of the field support operations project leader for the mitigation of the hazard and the completion of a Work Resumption Authorization Form (EP 2009-WRA) as required by AOP 09-10, *Work*

Planning and Control. The department manager shall sign the completed form prior to the restart of work.

5.0 DEFINITIONS

analysis request and chain of custody (ARCOC) – Method for documenting the history and possession of a sample from the time of its collection, through its analysis and data reporting, to its final disposition.
decontamination – A process used to clean equipment.

dedicated sampling equipment – Sampling equipment that is installed for use in only one monitoring well to prevent potential cross-contamination between wells.

duplicate (or split) sample – A sample which is split into subsamples contemporaneous in time and space.

equipment blank – A sample collected from chemically pure water (reagent-grade deionized [DI] water) that is passed through an item of field sampling equipment and returned to the laboratory for analysis. It is used to determine the effectiveness of equipment decontamination process. This may also be referred to as a decontamination rinsate blank.

field blank – Chemically pure water (reagent-grade DI water) that is subjected to all aspects of sample collection, field processing, preservation, transportation, and laboratory handling as an environmental sample.

groundwater – Water beneath the land surface contained in interconnected pores or secondary openings in the saturated zone that is under hydrostatic pressure. The water that enters wells and issues from springs.

headspace – The empty volume in a sample container between the water level and the cap.

mini-SAP – A detailed document describing the location of wells to be sampled; the frequency of sampling; the analysis to be performed; purge volumes, sample containers, sample preservatives, and sample holding times; and the analytical methods to be utilized. The plan references procedures used to collect, handle, and analyze groundwater samples. It includes all quality control measures that will be implemented to ensure that all activities meet any prescribed regulatory or programmatic requirements.

monitoring well – A well that is constructed for the purpose of extracting groundwater for physical, chemical, or biological testing, or for measuring water levels.

preservation – Storage conditions or addition of a reagent that will minimize the change in concentration of a constituent of interest until analysis can be performed.

purge – The process of removing stagnant water from a well prior to sampling.

Sample Management Office (SMO) – A SNL/NM organization responsible for coordinating with analytical laboratories to have groundwater samples analyzed. SMO receives sample bottles from the laboratory and is responsible for shipping samples.
saturated casing volume – The volume of water contained in one length of the saturated screen casing plus the volume of water contained in the borehole annulus surrounding the outside of the screen casing interval.

static water level – The elevation of the top of a column of water in a monitoring well that is at equilibrium.

trip blank – Laboratory prepared samples of chemically pure water (reagent-grade DI water) used to assess volatile organic compound contamination of the sample container, laboratory preparation water, or contamination resulting from handling procedures. Trip blanks are prepared in the same type of bottle used for an environmental sample and is kept with the set of sample bottles both before and after sample collection.

volatile organic compounds (VOCs) – Liquids or solid organic compounds that exhibit a tendency to pass into the vapor state.

6.0 EQUIPMENT AND MATERIALS

Two pumping methods are used to collect groundwater samples. Each method uses an inert gas (nitrogen) to operate the pump. No aeration of the sample occurs because the sample is isolated from the driving gas. The pump methods are:

1. A portable non-dedicated piston pump (Bennett model 1800 or equivalent) is used to purge water from the well casing.

2. A dedicated pneumatic bladder pump (QED micropurge) is used for low-flow technique that uses a dedicated pneumatic bladder sampling pump (QED micropurge). Only the discharge line from the pump must be purged.

The following list includes equipment and materials necessary to collect a sample, document its collection, and request the laboratory analyses. Not all of the equipment may be required for each sampling event. The list depends on the methods used for purging and sampling, and the potential presence of contaminants in groundwater at the site. Details are specified in the mini-SAP.

Consumables

- potential for hydrogen (pH) paper.
- DI water.

- Decontamination supplies listed in FOP 05-03 (detergents, DI water, reagent grade nitric acid, buckets, brushes, etc.). Additional decontamination requirements and supplies may be specified in the mini-SAP.
- Small and large zip-lock and bubble wrap bags.
- Insulated ice chest (coolers), blue ice or ice.
- Duct tape.
- Paper wipes.
- Wash bottles.
- Sample containers with the required reagents for field preservation of samples. They are identified in the mini-SAP and are provided by SMO and/or the laboratory. (Note: Visually inspect preservatives for discoloration or degradation prior to use to ensure reagent quality.).
- Seals (custody seal tape).
- Indelible black ink pens.
- Personal protective equipment. Reference PLA 05-09, *Groundwater Sampling Health and Safety Plan*.

Documentation Forms

- Groundwater Sample Collection Field Equipment Check Log, (FOP 05-02, Attachment A).
- Field Measurement Log for Groundwater Sample Collection (Attachment A).
- Examples of Sample Label and Sample Identification Numbers (Attachment B).
- Analysis request and chain of custody (ARCOC).

Other Equipment

- Portable Bennett piston pump system or equivalent.
- Compressed nitrogen gas cylinders with associated regulators, calibrated pressure relief valves and high pressure air lines, as necessary, to operate portable Bennett piston pump system or equivalent.
- Water level indicator.
- Empty 55-gallon close head poly drums for purge water/decontamination fluids.
- 0.45 micron membrane filter for filtering the dissolved metals.
- Equipment for groundwater field parameters (pH, specific conductivity [SC], temperature, dissolved oxygen [DO], turbidity, oxidation/reduction potential [ORP]; calibration standards) as specified in FOP 05-02.
- Equipment for field analysis water chemistry such as a digital titrator and colorimeter.

Additional Items

- Calculator.
- Location map of monitoring wells to be sampled.
- Well construction details of monitoring wells to be sampled (depth from top of casing, casing diameters, screen length and depths).

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- Key to well lock(s) and for gate access to site (if applicable).
- Equipment manuals.
- Tool box.
- 2-way radio.

7.0 PROCEDURE

7.1 Preparation

The field operations project leader and/or field technician must complete the following prior to field operations:

1. Review the mini-SAP with the sampling coordinator and schedule the sampling dates.

2. Obtain the required information listed below:

    a. Location of wells.
    b. Depth of wells.
    c. Diameter of well casings and other well construction data.
    d. Method to be used to purge wells.
    e. Methods used to sample wells.
    f. Analytical parameters including number of equipment blanks, duplicate samples, trip blanks.

3. Coordinate site access with the appropriate organization.

4. Notify SMO of expected sampling and delivery dates, number of samples, required analyses, and turnaround time for analytical results. Obtain the sample containers from SMO. Sample containers must be prepared with the appropriate preservatives by the laboratory or SMO prior to sampling.

5. Make provisions for proper storage and disposal of purge water, decontamination fluids, and other wastes generated during purging and sampling activities.

6. Obtain sample identification numbers from the SMO or field support operations project leader and prepare sample labels. Affix labels to sample bottles.

7. Complete as much as possible of the following forms prior to field operations:

    a. Groundwater Sample Collection Field Equipment Check Log (FOP 05-02, Attachment A),
    b. Field Measurement Log for Groundwater Sample Collection (Attachment A),
    c. ARCOC,

8. Load and secure the equipment and supplies in the sampling vehicle.

7.2 Documentation

Document all sampling activities by completing the appropriate forms. Use a dark indelible ink pen. Make any necessary corrections by drawing a single line through the incorrect entry, initial and date it, and place the correct entry adjacent to the incorrect entry.
The documentation forms are briefly discussed below:

Field Measurement Log for Groundwater Sample Collection, (Attachment A)**.** This form is used to record the following:

- Water level depth
- Purge volumes
- Purge field parameters
- Instrument calibration
- Sample collection
- Well condition
- Weather condition

Sample Label, (Attachment B). An adhesive-backed waterproof label is affixed to each sample container before sample collection. Complete the following entries on the label with a black waterproof ink pen:

- Sample ID #
- Sample Type
- Analysis
- Location
- Date
- Time
- Preservative
- Collector

See AOP 95-16 for more information on the sample label.

Sample Identification Number (Sample # / Sample ID), (Attachment B). A sample consists of groundwater collected at a specific location and time. A unique sample number and sample identification is assigned to each sample collected. The sample number is placed in the appropriate space of the Sample Label, and the ARCOC record.

An example of a Sample # is **001234-001** where the

- **001234** – References a unique sample identification number. This number is obtained by going to the SMO Home page and clicking the "Control Numbers" tab.
- **-001** – A fraction that references an analysis. For example -001 for a VOC analysis, -017 for a major cations analysis, and -027 for a cyanide analysis.

An example of a Sample Identification # is **MWL-MW1** where the

- **MWL** – References the monitor well location.
- **MW1** – References the monitor well number.

See AOP 95-16 for more information on the Sample Identification Number.

Analysis Request and Chain-of-Custody Record **(**ARCOC**)**. An original ARCOC record must accompany all samples from the field to the laboratory. The ARCOC provides a legal record of the sample from collection to disposal. The ARCOC also specifies the sample analysis. Instructions for completing the ARCOC are provided on the back of the form. ARCOC numbers are obtained at the SMO Home page and clicking the "Control Numbers" tab.

See AOP 95-16 for more information on the ARCOC.

7.3 Decontamination

Decontaminate all equipment used to sample groundwater prior to placement in a well. Follow the directions listed in FOP 05-03 for decontaminating equipment.

7.4 Static Water Level Measurements

Water level information is used to calculate the volume of water in a well casing and the minimum amount required for purging. The static water level is measured in each well prior to purging or obtaining a sample. Static water level measurements are taken to the nearest 0.01 foot using a water level indicator. Measurements are referenced to a surveyed mark of known elevation at the top the well casing. See FOP 03-02 for collecting a static water level measurement. (Note: Because the static water level measurement is used to calculate a purge volume it is not necessary to follow every step of FOP 03-02. Use it only as general guidance for obtaining a static water level measurement.)

7.5 Well Evacuation (Purging)

Purging a well removes stagnant water so that a representative sample of the groundwater can be obtained. Purging requirements are affected by one or more of the following and are detailed in the mini-SAP:

- Permit requirements
- The pump and sample method used (conventional vs. low-flow)
- Well construction
- Well recharge rate

Purge the well at a rate that creates minimal disturbance to the groundwater flow regime. This ensures the most representative sample of the groundwater. Monitor the water level during the purging process to help indicate minimal disturbance. Purge the well until the volume specified in the mini-SAP is met and until groundwater field parameters stabilize. See section 7.6 for more information on measuring groundwater field parameters. Instructions for purging using the two different pump methods are listed in the next two sections.

7.5.1 Portable Non-Dedicated Piston Pump System

Install the pump according to its operating manual and criteria specified in the mini-SAP. The pump intake should be se at or near the bottom of a well's screened interval. Nitrogen gas is used to operate the pump. The flow rate is controlled by varying the gas pressure on the pump. A minimum of one saturated casing volume (unless otherwise specified in the mini-SAP) needs to be purged when using a portable non-dedicated piston pump system. A saturated casing volume is defined as the volume of one length of the saturated screen (*V1*) plus the borehole annulus surrounding the outside of the well screen interval (*V3*). The following formulas are used to calculate a saturated casing volume:

$V1 = R1^2 \times \pi \times (H2 - H1) \times 7.48$ gallon/cubic feet (gal/ft^3)
$V2 = R2^2 \times \pi \times (H2 - H1) \times 7.48$ gal/ft^3
$V3 = (V2 - V1) \times 0.30$

Minimum purge volume or saturated casing volume = $V3 + V1$

where:

$\pi = 3.14$
R1 = radius of the well casing feet (ft) = [diameter of well casing inch (in) x 1(ft)/12 (in)] / 2
R2 = radius of borehole (ft) = [diameter of borehole (in) x 1 (ft)/12 (in)] / 2
V1 = volume of submerged screen length casing interval
V2 = volume of submerged screen length annulus
V3 = submerged annulus volume
H1 = depth to water in screen (ft) not to exceed length of screen
H2 = well depth (ft)
H2 - *H1* = static water height (ft) in well screen
0.30 = filter pack porosity

Begin purging the well after the minimum purge volume has been determined. If possible, purge the well at a flow rate equal to the recharge rate of the well. A pumping rate that is equal to the recharge rate will keep the water level in the well constant. Otherwise, turn down the flow rate to the lowest level possible and still maintain flow at the surface. Record groundwater field parameters at a minimum of every 5 gallons. Groundwater field parameters must stabilize before samples are collected. See Section 7.6 for more information on collecting groundwater field parameter data.

If the well goes dry during the purging process, allow the water in the well to recover to 80 percent of the static water level. If the recovery time exceeds 2 hours, collect the samples as soon as there is a sufficient volume.

7.5.2 Dedicated Low-Flow (Minimal Drawdown) Technique

The pump and its tubing were installed previously and are dedicated to the well. Nitrogen gas is used to operate the pump. The flow rate is controlled by varying the gas pressure on the pump. The flow rate is set to less than or equal to the recharge rate of the well.

A minimum of two tubing water volumes (unless otherwise specified in the mini-SAP) need to be purged when using the Dedicated Low-Flow technique. Calculate tubing water volumes using the following formula.

one tubing water volume = $\pi r^2 h * 28310$ milliliter (mL)/ft^3

where:

$\pi = 3.14$
r = radius of the sample tubing (ft) = [diameter of sample tubing (in) x 1(ft)/12 (in)] / 2
h = tubing length (ft)

The following formulas are provided on the "Field Measurement Log For Groundwater Collection" to calculate the volume of water in one tubing length.

Tubing Diameter

1/4" outer diameter, 0.17" inner diameter: 4.5 mL/ft X ____ (length of tubing in ft) = ____ mL
3/8" outer diameter, 0.25" inner diameter: 9.6 mL/ft X ____ (length of tubing in ft) = ____ mL

Set the purge rate to less than or equal to the recharge rate of the well. A purge rate of < 1000 mL/minute (min) is desired. Monitor the water level periodically and adjust the purge rate to minimize drawdown in the well to less than 0.1 meters. It is especially important to minimize disturbance to the water in the well when measuring the water level. Record groundwater field parameters a minimum of four readings per tubing volume. Samples are collected after a minimum of two tubing water volumes are purged and the groundwater field parameters are stabile. See Section 7.6 for more information on collecting groundwater field parameter data. (Note: Wait a minimum of 24 hours before sampling with a newly installed dedicated low-flow pump.)

7.6 Measuring Groundwater Field Parameter Data

Connect the flow-through cell to the pump tubing. The flow-through cell houses the probes used to measure most of the groundwater field parameters (pH, SC, temperature, ORP, DO). Water pumped from the well flows through the cell and contacts the probes. Turbidity is measured with a portable turbidimeter.

Groundwater field parameters are identified in the min-SAP. All instruments and their corresponding probes are function checked prior to recording groundwater field parameters. Function check the instruments in accordance with FOP 05-02.
The samples are collected (see Section 7.8) after the well or tubing is properly purged and the groundwater field parameters are stable. The following stability criteria apply (if no others are listed in the mini-SAP):

Four consecutive measurements of:

- +/- 0.1 standard units for pH.
- +/- 1.0 degrees Celsius for temperature.
- +/- 5 percent for SC.
- +/- 10 percent or ≤ 5 nephelometric turbidity units for turbidity.

Additional field parameters may include ORP and DO, as required in the mini-SAP.
Field measurements are recorded on the Field Measurement Log for Groundwater Sample Collection (Attachment A).

7.7 Field Analysis

Samples may be collected for field analysis such as alkalinity, hexavalent chromium, nitrate, and ferrous iron. The field analyses will be specified in the mini-SAP. Digital titrators and colorimeters are used to perform the field analyses. Follow the manufacturer's procedures when performing the analyses. Document the results on the Field Measurement Log for Groundwater Collection (Attachment A) or specific field analysis forms if applicable.

7.8 Sample Collection

Sample wells in the order specified in the mini-SAP. If an order is not specified, sample wells in the order from least contaminated to most contaminated. This will minimize the potential for cross-contaminating wells. If the potential for groundwater contamination has not been established at the site, sample wells from the up gradient direction toward the down gradient direction.

After the purging criteria have been met and groundwater field parameters are stable, collect the samples specified in the min-SAP. Collect samples in the order of decreasing volatilization sensitivity, as applicable:

Most Volatile: Least Volatile:	1. Volatile organic compounds 2. Total organic halogens 3. Total organic carbon (TOC) 4. Base-neutral and acid extractable organic compounds 5. Total metals 6. Dissolved metals 7. Phenols 8. Cyanide 9. Sulfate and chloride 10. Turbidity (for laboratory analysis) 11. Nitrate and ammonia 12. Radionuclides 13. Bacteria

7.8.1 Collection of Volatile Organic Analysis Fraction

Collect the VOC samples at a slow discharge rate to minimize volatilization. VOC sample containers should be filled at a rate not exceeding 100 mL/min. The sampling system may be modified in order to split the flow of water, such that the flow can be reduce to a rate of 100 ml/min or less.

Fill the sample vial completely. Pour the last few drops into the vial so that surface tension forms a convex meniscus on the water surface in the vial. Cap the bottle securely. Slight overflow will result in the elimination of air space in the bottle. Turn the bottle over and tap it gently to check for bubbles. If bubbles are present, repeat the procedure using a new sample container.

7.8.2 Filtration for Dissolved Metals and Major Cation Fractions

Sample fractions for dissolved metals and major cations (potassium, calcium, sodium, magnesium) require filtration to remove suspended solids. Use a disposable 0.45- micron in-line filter. Place over the discharge outlet. A minimum of over 500 mL should be drawn through the

filter before sampling. Please note, filtration of samples is not limited to dissolved metals and cations. Consult the mini-SAP as to when filtration is required.

7.8.3 Equipment Blanks, Field Blanks, and Duplicate (Split) Samples

Collect any equipment blanks, field blanks, duplicate, or split samples as specified in the mini-SAP.

When collecting duplicate or split samples, it is important to take them in a consecutive order. That is, take all the VOC samples, then all the TOC samples, then all the metals, etc. Do not pull one complete set of samples and then pull another complete set. The groundwater chemistry may change during sampling and that could affect the consistency of the sample results.

7.8.4 Sample Handling and Documentation

Mark sample labels with the date and time of collection. Seal the sample containers with custody seal tape so they cannot be opened without breaking the tape. Place the sample containers inside sealable plastic bags. Immediately place samples requiring preservation into a sample cooler with ice or blue ice. Complete an ARCOC and transport the samples to SMO (see Section 7.11) when all field activities at the well location are completed.

7.9 Waste Disposal

Containerize, label, and process all wastes generated during purging, sampling, and decontamination activities in accordance with FOP 05-04.

7.10 Well Condition and Security

Remove all non-dedicated sampling equipment from the well and secure the equipment for transport. Place the casing cap on the well. Secure and lock the outer protective casing cap. Clean up the sampling site. Note on the Field Measurement Log for Groundwater Sample Collection (Attachment A) any problems with the well (such as missing or damaged hasps, locks, concrete pads, protective posts, obstruction inside the well casings, well access, etc.). Immediately inform the field support operations project leader of the problem.

7.11 Sample Shipment

SMO personnel verify with the field technician that the sample labels and the ARCOC are filled out correctly before they take custody of the samples from the field technician. SMO is responsible for shipping the samples to the designated analytical laboratory within the required holding times. For further information on sample handling refer to AOP 95-16.

7.12 Quality Assurance

FOP 05-02 is used as the quality assurance mechanism for operations described in this procedure.

8.0 RECORDS

A record of purging and sample collection activities is required. Forms that provide the required documentation are listed below:

- Field Measurement Log for Groundwater Sample Collection (Attachment A).
- Examples of Sample Label and Sample Identification Numbers (Attachment B).
- ARCOC.
- Groundwater Sample Collection Field Equipment Check Log (FOP 05-02, Attachment A).

The completed documentation is reviewed by the field support operations project leader. SMO will review sample labels and the ARCOC upon delivery of samples to the facility. All of the original documentation with the exception of the ARCOC and sample labels are, provided to the sampling coordinator for review before submittal to the project leader. The project leader reviews, approves, and returns the documentation to the sampling coordinator for transmittal to the Customer Funded Record Center.

9.0 REFERENCES

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Sandia National Laboratories, Long-Term Stewardship, PLA 05-09, *Groundwater Monitoring Health and Safety Plan* (latest edition), SNL/NM.

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ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

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FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name:	Project No.:
Well I.D.:	Date:
Well Condition:	Weather Condition:
Method: Portable pump _____Dedicated pump _____ Pump depth: _____	

PURGE MEASUREMENTS

Depth to Water (ft)	Time 24 hr	Vol. (L/gal)	Temp (^{o}C)	SC (µS/cm)	ORP (mV)	pH	Turbidity (NTU)	DO (%)	Comments

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ATTACHMENT B

EXAMPLES OF SAMPLE LABEL AND SAMPLE IDENTIFICATION NUMBERS

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EXAMPLES OF SAMPLE LABEL AND SAMPLE IDENTIFICATION NUMBERS

Sandia National Laboratories **Environmental Programs** Sample ID.# _____ TYPE _____ANALYSIS_____ LOCATION _____ DATE _____TIME _____ PRESERVATIVES _____ COLLECTOR _____ SF2000-EPL(4-94)	SNL/NM 018562 SNL/NM 018563 SNL/NM 018564 SNL/NM 018565 SNL/NM 018566 SNL/NM 018567 SNL/NM 018568

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SANDIA NATIONAL LABORATORIES
LONG-TERM STEWARDSHIP

FIELD OPERATING PROCEDURE

FOP 05-02

GROUNDWATER MONITORING EQUIPMENT FIELD CHECK FOR WATER QUALITY MEASUREMENTS

Author: Robert Ziock, Subject Matter Expert — **Date:** 1/10/12

Approved: Michael Skelly, Project Leader — **Date:** 10 Jan 12

Approved: Don Schofield, Field Support Operations Project Leader — **Date:** 1/10/12

Approved: Pamela Puissant, Department Manager — **Date:** 1/24/12

Author: *How frequently does this document need to be reviewed and/or revised?*	*Every three years or when activities change*	
Manager: *Does this document need to be tracked?*	(Yes)	*No*

EFFECTIVE DATE: 1/24/12

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Revision History

Revision	Review Date	Effective Date	Summary of Changes
1	9/24/2005	10/10/2005	New document
2	6/13/2007	8/16/2007	Formatting changes. Updated section 2, Roles and Responsibilities; section 3, Training Qualifications; section 9, References.
3	11/12/2009	11/12/2009	Formatting changes. Added work planning and control information to section 4.0, Health & Safety. Updated section 3, Training Qualifications; section 9, References.
4	1/10/2012	1/24/2012	Formatting changes. Revision history changed from 2 years to 3 years. Removal of some forms (attachments) and replaced with hyperlinks to where the forms can be found. Updated section 3, Training Qualifications; section 9, References.

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FORMS

EP 2009-ALW – Environmental Planning – Activity Level Work Evaluation Form
EP 2009-AUL – Environmental Planning – Authorized Users List
EP 2009-OJT – Environmental Planning – On-the-Job Training
EP 2009-WRA – Environmental Planning – Work Resumption Authorization Form

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Acronyms & Abbreviations

Ag	silver
AgCl	silver chloride
AOP	administrative operating procedure
°C	degrees Celsius
DI	deionized
DO	dissolved oxygen
Eh	oxidation-reduction
ES&H	Environmental, Safety & Health
FOP	field operating procedure
LTES	Long Term Environmental Stewardship
mg/L	milligrams per liter
µmhos/cm	micromhos/centimeter
mV	millivolt
NTU	nephelometric turbidity units
ORP	oxidation/reduction potential
pH	potential of hydrogen
PHS	primary hazard screening
PLA	plan
SAP	sampling and analysis plan
SC	specific conductivity
SMO	Sample Management Office
SNL/NM	Sandia National Laboratories, New Mexico
THA	task hazard analysis

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1.0 PURPOSE, SCOPE, AND OWNERSHIP

Purpose This field operating procedure (FOP) provides guidance on operating instruments used to measure groundwater field parameters during groundwater sampling of monitoring wells. Analytical parameters may include potential of hydrogen (pH), specific conductivity (SC), temperature, oxidation/reduction potential (ORP), turbidity, and dissolved oxygen (DO) content. The procedure also provides information on function checks and calibrations of instruments that act as the quality assurance mechanism for FOP 05-01, *Groundwater Monitoring Well Sampling and Field Analytical Measurements*.

Scope This procedure applies to groundwater field parameters measured during groundwater sampling activities conducted at Sandia National Laboratories, New Mexico (SNL/NM).

Ownership The Long-Term Stewardship Department is responsible for development, approval, and revision of this document.

2.0 ROLES AND RESPONSIBILITIES

The **project leader** is responsible for the following:

- Reviewing and recommending approval of this procedure.
- Providing overall coordination and management of the project.
- Providing a sampling and analysis plan (SAP) that meets prescribed regulatory or programmatic requirements.
- Reviewing completed field forms and data pertaining to the sampling activities.
- Reporting all information as may be required by regulations or directives.

The **sampling coordinator** is responsible for the following:

- Generating a mini-SAP from the SAP. The mini-SAP is a field friendly version of the SAP. It details sampling activities for the field support operations project leader and field technicians. It summarizes sampling procedures, analytical parameters, field measured parameters, purge requirements, and waste management tasks. It also identifies monitoring well characteristics that may extend the sampling period (e.g., low yield wells, well construction issues, etc.).
- Coordinating sampling activities with the SNL/NM lead investigators, regulators, Kirtland Air Force Base and their environmental contractors, Sample Management Office (SMO), and field technicians.
- Providing the field support operations project leader with a copy of the mini-SAP.
- Coordinating sampling procedure variances with the project leader and the field support operations project leader.

- Reviewing completed field forms and data pertaining to the sampling activities.
- Ensuring that all data quality requirements are performed.
- Providing the project leader with a summary of field activities and sampling results.
- Reporting all information as may be required by regulations or directives.
- Submitting completed field forms to the Customer Funded Record Center and entry of relevant data to the Environmental Data Management System database.
- Managing, coordinating, and disposing of purge water and other waste generated from field operations in compliance with SNL/NM Corporate Policy ESH100 Environment Safety & Health, and FOP 05-04, *Groundwater Waste Management Plan.*
- Reviewing and providing recommendations for revisions to this procedure (if necessary).

The **field support operations project leader** is responsible for the following:

- Communicating with the sampling coordinator and the Field Support Operations Administrator regarding sampling activities.
- Supervising the field technicians.
- Reviewing training requirements for field technicians.
- Providing for on-the-job training of new field technicians.
- Assigning field technicians (qualified by training and experience) to conduct the activities described in this procedure.
- Coordinating sampling activities with the sampling coordinator, SMO, and field technicians.
- Ensuring the materials and equipment necessary to perform the work are available.
- Providing the field technicians with a copy of the mini-SAP.
- Reviewing field documentation.
- Maintaining the calibration records.
- Maintenance of the training matrix for all field personnel.
- Maintaining, reviewing, and revising all technical work documents.
- Notifying the project leader and sampling coordinator of unusual field conditions, wells requiring maintenance, or breach of well security.
- Reviewing and providing recommendations for revisions to this procedure (if necessary).

The **field technician** is responsible for the following:

- Completing all necessary and required training as specified by the field support operations project leader.
- Maintaining and decontaminating equipment.
- Field checking instruments according to the manufacturer's instructions and this procedure.
- Completing and reviewing field documentation forms.
- Providing recommendations for revisions to this procedure (if necessary).

3.0 TRAINING QUALIFICATIONS

Personnel conducting field activities shall complete the following:

- Read applicable sections of SNL/NM Corporate Policy ESH100 Environment Safety & Health.
- Read primary hazard screening (PHS) SNL05A01241, *Long Term Environmental Stewardship (LTES) Groundwater Monitoring Activities*.
- OJT for new field personnel performing field checks of water quality measurement equipment. Document training by completing On-the-Job Training form (EP 2009-OJT).
- Read and sign FOP 03-02, *LTES Groundwater Level Data Acquisition and Management*.
- Read and sign FOP 05-01, *Groundwater Monitoring Well Sampling and Field Analytical Measurements*.
- Read and sign FOP 05-03, *Groundwater Sampling Equipment Decontamination*.
- Read and sign FOP 05-04, *Groundwater Waste Management Plan*.
- Read and sign plan (PLA) PLA 05-09, *Groundwater Monitoring Health & Safety Plan*.
- Complete training courses listed in Table 1.
- Field personnel shall sign the Authorized Users List (EP 2009-AUL) to affirm they have read and understand this document, and agree to operate within the stated constraints.

Table 1. Training Course List

Course Code	Course Title
CHM100/103	Chemical Safety Training/Site-Specific Chemical Training
ELC105	Basic Electrical Safety (> 50 volts)
ELC901	Safe Switching Briefing
ENV100	OSHA Health & Safety Basic Training - General Worker (40 HR)
ENV103	OSHA Health & Safety Training Refresher (8 HR)
ENV112	Hazardous Waste & Environmental Management Training
ENV216	RCRA - Less Than 90-Day Area Accumulation Area for Owners & Emergency Coordinators
ENV316	RCRA - Less Than 90-Day Area Accumulation Area for Waste Workers
ENV416	RCRA - Less Than 90-Day Area Accumulation Area for Waste Workers - Site-Specific
ESH100	ES&H Awareness
FKL153	Forklift Operator and Hands-On Training
MCH200	Hand and Power Tool Safety
MED102	Standard First Aid
MED104	Heartsaver CPR
OTS101	Occupational Thermal Stress
PKX100	Basic Hazardous Material Transportation Training
PPE106	Personal Protective Equipment Training
PRS150	Pressure Safety Orientation

Table 1. Training Course List (concluded)

Course Code	Course Title
PRS250	Advanced Pressure Safety
RAD230	Radiological Worker II Training
RAD230R	Radiological Worker II Retraining
RGH100	Crane, Rigging, Hoisting, & Hands-on Training

CPR = Cardiopulmonary Resuscitation
ES&H = Environment, Safety and Health
HR = hour
OSHA = Occupational Safety and Health Administration
RCRA = Resource Conservation and Recovery Act

4.0 HEALTH AND SAFETY

A task hazard analysis (THA) has been performed on the activities described in this FOP as well as a hazard assessment survey performed by a SNL/NM industrial hygienist. They are detailed in the PLA 05-09, *Groundwater Monitoring Health & Safety Plan*. The THA was performed in conjunction with PHS SNL05A01241, *LTES Groundwater Monitoring Activities*.

An Activity Level Work Evaluation Form (EP 2009-ALW) was completed and approved by the department manager as required by administrative operating plan (AOP) AOP 09-10, *Work Planning and Control*.

A field technician or the field support operations project leader shall conduct a tailgate safety meeting and fill out a Tailgate Safety Meeting Form prior to the start of groundwater sampling activities as described in PLA 05-09, *Groundwater Monitoring Health & Safety Plan.*

In the event that work is stopped due to:

- Safety-related issues,
- an injury incurred while performing the tasks identified in this procedure, or
- as the result of an audit,

the field technicians shall immediately notify the field support operations project leader, the project leader, and the department manager. The field technicians shall seek the assistance of the field support operations project leader for the mitigation of the hazard and the completion of a Work Resumption Authorization Form (EP 2009-WRA) as required by AOP 09-10, *Work Planning and Control*. The department manager shall sign the completed form prior to the restart of work.

5.0 DEFINITIONS

dissolved oxygen (DO) content − The DO content of the water in milligrams per liter (mg/L) or percentage of oxygen saturation of the water at the indicated temperature.

specific conductivity (SC) − The ability of a cubic centimeter of water to conduct electricity. It varies directly with the amount of ionic substances in the water and is measured in micro-mhos per centimeter (µmhos/cm) at 25ºC. SC is an indirect measure of total dissolved solids in dilute solutions.

potential of hydrogen (pH) − The inverse log of the hydrogen ion concentration of a solution. A measure of the intensity for the basic or acidic condition of a solution. Range is from 0 to 14 with 1 being the most acidic. A neutral solution is at a pH of 7. Greater than 7 is considered basic.

oxidation/reduction potential (ORP) − The electric potential (usually measured in millivolts [mV]) required for the transfer of an electron from one molecule or element (the oxidant) to another molecule or element (the reductant). Used as a qualitative measure of the oxidation state of the molecules or compounds in solution. There are two types of ORP probes. A calomel probe and a silver (Ag)/silver chloride (AgCl) Ag/AgCl probe. Use the following equation to calculate oxidation-reduction (Eh) recorded with an ORP probe:

$$Eh = ORP + E^1$$

where:

E^1 (CALO MEL) = 244 mV

E^1 (Ag/AgCl) = 199 mV

temperature (°C) − The temperature of the water in degrees Celsius (°C).

turbidity (nephelo-metric) − The cloudiness in water due to suspended and colloidal organic and inorganic material. Water turbidity is measured in nephelometric turbidity units (NTUs).

6.0 EQUIPMENT AND MATERIALS

The following instruments are used to measure groundwater parameters:

- YSI Model 650 MDS with YSI 6920 Sonde and flow-through cell to measure °C, pH, SC, DO, and ORP.
- HACH 2100Q Turbidity Meter.

Equivalent instruments may be substituted. Follow manufacturer's instructions for calibration and operation.

The following list includes field documentation forms, equipment and materials necessary to calibrate/check field analytical equipment, and/or to measure the parameters.

Documentation Forms:

- Groundwater Sample Collection Field Equipment Check Log (Attachment A).

Calibration Standard Solutions − Calibration standard solutions must have factory supplied and have expiration dates and/or lot number on the container.

- pH 4.00,7.00, and 10.00 solutions.
- electrical conductivity solutions: 500 to 1500 micromhos/centimeter (µmhos/cm) at 25°C reference solution.
- standard for oxidation/reduction potential: solution range 200 to 250 mV @ 25° C.
- Gelex® or equivalent turbidity standards: ≤10, 20, 100, and 800 NTU.

Additional Items:

- manufacturer's instructions/operator/manuals
- deionized water (DI)
- material safety data sheets

7.0 PROCEDURES

7.1 Equipment Calibration and Function Check

Review the mini-SAP to determine the groundwater field parameters to be measured and the corresponding instruments needed.

Calibrate or perform a function check on the instruments prior to measuring groundwater field parameters. Complete the Groundwater Sample Collection Field Equipment Check Log (Attachment A). Note the condition and quality of calibration standards. Make sure they have not exceeded their expiration date. Replace if necessary.

7.1.1 YSI 6920 Sonde and YSI 650 Multi Display System

The following is a set of instructions for calibrating a SI 6820 Sonde using a YSI 650 Multi Display System. The Sonde includes a DO, conductivity, pH, ORP and temperature probes. For additional information reference the manufacturer's manuals.

1) Turn unit on by pressing the green power button.
2) Use the Down arrow to "**Sonde menu**". Press enter (small arrow key, middle right).
3) Use large arrow keypad to select "**Calibrate**". Press enter.

4) To calibrate for DO:
    - Use large arrow keypad to select "**Dissolved Oxy**". Press enter.
    - Loosen calibration cup on Sonde.
    - Press enter after the barometric pressure is displayed.
    - Record both DO% and DO milligrams/liter (mg/L). Press enter.
    - Press "**Esc**" button.
5) To calibrate for conductivity:
    - Use large arrow keypad to select "**Conductivity**". Press enter.
    - Select "**SpCond**". Press enter.
    - Enter calibration value of standard solution according to the correct temperature (°C) on jar ("**1.278**" @ 20°C).
    - Place Sonde in calibration solution with calibration sleeve. Press enter.
    - Let the reading stabilize. Press enter.
    - Press "**Esc**" button.
    - Remove Sonde from calibration solution and rinse with DI water.
6) To calibrate for pH:
    - Use large arrow keypad to select "**ISE1 pH**". Press enter.
    - Use large arrow keypad to select "**3 point**". Press enter.
    - Place Sonde in pH 7 solution. Enter the value "**7.00**". Press enter.
    - Let the reading stabilize. Press enter.
    - Remove Sonde from pH 7 solution and rinse with DI water.
    - Place Sonde in pH 4 solution. Enter the value "**4.00**". Press enter.
    - Let the reading stabilize. Press enter.
    - Remove Sonde from ph 4 solution and rinse with DI water.
    - Place Sonde in pH 10 solution. Enter the value "**10.00**". Press enter.
    - Let the reading stabilize. Press enter.
    - Press "E**sc**" button.
    - Remove Sonde from pH 10 solution and rinse with DI water.
7) To calibrate for oxidation/reduction:
    - Use large arrow keypad to select "**ISE2 Orp**". Press enter.
    - Place Sonde in ORP calibration solution.
    - Enter the value from the ORP chart (Ag/AgCl column) according to the correct temperature (°C) ("**237.5**" @ 20°C). Press enter.
    - Let the reading stabilize. Press enter.
    - Press the "**Esc**" button twice.
8) Use large arrow keypad to select "**Sonde run**". Press enter. The instrument is now ready to measure groundwater field parameters.

No calibration is required for the temperature.

Reference the manufacturer's manual if an "**out of range message**" is displayed during the calibration process. It may be necessary to replace a probe that cannot be calibrated.

7.1.2 HACH 2100P Turbidimeter

The HACH 2100Q Turbidimeter should be calibrated every 3 months using StablCal Stabilized Formazin Standards followed by assigning values to Gelex® Secondary Turbidity Standards. Refer to the "Instrument and Procedure Manual" to perform this operation.

Once a value has been assigned to the Gelex® Secondary Turbidity Standards they can be used to perform a daily function check on the instrument prior to groundwater sampling activities. The following is a set of instructions to perform a function check prior to groundwater sampling activities:

1) Wipe the Gelex® Secondary Turbidity Standard cells (≤10, 20, 100, and 800 NTU) with a soft, lint-free cloth.
2) Apply a thin film of silicone oil and wipe with a soft cloth to obtain an even film over the entire surface of the cell.
3) Press: "**I/O**". The instrument will turn on. Place the instrument on a flat, sturdy surface.

4) Insert the Gelex® Secondary Turbidity Standard cell in the instrument cell compartment so the diamond or orientation mark aligns with the raised orientation mark in front of the cell compartment. Close the lid.
5) Select manual or automatic range selection by pressing the "**RANGE**" key. The display will show "**AUTO RNG**" when the instrument is in automatic range selection.
6) Select signal averaging mode by pressing the "**SIGNAL AVERAGE**" key. The display will show "**SIG AV**" when the instrument is using signal averaging. Use signal average mode.
7) Press: "**READ**". The display will show "**----NTU**", then the turbidity in NTU. Record the value after the lamp symbol turns off.

If the reading is not within 5% of the previously established value, recalibrate the instrument with StablCal Stabilized Formazin Primary Standards as indicated in the "Instrument and Procedure Manual".

To obtain a turbidity value on a groundwater sample, fill an empty cell, wipe with a soft lint-free cloth, and repeat steps 2 through 7.

7.2 Equipment Maintenance

Store the equipment and perform routine maintenance as required by the manufacturer's instructions.

8.0 RECORDS

The completed documentation is reviewed by the field technician and sampling coordinator before it is provided to the project leader. The project leader reviews, approves, and transmits the documentation to the Customer Funded Records Center.

9.0 REFERENCES

HACH Company, CAT. NO. 46500-88, Portable Turbidimeter, Model 2100P, Instrument and Procedure Manual.

NovaLynx Corporation Model 230-355 Handheld Digital Barometer & Altimeter, Operating Instructions, File No. 355:440-1, (530) 823-7185 nova@novalynx.com.

Sandia National Laboratories, Corporate Policy ESH100 Environment Safety & Health, SNL/NM.

Sandia National Laboratories, Environmental Programs and Assurance Department, FOP 03-02, *Long Term Environmental Stewardship Water Level Data Acquisition and Management* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 05-01, *Groundwater Monitoring Well Sampling and Field Analytical Measurements* (latest edition), SNL/NM.
Sandia National Laboratories, Long-Term Stewardship, FOP 05-03, *Groundwater Monitoring Equipment Decontamination* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 05-04, *Groundwater Monitoring Waste Management* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, PHS SNL05A01241, *Groundwater Monitoring Activities* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, PLA 05-09, *Groundwater Monitoring Health and Safety Plan* (latest edition), SNL/NM.

YSI Incorporated, YSI 650 Multiparameter Display System (MDS) Operation Manual

YSI Incorporated, YSI 6-Series (6920 V2 Sonde) Environmental Monitoring Systems

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ATTACHMENT A

GROUNDWATER SAMPLE COLLECTION FIELD EQUIPMENT CHECK LOG

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GROUNDWATER SAMPLE COLLECTION FIELD EQUIPMENT CHECK LOG **Page 1 of 2**

SNL/NM Project Name:	SNL/NM Project No.:
Calibrations done by:	Date:

Make & Model:

YSI 6820 Sonde (S/N) with DO, Ec, pH, ORP, and temperature probes: _____

YSI 650 MDS (S/N): _____

pH Calibration

pH Calibrated to (std):			pH sloped to (std):			
Reference value:	4.00		7.00		10.00	
	Value	Temp	Value	Temp	Value	Temp
1. Time:						
2. Time:						
3. Time:						
4. Time:						
Standard lot no.:						
Expiration date:						

SC Calibration

Reference Value:			Standard Lot No.:
	Value	Temp	Expiration Date:
1. Time:			
2. Time:			
3. Time:			
4. Time:			

ORP Calibration

Reference Value:			Standard Lot No.
	Value	Temp	Expiration Date:
1. Time:			
2. Time:			
3. Time:			
4. Time:			

DO Calibration

Calibration Value:	81% air saturation @ 5200 ft.	Atmospheric Pressure in Hg
1. Time:		
2. Time:		
3. Time:		
4. Time:		

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GROUNDWATER SAMPLE COLLECTION FIELD EQUIPMENT CHECK LOG (continued) Page 2 of 2

SNL/NM Project Name:		Project No.:		
Calibration done by:		Date:		
TURBIDIMETER				
Make & Model: HACH 2100P		Serial No. S/N		
Reference Value	.1	20	100	800
Standard Lot No.				
1. Time				
2. Time				
3. Time				
4. Time				

Comments:

SANDIA NATIONAL LABORATORIES
LONG-TERM STEWARDSHIP

FIELD OPERATING PROCEDURE

FOP 05-03

GROUNDWATER MONITORING EQUIPMENT DECONTAMINATION

Author: Robert Ziock, Subject Matter Expert — **Date:** 1/10/12

Approved: Michael Skelly, Project Leader — **Date:** 10 Jan 12

Approved: Don Schofield, Field Support Operations Project Leader — **Date:** 1/10/12

Approved: Pamela Puissant, Department Manager — **Date:** 1/24/12

Author: *How frequently does this document need to be reviewed and/or revised?*	*Every three years or when activities change*	
Manager: *Does this document need to be tracked?*	(Yes)	*No*

EFFECTIVE DATE: 1/24/12

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Revision History

Revision	Review Date	Effective Date	Summary of Changes
1	9/29/2005	10/10/2005	New document
2	6/13/2007	8/16/2007	Formatting changes. Updated section 2, Roles and Responsibilities; section 3, Training Qualifications; section 8, References.
3	11/12/2009	11/12/2009	Formatting changes. Added work planning and control information to section 4, Health and Safety. Updated section 3, Training Qualifications; section 8, References.
4	1/10/2012	1/24/2012	Formatting changes. Revision history changed from 2 years to 3 years. Removal of some forms (attachments) and replaced with hyperlinks to where the forms can be found. Updated section 3, Training Qualifications; section 8, References.

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ATTACHMENTS

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FORMS

EP 2009-ALW – Environmental Planning – Activity Level Work Evaluation Form
EP 2009-AUL – Environmental Planning – Authorized Users List
EP 2009-OJT – Environmental Planning – On-the-Job Training
EP 2009-WRA – Environmental Planning – Work Resumption Authorization Form

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Acronyms & Abbreviations

AOP administrative operating plan

CHPD closed head polyethylene drum

DI deionized

ES&H Environment, Safety and Health

FOP field operating procedure

HNO_3 nitric acid

L liter

LTES Long Term Environmental Stewardship

ml milliliter

OJT on-the-job training

PHS primary hazard screening

PLA plan

PPE personal protective equipment

SAP sampling and analysis plan

SNL/NM Sandia National Laboratories, New Mexico

THA task hazard analysis

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1.0 PURPOSE, SCOPE AND OWNERSHIP

Purpose This field operating procedure (FOP) provides instruction for decontaminating groundwater sampling equipment.

Scope This procedure applies to all groundwater sampling equipment used during groundwater sampling activities conducted at Sandia National Laboratories/New Mexico (SNL/NM).

Ownership The Long-Term Stewardship Department is responsible for development, approval, distribution, revision, and control of this document.

2.0 ROLES AND RESPONSIBILITIES

The **project leader** is responsible for the following:

- Reviewing and recommending approval of this procedure.
- Providing overall coordination and management of the project.
- Providing a sampling and analysis plan (SAP) that meets prescribed regulatory or programmatic requirements.
- Reviewing completed field forms and data pertaining to the sampling activities.
- Reporting all information as may be required by regulations or directives.

The **sampling coordinator** is responsible for the following:

- Generating a mini-SAP from the SAP. The mini-SAP is a field friendly version of the SAP. It details sampling activities for the field support operations project leader and field technicians. It summarizes sampling procedures, analytical parameters, field measured parameters, purge requirements, and waste management tasks. It also identifies monitoring well characteristics that may extend the sampling period (e.g., low yield wells, well construction issues, etc.).
- Coordinating sampling activities with the SNL/NM lead investigators, regulators, Kirtland Air Force Base and their environmental contractors, Sample Management Office, and field technicians.
- Providing the field support operations project leader with a copy of the mini-SAP.
- Coordinating sampling procedure variances with the project leader and the field support operations project leader.
- Reviewing completed field forms and data pertaining to the sampling activities.
- Ensuring that all data quality requirements are performed.
- Providing the project leader with a summary of field activities and sampling results.
- Reporting all information as may be required by regulations or directives.
- Submitting completed field forms to the Customer Funded Record Center and entry of relevant data to the Environmental Data Management System database.

- Managing, coordinating, and disposing of purge water and other waste generated from field operations in compliance with SNL/NM Corporate Policy ESH100 Environment Safety & Health, and FOP 05-04, *Groundwater Waste Management Plan.*
- Reviewing and providing recommendations for revisions to this procedure (if necessary).

The **field support operations project leader** is responsible for the following:

- Communicating with the sampling coordinator regarding sampling activities.
- Supervising the field technicians.
- Reviewing training requirements for field technicians.
- Providing for the on-the-job training (OJT) of new field technicians.
- Assigning field technicians (qualified by training and experience) to conduct the activities described in this procedure.
- Ensuring the materials and equipment necessary to perform the work are available.
- Providing the field technicians with a copy of the mini-SAP.
- Reviewing field documentation.
- Maintenance of the training matrix for all field personnel.
- Maintaining, reviewing, and revising all technical work documents.
- Reviewing and providing recommendations for revisions to this procedure (if necessary).

The **field technicians** are responsible for the following:

- Completing all necessary and required training as specified by the field support operations project leader.
- Maintaining and decontaminating equipment.
- Completing and reviewing field documentation forms.
- Providing recommendations for revisions to this procedure (if necessary).

3.0 TRAINING QUALIFICATIONS

Personnel conducting equipment decontamination shall complete the following:

- Read applicable sections of SNL/NM Corporate Policy ESH100 Environment Safety & Health.
- Read primary hazard screening (PHS) SNL05A01241, *Long Term Environmental Stewardship (LTES) Groundwater Monitoring Activities.*
- OJT for new field personnel performing field checks of water quality measurement equipment. Document training by completing On-the-Job Training form (EP 2009-OJT).
- Read and sign FOP 03-02, *LTES Groundwater Level Data Acquisition and Management.*
- Read and sign FOP 05-01, *Groundwater Monitoring Well Sampling and Field Analytical Measurements.*
- Read and sign FOP 05-02, *Groundwater Monitoring Equipment Field Check for Water Quality Measurements.*
- Read and sign FOP 05-04, *Groundwater Waste Management Plan.*

- Read and sign FOP 09-05, *Conducting Slug Test Using Data Logger & Pressure Transducer* (only necessary if conducting slug test).
- Read and sign plan (PLA) PLA 05-09, *Groundwater Monitoring Health & Safety Plan*.
- Complete training courses listed in Table 1.
- Field personnel shall sign the Authorized Users List (EP 2009-AUL) to affirm they have read and understand this document, and agree to operate within the stated constraints.

Table 1. Training Course List

Course Code	Course Title
CHM100/103	Chemical Safety Training/Site-Specific Chemical Training
ELC105	Basic Electrical Safety (> 50 volts)
ELC901	Safe Switching Briefing
ENV100	OSHA Health & Safety Basic Training - General Worker (40 HR)
ENV103	OSHA Health & Safety Training Refresher (8 HR)
ENV112	Hazardous Waste & Environmental Management Training
ENV216	RCRA - Less Than 90-Day Area Accumulation Area for Owners & Emergency Coordinators
ENV316	RCRA - Less Than 90-Day Area Accumulation Area for Waste Workers
ENV416	RCRA - Less Than 90-Day Area Accumulation Area for Waste Workers - Site-Specific
ESH100	ES&H Awareness
FKL153	Forklift Operator and Hands-On Training
MCH200	Hand and Power Tool Safety
MED102	Standard First Aid
MED104	Heartsaver CPR
OTS101	Occupational Thermal Stress
PKX100	Basic Hazardous Material Transportation Training
PPE106	Personal Protective Equipment Training
PRS150	Pressure Safety Orientation
PRS250	Advanced Pressure Safety
RAD230	Radiological Worker II Training
RAD230R	Radiological Worker II Retraining
RGH100	Crane, Rigging, Hoisting, & Hands-on Training

CPR = Cardiopulmonary Resuscitation
ES&H = Environment, Safety and Health
HR = hour
OSHA = Occupational Safety and Health Administration
RCRA = Resource Conservation and Recovery Act

4.0 HEALTH AND SAFETY

A task hazard analysis (THA) has been performed on the activities described in this FOP as well as a hazard assessment survey performed by a SNL/NM industrial hygienist. They are detailed

in the PLA 05-09, *Groundwater Monitoring Health & Safety Plan*. The THA was performed in conjunction with PHS SNL05A01241, *LTES Groundwater Monitoring Activities*.
An Activity Level Work Evaluation Form (EP 2009-ALW) was completed and approved by the department manager as required by administrative operating plan (AOP) AOP 09-10, *Work Planning and Control*.

A field technician or the field support operations project leader shall conduct a tailgate safety meeting and fill out a Tailgate Safety Meeting Form prior to the start of groundwater sampling activities as described in PLA 05-09, *Groundwater Monitoring Health & Safety Plan.*

In the event that work is stopped due to:

- Safety-related issues,
- an injury incurred while performing the tasks identified in this procedure, or
- as the result of an audit,

the field technicians shall immediately notify the field support operations project leader, the project leader, and the department manager. The field technicians shall seek the assistance of the field support operations project leader for the mitigation of the hazard and the completion of a Work Resumption Authorization Form (EP 2009-WRA) as required by AOP 09-10, *Work Planning and Control*. The department manager shall sign the completed form prior to the restart of work.

5.0 EQUIPMENT AND MATERIALS

The following list includes equipment and materials necessary for decontaminating groundwater sampling equipment:

- 55-gallon closed head polyethylene drum (CHPD)
- deionized (DI) water
- hand-held squirt bottles containing DI water
- non-phosphate laboratory detergent (e.g., Liqui-Nox®)
- hand-held squirt bottles containing non-phosphate laboratory detergent and tap water
- bottle brushes
- paper wipes
- plastic containers/buckets with lids
- personal protective equipment (PPE) − nitrile or latex gloves, chemical safety goggles, safety boots
- plastic garbage bags and waste storage containers
- Decontamination Log form (Attachment A)
- Groundwater Monitoring Waste Generation Log form (FOP 05-04, Attachment C)
- reagent grade nitric acid (HNO_3)

6.0 PROCEDURES

6.1 Equipment Decontamination

Wear the PPE specified in the PLA 05-09, *Groundwater Monitoring Health & Safety Plan*, when decontaminating equipment. The following is a list of groundwater monitoring equipment that needs to be decontaminated after each use and a set of instructions for performing the decontamination process:

- **static water level indicator**

  1) Wipe the last three feet of cable and probe with a paper wipe wetted with a 0.1% (1 milliliter/liter [1 ml/L]) Liqui-Nox®/DI or distilled water solution.
  2) Wipe the last three feet of cable and probe with a paper wipe wetted with deionized or distilled water.
  3) Wipe the last three feet of cable and probe with a clean, dry paper wipe.

- **portable non-dedicated piston pump system**
  Complete the following after the pump and its tubing have been removed from the well:

  1) Remove Sonde from the flow-through cell and rinse the probes (potential for hydrogen, specific conductance, dissolved oxygen, temperature, oxidation/reduction potential) with DI or distilled water.
  2) Seal the opening on the flow-through cell with the cap.
  3) Make sure all of the tubing used in purging and sampling remains connected to the pump and is included in the decontamination process (including the flow-through cell).
  4) Pump the following solutions through the tubing in the order listed below: Collect solution discharge in a 55-gallon CHPD.
     - 5 gallons of DI or distilled water mixed with 20 ml Liqui-Nox®.
     - 5 gallons of DI or distilled water.
     - 5 gallons of DI or distilled water mixed with 20 ml reagent grade HNO_3.
     - 3 times 5 gallons of DI or distilled water for a total of 15 gallons
  5) Rinse outside of pump tubing with DI or distilled water.
  6) Complete Decontamination Log form (Attachment A)
  7) Complete a Groundwater Monitoring Waste Generation Log form (FOP 05-04, Attachment C)

- **Dedicated Low-Flow Pump System**
  The pump and tubing are dedicated to the well and are not removed for decontamination. However, the tubing that is connected from the well to the flow-through cell is decontaminated. Complete steps 1 through 4 and steps 6 through 7 listed above.

- **Pressure Transducer and Cable**

    1) Wipe the cable (portion immersed in the water) and pressure transducer with a paper wipe wetted with a 0.1% (1ml/L) Liqui-Nox® /deionized or distilled water solution.
    2) Wipe the cable (portion immersed in the water) and pressure transducer with a paper wipe wetted with deionized or distilled water.
    3) Wipe the cable (portion immersed in the water) and pressure transducer with a clean, dry paper wipe.

6.2 Decontamination Waste

Handle all decontamination waste according to FOP 05-04, *Groundwater Waste Management Plan*.

7.0 RECORDS

The completed documentation is reviewed by the field support operations project leader and sampling coordinator before it is provided to the project leader. The project leader reviews and approves the documentation for transmittal to the Customer Funded Record Center by the sampling coordinator.

8.0 REFERENCES

Sandia National Laboratories, Corporate Policy ESH100 Environment Safety & Health, SNL/NM.

Sandia National Laboratories, Environmental Programs and Assurance Department, FOP 03-02, *Long Term Environmental Stewardship Water Level Data Acquisition and Management* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 05-01, *Groundwater Monitoring Well Sampling and Field Analytical Measurements* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 05-02, *Groundwater Monitoring Equipment Field Check for Water Quality Measurements* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 05-03, *Groundwater Monitoring Equipment Decontamination* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 05-04, *Groundwater Monitoring Waste Management* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 09-05, *Conducting Slug Test Using Pressure Transducer and Data Logger* (latest edition), SNL/NM.

Sandia National Laboratories, Environmental Programs and Assurance Department, PHS SNL05A01241, *Long Term Environmental Stewardship Groundwater Monitoring Activities* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, PLA 05-09, *Groundwater Monitoring Health and Safety Plan* (latest edition), SNL/NM.

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Attachment A

Decontamination Log Form

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Portable Pump and Tubing / Water Level Indicator
Decontamination Log Form

Project Name: _____	**Monitoring Well ID #** : _____	**Date:** _____

The following equipment was decontaminated at completion of sampling activities in accordance with FOP-05-03

Pump and Tubing Bundle ID #: _____	**Water Level Indicator ID #:** _____
Personnel Performing Decontamination: _____ _____ Print Name: Initial: _____ _____ Print Name: Initial:	**Personnel Performing Decontamination:** _____ _____ Print Name: Initial: _____ _____ Print Name: Initial:

Condition of Equipment

Pump: _____ **Tubing Bundle**: _____ **Water Level Indicator:** _____

List of Decontamination Materials

Distilled or **Deonized** (circle one) **Source:** _____ **Lot Number:** _____	**HNO_3** **Grade:** _____ **UN #:** _____ **Manufacturer:** _____ **Lot Number:** _____

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SANDIA NATIONAL LABORATORIES
LONG-TERM STEWARDSHIP

FIELD OPERATING PROCEDURE

FOP 05-04

GROUNDWATER MONITORING WASTE MANAGEMENT

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Approved: Pamela Puissant, Department Manager — **Date:** 1/24/12

Author: *How frequently does this document need to be reviewed and/or revised?*	*Every three years or when activities change*	
Manager: *Does this document need to be tracked?*	(Yes)	*No*

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Revision History

Revision	Review Date	Effective Date	Summary of Changes
1	8/24/2005	10/10/2005	New document
2	6/13/2007	8/16/2007	Formatting changes. Updated section 3, Roles and Responsibilities; section 4, Training Qualifications; section 7, References.
3	11/12/2009	11/12/2009	Formatting changes. Added work planning and control information to section 5, Health and Safety. Updated section 4, Training Qualifications; section 7, References.
4	01/10/2012	01/24/2012	Formatting changes. Revision history changed from 2 years to 3 years. Removal of some forms (attachments) and replaced with hyperlinks to where the forms can be found. Updated section 4, Training Qualifications; section 7, References.

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FORMS

EP 2009-ALW – Environmental Planning – Activity Level Work Evaluation Form
EP 2009-AUL – Environmental Planning – Authorized Users List
EP 2009-OJT – Environmental Planning – On-the-Job Training
EP 2009-WRA – Environmental Planning – Work Resumption Authorization Form
SA2001-MWA – Less Than 90-Day Hazardous or Mixed Waste Accumulation Unit Inspection Form

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Acronyms & Abbreviations

AOP	administrative operating plan
CFRC	Customer Funded Records Center
CHPD	closed-head poly drum
COC	chain of custody
decon	decontamination
FOP	field operating procedure
HWMF	Hazardous Waste Management Facility
OJT	on-the-job training
PHS	primary hazard screening
PLA	plan
PPE	personal protective equipment
RCRA	Resource Conservation and Recovery Act
RMWDR	radioactive or mixed waste disposal request
RMWMF	Radioactive and Mixed Waste Management Facility
SAP	sampling and analysis plan
SNL/NM	Sandia National Laboratories, New Mexico
THA	task hazard analysis
WDDR	waste description and disposal request

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1.0 PURPOSE, SCOPE, AND OWNERSHIP

Purpose This field operating procedure (FOP) provides instruction on managing waste generated during groundwater sampling activities. Waste is managed in compliance with Sandia National Laboratories, New Mexico (SNL/NM) Corporate Policy ESH100 Environment Safety & Health.

Scope The scope of this procedure is limited to management of well purge waste water, equipment decontamination (decon) waste water, Hach Accu-Vac ampule waste, personnel protective equipment (PPE) waste (nitrile or latex gloves), and paper wipes generated during groundwater monitoring activities at SNL/NM sites.

Ownership The Long-Term Stewardship Department is responsible for development, approval, distribution, revision, and control of this document.

2.0 BACKGROUND

The New Mexico Environmental Department has indicated that groundwater monitoring will be required to address the uncertainty of future impacts of contamination on groundwater. Specific wells within the Chemical Waste Landfill, Mixed Waste Landfill, Tijeras Arroyo Groundwater, Technical Area V, and the Burn Site Groundwater areas will be proposed for long-term monitoring. Separate requirements and site-specific monitoring plans will be developed and detailed upon regulatory approval of corrective measure evaluation, post-closure care provisions, long-term monitoring and maintenance plans, and other regulatory procedures.

Based upon historical results, groundwater sampling of monitoring wells is not expected to produce waste or contaminated materials requiring special handling or regulated disposal.

3.0 ROLES AND RESPONSIBILITIES

The **project leader** is responsible for the following:

- Reviewing and recommending approval of this procedure.
- Providing overall coordination and management of the project.
- Providing a sampling and analysis plan (SAP) that meets prescribed regulatory or programmatic requirements.
- Reviewing completed field forms and data pertaining to the waste management activities.
- Reporting all information as may be required by regulations or directives.

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The **sampling coordinator** is responsible for the following:

- Generating a mini-SAP from the SAP. The mini-SAP is a field-friendly version of the SAP. It details sampling activities for the field support operations project leader and field technicians. It summarizes sampling procedures, analytical parameters, field measured parameters, purge requirements, and waste management tasks. It also identifies monitoring well characteristics that may extend the sampling period (e.g., low-yield wells, well construction issues, etc.).
- If needed, preparing a waste management plan for each sampling event.
- Providing the field support operations project leader with a copy of the mini-SAP.
- Coordinating waste management activities with the project leader and the field support operations project leader.
- Reviewing completed field forms and data pertaining to the sampling activities.
- Ensuring that all data quality requirements are performed.
- Reviewing all analytical data used for waste characterization.
- Obtaining waste determination from the environmental protection representative (non-regulated, hazardous, and radioactive).
- Managing, coordinating, and disposing of purge water and other waste generated from field operations.
- Obtaining discharge permits for purge and decontamination water from the Waste Water Discharge project leader.
- Submitting disposal request to the appropriate department (Hazardous Waste Management Facility [HWMF], Radioactive and Mixed Waste Management Facility [RMWMF], Waste Water, and Solid Waste).
- Coordinating with the field support operations project leader for disposal and discharges (Work Request Form, Attachment A).
- Tracking and documenting each waste activity.
- Performing and documenting weekly inspections of Building 9925 Resource Conservation and Recovery Act (RCRA) Less Than 90-Day Waste Accumulation Area.
- Performing and documenting weekly inventory of all waste stored at Building 9925 waste accumulation areas.
- Performing monthly inspection of emergency equipment.
- Maintaining documentation for waste disposal activities.
- Submitting completed field forms to the Customer Funded Record Center and entry of relevant data to the Environmental Data Management System database.
- Reviewing and providing recommendations for revisions to this procedure (if necessary).

The **field support operations project leader** is responsible for the following:

- Communicating with the sampling coordinator regarding sampling activities.
- Supervising the field technicians.
- Verifying field technicians' compliance with RCRA waste accumulation area training requirements.

- Providing for on-the-job training (OJT) of new field technicians.
- Assigning field technicians (qualified by training and experience) to conduct the activities described in this procedure.
- Coordinating sampling activities with the sampling coordinator, Sample Management Office, and field technicians.
- Ensuring the materials and equipment necessary to perform the work are available.
- Providing the field technicians with a copy of the mini-SAP.
- Reviewing field documentation.
- Maintenance of the training matrix for all field personnel.
- Maintaining, reviewing, and revising all technical work documents.
- Owner/manager/emergency coordinator of building 9925 RCRA Less Than 90-Day Waste Accumulation Area.
- Reviewing and providing recommendations for revisions to this procedure (if necessary).

The **field technicians** are responsible for:

- Completing all necessary and required training as specified by the field support operations project leader.
- Maintaining and decontaminating equipment.
- Managing and disposing of waste as directed by completed Work Request Forms and the field support operations project leader.
- Completing and reviewing field documentation forms.
- Providing recommendations for revisions to this procedure (if necessary).

The **waste water discharge project leader** is responsible for reviewing analytical data results of purge and decon water if requested by the sampling coordinator.

The **environmental protection representative** is responsible for reviewing analytical data results of purge and decon water if requested by the sampling coordinator.

The **health physicist** is responsible for reviewing analytical data results of purge and decon water if requested by the sampling coordinator.

4.0 TRAINING QUALIFICATIONS

Personnel conducting field activities shall complete the following:

- Read applicable sections of SNL/NM Corporate Policy ESH100 Environmental Safety & Health.
- Read primary hazard screening (PHS) SNL05A01241, *Groundwater Monitoring Activities*.
- OJT for new field personnel performing waste management activities. Document training by completing On-the-Job Training form (EP 2009-OJT).
- Read and sign FOP 03-02, *LTES Groundwater Level Data Acquisition and Management*.

- Read and sign FOP 05-01, *Groundwater Monitoring Well Sampling and Field Analytical Measurements*.
- Read and sign FOP 05-02, *Groundwater Monitoring Equipment Field Check*.
- Read and sign FOP 05-03, *Groundwater Sampling Equipment Decontamination*.
- Read and sign FOP 09-05, *Conducting Slug Test Using Data Logger & Pressure Transducer* (only necessary if conducting slug test).
- Read and sign Plan (PLA) PLA 05-09, *Groundwater Monitoring Health & Safety Plan*.
- Complete training courses listed in Table 1.
- Field personnel shall sign the Authorized Users List (EP 2009-AUL) to affirm they have read and understand this document, and agree to operate within the stated constraints.

Table 1. Training Course List

Course Code	Course Title
CHM100/103	Chemical Safety Training/Site-Specific Chemical Training
ELC105	Basic Electrical Safety (> 50 volts)
ELC901	Safe Switching Briefing
ENV100	OSHA Health & Safety Basic Training - General Worker (40 HR)
ENV103	OSHA Health & Safety Training Refresher (8 HR)
ENV112	Hazardous Waste & Environmental Management Training
ENV216	RCRA - Less Than 90-Day Area Accumulation Area for Owners & Emergency Coordinators
ENV316	RCRA - Less Than 90-Day Area Accumulation Area for Waste Workers
ENV416	RCRA - Less Than 90-Day Area Accumulation Area for Waste Workers - Site-Specific
ESH100	ES&H Awareness
FKL153	Forklift Operator and Hands-On Training
MCH200	Hand and Power Tool Safety
MED102	Standard First Aid
MED104	Heartsaver CPR
OTS101	Occupational Thermal Stress
PKX100	Basic Hazardous Material Transportation Training
PPE106	Personal Protective Equipment Training
PRS150	Pressure Safety Orientation
PRS250	Advanced Pressure Safety
RAD230	Radiological Worker II Training
RAD230R	Radiological Worker II Retraining
RGH100	Crane, Rigging, Hoisting, & Hands-on Training

CPR = Cardiopulmonary Resuscitation
ES&H = Environment, Safety and Health
HR = hour
OSHA = Occupational Safety and Health Administration
RCRA = Resource Conservation and Recovery Act

5.0 HEALTH AND SAFETY

A task hazard analysis (THA) has been performed on the activities described in this FOP as well as a hazard assessment survey performed by a SNL/NM industrial hygienist. They are detailed in the PLA 05-09, *Groundwater Monitoring Health & Safety Plan*. The THA was performed in conjunction with PHS SNL05A01241, *LTES Groundwater Monitoring Activities*.

An Activity Level Work Evaluation Form (EP 2009-ALW) was completed and approved by the department manager as required by administrative cooperating plan (AOP) AOP 09-10, *Work Planning and Control*.

A field technician or the field support operations project leader shall conduct a tailgate safety meeting and fill out a Tailgate Safety Meeting Form prior to the start of groundwater sampling activities as described in PLA 05-09, *Groundwater Monitoring Health & Safety Plan.*

In the event that work is stopped due to:

- Safety-related issues,
- an injury incurred while performing the tasks identified in this procedure, or
- as the result of an audit,

the field technicians shall immediately notify the field support operations project leader, the project leader, and the department manager. The field technicians shall seek the assistance of the field support operations project leader for the mitigation of the hazard and the completion of a Work Resumption Authorization Form (EP 2009-WRA) as required by AOP 09-10, *Work Planning and Control*. The department manager shall sign the completed form prior to the restart of work.

6.0 DESCRIPTION OF ACTIVITIES

The following is a description of activities for managing waste. They are summarized in a flowchart that is provided in Attachment B.

The project leader generates a SAP document. The SAP describes the groundwater sampling and waste management requirements identified in the permits or site closure plans for the specific sites.

The sampling coordinator prepares a mini-SAP that provides the field support operations project leader and field technicians with the information necessary for them to collect the groundwater samples and manage generated purge water, decon water, PPE, and paper wipe waste properly. The sampling coordinator may include additional sample analytical requirements that are not specified in the mini-SAP but are necessary to properly characterize the purge water, decon water, PPE, and paper wipe waste.

The field support operations project leader and field technicians use the information provided in the mini-SAP to perform the groundwater sampling at the designated locations. The waste generated during sampling activities includes purge water, decon water, PPE, paper wipes, and possibly HACH ampule waste. The mini-SAP identifies how the waste will be labeled and managed.

All purge water and decon water will be collected in separate 55-gallon closed-head poly drums (CHPDs). A label will be placed on each 55-gallon CHPD drum indicating the following:

- Initial Label Type (Hazardous or Non-regulated)
- Container Identification # (site-date-sequence)
- Project Name
- Waste Matrix (purge water or decon water)
- Accumulation Start Date
- Waste Owner, Organization, and phone number

All PPE and paper wipes will be placed in a plastic trash bag and waste receptacle. Both historical groundwater sample values and associated analytical results will be used to characterize the PPE and paper waste. A label will be placed on the waste container indicating the following:

- Initial Label Type (Hazardous or Non-regulated)
- Container Identification # (site-date-sequence)
- Project Name
- Waste Matrix (PPE, paper wipes)
- Accumulation Start Date
- Waste Owner, Organization, and phone number

The field technicians will complete a Groundwater Monitoring Waste Generation Log (Attachment C) as the waste is produced at each sampling location. The Groundwater Monitoring Waste Generation Log will identify:

- Container Identification # (site-date-sequence)
- Project Name
- Initial Label Type (Hazardous or Non-regulated)
- Waste Matrix (purge water, decon water, PPE, paper wipes)
- Container Type/Volume
- Volume of Waste
- Total Container Weight
- Chain of custody (COC) #: Sample#-Fraction
- Accumulation Start & Full Date
- Date Waste is moved to an Accumulation Area
- Accumulation Area Name

The 55-gallon drums will be moved to the appropriate storage area at completion of sampling activities. The 55-gallon drums labeled as containing hazardous waste will be placed in a RCRA Less Than 90-Day Waste Accumulation Area. The 55-gallon drums labeled as containing non-regulated waste will be kept at an area designated for non-regulated waste.

Because small quantities of PPE and paper wipe hazardous waste are generated, the 5-gallon poly bucket is temporarily stored in a Satellite Accumulation Area located in the groundwater sampling vehicle. It is moved to the appropriate waste accumulation area when the 5-gallon poly bucket is full.

HACH Accu-Vac ampule waste will be designated and labeled as a hazardous waste. It is collected in a 5-gallon poly bucket. Because small quantities of this waste are generated, it is temporarily stored in a Satellite Accumulation located in the groundwater sampling vehicle. It is moved to a RCRA Less Than 90-Day Waste Accumulation Area when the 5-gallon poly bucket is full.

The field support operations project leader will review and forward all completed field forms to the sampling coordinator at completion of sampling activities.

The field support operations project leader is responsible for managing and processing all hazardous and non-regulated waste once they are placed into the Building 9925 storage areas. Hazardous waste cannot exceed the 90-day hold time for a RCRA waste accumulation area. The sampling coordinator must complete a Less Than 90-Day Hazardous or Mixed Waste Accumulation Unit Inspection Form (SA2001-MWA) at time of the inspection. Completed inspection forms must be kept at or adjacent to the RCRA waste accumulation area. If an alternate 90-day area is used, the field support operations project leader will coordinate with the owner of the alternate site to ensure all regulatory and SNL/NM requirements are met.

To determine the disposal path of purge and decon water, the sampling coordinator reviews the analytical data results and determines whether:

1. The waste water discharge project leader (non-regulated waste) needs to review the data package.
2. The environmental protection representative (RCRA hazardous waste) needs to review the data package.
3. The health physicist (radioactive waste) needs to review the data package.

The disposal path of the PPE and paper wipe waste will also be determined by the disposal path of the purge and decon water analytical data results. The sampling coordinator prepares a data package that consists of a copy of the Waste Generation Log and a copy of the laboratory analytical results. The data package is then submitted to the appropriate person.

1. The waste water discharge project leader reviews the data package of non-regulated waste. After it is confirmed, the PPE and paper wipe waste can be disposed of as regular solid

waste. At this point there are three possible disposal paths for the non-regulated purge and decon water. They are:

- Discharge to the ground surface.
- Discharge to the sanitary sewer.
- Disposal through the HWMF.

Ground Surface Discharge — Only purge water may be discharged to the ground surface if the analytical data results meet 20.6.2 of the New Mexico Administrative Code. A surface discharge permit will be issued to the sampling coordinator by the waste water discharge project leader.

Sanitary Sewer Discharge — Purge and decon water that do not meet ground surface discharge requirements may be discharged to the sanitary sewer if the analytical data results meet the with Albuquerque Bernalillo County Water Utility Authority sanitary sewer discharge limits. A sanitary sewer discharge permit will be issued to the sampling coordinator by the waste water discharge project leader.

HWMF Disposal — Purge and/or decon water that does not meet sanitary sewer discharge requirements must be disposed through the HWMF. The waste water discharge project leader must provide a memo to the sampling coordinator stating that the purge and/or decon water must be disposed through the HWMF.

The sampling coordinator reviews the response given by the waste water discharge project leader and coordinates with the field support operations project leader for the authorized disposal of the purge and decon water accordingly.

If the purge and/or decon water must be disposed through the HWMF, then the sampling coordinator will fill out and submit a HWMF Waste Description and Disposal Request (WDDR) form. A copy of the laboratory analytical results (electronic or hard copy) must also be submitted to the HWMF.

If a permit was issued for discharge (ground surface or sanitary sewer), then the sampling coordinator will submit a Work Request Form (Attachment A) to the field support operations project leader to perform the discharge. The Work Request Form includes the following information:

- Project Name.
- Discharge Permit #.
- Indicate where the water will be discharged (ground surface or sanitary sewer).
- Number of containers to be emptied.
- Total volume of water to be discharged.
- Container identification numbers.
- Date of Discharge.

- Who completed the discharge.

The field support operations project leader receives the Work Request Form from the sampling coordinator to discharge the purge and/or decon water. The field support operations project leader schedules a field technician to discharge the purge and/or decon water as indicated in the Work Request Form. The completed Work Request Form is returned to the sampling coordinator by the field support operations project leader.

2. The environmental protection representative reviews the data package and verifies that the purge and decon water are a hazardous RCRA waste. The PPE and paper wipes associated with the purge and decon water will also be treated as hazardous waste. The sampling coordinator makes arrangements to dispose of the purge water, decon water, PPE, and paper wipes through the HWMF. All HACH Accu-Vac ampule wastes, regardless of sample location, will be treated as hazardous waste.

   To dispose of the waste, the sampling coordinator must fill out a HWMF WDDR form. The form is accessible on-line at:

   http://www-irn.sandia.gov/esh/hwmf_prgrm/wddr.htm

   The HWMF may request a data package on the waste in addition to the WDDR form.

3. The health physicist reviews the data package and verifies that the purge and decon water are a radioactive waste. The PPE and paper wipes associated with the purge and decon water will also be treated as radioactive waste.

   To dispose of the waste, the sampling coordinator must fill out a RMWMF Radioactive or Mixed Waste Disposal Request (RMWDR) form. The form is accessible on-line at:

   https://info.sandia.gov/esh/esh_center/Radioactive_Waste/RegWaste_dforms.htm

   The RMWMF may request a data package on the waste in addition to the RMWDR form.

7.0 REFERENCES

Sandia National Laboratories, Corporate Policy ESH100 Environment Safety & Health, SNL/NM.

Sandia National Laboratories, Environmental Programs and Assurance Department, FOP 03-02, *Long Term Environmental Stewardship Water Level Data Acquisition and Management* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 05-01, *Groundwater Monitoring Well Sampling and Field Analytical Measurements* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 05-02, *Groundwater Monitoring Equipment Field Check for Water Quality Measurements* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 05-03, *Groundwater Monitoring Equipment Decontamination* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 09-05, *Conducting Slug Test Using Pressure Transducer and Data Logger* (latest edition), SNL/NM.

Sandia National Laboratories, Environmental Programs and Assurance Department, PHS SNL05A01241, *Long Term Environmental Stewardship Groundwater Monitoring Activities* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, PLA 05-09, *Groundwater Monitoring Health and Safety Plan* (latest edition), SNL/NM.

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Attachment A

Work Request Form

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Work Request Form

Sampling Coordinator : _____ **Date Issued:_____**			
Project Name:			
Discharge Permit #:			
Discharge to: (Ground Surface or Sanitary Sewer)			
Number of containers to be emptied:			
Total Volume of Waste to be discharge:			
Container I.D. #'s:			
Date of Discharge:			
Discharge Completed by: (Field Technician)	Print Name: _____ Signature: _____	Print Name: _____ Signature: _____	Print Name: _____ Signature: _____

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Attachment B

Groundwater Waste Management Flowchart

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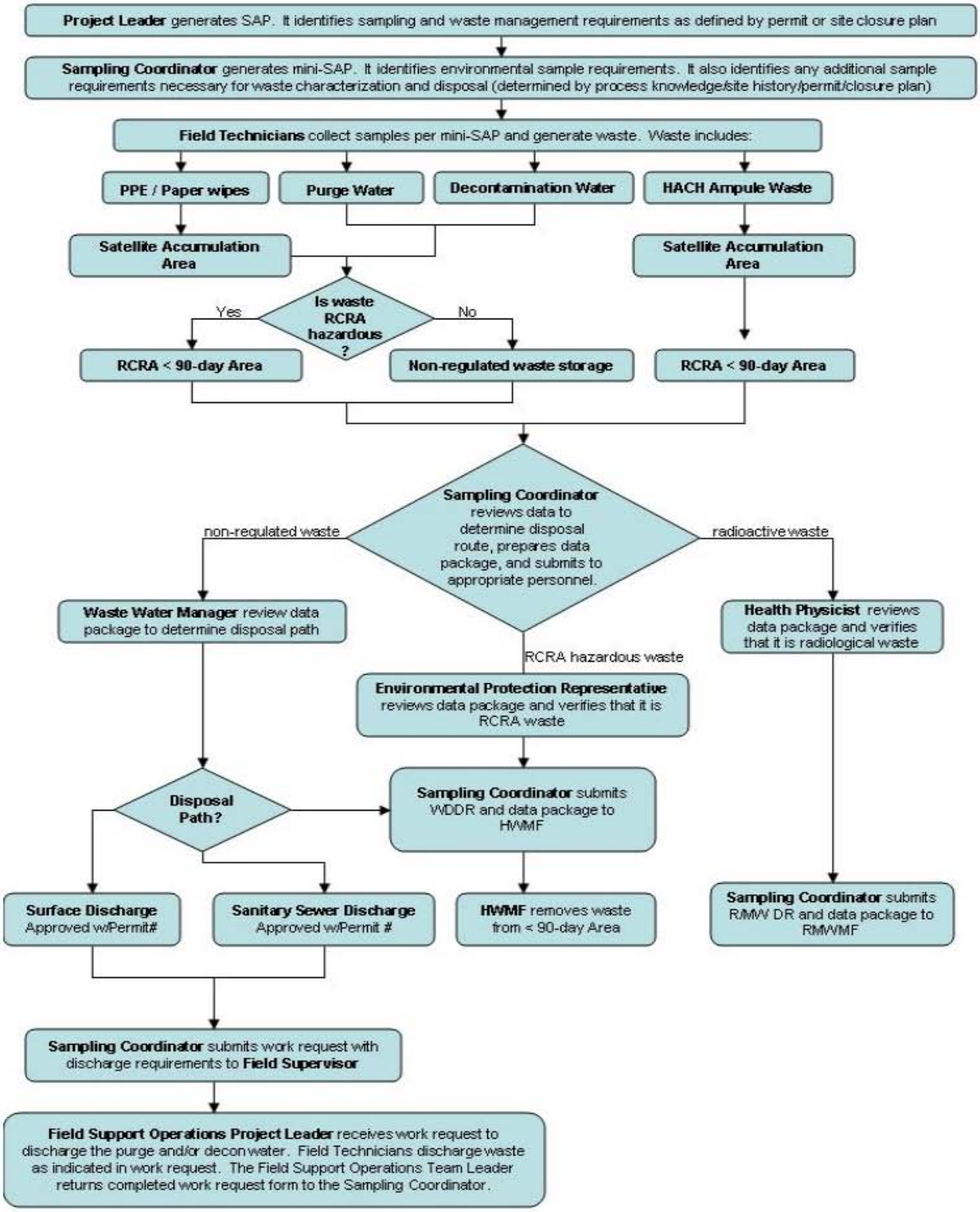
Groundwater Waste Management Flowchart



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Attachment C

Groundwater Monitoring Waste Generation Log

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Groundwater Monitoring Waste Generation Log

Waste Generator : _____ **Phone:** _____ project leader: _____			
Project Name			
Container ID # (site-date-sequence)			
Initial Label Type (Hazardous or Non-Regulated)			
Waste Matrix (purge water, decon water, HACH Accu-Vac ampule)			
Container Type / Volume			
Volume of Waste			
Total Container Weight			
COC#: Sample#-Fraction	_____ _____ _____ _____ _____ _____ _____	_____ _____ _____ _____ _____ _____ _____	_____ _____ _____ _____ _____ _____ _____
Accumulation Date	Start: Full:	Start: Full:	Start: Full:
Date Waste Moved to Accumulation Area			
Accumulation Area Name			
Comments:			

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SANDIA NATIONAL LABORATORIES
LONG TERM STEWARDSHIP DEPARTMENT (4142)

SAMPLE MANAGEMENT OFFICE (SMO) SAMPLE HANDLING, PACKAGING AND SHIPPING

LABORATORY OPERATING PROCEDURE

LOP 94-03
Revision 6

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Author: How frequently does this document need to be reviewed and/or revised?	Every 3 years
Manager: Does this document need to be tracked?	Yes

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Revision History

Revision	Effective Date	Summary of Changes
0	01/14/1994	New Document
1	05/14/1996	Administrative Updates
2	09/17/1998	Administrative Updates
3	12/16/2003	Organization ownership change from Sandia ES&H to Environmental Restoration Project
4	6/26/2007	Changed revision cycle from 2 to 3 years. Organization ownership change from Sandia Environmental Restoration Project to Sandia ES&H Organization.
5	6/29/2011	Programmatic revisions include the addition of the Sample Management Analysis Request Tool (SMART) and the addition of Industrial Hygiene (IH) sampling. Other revisions are definition updates, sentence structure, grammar, and formatting. Additions include Revision History page, tracking box and footnote disclaimer.
6	11/12/2013	Programmatic revisions include improvements to ARCOC processing, the addition of Bioassay sampling and changes to Industrial Hygiene (IH) sampling to include the use of the Radiological Process Knowledge Form (SF 6951-RRF). Chem101, PKX050, and OJT for HWMF Operations coordination were added to training requirements. A buddy system has been mandated for Friday work schedules. The chemicals were removed from use in addition to removing the use of the fume hood. The two Emergency Evacuation routes have been described with additional evacuation information. A requirement to stage first time samples waiting RCT survey in the RMA has been added. Other revisions include updating language to reflect current program elements and requirements.

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ACRONYMS AND ABBREVIATIONS

AOP	Administrative Operating Procedure
ARCOC	Analysis Request/Chain-of-Custody Record
COC	Chain-of-custody
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
IATA	International Air Transport Association
IH	Industrial Hygiene
LOP	laboratory operating procedure
MOU	memorandum of understanding
OP	operating procedure
PHS	Primary Hazard Screening
RCT	Radiation Control Technician
RMA	Radioactive Management Area
RPDP	Radiation Protection Dosimetry Program
RPPM	Radiation Protection Procedures Manual
RPSD	Radiation Protection Sample Diagnostics
SARF	Sample Analysis Request Form
SMART	Sample Management Analytical Request Tool
SMO	Sample Management Office
SMO-QAPP	Sample Management Office Quality Assurance Project Plan
SNL/NM	Sandia National Laboratories/New Mexico
SOW	Statement of Work

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1.0 PURPOSE, SCOPE, AND OWNERSHIP

The main purpose for this Laboratory Operating Procedure (LOP) is the following:

- Sample integrity is maintained during the packaging and shipping processes by Sandia National Laboratories/New Mexico (SNL/NM)/ Sample Management Office (SMO).
- SMO packaging processes meet regulatory requirements with applicable state, federal, local and international transportation regulations, U.S. Department of Energy (DOE) regulations and Sandia Environment, Safety and Health (ES&H) policies and procedures.

1.2 Scope

This document applies to all SMO employees and contractors responsible for the packaging and/or shipping of samples via a common carrier at SNL/NM.

1.3 Ownership

The SMO is responsible for the development, approval, distribution, revision and control of this document. Suggestions for improvement to this document should be submitted to the SMO.

2.0 RESPONSIBLE INDIVIDUALS AND ORGANIZATIONS

The following individuals and organizations have the specified responsibilities with regard to samples submitted to the SMO Packaging Facility for packaging and shipping.

Requesting Organization(s): Organizations that require SMO services are responsible for communicating requirements to the SMO at least two weeks prior to sample collection. This allows sufficient time to notify the analytical laboratories and provide sample kits (Bottle Orders) for sampling events. SMO customers, including field personnel, are responsible for providing complete sample documentation, completed Analytical Request Chain-of-custody (ARCOC) or Sample Request Analysis (SARF) forms (Attachment A, B and C), and Radiological Survey Forms (Attachment F) as applicable. In addition, SMO customers must notify the SMO of any special shipping requirements (i.e., late delivery, short hold times, limited quantity, etc.).

Packaging Coordinators: Trained SMO Packaging Coordinators (refer to Training section) are responsible for the packaging of all samples shipped to contract analytical laboratories through the Receiving/Mail & Material Movement Organization (10261) commonly referred to as "Shipping and Receiving". SMO Packaging Coordinators ensure that samples are properly

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processed, stored, and packaged for shipment to analytical laboratories in accordance with the current *SMO Quality Assurance Project Plan* (SMO-QAPP), DOE, US Department of Transportation (DOT), and International Air Transportation Administration (IATA) requirements. In addition, the Packaging Coordinators shall ensure that sample custody is maintained and documented in accordance with the current SMO-QAPP and the *Sample Management and Custody Administrative Operating Procedure* (AOP-95-16).

Hazardous Material Packaging Consultants: The Logistics Risk Management consultants in the Sandia National Laboratories Shipping and Receiving organization are responsible for oversight and guidance and are the final authority in the shipment of all samples processed at the SMO Packaging Facility as described in Section 7.3 of this document.

Radiological Control Technicians (RCTs): Radiation Protection Program RCTs are responsible for surveying all non-exempt samples prior to shipping. See Section 7.1 for a discussion regarding sample exemption.

3.0 TRAINING QUALIFICATIONS

Requesting Organization: Customers requesting SMO services on a regular basis shall read this procedure and sign the SMO Sample Handling, Packaging and Shipping LOP Authorized Users List. Customers who use SMO services occasionally are not required to sign the Authorized Users List.

Packaging Coordinator: Required training is listed in the Primary Hazard Screen (PHS) document (PHS 972834764), *SMO Packaging Facility Operations* (current revision). Upon completion of required training, the SMO Packaging Coordinator is qualified to process and package samples for shipping through Logistics Risk Management SNL Shipping and Receiving/Mail & Material Movement organizations. This training is in compliance with the Code of Federal Regulations 49 CFR Subpart H, Part 172.700-704. The Packaging Coordinator must complete training listed in Table 1.

Table 1 - Training Course List

Course Code	Course Title
CHM100	Chemical Safety
CHM 101	Chemical Safety Training Update for GHS
CHM103	Site Specific Chemical Safety
ESH 100	ES&H Awareness
ESH 200	Safety Management
ENV102	OSHA Health & Safety Basic Training – Occasional Worker (24 HR)
ENV103	OSHA Health & Safety Training Refresher (8 HR)

Table 1 - Training Course List (concluded)

Course Code	Course Title
ENV112	Hazardous Waste & Environmental Management Training
PKX050	Site Specific Packaging and Transportation of Hazardous Materials Training
PKX100	Basic Hazardous Material Transportation Training
PKX112	Basic Hazardous Waste Transportation Training
PKX115	Basic Hazardous Material Driver Training
PKX130	Basic International Air Transportation (IATA) Training
PKX111	Basic Radioactive Materials Transportation Training
PKX211	Advanced Radiological Materials Transportation Training
PPE106	Personal Protective Equipment Training
RAD102	General Employee Radiological Training (May be replaced with RAD210, Rad230 or SNL qualified RCT training)
RAD210	Radiological Worker I Training
OJT	HWMF Operations Coordination (Contingency Plan and MOU)

4.0 HEALTH AND SAFETY

Hazards Identification:
A complete listing of hazards is identified in PHS 972864764, *SMO Packaging Facility Operations* (current version). In addition, Sampling/Field Technicians shall inform SMO Packaging Coordinators and Packaging Facility Staff of other known potential hazards associated with samples to be packaged and shipped by SMO. Hazards associated with sample handling and packaging activities include, but are not limited to, the following:

- Chemical hazards
- Radiological hazards
- Physical hazards
- Biological hazards (etiologic agents) are a remote possibility not incident to normal working conditions.

5.0 EQUIPMENT AND MATERIALS

The Packaging Facility equipment and materials include but are not limited to the following list.

Equipment

- Eberline E600 Survey Meter with attached SHP380AB (or equivalent) is used by the RCTs in accordance with the Radiation Protection Operating Procedure RPO-03-31 for indication only. Daily instrument source checks are performed in accordance with the

Radiation Protection Procedures Manual (RPPM), Chapter 12, Attachment 12-1.

- Work Table Commercial Scale with a capacity of 150 lbs/68 kg. for weighing shipping containers/coolers.
- Various laboratory refrigerators and freezers for sample storage, including storage of containers/coolers, and Blue Ice™.

Materials

- Re-sealable plastic bags and bubble bags (assorted sizes)
- Insulated plastic ice chests/coolers (preferably without a spout)
- Absorbent packing material (i.e., Powersorb™ Universal Sorbent Pads)
- Large plastic bags
- Strapping tape
- Strapping bands
- Crimping supplies
- Custody seal tape
- Labels: Up arrows, "Fragile" and various hazard and handling DOT/IATA approved labels (i.e., "Flammable", "Corrosive", etc.)
- Cooling material (frozen) (i.e., Blue Ice™). In the event that cooling material is not readily available, ice may be substituted, provided that the ice is double-bagged, sealed and placed in the cooler with the bag opening facing up.
- Gloves: chemical resistant gloves and disposable, latex, polyvinyl chloride (PVC), nitrile, etc.
- Safety glasses
- Lab coat or coveralls
- Steel toed shoes
- Thermoluminescent dosimeter (TLD) for personnel involved in handling radioactive materials and samples which have not been screened by an RCT.

6.0 SMO PACKAGING FACILITY (BUILDING 928) HOURS OF OPERATION

SMO Packaging Coordinators are available at the Packaging Facility (Building 928) on ***Monday through Thursday from 7AM to 5PM*** **and on** ***Friday, from 7AM to 12***. The SMO customer shall make special arrangements with the SMO in advance for sample delivery to Building 928 during non-standard hours of operation. The SMO uses a buddy system on Fridays due to historical light work load and single person packaging support. The SMO Packaging Coordinator working on Friday, shall notify one other SMO support staff when work is complete and the coordinator is leaving for the day/week.

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If same day packaging and shipping is required, samples shall be delivered to the SMO Packaging Facility, Building 928, ***before 11:00AM***. This allows sufficient time for the SMO Packaging Coordinator to complete the packaging process and meet corporate shipping deadlines. If corporate shipping deadlines cannot be met and sample integrity or customer requirements may be compromised, the SMO Packaging Coordinator or authorized representative may deliver samples to the FedEx drop-off located at the Albuquerque International Sunport (3720 Spirit Dr SE). The SMO Packaging Coordinator or authorized representative will deliver the entire consignment to the carrier for transport. **This applies to non-hazardous samples only.** Non- hazardous samples are described in the RPPM, Chapter 6: "*ES&H samples are exempted from the requirements of the RPPM if it is reasonably expected that the exterior of the sample container exhibits contamination levels less than those listed in Attachment 6-1, 'Radioactive Contamination Limits', and if dose rate on contact with the container is less than 0.5 mrem per hour".*

7.0 SAMPLE RECEIPT AND PACKAGING PROCEDURES

If samples are determined to be hazardous (flammable, corrosive, radioactive, etc.), the type of hazard shall be documented and SMO shall be notified prior to receiving samples. The SMO Packaging Coordinator shall follow the procedures outlined in Section 7.2 of this procedure.

7.1 Receiving Non-Hazardous Samples

- A minimum of one chain-of-custody must accompany submitted samples. The SMO Packaging Coordinator or SMO Support Staff shall be present during the acceptance of samples at the SMO Packaging Facility in Building 928 (Section 7.1.1).

- If the samples are not packaged for shipment immediately and refrigeration is required, the SMO Packaging Coordinator shall refrigerate the samples to maintain the temperature at $\leq 6^{o}C$ until shipment to the analytical laboratory.

- Items containing Radioactive Material shall be stored in the area posted "Controlled Area" and "Radioactive Material Area (RMA)".

- Based on process knowledge, IH media and samples are shipped as non-regulated.

- An RCT shall survey all non-exempt samples before they are shipped. Samples that are exempt and *do not* require an RCT survey prior to shipment include non-hazardous ground water samples, IH and any other samples with a Clearance – Radiological Process Knowledge Form (SF 6951-RRF) on file and exempt bioassay samples. Exempt bioassay samples that meet the following definitions and other criteria are qualified for the exemption

(Diagnostic Specimen Exemptions: under IATA DGR 2005, Amendment III):

- Specimens are those collected directly from humans or animals, including, but not limited to, excreta, secreta, blood and its components, tissue and tissue fluid, swabs, and body parts being transported for purposes such as research, diagnosis, investigational activities, disease treatment, and prevention.
- A patient or animal specimen is considered exempt if there is a minimal likelihood that pathogens are present. In determining whether a patient or animal specimen has a minimal likelihood that pathogens are present, an element of professional judgment is required to determine if a substance is exempt. This judgment should be based on known history, symptoms, and individual circumstances of the source, human or animal, and endemic local conditions.
- Examples of specimens which may be transported under the exemption include the blood or urine tests to monitor cholesterol levels, blood glucose levels, hormone levels, PSA tests, tests required to monitor organ function such as heart, liver, or kidney function for humans or animals with non-infectious diseases, or therapeutic drug monitoring; tests conducted for insurance or employment purposes, biopsies to detect cancer; and antibody detection in humans or animals.

- The SMO Packaging Facility shall not ship any samples that have specific activity above that specified by the Nuclear Regulatory Commission (NRC) license of the contract analytical laboratory and/or IATA Section 6. Or, those samples that fail to meet the definition and other criteria under IATA DGR 2005 for Diagnostic Specimen Exemptions.

7.1.1 SAMPLE CHECK- IN

7.1.1.1 Documentation

Ensure that all applicable documentation is correct and present. Nitrile gloves shall be worn when handling all samples.

- Ensure that the information on the Analysis Request and Chain-of-custody (ARCOC) and/or SARF for the IH program, Radiation Protection Dosimetry Program (RPDP) or the Onsite Laboratory (RPSD) forms are legible. (Attachment A, B, C and D). Illegible request forms will not be accepted.

- Ensure that sample containers are labeled and that all labels are legible and complete. The container labels in Attachment E are required for customers submitting samples on the ARCOC. Illegible sample labels will not be accepted.

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- If samples are from a radiological controlled area, the Sample Team Member shall have the *Radiological Survey* documentation (Attachment F) and/or the radiological survey

number present upon sample delivery to the SMO Packaging Facility.

- If samples are destined for the RPSD laboratory for analysis (i.e., gamma spec, alpha, beta, etc.), a completed *Onsite Laboratory (RPSD) SARF* from the Sample Team Member shall accompany the samples to the laboratory. (Attachment D).

- The Sample Team Member shall work with the SMO Packaging Coordinator or other SMO support staff to ensure that all sample containers and request forms are correct and sample information is cross-referenced and complete.

7.1.1.2 Sample Container Inspection

The SMO Packaging Coordinator and/or the Support Staff have the authority to refuse samples that do not meet the following criteria.

- Ensure that containers are clean, sealed and intact.
- Verify that each sample container has double containment in a re-sealable plastic bag. Glass containers shall be placed in sealed plastic bubble bags.
- Verify that no sample containers are leaking or broken.
- Verify that all sample container lids are secured with SNL approved custody tape. 40 ml glass vial containers for aqueous samples like groundwater, and IH containers, are exempt from this requirement. The container(s) are placed in a plastic bag and the bag, not the container(s), is secured with the custody tape.
- Verify that all sample containers are labeled with a complete and legible label. The label in Attachment E is required for all samples submitted on an ARCOC.
- Bioassay sample packaging must consist of the following three components:
    - a leak-proof primary receptacle(s);
    - a leak-proof secondary packaging, and
    - outer packaging of adequate strength for its capacity, mass and intended use, and with at least one surface having minimum dimensions of 100mm x 100mm.

7.1.1.3 Chain-of-custody Verification

Contract Laboratory SMO ARCOC

Review the Contract Laboratory ARCOC to verify that:

- The controlled document ARCOC form is used. This is SMO 2012-ARCOC (4-2012).
- The *ARCOC Number* is present.
- The *Page Numbers* are present and correct.
- The *Project Information* is correct (Dept. No./Mail Stop, Project/Task Manager, Service Order Number). This information can be found in the Project Management table in the Sample Management Analysis Request Tool (SMART) application. This information is uploaded from the Electronic Bottle Order and from the Electronic ARCOC.
- The *Analytical Lab* information is correct (Lab Contact, Lab Destination). External analytical lab information is uploaded from the Electronic Bottle Order and from the Electronic ARCOC. (Note that Analytical Lab information is not uploaded for the IH and RPDP SARF COC.) The SMO Packaging personnel may verify this information by checking the Lab Management Table in the SMART Application.
- The analytical laboratory *Contract Number* is correct. Contract numbers are found in the Lab Management Table in the SMART Application and are uploaded from the Electronic Bottle Order and the Electronic ARCOC.
- The *Project/Task No. and Customer group* are correct. This information is found in the SMART Application's most recent Project Management Tables and is uploaded from the Electronic Bottle Order and the Electronic ARCOC.
- The appropriate box in the Radiation Material Area, *RMA*,section is marked. If "Yes" is checked in the *RMA* box, verify that the Rad Survey data is provided and write "*Rad Survey Data Provided*" under *Comments*.
- The appropriate *Sample Disposal* box has been marked.
- The appropriate *Turnaround Time* (TAT) has been indicated. 30 days is a normal TAT. For a *Negotiated TAT*, the Sample Team Member shall indicate the number of days requested for the rush delivery (i.e., 3, 5 etc.). The 3, 7-Day TAT and Negotiated TAT prior authorization is completed when the Electronic Bottle Order is submitted.
- The *Special Instructions/QC Requirements* section of the ARCOC may be used by the Sample Team Member to indicate special instructions for SMO and/or the analytical laboratory.
- The *Sample Team Members* section has been completed. A signature for each field technician listed is required.
- The sample information on the ARCOC matches the information on the sample labels. All information must be cross-referenced and correct. If there are multiple sample containers assigned to a *Sample No.-Fraction*, verify that the number of sample containers submitted matches those indicated in the *Container-Volume* column (i.e., 3X40 mL will have three 40 mL containers for that sample).
- To relinquish samples go to Section 7.1.1.4.

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IH SARF Chain-of-custody

Review the IH SARF Chain-of-custody Report (Attachment B) to verify:

- The *IH Survey ID* is present.
- The *Sample Location* is indicated.
- The *Lab receiving sample* is indicated.
- The *Submitted By and Submission Date* are indicated and correct.
- The *Charge code* (Project/Task number) is correct. This information is found in the most recent Project Management Table of the SMART Application.
- The *Send Report To* and *Phone* are indicated.
- The *Attention of* line is completed with the name of the person that will receive the final data package. The *Email* line is filled in with this person's e-mail address. Filling in the *Fax* line is optional.
- The *Analysis requested* is completed.
- The *General Comments to lab personnel* are included. Generally, contact information and more specific sample information are indicated in this section.
- The *IH Sample #, Col. Date, Turn-Around-Time* and *Matrix* are indicated.
- The *Sample Comments* lists an SMO Sample Number-Fraction to correspond to each *IH Sample #.*
- The sample information on the SARF concurs with the samples delivered. All information must be cross-referenced and correct.
- Note that the IH SARF COC is 2 pages. The second page is the signature page for received and relinquished signatures. Verify that the IH Survey ID number is listed on the second page.
- To relinquish samples go to Section 7.1.1.4.

RPDP SARF

Review the RPDP SARF COC to verify that:

- The *RPDP Batch No* is present.
- The *Page Numbers* are *present and* correct.
- The *Customer Name, Organization (4121), Phone (845-DOSE/284.5598), email (dosimetry@sandia.gov) and program Name (Radiation Protection Dosimetry Program* are listed.
- The *Analytical Lab* information is correct (Lab Contact, Lab Destination). The analytical laboratory *Contract Number* is correct. Contract numbers are found in the Lab Management Table in the SMART Application.

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- The appropriate *Turnaround Time* (TAT) has been indicated. Normal (N) TAT is 30 days, Rush (R) TAT is 15 days and Urgent (U) TAT is 7 days.
- *Date Needed By* has been filled.
- The *Special Instructions/QC Requirements* section is completed. This section should include "Biological Sample – Treat with Caution" and an RPDP contact (name and phone).
- The sample information on the RPDP SARF matches the information on the sample labels. All information must be cross-referenced and correct. If there are multiple sample containers assigned to a *Customer Sample ID*, verify that the number of sample containers submitted matches those indicated in the *Qty/Tot Volume Tare Wt* column.
- Assure that the Electronic Data Delivery, *EDD,* box is checked either yes or no.
- To relinquish samples go to Section 7.1.1.4.

7.1.1.4 Relinquishing Samples

Samples are relinquished after the chain-of-custody document is deemed correct and complete. A Chain-of-custody (on ARCOC) or Submitted by customer (on IH SARF) or person delivering the bioassay samples shall sign and date the appropriate *Relinquished By* box.

- The SMO representative shall sign and date the appropriate *Received By* box. For the ARCOC and RPDP SARF, this box is located directly below the *Relinquished by* signature. For the IH SARF, this box is located directly across from the *Relinquished by* signature.
- For the ARCOC, authorized SMO personnel shall sign the *SMO Authorization* line.
- The IH SARF is 2 pages. The second page is the signature page for relinquishing and receiving samples. Verify that the IH Survey ID number is indicated on the second page.
- Assure that all pages of the chain-of-custody are identified with the ARCOC Number, IH Survey ID Number or RPDP Batch Number.
- Give a copy of the ARCOC, IH SARF or RPDP SARF to the customer.
- Enter all pertinent ARCOC, IH SARF or RPDP SARF information in the Sample Management Log (Attachment G).
- Place the original ARCOC, IH SARF or RPDP SARF and accompanying documentation with the samples in preparation for packaging and shipping

7.1.2 SAMPLE PACKAGING FOR ENVIRONMENTAL OR IH SAMPLES

Follow the listed steps when packaging Environmental or IH samples in preparation for shipment. Nitrile gloves shall be worn when handing all samples.

1. Verify that:
   - Each sample container is in a re-sealable plastic bag and that the bag is sealed.
   - Glass containers are placed in a re-sealable bubble bag and the bag is sealed. Glass containers larger than the plastic bags are surrounded with cushioning material (bubble wrap) or placed in a "bubble" sleeve.

2. Place absorbent material (Powersorb™ Universal Sorbent Pads) in the bottom of the cooler and place an appropriately sized waterproof plastic bag on top of the absorbent. If the cooler contains water samples, place an additional sorbent pillow inside the plastic bag at the bottom of the cooler. Place the protected sample container(s) in the large plastic bag and alternate glass containers with plastic containers or padding. This step does not pertain to IH samples which are packaged and shipped in boxes.

3. Place frozen cooling material (Blue Ice™) in the cooler for samples requiring temperature preservation. Avoid direct contact of the Blue Ice™ with sample containers (Blue Ice™ is often below 0°C). Insulate 40 mL vials with other sample containers or with water filled plastic bottles if necessary. (40 mL vials freeze or break if they are not protected due to the small volume of liquid.)

4. Pack the container with cushioning material to minimize the possibility of breakage from dropping or severe shock. Seal the large plastic bag containing samples with duct or plastic tape or a strong rubber band.

5. Log on to Web Shipper and follow the on-line instructions to complete the Web Shipper form.
   - A Shipper Number is automatically assigned. All coolers or boxes shipped to the same laboratory may be included on one shipper. Each laboratory location requires a separate shipper. Write the Shipper Number on the associated chain(s) of custody.
   - Assign a cooler or box number (i.e., #1, #2, #3, etc.) for each cooler that is being shipped to the same location.
   - For the Description on the Line Item List enter the cooler/box number, volume of the cooler and the corresponding ARCOC number, IH Survey ID or RPDP Batch Number of the samples packed in the cooler. (Example, "Cooler #1; 3.0 Cu. Ft.; COC606877")
   - Do not close the Web Shipper form at this time. Go to Step 6. The Web Shipper will be completed after Steps 6-11 are completed in Step 12.
   - Write the Shipper Number on all chain(s) of custody associated with the shipper.

6. Make a copy of the original ARCOC or SARF. Place the original ARCOC or SARF in a re-sealable plastic bag and place it on top of the large sealed and closed plastic bag

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containing the samples. Close the cooler/box lid.

7. If the cooler has a drain plug, secure the drain in the closed position with packing or duct tape.

8. Secure the cooler lid with packing tape in two locations. Use strapping bands completely around the cooler in two locations.

9. Mark and label the cooler as indicated below:
   - Place the appropriate analytical laboratory pre-printed address label on the cooler lid and ensure that the ARCOC number, IH Survey ID number or RPDP Batch Number on the shipper form matches the ARCOC number or IH Survey ID number on the address label. Cover with transparent tape.
   - Place "Up" arrow labels on two opposing sides of all coolers containing liquids. Put a "Fragile" label on the cooler lid for all coolers with glass containers.
   - Record the shipper number and cooler number (i.e., "1 of 3") on the packing tape located on the cooler lid. Do not write directly on the cooler lid. The packing tape will be removed and the cooler will be re-used.

10. Weigh each cooler and record the weight in the Sample Management Log (Attachment G). The weight of the cooler will also be recorded in the *Comments* section of the Web Shipper (Step #12).

11. Measure the dimensions of the cooler and record the total cubic feet on the appropriate line on the address label. The cooler dimensions will also be recorded in the *Comments* section of the Web Shipper (Step #12).

12. Return to the Web Shipper form.
    - In the *Comments* section, enter the weight of the filled cooler (Step #10), the volume and dimensions of the cooler (Step #11) and enter: "FED-EX FIRST OVERNIGHT". (Example, "44LBS; 3.0 CU. FT.=23X14X15; DO NOT RE-PACK, FED-EX FIRST OVERNIGHT")
    - The completed shipper is approved electronically and is automatically sent to Shipping and Receiving.
    - Print 1 copy of the completed shipper. This copy is taken to Shipping and Receiving with the corresponding cooler(s). After samples are shipped, Shipping and Receiving will send a notification with a completed shipper that includes a tracking number.

13. Transport the cooler(s) and or boxes to Shipping and Receiving, Building 957 and present the Web Shipper form to the Service Clerk. DOT driver training is not required to transport non-hazardous samples but is required for the transportation of hazardous and

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radioactive samples.

14. Complete all entries in the SMO Packaging Facility Sample Management Log (Attachment G).

15. Documentation submitted to the SMO data administrator may be submitted by one of the following options:

- Make a pink and yellow copy of the ARCOC or the IH SARF COC. Place these copies, a copy of the shipper and other documentation pertaining to the ARCOC or IH SARF COC in a large Ziploc™ bag and deliver to the SMO data administrator. The yellow copy is part of the laboratory data package and is sent to the SNL Records Center. The pink copy is kept at SMO as a reference copy.
- Or, the completed chain(s) of custody with associated documentation pertaining to the ARCOC or IH SARF COC is scanned and placed in the SMO COCsPackaging folder on the SMO shared drive.

7.1.3 SAMPLE PACKAGING FOR BIOASSAY SAMPLES

1. RPDP will deliver unsealed, packed bioassay coolers for shipment. The bioassay samples will be packed per Procedure No: RPDP-03-03 (current issue). The samples will be accompanied with an RPDP SARF.
2. Inspect the sample containers to verify that:
    - Sample containers are in a re-sealable plastic bag and that the bag is sealed.
    - Verify that no sample containers are leaking.
    - Verify that sample containers are labeled with a complete and legible label.
3. Follow Steps 1-15 in Section 7.1.2 (Sample Packaging for Environmental or IH Samples)

7.2 Receiving Hazardous Samples

The following steps must be followed when hazardous samples are received. Refer to *Shipment Planning* at Ship an Item (Web Shipper).

- If a sample is determined to be hazardous upon field-testing, via process knowledge and/or during sample survey, SMO personnel shall be notified of the specific hazard prior to sample delivery.
    - If unanticipated radioactive material or removable surface contamination exceeding RPPM Attachment 6-1 limits is determined refer to the **EMERGENCY PROCEDURES** section of this document.

- All samples that are labeled radioactive by an RCT shall be stored in the Radioactive

Material Area (a labeled refrigerator).
  - General area radiation levels are maintained at a level that does not require posting as a controlled area (<100 mrem per year or about ≤0.05 mrem/hr). If total samples present increase the general area dose rate to greater than 0.05 mrem/hr, the Controlled Area boundaries will be extended to reduce radiation exposure to personnel. The SMO support RCT is responsible for all radiation related postings or meter readings.

- Radiation screening shall be conducted on a representative sample fraction at the onsite RPSD laboratory to determine the total isotopic activity.
  - A sample that has a specific activity of 0.002 μCi/g or less may be packaged and shipped as an environmental sample with a disclaimer (Attachment H).
  - A sample that has a specific activity greater than 0.002 μCi/g shall be regarded as a radioactive material [IATA Section 6.0.1.3(a)].

- If a sample is determined to be radioactive, it must be within the allowable limits of the contract laboratory NRC license. Copies of NRC licenses documenting allowable radioactive limits are on file at the SMO Packaging Facility or electronically from SMO personnel or on the SMO shared drive in the NRC Licenses folder. The SMO Packaging Facility shall not accept a radioactive sample for packaging if it does not meet the allowable limits of the contract laboratory NRC license. The SMO Packaging Coordinator shall notify the customer when a sample is refused and the customer shall take custody of the sample immediately upon notification.

- If a sample is determined to be radioactive and within the allowable limits of the contract laboratory license, the SMO Packaging Coordinator and/or Packaging Facility staff will prepare the sample for shipment in accordance with IATA Section 10 as it applies to the packaging, marking, labeling, certification and documentation requirements for Class 7 radioactive materials (Preparing Hazardous Samples section). The SMO Packaging Coordinator shall deliver these radioactive samples SNL Shipping and Receiving for packaging and shipping.

- Radioactive samples shall only be delivered to SNL Shipping and Receiving by SMO staff in accordance with Corporate Procedure SCM100.3.19, *Movement of Hazardous Material.*

7.3 Preparing Hazardous Samples

The SMO Packaging Coordinator or SMO Packaging Staff shall take samples deemed hazardous, but not classified as radioactive materials, to Sandia Shipping and Receiving for packaging and shipping. The SMO Packaging Coordinator shall reference the section, *"How to*

Use the Regulations" in the current edition of the IATA Dangerous Goods Manual when preparing hazardous samples for delivery to Shipping and Receiving (Building 957). The steps below provide general guidance when preparing hazardous samples for delivery to Shipping and Receiving.

1. Inform the Hazardous Material Packaging Consultant of the specific hazards and the composition and amount of the specific hazards (Hazardous Material Packaging, Packaging Engineers).

2. Prepare and complete the required forms:
   - Web Shipper
   - Information for Hazardous Material Shipments at *Shipment Planning*
   - Print two copies of the completed *Web Shipper* and *Hazardous Material Shipments* form. (One copy is for Shipping and Receiving and one is for SMO records.)
   - Attach the completed *Hazardous Material Shipments* form to the *Web Shipper*.

3. Complete the remainder of the *SMO Use Only* section on the ARCOC form (Attachment A) with the required information.

4. Deliver the following to Shipping and Receiving, Building 957:
   - Hazardous samples
   - Completed *Web Shipper* and attached *Hazardous Material Shipments* form

5. The Hazardous Material Packaging Consultant shall review the *Web Shipper* and attached *Hazardous Material Shipments* form for completeness and correctness. If errors are found, the package shall be refused for shipment until all corrections are made.

EMERGENCY PROCEDURES

An emergency is defined as an unplanned, significant event or condition that requires time-urgent actions from emergency response resources to ensure the:

- Health and safety of Members of the Workforce and the public.
- Protection of the environment.
- Security of operations.

Emergency procedures shall be in accordance with established SNL policies and procedures. Refer to ESH100.3.1, *Prepare for and Manage Emergencies*, and refer to the current version of the *Contingency Plan for the Hazardous Waste Management Facility* (HWMF) (PLA94-23). The SMO Packaging Facility is a close neighbor to the HWMF, directly east. When Tone Alert

Radio (TAR) alerts go off at the HWMF, they also go off in Building 928. SMO personnel in the SMO Packaging Facility shall follow the procedure outlined in the HWMF Contingency Plan when TAR alerts sound.

General post-incident actions by involved personnel are:

- Stop activity.
- Secure the scene to prevent further injury or damage, if it is safe to do so.
- Evacuate if necessary. The SMO facility has two evacuation routes, one to the north and one to the south. Personnel shall check the wind socks at the HWMF and make a determination on the most appropriate evacuation route going away from potential inhalation hazards.
- Do not disturb the scene.
- Notify Department Manager.

Actions required when discovering unanticipated radioactive material or removable surface contamination are listed below.

- Discovery of unanticipated radioactive material will require employees to place work and materials into a safe configuration and exit the building pending a radiological survey and evaluation by SNL Radiation Protection and Facility Management. To mitigate the chance of unanticipated radioactive material, all new samples without process knowledge, are placed in the facility RMA prior to RCT scans.

- Discovery of material with removable surface contamination in excess of RPPM Attachment 6-1 limits for removable surface contamination will require employees to place work and materials into a safe configuration and exit the building pending a radiological survey and evaluation by SNL Radiation Protection and Facility Management.

The following information from ESH100.3.1, *Prepare for and Manage Emergencies* provides guidance for both emergency and non-emergency situations.

Table 8. Hazardous Materials Release, Emergency

1. At SNL/NM, call 911 or 844-0911 (cellular).
2. Evacuate and isolate the immediate area. Keep personnel from walking or driving through the affected area. For an outdoor release, stay upwind to avoid fumes.
3. If it is possible to do so safely, determine the chemical and quantity spilled; provide this information to emergency responders.
4. Consult the Material Safety Data Sheets and area ES&H Safety Operating Procedures for information about the released material and provide to emergency responders.

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Table 9. Hazardous Materials Release, Non-Emergency

1. For a non-emergency situation, call 311 or 844-6515 or 844-0311 (cellular). To clean up large spills, call the Non-Emergency Hotline (844-6515) for spill response and cleanup.
2. Clean up small spills generated by personnel, as long as you have the correct training and equipment. If you do not feel comfortable doing so, request advice or assistance from the Non-Emergency Hotline (844-6515).
3. Handle all spilled material, absorbents, neutralizers and contaminated PPE as chemical waste. Follow the requirements for containment, labeling, storage, and disposal request specified in ESH100.2.ENV.22, Manage Hazardous Waste at SNL/NM.

Call for Help:

- 911 or 844-0911 (cellular)
- Call 311 or 844-6515 or 844-0311 (cellular), Non-Emergency Phone Numbers, when observing or experiencing an unusual condition that does not appear to constitute an emergency.
- Call the appropriate phone number in (as soon as it is safe to do so) when:
    - An emergency condition is observed or experienced.
    - You are unsure whether you have an emergency or not.

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8.0 REFERENCES

International Air Transport Association, Dangerous Good regulations, 52nd edition (updated annually), International Air Transport Association, Montreal, Canada.

Sandia National Laboratories Environment Safety and Heath, Corporate Processes and Procedures, https://my.sandia.gov/authsec/portal/cps/environmentalSafetyHealth

Sandia National Laboratories Quality Assurance Project Plan for the SNL/NM Sample Management Office, SMO QAPP, Current Revision, Sandia National Laboratories/New Mexico Sample Management Office, Albuquerque, New Mexico.

Sandia National Laboratories Sample Management and Custody Administrative Operating Procedure (AOP-95-16), Current Revision, Sandia National Laboratories/New Mexico, Albuquerque, New Mexico.

Sandia National Laboratories Statement of Work for Analytical Laboratories, Current Revision, Sample Management Office, Sandia National Laboratories/New Mexico (SNL/NM), Albuquerque, New Mexico.

Sandia National Laboratories Supply Chain Management Corporate Processes and Procedures, SCM100.3.6, https://my.sandia.gov/authsec/portal/cps/supplyChainManagement

US Environmental Protection Agency (EPA), Code of Federal regulations, CFR Title 40, (http://www.epa.gov/epahome/cfr40.htm).

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ATTACHMENTS

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ATTACHMENT A:
CONTRACT LABORATORY ANALYSIS REQUEST AND CHAIN-OF-CUSTODY
SMO 2012-ARCOC

SMO 2012-ARCOC (4-2012)

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY

AOP 95-16

Internal Lab

Page 1 of ___

Batch No. — SMO Use — **AR/COC**

Project Name:	Date Samples Shipped:	SMO Authorization:	☐ Waste Characterization ☐ RMMA ☐ Released by COC No.
Project/Task Manager:	Carrier/Waybill No.	SMO Contact Phone:	
Project/Task Number:	Lab Contact:		☐ 4° Celsius
Service Order:	Lab Destination:	Send Report to SMO:	Bill to: Sandia National Laboratories (Accounts Payable), P.O. Box 5800, MS-0154, Albuquerque, NM 87185-0154
Tech Area:	Contract No.:	Rita Kavanaugh/505.284.2553	
Building: Room:	Operational Site:		

Sample No.	Fraction	Sample Location Detail	Depth (ft)	Date/Time Collected	Sample Matrix	Container Type	Container Volume	Preserv-ative	Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID

Last Chain: ☐ Yes	Sample Tracking SMO Use	Special Instructions/QC Requirements:	Conditions on Receipt
Validation Req'd: ☐ Yes	Date Entered:	EDD ☐ Yes ☐ No	
Background: ☐ Yes	Entered by:	Turnaround Time ☐ 7 Day* ☐ 15 Day* ☐ 30 Day	
Confirmatory: ☐ Yes	QC inits.:	Negotiated TAT ☐	
		Sample Disposal ☐ Return to Client ☐ Disposal by Lab	
		Return Samples By:	
		Comments:	Lab Use

Sample Team Members	Name	Signature	Init.	Company/Organization/Phone/Cell

1. Relinquished by	Org.	Date	Time	3. Relinquished by	Org.	Date	Time
1. Received by	Org.	Date	Time	3. Received by	Org.	Date	Time
2. Relinquished by	Org.	Date	Time	4. Relinquished by	Org.	Date	Time
2. Received by	Org.	Date	Time	4. Received by	Org.	Date	Time

*Prior confirmation with SMO required for 7 and 15 day TAT

This ARCOC is for example purposes only. The ARCOC currently in effect is posted on the 4100 Controlled Documents homepage (SMO 2012-ARCOC).

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ATTACHMENT B: Industrial Hygiene (IH) SARF Chain-of-custody

SANDIA
SNL NM
SARF Chain of Custody Report

IH Survey ID: S01013 Lab Log Batch ID: Lab receiving sample

Sample location TA1 897 1300

Submitted By: CASTILLO,R Submission Date:

Charge code:

Send Report To: SNL NM Attention of: CASTILLOR

Address: Email:

Phone: Fax:

Analysis requested (please be specific if possible)
CADMIUM

General comments to lab personnel
Additional Potential Hazards, Name and phone/pager of a person knowledgeable about the sample origin and hazards

IH Sample #	Lab ID	Col. Date	Turn-Around-Time	Matrix	Sample Comments
12345678901		11/17/2010	NORMAL (15 DAYS)	SWIPE	088750-001
12345678902			NORMAL (15 DAYS)	SWIPE	088750-002
12345678903			NORMAL (15 DAYS)	SWIPE	088750-003

Samples Checked For
☐ Container Integrity
☐ Sample Size
☐ Sampling Label

Condition of Sample Receivec
☐ Acceptable
☐ Not Acceptable

Custody Seals
☐ Present
☐ Not Present

ATTACHMENT C
RPDP SAMPLE ANALYSIS REQUEST FORM
RPDP SARF

SAMPLE ANALYSIS REQUEST FORM (SARF)
RADIATION PROTECTION DOSIMETRY PROGRAM (RPDP)

Page 1 of 1

RPDP BATCH NO. _____ RPSD LOG NO. _____

Customer Name: Goke, Sarah Hayes
Organization: 4121
MailStop: 0651
Phone: 845-DOSE / 284-5598
Email: dosimetry@sandia.gov
Prgm Name: Radiation Protection Dosimetry Program

Analytical Lab: _____
Lab Contact: _____
Contract No.: _____
Date Shipped: _____
Shipper No.: _____
RPDP Contact/Ph: Sarah Hayes Goke / 505.284.5598

Send Results to: RPDP
P.O. Box 5800, MS-0651
Albuquerque, NM 87185
Email: dosimetry@sandia.gov
FAX: 505.844.8313

Bill to: Sandia National Laboratories
Accounts Payable Department
P.O. Box 5800, MS-1383
Albuquerque, NM 87185-1383

Customer Sample ID	Lab Sample ID	Date Collected	Time Collected 0-24 HRS	TAT	Sample Matrix	Qty/Tot Volume Tare Wt	Rad Screen (cpm)	QC Set	EDD (Off-Site Labs) [ ] Yes [X] No: Parameter / Method Requested	Lab Notes

Turn Around Time(TAT) Instructions
ENTER DATE NEEDED BY: (applicable to all samples)

N - Normal, R - Rush, U - Urgent

Special Instructions/Hazards
Biological Sample - Treat With Caution
Contact: Sarah Hayes Goke, 284-5598, pager (800) 237-6849

Sample(s) Condition on Receipt
[ ] Normal
[ ] Abnormal
If abnormal, fill out the attached Sample Condition Upon receipt form and contact the customer about the sample condition before proceeding further.

	Org.	Date		Org.	Date
1. Relinquished by			1. Received by		
2. Relinquished by			2. Received by		
3. Relinquished by			3. Received by		
4. Relinquished by			4. Received by		
5. Relinquished by			5. Received by		
6. Relinquished by			6. Received by		

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ATTACHMENT D: ONSITE LABORATORY (RPSD) ANALYSIS REQUEST & CHAIN-OF-CUSTODY

RPSD SARF

Sandia National Laboratories
Sample Analysis Programs

Sample Analysis Request Form
Page ____of ____

To be completed by Customer

Shaded areas are for Lab use only

Customer Name: _____
Customer Email ID: _____
Organization: _____
Phone: Sample _____
Location (Bldg/Rm): _____
Date Results Needed: _____
Project/Task Number: _____

Hazards/Special Instructions:

☐ Provide EDD

Batch Log No: _____
Logged By: _____

o RPOP - Rad Protection Operation
o RPID - Dosimetry
o RPSD - Sample Diagnostics
o IH - Industrial Hygiene
o DND -DeconDecom
o EXT- External
o SND - Source & Device
o WM – Waste Management
o OTH - Other
o EM - Environment Monitoring
o EMAA - Ambient Air
o EMWW - Waste Water
o EMGW - Ground Water
o EMTS - Terrestrial surveil
o EMSW - Storm Water
o CMC – Coop Monitoring Ctr
o ER – Enviroment Restoration

Customer Sample ID	Sample Type	Date/Time Collected	Sample Amount or Flow Rate	Requested Analysis	Survey or COC#	Lab ID	Rad Screen(CPM)	Remarks/Aliquot Amount

Relinquished by _____ Date _____ Received by _____ Date_____

Relinquished by _____ Date _____ Received by _____ Date_____

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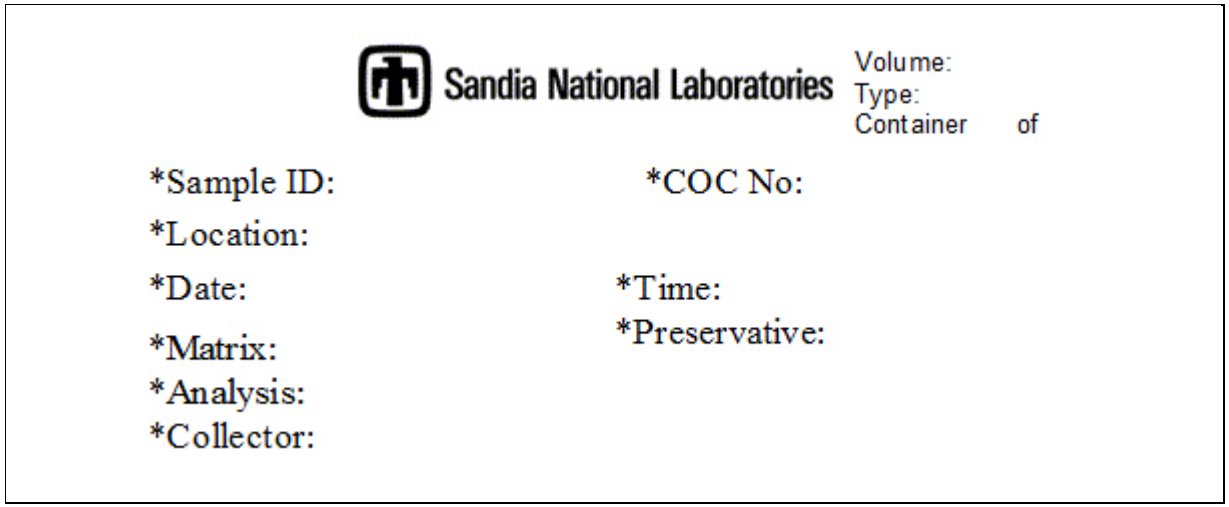
ATTACHMENT E
SAMPLE LABEL



* Required Fields

Attachment F: Radiological Survey Form
http://www-irn.sandia.gov/esh/radpro_procedures/forms/rsf.dot

Survey Number:

RADIOLOGICAL SURVEY FORM

Page: _____ of _____

Location:	Requester/Org.:	Date:	Time:
Purpose:	Request #:	RWP#:	

Instrument and Probe Type and Serial Number	Surveyor(s) Printed Name(s)	Surveyor(s) Signature/Date

#	Item Description/Location	BETA-GAMMA ACTIVITY Counting Data Attached: ☐ YES ☐NO % Eff.: [e] _____ Radionuclide: _____				ALPHA ACTIVITY Counting Data Attached: ☐ YES ☐NO % Eff.: [e] _____ Radionuclide: _____				RADIATION SURVEY Background: _____ mrem/hr Radiation Type: Gamma	
		cpm	Bkg. cpm	dpm[a, b] 100cm2	T/R/F[c]	cpm	Bkg. cpm	dpm[a, b] 100cm2	T/R/F[c]	mrem/hr	Distance from Source[d]

[a] ND = No detectable activity above background [b] If other than 100 cm^2, indicate area or record as 'dpm/probe' or 'dpm/LAW' (large area wipe). [c] T/R/F = Total/Removable/Fixed [d] OC or CT = On Contact [e] %Eff-Removable/Direct

Remarks:		
	Reviewed by:	Date:

ATTACHMENT G: Sample Management Log

DATE	PROJECT NAME	RELINQUISHED BY	RCVD. BY	PARENT C.O.C.	SHIP DATE	DESTINATION LAB	SHIPPER #	WAYBILL #	<5 Y/N	QTY.	WGHT.	COMMENTS

ATTACHMENT H: DISCLAIMER

NOTE:

The samples in this cooler are labeled radioactive per Sandia National Laboratory policies and procedures.

However, the samples have been analyzed by gamma spectroscopy and are not radioactive materials per DOT regulations (49 CFR 173.403). Gamma spectroscopy results are enclosed with the chain-of-custody.

Signature:_____ Date:_____

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Page _____ of _____

AUTHORIZED USERS LIST

Document Title: Sample Management Office (SMO) Sample Handling, Packaging and Shipping Laboratory Operating Procedure

Document Number: LOP 94-03 **Revision:** 6

By my signature below, I affirm that I have read and understand this document, and all references called out in procedural steps, and I agree to operate within the stated constraints.

Name (printed)	Signature	Dept./Company	Date

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SANDIA NATIONAL LABORATORIES
LONG-TERM STEWARDSHIP

HEALTH AND SAFETY PLAN

PLA 05-09

GROUNDWATER MONITORING HEALTH AND SAFETY PLAN

Author: Robert Ziock, Subject Matter Expert — **Date:** 1/10/12

Approved: Michael Skelly, Project Leader — **Date:** 10 Jan 12

Approved: Don Schofield, Field Support Operations Project Leader — **Date:** 1/10/12

Approved: Pamela Puissant, Department Manager — **Date:** 1/24/12

Author: *How frequently does this document need to be reviewed and/or revised?*	*Every three years or when activities change*	
Manager: *Does this document need to be tracked?*	*Yes*	*No*

EFFECTIVE DATE: 1/24/12

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Revision History

Revision	Review Date	Effective Date	Summary of Changes
1	9/29/2005	10/10/2005	New document
2	7/30/2007	8/16/2007	Formatting changes. Updated section 2, Roles and Responsibilities; section 3, Training Qualifications; section 11, References.
3	3/4/2010	3/4/2010	Formatting changes. Added work planning and control information to section 6, Task Hazard Analysis. Updated section 3, Training Qualifications; section 11, References.
4	1/10/2012	1/24/2012	Formatting changes. Revision history changed from 2 years to 3 years. Removal of some forms (attachments) and replaced with hyperlinks to where the forms can be found. Updated section 3, Training Qualifications; section 11, References.

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EP 2009-ALW – Environmental Planning – Activity Level Work Evaluation Form
EP 2009-AUL – Environmental Planning – Authorized Users List
EP 2009-OJT – Environmental Planning – On-the-Job Training
EP 2009-WRA – Environmental Planning – Work Resumption Authorization Form

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Acronyms & Abbreviations

ABC	Rating system for fire extinguishers. Class A extinguisher are for ordinary combustible materials; Class B extinguishers are for flammable or combustible liquids; Class C extinguishers are for electrical fires (extinguishing agent is non-conductive).
AOP	administrative operating plan
EOC	Emergency Operations Center
ES&H	Environment, Safety and Health
FOP	field operating procedure
GFCI	ground fault circuit interrupter
HASP	health and safety plan
HCl	hydrochloric acid
HNO_3	nitric acid
H_2SO_4	sulfuric acid
KAFB	Kirtland Air Force Base
LOP	laboratory operating procedure
LTES	Long Term Environmental Stewardship
MSDS	Material Safety Data Sheet
NaOH	sodium hydroxide
OJT	on-the-job training
OSHA	Occupational Safety and Health Administration
pH	potential of hydrogen
PHS	primary hazard screening
PLA	plan
PPE	personal protective equipment
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
SAP	sampling and analysis plan
SNL/NM	Sandia National Laboratories, New Mexico
THA	task hazard analysis
TWD	technical work document
VOC	volatile organic compound

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1.0 Purpose, Goals and Objectives

Purpose The purpose is to recognize and anticipate all potential hazards associated with performing groundwater monitoring activities at Sandia National Laboratories, New Mexico (SNL/NM).

Goals The goal is to perform groundwater sampling activities with zero occupational injuries and reportable occurrences. The activities are described in detail in the associated technical work documents (TWDs) (i.e., administrative operating procedure [AOP], field operating procedures [FOPs], laboratory operating procedure [LOP], sampling analysis plan [SAP], and mini-SAP).

Objectives The objectives are:

- Perform work identified in the TWDs for groundwater sampling activities.
- Plan this work so that potential hazards are recognized and controlled.
- Perform health and safety protocols to prevent hazards to workers and protection of the environment.
- Execute the work **only** as it is identified and described in the TWDs for groundwater sampling activities listed in section 3.0. The work shall be performed in a manner that protects personnel from hazards, thus preventing injury.
- Limit work activities to authorized and trained personnel.
- Improve this document and work processes (if necessary) based on feedback from personnel and lessons learned.

2.0 Roles and Responsibilities

The Long-Term Stewardship Department is responsible for development, approval, distribution, revision, and control of this document.

The **project leader** is responsible for the following:

- Reviewing and recommending approval of this procedure.
- Providing overall coordination and management of the project.
- Providing a SAP that meets prescribed regulatory or programmatic requirements.
- Reviewing completed field forms and data pertaining to waste management activities.
- Reporting all information as may be required by regulations or directives.

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The **sampling coordinator** is responsible for the following:

- Generating a mini-SAP from the SAP. The mini-SAP is a field friendly version of the SAP. It details sampling activities for the field support operations project leader and field technicians. It summarizes sampling procedures, analytical parameters, field measured parameters, purge requirements, and waste management tasks. It also identifies monitoring well characteristics that may extend the sampling period (e.g., low yield wells, well construction issues, etc.).
- Preparing a waste management plan for each sampling event.
- Providing the field support operations project leader with a copy of the mini-SAP.
- Coordinating waste management activities with the project leader and the field support operations project leader.
- Reviewing completed field forms and data pertaining to sampling activities.
- Ensuring that all data quality requirements are performed.
- Reviewing all analytical data used for waste characterization.
- Obtaining waste determination from the environment protection representative (non-regulated, hazardous, and radioactive).
- Managing, coordinating, and disposing of purge water and other waste generated from field operations.
- Obtaining discharge permits for purge and decontamination water from the Environmental Programs Water Quality Group.
- Submitting disposal request to appropriate department (Hazardous Waste Management Facility Radioactive and Mixed Waste Management Facility, Waste Water, and Solid Waste).
- Coordinating with the field support operations project leader for disposal and discharges.
- Tracking and documenting each waste activity.
- Performing and documenting weekly inspections of Building 9925 Resource Conservation and Recovery Act (RCRA) Less Than 90-Day Waste Accumulation Area.
- Performing and documenting weekly inventory of all waste stored at Building 9925 waste accumulation areas.
- Performing monthly inspection of emergency equipment.
- Maintaining documentation for waste disposal activities.
- Submitting completed field forms to the Customer Funded Record Center and entry of relevant data to the Environmental Data Management System (EDMS) database.
- Reviewing and providing recommendations for revisions to this plan (if necessary).

The **field support operations project leader** is responsible for the following:

- Communicating with the sampling coordinator regarding sampling activities.
- Supervising the field technicians.
- Reviewing training requirements for field technicians.
- Providing for the on-the-job training (OJT) of new field technicians.
- Assigning field technicians (qualified by training and experience) to conduct the activities described in this procedure.

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- Coordinating sampling activities with the sampling coordinator, Sample Management Office and field technicians.
- Ensuring the materials and equipment necessary to perform the work are available.
- Providing the field technicians with a copy of the mini-SAP.
- Reviewing field documentation.
- Maintaining the training matrix for all field personnel.
- Maintaining, reviewing, and revising all TWDs.
- Owner/manager/emergency coordinator of Building 9925 RCRA Less Than 90-Day Waste Accumulation Area.
- Reviewing and providing recommendations for revisions to this plan (if necessary).

The **field technicians** are responsible for:

- Stopping work if any operation threatens worker or public health and safety.
- Completing all necessary and required training as specified by the field support operations project leader.
- Conducting a tailgate safety meeting prior to the start of all field activities.
- Maintaining and decontaminating equipment.
- Managing and disposing of waste as directed by completed Work Request Forms, (FOP 05-04, Attachment A) and the field support operations project leader.
- Completing and reviewing field documentation forms.
- Providing recommendations for revisions to this plan (if necessary).

3.0 Training Qualifications

Personnel conducting field activities shall complete the following:

- Read applicable sections of SNL/NM Corporate Policy ESH100 Environment Safety & Health
- Read primary hazard screening (PHS) SNL05A01241, *Long Term Environmental Stewardship (LTES) Groundwater Monitoring Activities.*
- Read and sign AOP 95-16, *Sample Management and Custody*.
- Read and sign laboratory operating procedure (LOP) LOP 94-03, *Sample Handling, Packaging and Shipping*.
- Read and sign FOP 05-01, *Groundwater Monitoring Well Sampling and Field Analytical Measurements*.
- OJT for new field personnel performing groundwater monitoring activities if it pertains to any of the FOPs listed below. Document training by completing On-the-Job Training form (EP 2009-OJT).
- Read and sign FOP 03-02, *LTES Groundwater Level Data Acquisition and Management*. (Note: The training requirements denoted with an "*" in Table 1 below are all that are required for FOP 03-02.)
- Read and sign FOP 05-02, *Groundwater Monitoring Equipment Field Check.*
- Read and sign FOP 05-03, *Groundwater Sampling Equipment Decontamination.*

- Read and sign FOP 05-04, *Groundwater Waste Management Plan.*
- Read and sign FOP 09-05, *Conducting Slug Test Using Data Logger & Pressure Transducer* (only necessary if conducting slug test).
- Read and sign FOP 10-01, *Borehole and Downhole Well Video Inspection*. (Note: The training requirements denoted with an "*" in Table 1 below are all that are required for FOP 10-01).
- Complete training courses listed in Table 1.
- Field personnel shall sign the Authorized Users List (EP 2009-AUL) to affirm they have read and understand this document, and agree to operate within the stated constraints.

Table 1. Training Course List

Course Code	Course Title
*CHM100/103	Chemical Safety Training/Site-Specific Chemical Training
*ELC105	Basic Electrical Safety (> 50 volts)
ELC901	Safe Switching Briefing
ENV100	OSHA Health & Safety Basic Training - General Worker (40 HR)
*ENV102	OSHA Health & Safety Basic Training - General Worker (24 HR)
*ENV103	OSHA Health & Safety Training Refresher (8 HR)
*ENV112	Hazardous Waste & Environmental Management Training
ENV216	RCRA - Less Than 90-Day Area Accumulation Area for Owners & Emergency Coordinators
ENV316	RCRA - Less Than 90-Day Area Accumulation Area for Waste Workers
ENV416	RCRA - Less Than 90-Day Area Accumulation Area for Waste Workers - Site-Specific
*ESH100	ES&H Awareness
FKL153	Forklift Operator and Hands-On Training
*MCH200	Hand and Power Tool Safety
*MED102	Standard First Aid
*MED104	Heartsaver CPR
*OTS101	Occupational Thermal Stress
PKX100	Basic Hazardous Material Transportation Training
*PPE106	Personal Protective Equipment Training
PRS150	Pressure Safety Orientation
PRS250	Advanced Pressure Safety
*RAD102	General Employee Radiological Training
RAD230	Radiological Worker II Training
RAD230R	Radiological Worker II Retraining
RGH100	Crane, Rigging, Hoisting, & Hands-on Training

*Training requirements are all that are required for FOP 10-01
CPR = Cardiopulmonary Resuscitation
ES&H = Environment, Safety and Health
HR = hour
OSHA = Occupational Safety and Health Administration
RCRA = Resource Conservation and Recovery Act

4.0 Scope of Work

The scope of work covered by this health and safety plan (HASP) **only** includes the activities as they are identified and described in the TWDs listed in Section 3.0. This HASP **can not** be utilized for any other work without the explicit authorization from the field support operations project leader or higher authority.

5.0 Personal Protective Equipment

Personnel are required to wear the personal protective equipment (PPE) identified by the task hazard analysis described in Section 6.0. Level D PPE will be the minimum level of protection for all activities (Table 2).

6.0 Task Hazard Analysis

A task hazard analysis (THA) has been performed on all groundwater sampling activities in conjunction with a PHS SNL05A01241, *LTES Groundwater Monitoring Activities*. The PHS helps identify potential hazards that can be expected when performing the work. The THA classifies the potential hazards and rates them based on the probability of occurrence (Table 2). The THA lists control measures that will be used to mitigate the potential hazards (Table 2). The control measures may include courses and training that are identified as part of the PHS results. This approach to identifying, rating, and controlling hazards is consistent with SNL/NM's Integrated Safety Management System.

Hazard assessment surveys were performed for groundwater sampling activities by an SNL/NM industrial hygienist. The following hazard assessment survey reports concluded that the potential for exposure to health hazards has been categorized as well-controlled; therefore acceptable:

- SNLNM00825, *9925/1 (High-Bay)* (equipment decontamination)
- SNLNM00827, *Groundwater Monitoring: Roving* (groundwater sampling)
- SNLNM01481, *Groundwater Surveillance: Roving* (measuring groundwater levels)
- SNLNM01520, *Chemwaste Landfill Groundwater Surveillance: Roving* (measuring groundwater levels at the Chemical Waste Landfill)

An Activity Level Work Evaluation Form (EP 2009-ALW) was completed and approved by the department manager as required by AOP 09-10, *Work Planning and Control*. The completed form applies only to the activities as they are identified and described in the FOPs, AOP, and LOP listed in Section 3.0

A brief description of groundwater sampling activities is listed below and is followed by a THA table.

Groundwater monitoring consists of taking water samples from wells located on Kirtland Air Force Base (KAFB) and SNL. The following is the general order in which theses activities are performed:

- Equipment decontamination
- Calibration of monitoring equipment
- Collecting a depth-to-water measurement
- Lowering of pumps and or monitoring equipment
- Operating pumping equipment to purge the well (or sample line)
- Monitoring (measuring) chemical properties of water
- Operating pumping equipment to fill sample bottles
- Raising pumping equipment after samples have been collected
- Managing samples
- Managing waste water
- Documentation of all activities

Table 2. Task Hazard Analysis - *Level of Protection* – Level D PPE (safety shoes/boots, chemical safety goggles)

Potential Hazard	Hazard Rating	Control
Chemical 1) Decontamination of pump tubing using a diluted nitric acid (HNO_3) rinse and a detergent rinse. 2) Contaminated groundwater containing volatile organic compounds (VOCs), nitrates & nitrites (20 parts per million (ppm). 3) Sample preservatives include sodium hydroxide (NaOH), hydrochloric acid (HCl), HNO_3, and sulfuric acid (H_2SO_4). Standardized solutions include Zobell solution, potential of hydrogen (pH) buffers, electrical conductivity solution. Other chemicals include various Hach ACCU-VAC ampules.	Medium	Wear chemical safety goggles and latex or nitrile gloves when handling potential chemical hazards. Portable eyewash is located in sampling vehicle. No eating, drinking, and smoking will be permitted around sampling operations. All purge water is treated as a non-regulated waste (based on process knowledge of prior sampling) until analytical results show otherwise. Notebook containing Material Safety Data Sheets (MSDSs) kept in sampling vehicle.
Mechanical (pinch points) 1) Motorized reel for raising and lowering pump. 2) Hydraulic lift on back of sampling vehicle.	Medium	Be aware of potential pinch points. Do not wear loose fitting clothing, dangling badges or jewelry when operating this equipment.

Table 2. Task Hazard Analysis - *Level of Protection* – Level D PPE (safety shoes/boots, chemical safety goggles) (continued)

Potential Hazard	Hazard Rating	Control
Physical 1) Heat exhaustion & hypothermia. 2) Sunburn. 3) Lifting injury from equipment, pumps, and 55-gallon drums containing purge water. 4) Operation of water level meter (shoulder strain). 5) Lowering and raising pump (back strain). 6) Slips, trips, and falls. 7) Tools.	Medium	1) Weather conditions are addressed in Tailgate Safety Meeting. Workers trained on heat exhaustion & hypothermia. Wear appropriate clothing and hydrate as necessary. 2) Provide workers with sunscreen. 3) Use proper lifting techniques. Utilize hydraulic lift on back of sampling vehicle and a forklift with a Valley Craft model number UG III-2K# drum handler. 4) Use water level meter support device. 5) A motorized reel is used to lower and raise the pump. 6) Maintain proper housekeeping of work area. Use step stools. 7) Use correct tools and inspect them prior to use.
Radiological	Low	None are expected although a minimum of (Radiological Awareness or Radworker I) training is required.
Fire	Low	Fire extinguishers are located in mobile equipment.
Biological • Snakes, rodents, insects	Low	Care will be taken to observe that the well casings pose a potential for insects and other animals. Immediate area around wells will be kept clean and places of refuge for biological hazards minimized.

7.0 Work Practices

The following work practices will be enforced:

- All personnel must comply with OSHA, U.S. Department of Energy, and SNL/NM requirements regarding health and safety.
- No task will be performed until a PHS and THA has been prepared and reviewed with the personnel performing the task.
- All personnel must conduct their activities in a manner pursuant to the contents of this HASP.
- A tailgate meeting will be held prior to starting the day's sampling activities.
- Any unnecessary contact with potentially contaminated substances must be avoided. This includes contact with potentially contaminated surfaces and/or equipment.
- Eating, drinking, smoking, chewing gum or tobacco, or any other hand-to-mouth activities are prohibited in the sampling vehicle lab.

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- A "buddy system" is implemented for all groundwater sampling activities. A "buddy system" is defined as a system of organizing personnel into work groups in such a manner that each member of the work group is designated to be observed by at least one other member in the group. The purpose of the "buddy system" is to provide rapid assistance to sampling personnel in the event of an emergency. In addition, a person is required to report his/her destination when leaving the other team member(s).
- All members of the sampling crew will carry a cell phone or portable radio capable of contacting the Emergency Operations Center (EOC).
- All members of the sampling crew will carry an EOC pager so they can be notified of any KAFB emergencies or weather alerts.
- An ABC fire extinguisher will be located in each of the field sampling vehicles.
- An eyewash device will be located in each of the sampling vehicles.
- A First Aid kit will be located in each of the sampling vehicles.

8.0 Tailgate Safety Meeting

A field technician or field support operations project leader must conduct a tailgate safety meeting and fill out a Tailgate Safety Meeting Form (Attachment A) prior to the start of groundwater sampling activities. The person conducting the meeting must possess knowledge of groundwater sampling activities and the topics discussed in this HASP. All personnel/visitors who attend the meeting must document that they have attended and understood the meeting by signing the Tailgate Safety Meeting Form.

9.0 Shutdown of Work Activities

Any individuals have the authority to shutdown groundwater sampling activities if they feel that safety is being compromised. A shutdown could be the result of the following:

- Personnel not following health and safety protocols.
- Not having the appropriate safety gear on site (eyewash, first aid kit, fire extinguisher, appropriate PPE)
- Inadequate equipment or equipment failure.
- Weather
  - If lightning is observed within 5 miles (25 seconds from time of flash to thunder) or the EOC issues a lightning warning (via EOC pager).
  - High winds (greater than 40 miles per hour)
  - Severe snow storms (discretion of sampling crew)
  - Sever rain storms (discretion of sampling crew)
  - Severe heat or cold (discretion of sampling crew)
  - Tornado warnings
- Unsafe conditions around sampling location (discretion of sampling crew)

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In the event that work is stopped due to:

- Safety-related issues,
- an injury incurred while performing the tasks identified in this procedure, or
- as the result of an audit,

the field technicians shall immediately notify the field support operations project leader, the project leader, and the department manager. The field technicians shall seek the assistance of the field support operations project leader for the mitigation of the hazard and the completion of a Work Resumption Authorization Form (EP 2009-WRA) as required by AOP 09-10, *Work Planning and Control*. The department manager shall sign the completed form prior to the restart of work.

10.0 Emergency Response Plan

A variety of emergency situations could possibly occur during groundwater sampling activities. These include:

- Personal injury/illness
- Fire
- Meteorological events any other natural disaster
- Security incidents
- KAFB closures

Points of contact and Emergency Telephone Numbers are provided in Table 3.

Table 3. Points of Contact and Emergency Telephone Numbers

Resources and Contact	Telephone Number
SNL/NM Incident Command System (Fire, Ambulance)	911 (505-844-0911 from cell phone)
SNL/NM Medical Clinic	845-8159 or 844-0081
SNL/NM Non-Emergency Number	262-7222 (urgent care)
Poison Control Center	272-2222
Sandia Security / Key Service	North: 844-4657 South: 845-3114
ES&H concerns	844-6515
National Response Center (Environmental Emergencies)	800 822-9761
Personnel to Notify If an Incident Occurs	
SNL/NM Field Support Operations Project Leader Don Schofield	office: 844-4088 mobile: 259-7098
SNL/NM Project Leader Michael Skelly	office: 845-7697 pager: 540-5513

Table 3. Points of Contact and Emergency Telephone Numbers (continued)

Personnel to Notify If an Incident Occurs	
SNL/NM Department Manager Pamela Puissant	office: 844-3185 mobile: 239-9144
Industrial Hygiene/Safety Jeffrey Throman	office: 844-5779 pager: 283-1381

A First Aid kit is available on site to treat minor injuries. Minor injuries must be examined by the Sandia Medical Clinic.

Paramedic services can be dispatched through SNL/NM Incident Command System (911 or 844-0911).

10.1 Directions to Medical Facilities

Directions to SNL/NM Medical Facility: From Technical Area I (**TA-I**) proceed to Harding Boulevard and/or Wyoming Boulevard. On Hardin Boulevard proceed west to Wyoming Boulevard. Turn right (north) on Wyoming Boulevard and travel north to F Street. Turn right (east) on F Street and proceed to 7th Street. The medical facility is located at the west end of Building 831 at the intersection of F and 7th Streets.

From Technical Area II (**TA-II**) proceed to East Ordnance Road. Proceed west on East Ordnance Road to Wyoming Boulevard. Turn right (north) to F Street. Turn right (east) on F Street and proceed to 7th Street. The medical facility is located at the west end of Building 831 at the intersection of F and 7th Streets.

From **Tijeras Arroyo** proceed to the Landfill Road. Proceed southwest on Landfill Road to Pennsylvania Street. Turn right on Pennsylvania Street and travel northwest to Wyoming Boulevard. Turn right (north) on Wyoming Boulevard and travel north to F Street. Turn right (east) on F Street and proceed to 7th Street. The medical facility is located at the west end of Building 831 at the intersection of F and 7th Streets.

See Attachment B for SNL Medical Clinic location map.

11.0 References

Sandia National Laboratories, Corporate Policy ESH100 Environment Safety & Health, SNL/NM.

Sandia National Laboratories, Sample Management Office, AOP 95-16, *Sample Management and Custody* (latest edition), SNL/NM.

Sandia National Laboratories, Sample Management Office, LOP 94-03, *Sample Handling, Packaging and Shipping* (latest edition), SNL/NM.

Sandia National Laboratories, Environmental Programs and Assurance Department, FOP 03-02, *Long Term Environmental Stewardship Water Level Data Acquisition and Management* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 05-01, *Groundwater Monitoring Well Sampling and Field Analytical Measurements* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 05-02, *Groundwater Monitoring Equipment Field Check for Water Quality Measurements* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 05-03, *Groundwater Monitoring Equipment Decontamination* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 05-04, *Groundwater Monitoring Waste Management* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 09-05, *Conducting Slug Test Using Pressure Transducer and Data Logger* (latest edition), SNL/NM.

Sandia National Laboratories, Environmental Programs and Long-Term Stewardship, FOP 10-01, *Borehole and Downhole Well Video Inspection*, (latest edition), SNL/NM.

Sandia National Laboratories, Environmental Programs and Assurance Department, PHS SNL05A01241, *Long Term Environmental Stewardship Groundwater Monitoring Activities* (latest edition), SNL/NM.

SNLNM00825, *9925/1 (High-Bay)*, SNL/NM, September 2009.

SNLNM00827, *Groundwater Monitoring: Roving*, SNL/NM, September 2009.

SNLNM01481, *Groundwater Surveillance: Roving*, SNL/NM, February 2010.

SNLNM01520, *Chemwaste Landfill Groundwater Surveillance: Roving*, SNL/NM, February 2010.

Valley Craft UG III-2K# STD F89815A5, August 30, 2010

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Attachment A

Tailgate Safety Meeting Form

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TAILGATE SAFETY MEETING FORM

Dept: _____Well Location: _____Date: _____ Time: _____

Activities: _____
(Anyone has the right to cease field activities for safety concerns. The buddy system will be used when needed.)

Weather Conditions:
Temp: _____ °F Wind Speed: _____ MPH Humidity: _____ % Wind Chill ____ °F

Chemicals Used: Acids in sample containers, standard solutions, Hach ACCU-VAC ampules_____
Other: _____

Safety Topics Presented

□ Be aware of slips, trips, and falls. Keep work area clean and use a stepping stool when necessary.		□ Be aware of environmental conditions (heat / cold stress). Dress accordingly. Wear sunscreen if necessary. Stay hydrated.
□ Wear safety boots.		□ Be aware of electrical hazards
□ Use safe lifting practices. Wear leather gloves if necessary.		□ Be aware of pressure hazards.
□ Be aware of pinch points on pump cable reel and hydraulic tailgate lift.		□ No eating or drinking at sampling counter.
□ Be aware of chemical hazards.		□ Be aware of biohazards (snakes, spiders, etc.)
□ Wear nitrile or latex gloves when sampling.		□ Wear communication device (cell phone, EOC pager).
□ Wear chemical safety goggles.		□ Avoid spilling purge / decon water.

Hospital/Clinic: Sandia Medical Clinic Phone: 844-0911/911

Attendees

_____	_____
Printed Name	Signature
_____	_____
Printed Name	Signature
_____	_____
Printed Name	Signature
_____	_____
Printed Name	Signature
_____	_____
Printed Name	Signature

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Attachment B

SNL Medical Facilities Location Map

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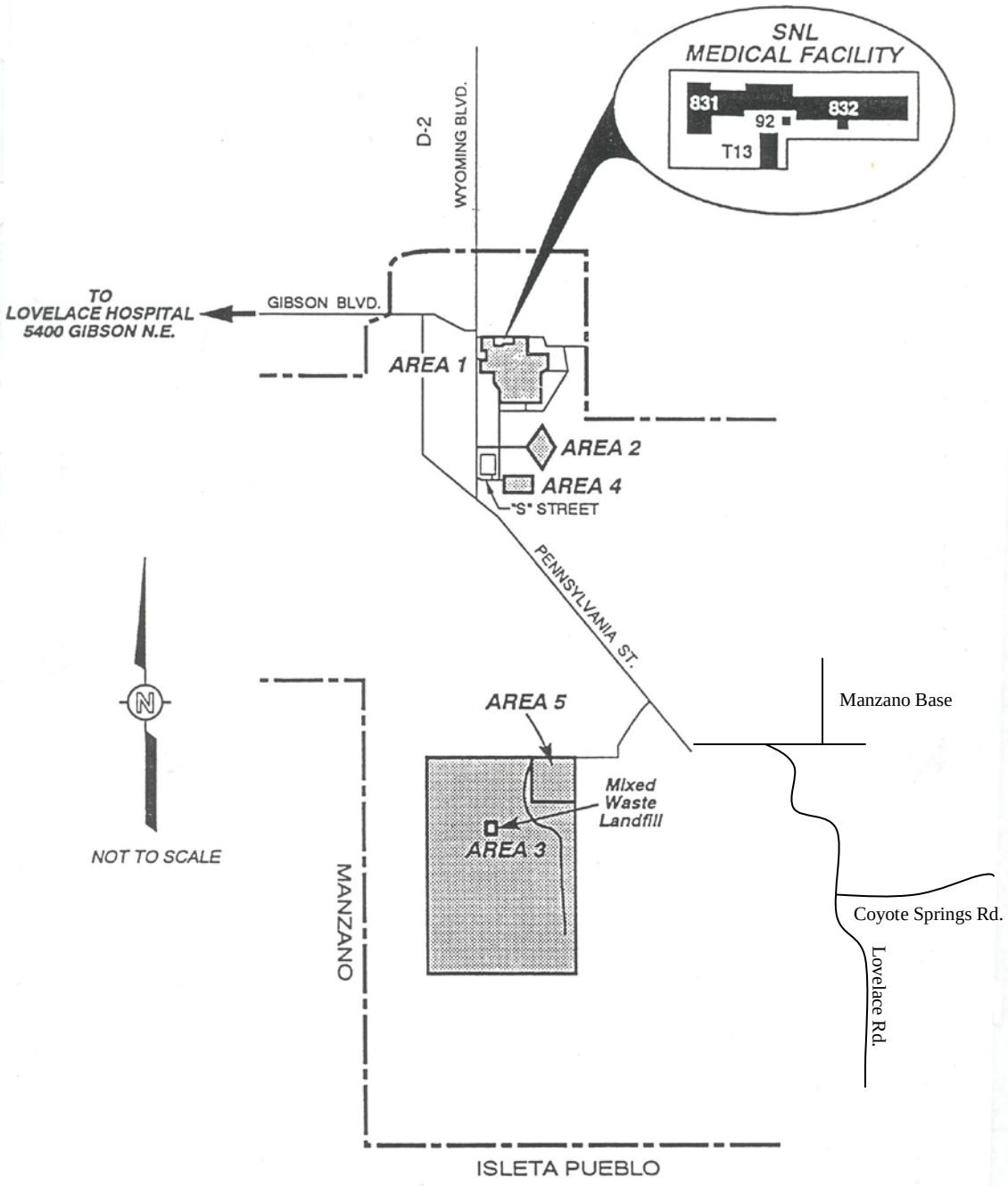
SNL
MEDICAL FACILITY
831
832
92
T13
D-2
WYOMING BLVD.
TO
LOVELACE HOSPITAL
5400 GIBSON N.E.
GIBSON BLVD.
AREA 1
AREA 2
AREA 4
"S" STREET
PENNSYLVANIA ST.
N
NOT TO SCALE
AREA 5
Mixed
Waste
Landfill
AREA 3
MANZANO
Manzano Base
Coyote Springs Rd.
Lovelace Rd.
ISLETA PUEBLO

SANDIA NATIONAL LABORATORIES
Sample Management Office (SMO) DEPARTMENT 4142

PROCEDURE FOR COMPLETING THE CONTRACT VERIFICATION REVIEW (CVR)

SMO-05-03
Revision 05

Approved: Wendy Palencia **Date:** 11.5.2013
Wendy Palencia, Author,
SMO Technical Support

Approved: **Date:** 11.05.2013
Lorraine Herrera, SMO Technical Support

Approved: **Date:** 11/12/13
Pamela Puissant, Manager

Author: *How frequently does this document need to be reviewed and/or revised?*	*Every 3 years*
Manager: *Does this document need to be tracked?*	*Yes*

EFFECTIVE DATE: 11/12/13

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Revision History

Revision	Effective Date	Summary of Changes
Rev 1	June 9, 1999	New document, first issue
Rev 2	December 2, 2003	Technical changes
Rev 3	April 30, 2007	Technical changes
Rev 4	May 11, 2010	Edited sections due to method changes. Added section to cover the Data Anomaly Report (DAR). Renamed Issue to Revision.
Rev 5	November 12, 2013	Expanded section on processing the DAR. Added Responsible Individual descriptions, footnote disclaimer, and Acronyms and Abbreviations. Minor sentence and grammar edits. Added yes/no option for closure to Problem Resolution section of CVR form. Removed yes/no "Resolved" boxes on section 1 and 2 of CVR form.

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ACRONYMS AND ABBREVIATIONS

AOP	Administrative Operating Procedure
ARCOC	Analysis Request and Chain of Custody
brw	Oracle Query Builder File
CSV	Comma Separated Values file
CVR	Contract Verification Review
DAR	Data Anomaly Report
EDD	Electronic Data Deliverable
EPA	U.S. Environmental Protection Agency
GC/HPLC	Gas Chromatography/High Performance Liquid Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
HRGC/HRMS	High Resolution Gas Chromatography/High Resolution Mass Spectrometry
ICP	Inductively Coupled Plasma
ICS	Interference Check Sample
IDL	Instrument Detection Limit
L_c	Critical Level
LC/MS/MS	Liquid Chromatography/Mass Spectrometry/Mass Spectrometry
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MB	Method Blank
MDA	Minimum Detectable Activity
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NNSA/SFO	National Nuclear Security Administration/Sandia Field Office
OP	Operating Procedure
ppm	Parts Per Million
PQL	Practical Quantitation Limits
QAPP	Quality Assurance Project Plan
QC	Quality Control
RRT	Relative Retention Time
SA	Sample
SDG	Sample Delivery Group
SMO	Sample Management Office
SNL/NM	Sandia National Laboratories New Mexico
SOW	Statement of Work
STAR	Sample Tracking and Analytical Results
TAT	Turnaround Time
TIC	Tentatively Identified Compounds

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1.0 PURPOSE, SCOPE, AND OWNERSHIP

1.1 Purpose

This document provides instructions for performing a contract verification review (CVR) of analytical data packages received by the Sandia National Laboratories/New Mexico (SNL/NM) Sample Management Office (SMO). The CVR checks completeness and compliance of the sample custody and laboratory report documentation. Sample custody documentation is generated during a sampling event. The laboratory that performs the sample analyses generates the laboratory analytical report. The CVR determines whether or not sample custody is completely documented, and whether or not the laboratory complied with technical and reporting requirements of their contract.

The CVR examines specific items of sample management, custody, and laboratory reporting. The field sampling team and the analytical laboratory enter the sample management and custody items on the Analysis Request and Chain of Custody (ARCOC) form SMO 2012-ARCOC. After sample receipt at the laboratory, the laboratory completes the ARCOC and returns a copy to the SMO for sample login verification. Additionally, the complete ARCOC original is included in the final laboratory analytical report.

Contract verification review items checked in the laboratory analytical report are technical, quality control (QC), and reporting requirements imposed upon the laboratory through the *SNL/NM Contract Statement of Work (SOW) for Analytical Laboratories*. The laboratory is required to provide specific information in all analytical reports at the request of SNL/NM SMO. These data are often in addition to the laboratory's standard operating procedures or requirements of the analytical method. The CVR provides the SMO with a record of laboratory performance on a report deliverable basis, and allows for SMO tracking of reporting deficiencies, correction requests, and problem resolutions. The SMO monitors the performance of contracted laboratories, in part, using results from the CVR.

1.2 Scope

This procedure applies to all sampling and analysis events coordinated through the SNL/NM SMO and/or utilizing analytical laboratories under contracts administered by the SMO. Any sampling and analysis event, whether for environmental monitoring, site investigation, site restoration, waste characterization, industrial hygiene, bioassay or other purpose, which is tracked by the SMO and for which an SMO contract laboratory generates a data report, will be monitored by the SMO utilizing the CVR. The SMO is responsible for completing the CVR, initiating and tracking any corrective actions based upon the CVR, and documenting corrective action closure.

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1.3 Ownership

The SNL/NM SMO is the owner of this operating procedure (OP). The SMO is responsible for maintaining and revising this OP as necessary. Any comments or suggestions for improvement should be forwarded to the SMO.

2.0 RESPONSIBLE INDIVIDUALS AND ORGANIZATIONS

The **Department Manager** is responsible for the following:

- Providing programmatic guidance leading to the development of this OP.
- Reviewing and approving this procedure.
- Acting as liaison to U.S. Department of Energy (DOE) and National Nuclear Security Administration/Sandia Field Office (NNSA/SFO) regarding sample management issues.

The **SMO Technical Lead** is responsible for the operations and activities conducted within the SMO. The principal responsibilities of the SMO Technical Lead include the following:

- Updating this procedure.
- Developing and maintaining the *SNL/NM Contract SOW for Analytical Laboratories*.
- Managing contractor laboratory services, including procurement, reviewing routine performance assessments, and conducting general laboratory oversight.

The **SMO QA Coordinator** is responsible for the following:

- Providing project data quality assurance guidance.
- Ensuring that this procedure is distributed to the appropriate personnel for project/program use.
- Ensuring that sufficient quality checks are in place to maintain the integrity of the SMO sample information management and analytical result database.
- Documenting non-conformances and corrective actions in accordance with the applicable SMO-QAPP.
- Interfacing with the Records Management Coordinator for maintenance of project documentation and to resolve record management concerns for storage and maintenance of sampling and analysis records.

The **Project Coordinator** is responsible for coordinating efforts associated with SMO analytical services. The principal responsibilities of the Project Coordinator include the following:

- Acting as a point of contact between Task/Project Leaders and the analytical laboratories.
- Obtaining appropriate sample containers from a vendor or analytical laboratory.

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- Scheduling projects with contract laboratories.
- Notifying analytical laboratories of any quality assurance, environmental, safety, health, and sample matrix requirements regarding sample handling, preparation, and analysis.
- Resolving problems, issues, non-conformances, and errors for projects with regard to analytical data.
- Performing CVR to ensure appropriate QC analyses have been performed in accordance with the *SNL/NM Contract SOW for Analytical Laboratories*.
- Performing QC of data entered into the SMO database.
- Performing electronic data QC and transfer.
- Processing and follow-up on any data package corrections, both hardcopy and electronic.
- Providing technical guidance and information, as required.
- Reviewing, verifying, and processing proformas and invoices from contractors.

The principal responsibilities of the **Laboratory Oversight/Data Validation Contractor**, as reflected in the applicable contract, include the following:

- Performing laboratory oversight as directed by the SNL/NM SMO.
- Conducting visits to and technical system audits of, contractor laboratories to ensure compliance with *SNL/NM Contract SOW for Analytical Laboratories*.
- Performing data validation in accordance with the applicable procedures.
- Communicating non-compliance issues to the SMO Technical Lead and/or SMO Project Coordinator(s).
- Verifying implementation of laboratory corrective action plans.

3.0 PROCEDURES

3.1 Prerequisites and Associated Procedures

Prerequisite to completing the CVR, reviewers must be familiar with the appropriate requirement documents and associated procedures. SMO personnel shall read this procedure and sign the Authorized Users List, EP 2009-AUL. Applicable documents include current revisions of the following:

- *Quality Assurance Project Plan (QAPP) for the SNL/NM Sample* Management *Office*, SMO QAPP,

- The current analytical laboratory contract including the *SNL/NM Contract SOW for Analytical Laboratories*, and

- The project specific sampling and analysis plan and/or quality assurance project plan (or equivalent).

Associated procedures include current revisions of the following:

- *SMO Data Management Plan*, Administrative Operating Procedure (AOP) 95-44,
- *Procedure for Electronic Data Deliverable (EDD) Processing*, SMO-05-04,
- *Administrative Operating Procedure for Sample Management and Custody*, AOP 95-16, and
- *Data Validation Procedure for Chemical and Radiochemical Data SNL/SMO*, AOP 00-03.

3.2 Completing the CVR

The CVR will be completed on analytical data packages delivered to the SMO from the contracted analytical laboratories. The CVR must be completed prior to validation and forwarding to the sampling task manager and the Records Center. The CVR shall be maintained in the Records Center in accordance with the requirements in section 2.4.1 of the SMO QAPP. A copy of the CVR form can be found on the SNL Controlled Document site under SMO Forms, SMO 2012-CVR. Alternatively, the CVR may be completed and electronically signed and date stamped using the CVR tool at https://rails-rn-prod.sandia.gov/esh_smo/cvr/.

Upon receipt of the analytical data package, the SMO will log the Sample Delivery Group (SDG) number and receipt date into the Sample Tracking and Analytical Results (STAR) database, retrieve the current correspondence and documentation files associated with the specific sampling activity, and place the package in queue awaiting CVR.

The CVR is divided into six topical sections, with line entries to be checked as complete or incomplete under each section. The six sections are:

IMPORTANT NOTICE: A printed copy of this document may not be the document currently in effect. The official version is located on the Sandia Restricted Network (SRN), 4100 Controlled Documents home page.

- 1.0 Analysis Request and Chain of Custody Record and Log-In Information
- 2.0 Analytical Laboratory Report
- 3.0 Data Quality Evaluation
- 4.0 Calibration and Validation Documentation
- 5.0 Data Anomaly Report
- 6.0 Problem Resolution

The electronic CVR Form can be found on: Q:\SMO\SMO-2012-CVR.doc.

A copy of the CVR form is provided in Appendix A.

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To complete the CVR, gather the analytical data report including the original, signed, returned ARCOC, and the current correspondence and documentation file. Complete the following information.
Header Information

- Project Leader
- Project Name
- Project/Task Number
- ARCOC Number
- Analytical Lab
- SDG Number

The header information items will be found on the ARCOC and on the analytical laboratory report.

Review the items indicated on each line of the CVR. If the items indicated are complete and correct check "Yes" in the appropriate column. If the items are incomplete or incorrect check "No" and record an explanatory note. The reviewer should resolve any deficiencies with the documentation, if possible, during the review.

3.2.1 Review the ARCOC and laboratory login information and complete the CVR Section 1.0.

Line 1.1 All items on ARCOC complete – data entry clerk initialed and dated

All information prompted for on the ARCOC is necessary for accurate tracking of the samples and documenting sample custody. Verify that all items have been completed and that the sample custody record is complete and unbroken. Check that the SMO data entry clerk has initialed and dated the ARCOC (on the field copy) indicating when the sample data were entered into the STAR database.

Line 1.2 Container type(s) correct for analyses requested

Check that the recorded sample container types are compatible with the sample matrices and analyses requested. Recommended containers are listed in Attachment 5, *SNL/NM Contract SOW for Analytical Laboratories*.

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Line 1.3 Sample volume adequate for # and types of analyses requested

Check that the volume or mass of sample provided meets or exceeds the analysis minimum requirement, including sufficient volume/mass required for quality control analyses.

Line 1.4 Preservative correct for analyses requested

Sample preservation, both chemical and thermal, must be consistent with guidance and requirements of the U.S. Environmental Protection Agency (EPA). Correct preservatives are found in Attachment 5, *SNL/NM Contract SOW for Analytical Laboratories*.

Line 1.5 Custody records continuous and complete

Check that a member of the sampling team listed on the ARCOC was first to relinquish the samples. There should be no time gaps in the custody record and all custodians should be identified, from sample collection until receipt at the laboratory. If an express carrier transported samples to the laboratory they should be identified and the shipment waybill number recorded.

Line 1.6 Lab sample number(s) provided and SNL sample number(s) cross referenced and correct

Laboratory sample numbers that uniquely correspond to the SNL/NM assigned sample numbers must be indicated on the returned ARCOC or sample acknowledgement. SNL/NM sample numbers must be correctly cross-referenced to the laboratory sample numbers in the analytical data package.

Line 1.7 Date samples received

The date that samples were received at the laboratory must be indicated on the ARCOC. The date received is noted in the laboratory's acknowledgement of custody.

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Line 1.8 Condition upon receipt information provided

The laboratory should make notation as to whether or not the samples were received intact, in good condition, and correctly preserved. Any anomalies should be noted.

3.2.2 Review the analytical laboratory report and complete the CVR Section 2.0.

Line 2.1 Data reviewed, signature

Check that there is a transmittal letter or section in the laboratory report case narrative testifying to laboratory management's review and approval for release of the analytical data. The testimonial should bear the signature of an appropriate laboratory manager.

Line 2.2 Method reference number(s) complete and correct

The analytical methods used by the laboratory should be standard, published methods and reflect the latest promulgated revisions. EPA numbers will typically identify the methods in the report. Check that the analytical methods are referenced and conform to the ARCOC.

Line 2.3 QC analysis and acceptance limits provided (MB, LCS, and sample replicate)

Analytical laboratory batch QC sample analysis results and result acceptance limits must be provided in the report. The types of QC samples analyzed will depend on the analytical method and requirements of the *SNL/NM Contract SOW for Analytical Laboratories*. Typically, minimum batch quality control might consist of a method blank (MB), laboratory control sample (LCS), and laboratory control sample duplicate (LCSD). Sample replicates should not be performed on field QC samples. Sample replicates are required for most inorganic and radiochemical analyses.

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Line 2.4 Matrix spike/matrix spike duplicate data provided

Organic method sample matrix spike analyses are run in duplicate on representative sample matrices, per batch, if adequate sample volume is provided. Check that the laboratory analyzed matrix spike/ matrix spike duplicate (MS/MSD) on the sample(s) and that accuracy and precision data in the sample matrix are reported. Inorganic and radiochemistry methods require MS only. MS should not be performed on field QC samples.

Line 2.5 Detection limits provided; PQL, MDL (or IDL), MDA and L_C

Limits of detection should be provided in the report for each sample analysis. The reported limits of detection should be appropriate to the analysis and in compliance with the *SNL/NM Contract SOW for Analytical Laboratories*.

Line 2.6 QC batch numbers provided

Check that analytical laboratory QC samples are identified by laboratory assigned batch numbers.

Line 2.7 Dilution factors provided and all dilution levels reported

Check that dilution factors are reported for all samples. Most samples will have a dilution factor of "1" indicating that the sample, digestion solution, or extract was analyzed using the optimum preparation weights and volumes described in the analytical method. All liquid samples, solid sample digestions, or extracts that may have required further dilution to be analyzed within the linear working range of the test instrumentation or standards curve must be identified and the dilution factor used must be provided.

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Line 2.8 Data reported in appropriate units and using correct significant figures

The number of significant figures to be reported is specified in the *SNL/NM Contract SOW for Analytical Laboratories*. Typically, final analytical results may be reported at three significant figures and limits of detection reported at two significant figures. Check that results are reported in the appropriate units and with the correct number of significant figures. All data for inorganic and metal parameters shall be reported in parts per million (ppm).

Line 2.9 Radiochemistry analysis uncertainty (2-sigma error) and tracer recovery provided

Confirm that total measurement errors, expressed as plus and minus two standard deviations, i.e., 2-sigma, are reported for all final radiochemistry activity concentration results. Confirm the tracer recoveries are reported for alpha spectroscopy, and any other applicable radiochemical method.

Line 2.10 Narrative provided

Check that the analytical report narrative conforms to requirements in the *SNL/NM Contract SOW for Analytical Laboratories*. Generally, the report narrative will describe the contents of the data package, provide an index or list of analyses performed and samples processed, and describe the circumstances leading to laboratory qualification of any analysis result.

Line 2.11 Turnaround times (TAT) met

The analytical report is due at SNL/NM SMO after the elapsed time specified in the *SNL/NM Contract SOW for Analytical Laboratories* and indicated on the ARCOC (typically 30 calendar days from receipt of the samples). Mutually agreed upon expedited turnaround times may be applicable if documented and so noted on the ARCOC. Verify that the analytical report was received within the required turnaround time. Analytical data packages not meeting turnaround performance requirements may result in reduced or non-payment for services.

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Line 2.12 Holding times met

Sample analysis holding times are counted as days from when the sample was taken until when it was prepared, if applicable, and analyzed. Analysis holding times may be required for valid analysis results or just recommended per industry guidance. Holding times for SNL/NM samples are listed in Attachment 5, *SNL/NM Contract SOW for Analytical Laboratories*. Analytical data not meeting holding times may result in reduced or nonpayment for services.

Line 2.13 Contractual qualifiers provided

The *SNL/NM Contract SOW for Analytical Laboratories* requires the laboratory to assign standard data qualifiers to analytical results not meeting specified criteria. For example, "B" will be assigned when sample analyte contamination was observed above the detection limit and in the associated batch preparation blank sample, and "J" will be assigned to indicate an estimated result less than a limit of quantitation but greater than a method detection limit. Check that the laboratory has appropriately assigned the correct data qualifiers. Qualifiers for SNL/NM samples are listed in Appendix G, *SNL/NM Contract SOW for Analytical Laboratories*.

Line 2.14 All requested result and Tentatively Identified Compounds (TIC) data provided

Confirm that all information requested from the laboratory on the ARCOC, in the *SNL/NM Contract SOW for Analytical Laboratories*, and in task specific correspondence was supplied.

3.2.3 Section 3.0 of the CVR, "Data Quality Evaluation," provides opportunity to evaluate the analytical QC performance measures reported by the laboratory. Sample numbers are recorded to identify sample analysis results associated with nonconforming conditions or poor QC measurement results. Review line items in Section 3.0 highlight those laboratory reporting and technical performance measures checked for completeness in Section 2.0.

Complete the data quality evaluation, Section 3.0 of the CVR.

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Line 3.1

Are reporting units appropriate for the matrix and meet SMO contractual specified or project-specific requirements? Inorganics and metals reported as ppm (mg/liter or mg/Kg)? Tritium reported in picocuries per liter with percent moisture for soil samples? Units consistent between QC samples and sample data?

Note the sample numbers for analytical results not meeting reporting unit conventions or requirements.

Line 3.2 Quantitation limit met for all samples

Note the sample number of analyses associated with elevated quantitation limits. Some analytical laboratories also call the quantitation limit the detection or reporting limit; for radiochemical analyses, the L_C or MDA are the limits reported. Quantitation limits will be elevated when high concentration of an analyte is present. This may only be a cause for concern when the other analytes are not detected in the same analysis.

Line 3.3 Accuracy

Note the sample numbers of analyses associated with nonconforming QC accuracy measurements. Analytical batch LCS analyte percent recoveries must fall within the specified control limits. Sample-specific surrogate compound percent recoveries (organic compound analyses) must be within established control limits. And, if required, matrix spike percent recoveries should also fall within acceptable limits.

Line 3.4 Precision

Note the sample numbers of analyses associated with nonconforming QC precision measurements. Precision measurement values are calculated as relative percent difference between the MS and MSD for organics, sample and sample replicate for inorganics, and paired LCS/LCSD for some analysis. Precision for radiochemistry is reported as the replicate error ratio.

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Line 3.5 Blank data

Note the sample numbers associated with any blank sample in which significant positive results are observed. Contamination observed in a laboratory batch method blank sample, field or trip blank, or equipment rinse blank may indicate inadvertent or cross-sample contamination.

Line 3.6 Contractual qualifiers provided: "J"- estimated quantity; "B"- analyte found in method blank above the MDL for organic and inorganic; "U"- analyte undetected (results below the MDL, IDL or MDA (radiochemical)); "H"- analysis done beyond the method prescribed holding time; "h"- analysis done beyond the extraction/preparation holding time; "N" - result associated with spike analysis outside control limits.

Qualifier flags are to be assigned to analytical result data in accordance with requirements in the *SNL/NM Contract SOW for Analytical Laboratories*. Verify that laboratory qualifiers are correctly assigned and if not, record the affected sample numbers.

Line 3.7 Narrative addresses planchet flaming for gross alpha/beta

Check that the narrative includes information concerning planchet flaming for all gross alpha/beta analysis.

Line 3.8 Narrative included, correct, and complete

Check that information provided by the laboratory in the case narrative is accurate and in agreement with the analysis and QC data presented in the report. If the report narrative is inaccurate, note the sample numbers directly impacted.

Line 3.9 Second column confirmation data provided for methods 8330 (high explosives), pesticides/PCBs 8081 and 8082 and herbicides 8151.

Check that confirmation results data is provided for detected compounds for high explosive, pesticide/PCB and herbicide analyses.

3.2.4 Review the analytical data report to ensure it includes the required calibration and validation documentation and complete Section 4.0 for the CVR.

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Line 4.1 GC/MS (8260 and 8270)

Verify the 12-hour tune check, initial calibration, continuing calibration, internal standard performance data, and instrument run logs are provided.

Line 4.2 GC/HPLC (8330, 8082, 9070A, and 8010)

Verify the initial calibration, continuing calibration and instrument run logs are provided.

Line 4.3 HRGC/HRMS (1668)

Verify the 12-hour tune check, initial calibration, continuing calibration, internal standard performance data, labeled compound recovery data, Relative Retention Times (RRTs) and ion abundance ratios for samples and standards, and instrument run logs are provided.

Line 4.4 LC/MS/MS (6850)

Verify the initial calibration, continuing calibration, CRI, internal standard performance data and instrument run logs are provided. For perchlorate analysis, verify that chlorine isotope ratios and ICS data are also provided.

Line 4.5 Inorganics (metals)

Verify the initial calibration, continuing calibration, ICP interference check sample data, ICP serial dilution, and instrument run logs are provided.

Line 4.6 Radiochemistry and General Chemistry

Verify the instrument run logs are provided.

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Section 5.0 of the CVR, "Data Anomaly Report (DAR)," evaluates data results to historical monitoring data points to determine outliers and a need for data verification or sample reanalysis. The DAR is generated for monitoring and surveillance data.

3.2.5 Run the DAR and complete section 5.0 of the CVR.

Line 5.1 DAR completed for monitoring and surveillance data

When applicable, process the DAR according to steps below. The DAR shall be completed for all applicable sample data indicated as "SA", not field QC samples.

Update the Historical file

- Open Oracle Query builder
- Log in with user ID, password, "gspr1", press OK
- Click on "Open Query from File System"
- Press OK
- Open \\catbert\7500\SMO\STAR\SAR (suspected/data anomaly report) folder
- Select applicable browser file (i.e., SAR_Ambient_Filters.brw)
- Press "Open", then OK
- Execute query
- Maximize window
- Click on the "File" tab
- Select "Export Data"
- Select "Comma-Delimited (CSV)" as format
- Open "Select" window and open C:\SandiaSAR\SandiaSAR_Ver1p2\ applicable CSV file, press "Save", select "Yes" for "Save As"
- Press OK on export data window, then OK again
- Close file, press No

Run anomaly report

- Open SAR Application
- Press "Select EDD File"
- Go to \\catbert\7500\SMO\STAR\EDD by COC
- Highlight applicable EDD and press "Open"

- Press "Select Historical Data File" – select the CSV file you just updated under C:\SandiaSAR\SandiaSar_Ver1p2, then press "Open"
- Press "Load Parameters.xls"
- Highlight "parameters.xls", then press "Open"
- Press "Generate Report" – the report opens in a PDF format
- Right click on the PDF report and go to "Send to Mail Recipient"
- Select "PDF Format", then press OK
- Send Report to your mailbox and save in a file
- Press "Close Print Preview"
- Press "Generate SAR Workbook" – the report opens in an Excel format
- The Excel Report is automatically saved to your desktop under "SAR_ARCOC#"
- Review the report and note any anomalies on the CVR
- Notify task leader of any anomalies

3.2.6 Complete the CVR by noting the review results and correction tracking at the end of the form in Section 6.0 "Problem Resolution." Note any deficiencies and their resolution on the CVR, or initiate a nonconformance report or correction request. The Correction Request Form can be found on: Q:\SMO\Correction Request Form.doc.

A copy of the Correction Request Form is provided in Appendix B.

Record the date that any nonconformance report or correction request was forwarded to the laboratory. Sign and date the CVR. If corrections to the analytical report were required, then the CVR remains active and open until the corrected laboratory report is received. After receipt, review, and acceptance of the corrected analytical report, note closure of the corrective action by date and signature.

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4.0 References

Sandia National Laboratories, *Administrative Operating Procedure for Sample Management and Custody*, AOP 95-16, current revision, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, *Data Validation Procedure for Chemical and Radiochemical Data*, AOP 00-03, current revision, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, *Procedure for Electronic Data Deliverable (EDD) Processing*, SMO-05-04, current revision, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, *Quality Assurance Project Plan for the SNL/NM Sample Management Office*, SMO QAPP, current revision, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, *SMO Data Management Plan*, AOP 95-44, current revision, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, *SNL/NM Contract SOW for Analytical Laboratories*, current revision, Sandia National Laboratories, Albuquerque, New Mexico.

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APPENDIX A
CONTRACT VERIFICATION REVIEW FORM

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Contract Verification Review (CVR)

Project Leader _____ Project Name _____ Project/Task No. _____

ARCOC No. _____ Analytical Lab _____ SDG No. _____

In the tables below, mark any information that is missing or incorrect and give an explanation.

1.0 Analysis Request and Chain of Custody Record and Log-In Information

Line No.	Item	Complete? Yes	Complete? No	If no, explain
1.1	All items on ARCOC complete - data entry clerk initialed and dated			
1.2	Container type(s) correct for analyses requested			
1.3	Sample volume adequate for # and types of analyses requested			
1.4	Preservative correct for analyses requested			
1.5	Custody records continuous and complete			
1.6	Lab sample number(s) provided and SNL sample number(s) cross referenced and correct			
1.7	Date samples received			
1.8	Condition upon receipt information provided			

2.0 Analytical Laboratory Report

Line No.	Item	Complete? Yes	Complete? No	If no, explain
2.1	Data reviewed, signature			
2.2	Method reference number(s) complete and correct			
2.3	QC analysis and acceptance limits provided (MB, LCS, Replicate)			
2.4	Matrix spike/matrix spike duplicate data provided			
2.5	Detection limits provided; PQL and MDL(or IDL), MDA and L_c			
2.6	QC batch numbers provided			
2.7	Dilution factors provided and all dilution levels reported			
2.8	Data reported in appropriate units and using correct significant figures			
2.9	Radiochemistry analysis uncertainty (2 sigma error) and tracer recovery (if applicable) reported			
2.10	Narrative provided			
2.11	TAT met			
2.12	Holding times met			
2.13	Contractual qualifiers provided			
2.14	All requested result and TIC (if requested) data provided			

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Contract Verification Review (Continued)

3.0 Data Quality Evaluation

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
3.1 Are reporting units appropriate for the matrix and meet contract specified or project-specific requirements? Inorganics and metals reported as ppm (mg/liter or mg/Kg)? Tritium reported in picocuries per liter with percent moisture for soil samples? Units consistent between QC samples and sample data			
3.2 Quantitation limit met for all samples			
3.3 Accuracy a) Laboratory control sample accuracy reported and met for all samples			
b) Surrogate data reported and met for all organic samples analyzed by a gas chromatography technique			
c) Matrix spike recovery data reported and met			
3.4 Precision a) Replicate sample precision reported and met for all inorganic and radiochemistry samples			
b) Matrix spike duplicate RPD data reported and met for all organic samples			
3.5 Blank data a) Method or reagent blank data reported and met for all samples			
b) Sampling blank (e.g., field, trip, and equipment) data reported and met			
3.6 Contractual qualifiers provided: “J”- estimated quantity; “B”- analyte found in method blank above the MDL for organic and inorganic; “U”- analyte undetected (results are below the MDL, IDL, or MDA (radiochemical)); “H”- analysis done beyond the holding time; “h” - analysis done beyond the extraction/preparation holding time; “N” - result associated with spike analysis outside control limits			
3.7 Narrative addresses planchet flaming for gross alpha/beta			
3.8 Narrative included, correct, and complete			
3.9 Second column confirmation data provided for methods 8330 (high explosives), pesticides/PCBs 8081 and 8082 and Herbicides 8151			

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Contract Verification Review (Continued)

4.0 Calibration and Validation Documentation

Item	Yes	No	Comments
4.1 GC/MS (8260, 8270)			
a) 12-hour tune check provided			
b) Initial calibration provided			
c) Continuing calibration provided			
d) Internal standard performance data provided			
e) Instrument run logs provided			
4.2 GC/HPLC (8330, 8082, 9070A, and 8010)			
a) Initial calibration provided			
b) Continuing calibration provided			
c) Instrument run logs provided			
4.3 HRGC/HRMS (1668)			
a) 12-hour tune check provided			
b) Initial calibration provided			
c) Continuing calibration provided			
d) Internal standard performance data provided			
e) Labeled compound recovery data provided			

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f) RRTs for samples and standards provided			
g) Ion abundance ratios for samples and standards provided			
h) Instrument run logs provided			
4.4 LC/MS/MS (6850) a) Initial calibration provided			
b) Continuing calibration provided			
c) CRI provided			
d) Internal standard performance data provided			
e) Chlorine isotope ratios provided (perchlorate only)			
f) ICS provided (perchlorate only)			
4.5 Inorganics (metals) a) Initial calibration provided			
b) Continuing calibration provided			
c) ICP interference check sample data provided			
d) ICP serial dilution provided			
e) Instrument run logs provided			
4.6 Radiochemistry and General Chemistry a) Instrument run logs provided			

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Contract Verification Review (Concluded)

5.0 Data Anomaly Report

Item	Yes	No	Comments
5.1 DAR completed for monitoring and surveillance sample data			
5.2 Problems or outliers noted			
5.3 Verification or reanalysis requested from lab			

6.0 Problem Resolution

Summarize the findings in the table below. List only samples/fractions for which deficiencies have been noted.

Sample/Fraction No.	Analysis	Problems/Comments/Resolutions

Were deficiencies unresolved? θ Yes θ No

Based on the review, this data package is complete. θ Yes θ No

If no, provide nonconformance report or correction request number _____ and date correction request was submitted: _____

Reviewed by: _____ Date: _____

Were resolutions adequate and data package complete? θ Yes θ No

Closed by: _____ Date: _____

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APPENDIX B
CORRECTION REQUEST FORM

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Date: _____

To: _____ From: _____

Company: _____ Org: _____

Phone: _____ Phone: _____

Fax: _____ Fax: _____

Correction Request

COC: _____ SDG: _____ Tracking No: _____

NOTE:

Sandia National Laboratories
Sample Management Office
P.O. Box 5800
Albuquerque, New Mexico 87185-1331

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SANDIA NATIONAL LABORATORIES
LONG TERM STEWARDSHIP DEPARTMENT

FIELD OPERATING PROCEDURE

FOP 08-22
SOIL VAPOR SAMPLING

Author: Robert Ziock, SME — **Date:** 6/8/11

Approved: Don Schofield, Field Support Operations Project Leader — **Date:** 6/9/11

Approved: Paul Freshour, Department Manager — **Date:** 6/8/11

Author: *How frequently does this document need to be reviewed and/or revised?*	*Every three years, or when activities change.*	
Manager: *Does this document need to be tracked?*	(Yes)	*No*

EFFECTIVE DATE: 06/09/11

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Revision History

Revision	Review Date	Effective Date	Summary of Changes
00	1/26/2009	1/27/2009	Original Issue
01	5/27/09	5/27/09	Section 6.3 – "Quality Control Sample Equipment Setup and Sampling Procedure" added.
02	6/08/2011	6/09/2011	The rewrite makes FOP not specific to the CAMU. It now applies to soil vapor sampling at any SNL/NM site. Site-specific information for CAMU, CWL, MWL, and TA-V included in the attachments.

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Acronyms

AR/COC	Analysis Request/Chain Of Custody
AOP	Administrative Operation Procedure
CAMU	Corrective Action Management Unit
CWL	Chemical Waste Landfill
ES&H	Environmental Safety & Health
ft	foot/feet
FOP	Field Operating Procedure
GFCI	ground fault circuit interrupter
Hg	mercury
In.	inch/inches
LTMMP	Long-Term Monitoring and Maintenance Plan
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
PCC	Post-Closure Care
PHS	Primary Hazard Screening
PID	photoionization detector
psi	pounds per square inch
QA/QC	quality assurance / quality control
SAP	sampling and analysis plan
SMO	Sample Management Office
SNL/NM	Sandia National Laboratories/New Mexico
TA-V	Technical Area V
TEDS	Training and Employee Development System
THA	task hazard analysis
VOC	Volatile Organic Compound

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1.0 PURPOSE, SCOPE, AND OWNERSHIP

Purpose

The purpose of this field operating procedure (FOP) is to provide guidelines and procedures for soil vapor sampling at Sandia National Laboratories/New Mexico (SNL/NM). This procedure addresses the collection and analysis of soil vapor samples at different SNL/NM project sites. While the basic procedure for collecting soil vapor samples is the same for all locations, different sites are subject to different regulatory requirements. In addition, construction of the soil vapor monitoring systems also varies (i.e., well head, above ground enclosure, Primary Sub-Liner Monitoring Subsystem), which may cause minor changes to the general sampling procedure. This procedure shall be used, as applicable, based upon the regulatory requirements for each site. Site-specific information, requirements and protocol are summarized in site-specific permits, and in attachments to this FOP.

Scope

This FOP is applicable to all Sandia Corporation (Sandia) employees and contractors who perform soil vapor sampling activities at SNL/NM. SNL/NM sites where soil vapor samples are collected include the Corrective Action Management Unit (CAMU) containment cell, Chemical Waste Landfill (CWL), Mixed Waste Landfill (MWL), and Technical Area V (TA-V). Site-specific information is provided in Attachments A, B, C, and D for the CAMU, CWL, MWL, and TA-V, respectively.

If other SNL/NM sites are subject to soil vapor sampling in the future, additional attachments will be added to this FOP to address site-specific requirements and any variations to the general sampling procedure covered in this FOP. If requirements change for the sites already addressed in this FOP, revisions will be made to the site-specific attachment.

Ownership

The Long Term Stewardship Department is responsible for development, approval, and revision of this document.

2.0 RESPONSIBLE INDIVIDUALS AND ORGANIZATIONS

The **Department Manager** is responsible for the following:

- Providing programmatic guidance leading to the development of this FOP.
- Review and approval of the procedure.
- Establishing and documenting field technician training in compliance with this FOP, site-specific permits (CAMU and CWL), and Long-Term Monitoring and Maintenance Plan (LTMMP) (MWL).

The **Field Support Operations Project Leader** is responsible for the following:

- Coordinating with the Department Manager, Project Leader and Field Technicians regarding soil vapor sampling activities and the documentation of all required training.
- Assigning qualified Field Technicians to conduct the activities described in this procedure.
- Supervising the Field Technicians.
- Coordinating On-the-Job Training (Attachment E) for Field Technicians (trainees) performing the activities described in this procedure for the first time.
- Reviewing, implementing, and verifying the completion of all training required for Field Technicians.
- Providing Field Technicians with necessary equipment and supplies to conduct field work.
- Reviewing, revising, and maintaining technical work documents.

The **Project Leader** or designee is responsible for the following:

- Reviewing and concurring with this procedure and the related site-specific attachment(s).
- Providing overall coordination and management of site-specific soil vapor sampling events.
- Providing copies of the relevant sections of the site-specific permit and sampling and analysis plan (SAP) (CAMU and CWL) and LTMMP (MWL) for Field Technician review and signoff, prior to sampling.
- Reviewing field documentation and analytical results.
- Assisting with the revision of this procedure as necessary or every three years.

The **Field Technician** is responsible for the following:

- Completing all necessary and required training as specified by the Field Support Operations Project Leader. At a minimum, required training shall include the training defined in this FOP, site-specific permits (CAMU and CWL), and LTMMP (MWL).
- Maintaining requisite training status.
- Inspecting and maintaining equipment.
- Completing a tailgate safety briefing prior to each day's sampling activities.
- Collecting and storing samples properly.
- Delivering samples to the Sample Management Office (SMO) in a timely manner, relative to analytical holding times.
- Completing and reviewing field documentation forms.
- Inspecting soil vapor monitoring locations during each sampling event and documenting the inspections along with any deficiencies and/or repairs, or breach of monitoring location security. Reporting deficiencies and/or breach of security to the Field Support Operations Project Leader and the Project Leader.

- Providing recommendations for revisions to this procedure (i.e., process improvement feedback as appropriate).

3.0 TRAINING QUALIFICATIONS

Personnel conducting soil vapor sampling shall complete all training required to perform work under this FOP and in accordance with site-specific permits and LTMMPs:

- Read this procedure and attachments relevant to the sampling being conducted.
- Read any applicable site-specific training (i.e, SNL Primary Hazard Screening [PHS], Health and Safety Plan, etc.)
- Read applicable sections of site-specific permit and SAP (CAMU and CWL), LTMMP (MWL) and comply with the related training program requirements.
- Meet and document minimum requirements (CAMU, CWL, MWL) for a Field Technician (on file at the CAMU Administrative Trailer).
- Complete training courses listed in Table 1.
- On-the-Job Training (Attachment E) is required for trainees. This training shall be completed at the request of the Field Support Operations Project Leader by an experienced Field Technician working with the trainee and documented on the form provided as Attachment E.
- Sign Authorized User List (Attachment F).

Table 1 - Training Course List

Course Code	Course Title
CHM100	Chemical Safety
CHM103	Site Specific Chemical Safety
ELC105	Basic Electrical Safety (> 50 volts)
ENV100	OSHA Health & Safety Basic Training – General Worker (40 HR)
ENV103	OSHA Health & Safety Training Refresher (8 HR)
ENV112	Hazardous Waste & Environmental Management Training
ESH100	ES&H Awareness
MCH200	Hand and Power Tool Safety
MED102	Standard First Aid
MED104	Heartsaver CPR
OTS101	Occupational Thermal Stress
PPE106	Personal Protective Equipment Training
RAD102	General Employee Radiological Training

4.0 HEALTH AND SAFETY

A task hazard analysis (THA) has been performed on the activities described in this FOP and is detailed in Section 4.1. The THA classifies the potential hazards and rates them based on the probability of occurrence. The THA lists control measures that will be used to mitigate the

potential hazards. A site-specific PHS shall be completed prior to soil vapor sampling activities to help identify potential hazards that can be expected when performing the work. The control measures may include exposure assessment surveys (by a SNL/NM industrial hygienist), courses, and training that are identified as part of the PHS results. This approach to identifying, rating, and controlling hazards is consistent with SNL/NM's Integrated Safety Management System initiative. Hazards classification is low for activities identified in this FOP.

A site-specific Activity Level Work Evaluation Form shall be completed and approved by the Department Manager as required by Administrative Operating Procedure (AOP) 09-10, *Work Planning and Control*. Blank forms are available in Appendix C of AOP 09-10.

A site-specific tailgate safety and emergency response briefing shall be conducted by a qualified Field Technician each day before the start of field activities. A Tailgate Safety Briefing Form (Attachment G) shall be completed at the time of the briefing.
In the event that work is stopped due to:

- safety related issue(s),
- an injury incurred while performing the tasks identified in this procedure, or
- as the result of an audit,

the Field Technician will immediately notify the Project Leader, the Field Support Operations Project Leader, and the Department Manager. The Field Technician will seek the assistance of the Project Leader and Field Support Operations Project Leader for the mitigation of the hazard and/or issue and the completion of a Work Resumption Authorization Checklist. The checklist is available in Appendix D of AOP 09-10, *Work Planning and Control*. The Department Manager must sign the completed checklist prior to the restart of work.

4.1 Task Hazard Analysis

Task Description

Soil vapor samples are collected from various SNL/NM sites (i.e., CAMU, CWL, MWL, TA-V) and are analyzed to determine levels of VOC contaminants in the surrounding soil pore space. VOC screening with a photoionization detector (PID) or equivalent detector is performed prior to sample collection to provide real-time data relative to stabilization of organic soil vapor concentrations during the purging process. (Note: Based upon historic soil vapor concentrations documented at the sites, VOC screening with a PID or equivalent detector during the purging and sampling process is not necessary for worker health and safety purposes). The samples are collected by connecting tubing from a sampling pump to a sampling port on the soil vapor monitoring system. A SUMMA® canister is connected in line with the tubing system. The SUMMA® canister is under a vacuum and has a valve that when opened, draws in the vapor sample. The pump is run to purge the air from the sampling tube and draw representative soil vapor from the soil pore space surrounding the sampling port in the subsurface prior to collecting the soil vapor sample. After the air has been purged from the sampling tube and area

immediately surrounding the sample port, the pump is turned off and a valve is opened on the SUMMA® canister which draws in the vapor sample.

Table 2 – Task Hazard Analysis

Level of Protection—Level D Personal Protective Equipment (safety shoes/boots, safety glasses)

Potential Hazard	Hazard Rating	Control
• Chemical (various VOCs)	Low	• There will be no contact with contaminated soils during soil vapor sampling activities. Soil vapors will be monitored using a PID as part of the purging process. Historically VOC levels have been low (parts per million). Eating, drinking and smoking will not be permitted while performing soil vapor sampling activities.
Physical • Heat stress • Cold stress • Sunburn • Mechanical hazards • Pinch points • Strains, and lifting hazards • Slips, trips, falls • Motor vehicle accident • Electrical • Vacuum (negative pressure)	Low	• Monitoring activities are not physically demanding. Workers will be trained on heat stress, cold stress, and sunburn hazards. Sunscreen will be provided. • Appropriate inspections of equipment will be performed prior to use. • Leather work gloves will be worn when handling steel cable and removing vault covers. • Proper lifting techniques will be reinforced. • Proper housekeeping will be maintained. • Holes around monitoring area will be filled or covered to eliminate slip, trip hazards. • Seat belts will be worn anytime drivers and passengers are in a moving motor vehicle. • Proper ground fault circuit interrupter (GFCI) devices will be used for the electric equipment and tested before each use. • A management approved pressure safety data package is in place for equipment used for soil vapor sampling.
Radiological	None	• CAMU – There are no radiological hazards specifically related to soil vapor sampling at the CAMU. • CWL – There are no radiological hazards specifically related to soil vapor sampling at the CWL. • MWL – There are no radiological hazards specifically related to soil vapor sampling at the MWL. • TA-V – Entry into TA-V requires training that discusses radiation hazards and alarms associated with facilities in TA-V, but there are no radiological hazards specifically related to TA-V soil vapor sampling.
Fire	Low	• Fire extinguishers will be located in mobile equipment.

5.0 EQUIPMENT AND MATERIALS

The equipment and materials required for performing soil vapor sampling activities are as follows:

- Analysis Request/Chain-of-Custody (AR/COC) forms and sample labels.*
- Logbook (if applicable).
- Field forms:
  - SUMMA® Canister Log (Attachment H).

  - Soil Vapor Sampling Log (Attachment I).
- AC power provided by ground fault circuit interrupter (GFCI) outlets.
- Vacuum pump and sampling manifold assembly.
- Flow rate meter.
- Vacuum gauge.
- VOC monitoring equipment (PID or equivalent).
- SUMMA® canister(s).
- Ultra pure nitrogen gas cylinder for collecting quality control samples.
- Regulator manifold assembly specific to ultra pure nitrogen quality control sample collection.
- Key(s) to unlock padlocks.

Additional equipment requirements may exist at the different sites. See Attachments A (CAMU), B (CWL), C (MWL), and D (TA-V) for site-specific requirements and protocol.

6.0 PROCEDURES

Note: Prior to conducting sampling refer to site-specific Attachments in this FOP for additional information.

Soil vapor sampling involves pre-sampling preparation, monitoring system and equipment inspection, equipment set up and purging/sample collection, quality control sample collection (if required for site), and shipment of samples to the analytical laboratory. The following sections detail the overall soil vapor sampling procedure in the sequence the activities will be performed.

6.1 Pre-Sampling Preparations

The following must be completed before soil vapor sampling can begin:

1) Obtain the SUMMA® canisters from the SMO and check their vacuums by:
   - Connecting the vacuum gauge provided by the laboratory to the valve on top of the SUMMA® canister.
   - Open dial on needle valve.
   - Record vacuum for each canister on the SUMMA® Canister Log.
   - Close valve before removing vacuum gauge.

   The nominal vacuum at SNL/NM (approximate elevation 5,400 feet [ft]) is 23 to 25 inches (in.) mercury (Hg). A copy of the SUMMA® canister vacuum readings shall be sent to the laboratory with the canisters after soil vapor sampling is completed.
2) Obtain AR/COC and sample control numbers from the SMO Home Page, http://info.sandia.gov/esh/smo/index.html. Prepare and print out AR/COC and sample labels.

3) Calibrate the VOC monitoring instrument according to manufacturer's manual prior to use during sampling, or obtain monitoring instruments from the SNL/NM Safety and Health Instrumentation Program.

6.2 Soil Vapor Monitoring Inspection

An inspection of the sampling equipment and each soil vapor monitoring location shall be performed as part of each sampling event. The inspection shall be documented on the Soil Vapor Monitoring Inspection Form provided in Attachment J. Deficiencies shall be noted and repaired within 60 days. Details regarding the repair work (who performed work, what was done, and when it was completed) shall also be documented on the form.

6.3 Equipment Setup and General Soil Vapor Sample Collection

Equipment Setup

1) Load equipment detailed in Section 5.0 into sampling vehicle.
2) Position sampling vehicle adjacent to sampling location. The vehicle engine shall be turned off during purging and soil vapor sample collection.
3) Connect vacuum pump to AC power.

See Figure 6-3 for a general schematic of the vacuum pump and SUMMA® canister setup.

4) Connect stainless steel line from soil vapor sampling manifold to SUMMA® canister port.
5) Connect intake tube of vacuum pump to sampling port.
6) Open both in-line valves. Make sure SUMMA® canister valve and pump relief valve are closed.
7) Turn on pump to purge sampling tube and/or borehole. Use the sampling tube and/or borehole volume (see information below and Attachments A [CAMU], B [CWL], C [MWL], and D [TA-V] for site-specific purging information) and flow rate meter value to calculate the purge time (see purging information below).
8) Purge for length of time that allows a minimum of three volumes of the sampling tube and/or borehole to be purged (see purging information below).
9) After three volumes have been purged, monitor the VOC levels by attaching the VOC monitoring instrument to the exhaust port of the vacuum pump. Continue the purging process until the VOC levels stabilize. Record stabilized VOC reading on the Soil Vapor Sampling Log (Attachment I).
10) Upon completing purging of three sampling tube volumes and stable final VOC measurements, close in-line valve closest to the pump.
11) Open pump relief valve.
12) Open SUMMA® canister valve.

13) When the vacuum gauge on the manifold reaches approximately minus 10 in. Hg, close the SUMMA® canister valve. This will prevent the canister from going to ambient pressure (0 in. Hg).
    (Note: The analytical laboratory, Test America, requests that approximately minus 10 in. Hg of vacuum remain in the SUMMA® canister at completion of sampling.)
14) Remove manifold from the SUMMA® canister.
15) Verify end vacuum of approximately minus 10 in. Hg by connecting the vacuum gauge provided by the laboratory to the valve on top of the SUMMA® canister.
16) Open SUMMA® canister valve.
17) Record the ending vacuum for the canister on the SUMMA® Canister Log (Attachment H).
18) Close the SUMMA® canister valve, remove vacuum gauge and replace Swagelok® dust cap.
19) Disconnect intake tube of vacuum pump from sampling port and replace Swagelok® dust cap.
20) Fill out date and time on sample label and attach it to SUMMA® canister tag. Do not attach sample label to canister itself.
21) Complete appropriate Soil Vapor Sampling Log. Complete AR/COC.

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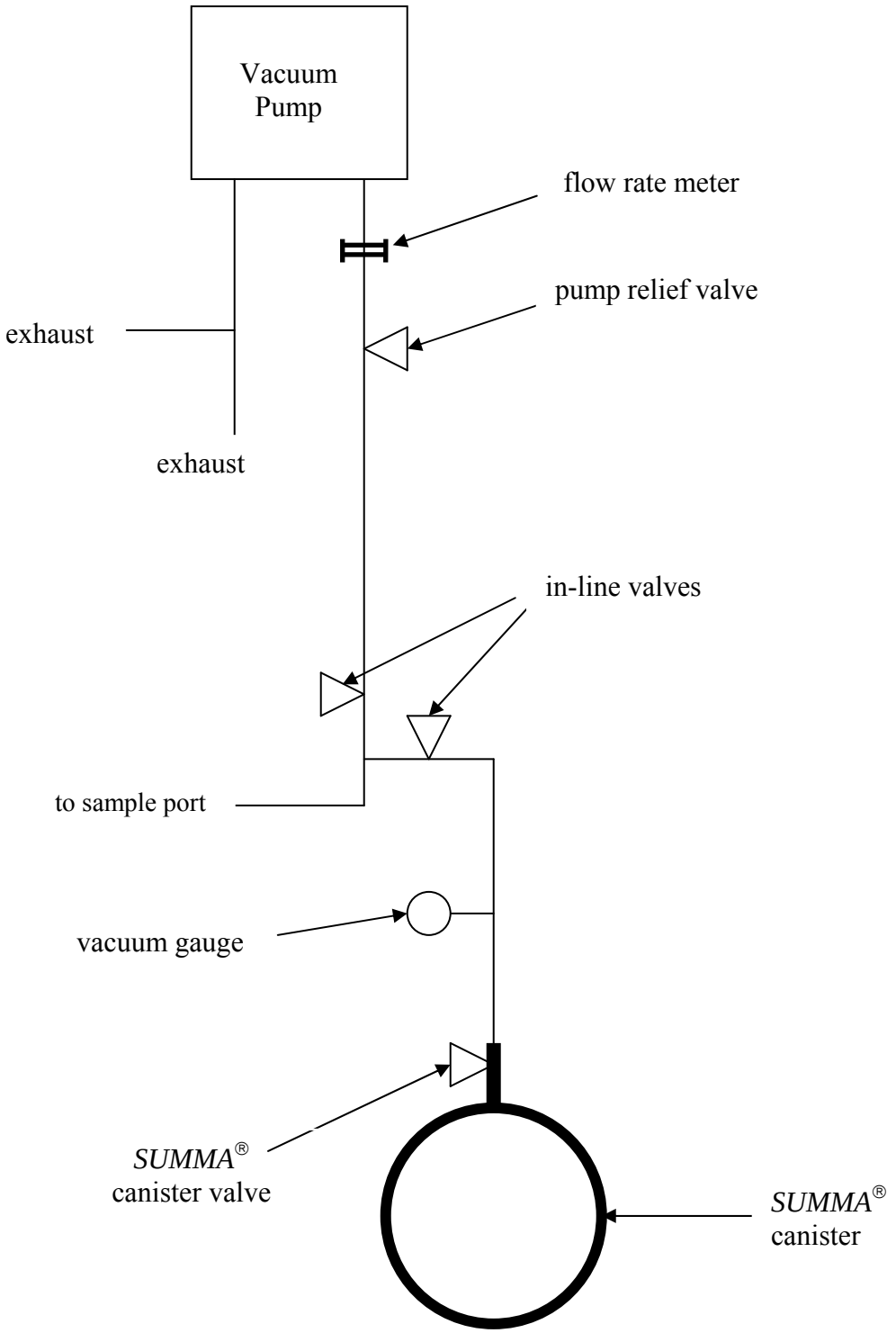
Figure 6-3
Vacuum Pump and SUMMA® Setup



Purging Information

The purge time is a function of the volume of the sampling tube and/or borehole that needs to be purged and the flow rate through the sampling tube. A minimum of three sampling tube and/or borehole volumes are purged at each location before a sample is collected.

Volume calculations for cylindrical pipes and sampling tubes are as follows:

$V = \pi(D^2/4)L$ where: V = volume
D = diameter
L = length

Minimum pump running time to evacuate three sampling tube/well volumes from each sampling port is calculated as follows:

$t = (V/Q)*3$ where: t = time
V = volume
Q = flow rate

See Attachments A (CAMU), B (CWL), C (MWL), and D (TA-V) for site-specific purge volumes based upon individual soil vapor monitoring location construction details.

6.4 Quality Control Sample Equipment Setup and Sampling Procedure

The site-specific SAP may require that a quality control sample of ultra pure nitrogen gas be collected in a SUMMA® canister. The quality control sample shall be kept in the presence of the other SUMMA® canisters during routine sample collection and will accompany the routine samples to the laboratory for analysis.

Use the following procedure for collecting the ultra pure nitrogen gas sample. See Figure 6-4 for diagram of equipment set up.

1) Close needle valve, purge valve, and regulator valve.
2) Connect regulator manifold assembly to SUMMA® canister and cylinder containing nitrogen gas.
3) Open nitrogen gas cylinder valve.
4) Adjust regulator valve to 8 pounds per square in. (psi) line pressure.
5) Adjust needle valve until compound gauge measures positive 8 psi.
6) Close nitrogen gas cylinder valve.
7) Open purge valve to purge line.
8) Close purge valve when compound gauge measures zero.
9) Repeat steps 3 through 8 a total of two times.
10) Open nitrogen gas cylinder valve.

11) Open SUMMA® canister valve.
12) Close SUMMA® canister valve when compound gauge measures negative 10 in. of Hg.
13) Close nitrogen gas cylinder valve.
14) Open purge valve.
15) Disconnect regulator manifold assembly from SUMMA® canister and nitrogen gas cylinder.
16) Close needle valve, purge valve, and regulator valve.

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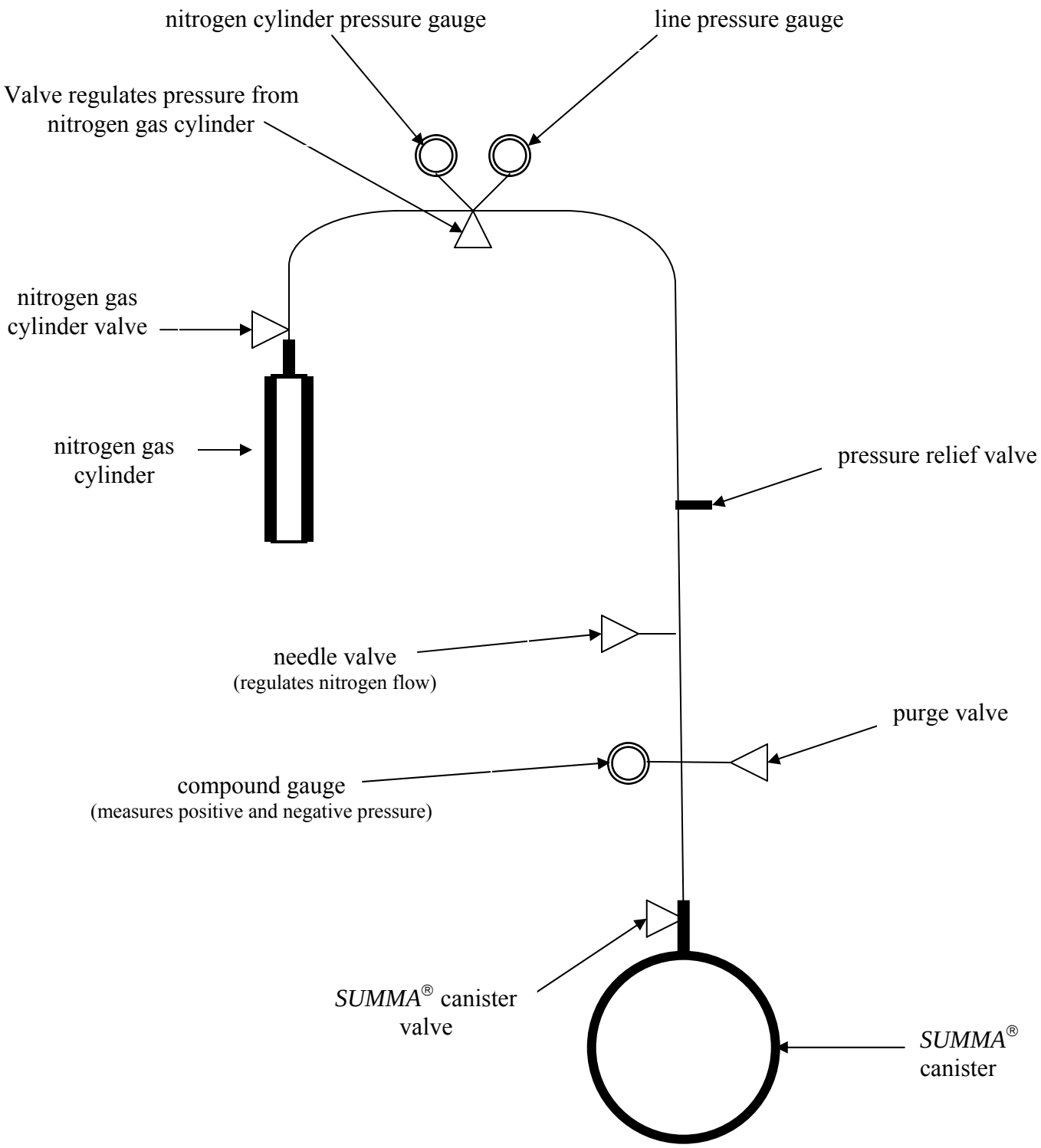
Figure 6-4
Quality Control Sample Regulator Manifold and SUMMA® Setup



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6.5 Shipping Samples to Laboratory

The SUMMA® canisters, AR/COC, and SUMMA® Canister Log will be taken to the SMO for shipment to the laboratory.

7.0 QUALITY ASSURANCE / QUALITY CONTROL

See site-specific quality assurance/quality control (QA/QC) guidelines and requirements as detailed in Attachments A through D and associated site-specific permits (CAMU and CWL) and LTMMP (MWL).

8.0 RECORDS

Analytical reports will be provided with acceptable QA/QC. The following records will be maintained at the Customer Funded Record Center:

- authorized user list
- sampling and analytical results
- field forms
- inspection forms
- logbooks (if applicable).

Sampling results shall be kept electronically in the Environmental Data Management System database. Copies of logbooks (if applicable), authorized user list, field and inspection forms shall be maintained at the CAMU Administrative Trailer for the CAMU, CWL, and MWL per site-specific permits (CAMU and CWL) and LTMMP (MWL). Training records shall be kept electronically in the Training and Employee Development System (TEDS) database. TEDS shall be accessible from the CAMU Administrative Trailer. Copies of inspection forms for the CAMU, CWL, and MWL shall be included in annual reports.

9.0 REFERENCES

Appendix E of the Class III Permit Modification for the Management of Hazardous Remediation Waste in the CAMU, Technical Area III, SNL/NM, ER Project, September 1997, Final, as amended.

ASSOP 01-04, "ASSOP Active Soil-Gas Sampling Using Method TO-14 at the CAMU", SNL/NM, November 2001.

ES&H Manual, SNL/NM, (latest edition).

New Mexico Environment Department (NMED), October 2009. "Final Permit Decision and Response to Comments, Post-Closure Care Permit for the Chemical Waste Landfill, Sandia

National Laboratories, EPA ID# NM5890110518, SNL-06-002." New Mexico Environment Department Hazardous Waste Bureau, Santa Fe, New Mexico.

PLA 04-01, "Health and Safety Plan for the CAMU Containment Cell", SNL/NM, Environmental Programs and Assurance, (latest edition).

SNL PHS # SNL05A01119 "CAMU Containment Cell Monitoring", SNL/NM, (latest edition).

SNL PHS # SNL06A00497 "Vadose Zone Monitoring at the Mixed Waste Landfill", SNL/NM, (latest edition).

SNL PHS # SNL11A00081 "Technical Area V Soil Vapor Well Sampling", SNL/NM (latest edition)

Attachment A

Corrective Action Management Unit

Site-Specific Information

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Corrective Action Management Unit (CAMU) Introduction and Background

Soil vapor monitoring requirements are defined in Appendix E (Proposed Alternative to Groundwater Monitoring for the Corrective Action Management Unit) of the CAMU Permit Application (SNL/NM September 1997), incorporated by reference as part of the Hazardous and Solid Waste Amendments Module of the Resource Conservation and Recovery Act (RCRA) Permit issued by U.S. Environmental Protection Agency (EPA) Region 6 (EPA 1993) and administered by the New Mexico Environment Department (NMED).

Prior to performing work field technicians shall complete/document all required training as indicated in Table 1 of FOP 08-22, *Soil Vapor Sampling* and pertinent training as listed in PLA 04-01, *Health & Safety Plan for the Corrective Action Management Unit*.

CAMU Soil Vapor Sampling Network

The CAMU uses the following three monitoring subsystems to monitor for volatile organic compounds (VOCs) as supplemental data for the CAMU Vadose Zone Monitoring System (VZMS) leak detection program:

VSA - The Vertical Sensor Array (VSA) consists of eleven pairs of vertically oriented monitoring locations. Five are located on both the eastern and western margins of the containment cell. The eleventh monitoring location is situated at the northern end of the cell. Each VSA location contains a soil vapor sampling port at 5 ft and 15 ft beneath the containment cell sub-liner. Tubing extends from the two soil vapor sampling ports and terminates in the above ground enclosure (AGE) where there are connections for the sampling tube to connect to the vacuum pump.

CSS - The six Chemical Waste Landfill Sanitary Sewer (CSS) boreholes are located between the CAMU containment cell and the sanitary sewer line. Each monitoring location consists of a 2 in. diameter steel pipe driven to approximately 20 feet (ft) below grade. Each pipe has a screened section at the bottom to allow for soil vapor sampling. 2 ft of the pipe protrudes above ground and is protected by a steel casing with a locking cap.

PSL - The Primary Sub-Liner (PSL) consists of five, 6-inch (in.) inside diameter vitrified clay pipe (VCP) runs that are oriented horizontally under the CAMU containment cell. The end of each VCP run is connected to 6 in. poly vinyl chloride (PVC) pipe risers that are located on the north and south ends of the CAMU containment cell. The PVC risers are protected above ground by locked steel casings. The PVC risers are used to access the PSL system.

CAMU Equipment Setup and Sampling Process

Follow the procedure detailed in Section 6.3 of FOP 08-22 and the specific instructions provided below for the VSA, CSS, and PSL subsystems respectively.

VSA Subsystem

1) Position sampling vehicle adjacent to VSA location's AGE.
2) Unlock and remove padlock from AGE.
3) Release the two door clamps and open the door.
4) The 5-ft and 15-ft soil vapor sample ports are clearly labeled inside AGE. Remove Swagelok® dust cap and connect intake tube from vacuum pump to the appropriate soil vapor sampling port (5-ft or 15-ft).
5) Collect soil vapor sample as described in Section 6.3 of FOP 08-22.
6) After samples have been collected, replace Swagelok® dust cap, close door and secure door clamps. Lock padlock on AGE hasp.
7) Repeat steps 2 through 6 for remaining VSA locations.

CSS Subsystem

1) Position sampling vehicle adjacent to CSS well to be sampled.
2) Unlock and open wellhead lid.
3) Remove Swagelok® dust cap from the soil vapor sample port on top of the well standpipe.
4) Collect soil vapor sample as described in Section 6.3 of FOP 08-22.
5) After soil vapor sample has been collected, replace Swagelok® dust cap and close and lock wellhead lid.
6) Repeat steps 2 through 5 for remaining CSS boreholes.

PSL Subsystem

Equipment items required in addition to those listed in Section 5.0 of FOP 08-22 include:

1) Aluminum centralizer.
2) Pulley assembly with locking pin.
3) Cable guide.
4) Cable winch (mounted to floor of sampling vehicle).
5) 500 ft polyethylene tube on a reel. The tube has a 0.25 in. outside diameter and 0.17 in. inside diameter.
6) Two-way radios.

At the south end of the CAMU containment cell:

1) Position vehicle so cable winch is aligned with south opening of PSL to be sampled.
2) Thread winch cable and polyethylene tube through pulley assembly.
3) Loosen allen screws on slotted end of aluminum capsule/centralizer.
4) Remove slotted end cap and feed winch cable through slot.
5) Reattach slotted end cap and secure allen screws.
6) Attach polyethylene tube from reel to aluminum capsule/centralizer using duct tape.

7) Unlock and open protective steel casing cap.
8) Unhook resident steel cable from 6 in. PVC cap and attach resident steel cable to swivel/carabiner assembly on aluminum capsule/centralizer.
9) Place aluminum capsule/centralizer into opening of PVC pipe.
10) Slide pulley assembly into unistrut fixture mounted on top inside of protective steel casing. Use locking pin to hold pulley assembly in place.
11) Take up slack in winch cable and zero cable winch footage counter.
12) Release winch drive lock to allow winch drum to turn freely.
13) Remain with vehicle to monitor cable winch while coworker goes to north end of PSL.

At the PSL north end:

14) Unlock protective steel casing cap and remove 6 in. PVC cap.
15) Unhook resident steel cable end from 6 in. PVC cap and thread resident steel cable through cable guide. Immediately hook resident steel cable end back to 6 in. PVC cap to prevent cable end from sliding into PSL.
16) Insert cable guide into unistrut fixture mounted on inside bottom of protective steel casing.
17) Notify coworker on south end by two-way radio and begin pulling resident steel cable. Pull resident steel cable 170 ft to position gas sampling tube in midway point of PSL.

At the PSL south end:

18) Polyethylene tube from reel and winch cable are played out simultaneously while resident steel cable is pulled through PSL.
19) South end worker will use 2-way radio to notify north end worker when footage counter indicates polyethylene tube is positioned 170 ft inside PSL.
20) Connect intake tube of vacuum pump to the Swagelok® connector on polyethylene tube at reel hub.
21) Collect sample as described in Section 6.3 of FOP 08-22.
22) After soil vapor sample has been collected, disconnect intake tube of vacuum pump from polyethylene tube at reel hub. Retrieve winch cable and 170 ft polyethylene tube simultaneously.
23) Disconnect resident steel cable from aluminum capsule/centralizer and reattach it to 6 in. PVC cap.
24) Replace 6 in. PVC end cap and lock protective steel casing cap.

At the PSL north end:

25) Unhook resident steel cable from 6 in. PVC cap and remove cable guide.
26) Reattach resident steel cable to 6 in. PVC cap.
27) Replace 6 in. PVC end cap and lock protective steel casing cap.

Repeat steps 7 through 27 for the remaining PSL locations.

CAMU Tube Volumes and Purge Time Calculations

Standard practice calls for purging soil vapor until a minimum of three tube volumes are evacuated. Volume calculations and purge time are calculated below. Because minimum purge times are so small, they have been increased to a required purge time. Table A-1 presents the purge volumes, minimum purge times, and the required purge times for the VSA, CSS, and PSL soil vapor monitoring locations.

Volume calculations for tubes are as follows:

$V = \pi(D^2/4)L$ where: V = volume
D = diameter
L = length

Minimum pump run time to evacuate three tube volumes is calculated as follows:

$t = (V/Q)*3$ where: t = time
V = volume
Q = flow rate (has been predetermined for the VSA, CSS, and PSL)

VSA Subsystem

Volume of the VSA soil vapor screen and ¼-inch polyethylene sampling tube is calculated as follows:

V of soil vapor screen $= \pi * [(2 \text{ in.})^2 / 4] * 12 \text{ in.} * [1 ft^3 / (12 \text{ in.})^3] = 0.022 ft^3$
V of sampling tube $= \pi * [(0.25 \text{ in.})^2 / 4] * 50 \text{ ft} * (12 \text{ in./ft}) * [1 ft^3 / (12 \text{ in.})^3] = 0.017 ft^3$

Minimum pump running time to evacuate three volumes from each VSA sampling port is calculated as follows:

$t = [(0.022 ft^3 + 0.017 ft^3) / (1.3 ft^3/\text{minute})] * 3 = 0.09$ minute or 5 seconds

CSS Subsystem

Volume of the CSS tube (galvanized well pipe) are calculated as follows:

V of galvanized pipe $= \pi * [(2.07 \text{ in.})^2 / 4] * 21 \text{ ft} * (12 \text{ in./ft}) * [1 ft^3 / (12 \text{ in.})^3] = 0.49 ft^3$

Minimum pump running time to evacuate three volumes from each CSS well is calculated as follows:

$t = [(0.49 ft^3) / (1.3 ft^3/\text{minute})] * 3 =$ 1.13 minutes or 68 seconds

PSL Subsystem

Based on the construction of the PSL monitoring subsystem, it is not practical to purge the large tube volumes (VCP + PVC) associated with each of the five monitoring locations. Instead, the purge volume and purge time is based on the length of sampling tube inserted into each of the PSL tubes.

The soil vapor samples drawn from the VCPs in the PSL are taken from midway down the length of each pipe. 500 ft of polyethylene tube, with a 0.17 in. nominal inside diameter, is unrolled from a reel and pulled down the VCPs with a winch and wire cable to the midpoint of the VCPs. The other end of the tube is connected to the soil vapor sampling system. The vacuum pump is used to draw soil gas from the VCPs and evacuate the 500 ft of polyethylene tube.

$$V \text{ of sampling tube} = \pi * [(0.17 \text{ in.})^2 / 4] * 500 \text{ ft} * (12 \text{ in./ft}) * [1 \text{ft}^3 / (12 \text{ in.})^3] = 0.079 \text{ ft}^3$$

Minimum pump running time to evacuate three volumes from the 500 ft. reel of tube is calculated as follows:

$$t = [(0.079 \text{ ft}^3) / (1.3 \text{ ft}^3/\text{minutes})] * 3 = 0.18 \text{ minute or } 11 \text{ seconds}$$

Table A-1 CAMU VZMS Soil Vapor Sampling Purge Volumes and Purge Time

System	VSA	CSS	PSL
Purge Volume (ft^3)	0.039	0.49	0.079
Minimum Purge Time (seconds)	5	68	11
Required Purge Time (minutes)	2	3	5

Attachment B

Chemical Waste Landfill

Site-Specific Information

IMPORTANT NOTICE: A printed copy of this document may not be the document currently in effect. The official version is located on the Sandia Restricted Network (SRN), department home page

Chemical Waste Landfill (CWL) Introduction and Background

Soil vapor sampling at the CWL shall be performed under the New Mexico Environment Department (NMED) approved Post-Closure Care Permit (PCCP) (NMED October 2009). The PCCP includes a description of the soil gas monitoring process and network, as well as a Soil Gas Sampling and Analysis Plan (SAP). The SAP also references Sandia National Laboratories/New Mexico (SNL/NM) operating procedures and the *Sample Management Office Statement of Work for Analytical Laboratories and Quality Assurance Project Plan*. In all cases, the requirements of the PCCP SAP take precedence over those of any other referenced or listed document and/or procedure, including FOP 08-22, *Soil Vapor Sampling*.

Prior to performing any work under the CWL PCCP, field technicians shall read the pertinent sections of the PCCP and complete/document all required training. Table B-1 summarizes important sections in the PCCP that pertain to soil-gas sampling.

Table B-1 CWL Permit Sections that Pertain to Soil Gas Sampling

Requirement	Permit Section	Comments
Monitoring and Records	Part 1, 1.8.7, p.8	Requirements for information that must be documented as part of the monitoring program. • The dates, exact place, and times of sampling or measurements; • The names of the individuals who performed the sampling or measurements; • The name and address of the laboratory that performed the analysis; • The dates analyses were performed; • The names of the individuals who performed the analyses; • The analytical techniques or methods used; and • The results of such analyses.
Record Keeping and Reporting	Part 2, 2.6, p. 15	Requirements for retention of all raw data, such as field forms, laboratory reports, and other supporting information gathered or generated during monitoring activities at the CAMU Administrative Trailer and/or the Record Center.
Soil Gas Monitoring - General	Part 3, 3.5, p. 26	General information on the CWL soil-gas sampling and analysis procedures and requirements that are described in Attachments 1 and 3 of the Permit
Personnel Training and Qualifications	Part 3, 3.6, p. 26	Requirement for compliance with the CWL-specific personnel training program detailed in Attachment 5 of this Permit.
Soil Gas Monitoring Process	Attach 1, 1.8.2.1 and 1.8.2.2, p. 39	General information on the CWL soil-gas sampling and analysis procedures and requirements.
Record Keeping – CAMU Admin Trailer & ESH Records Center	Attach 1, 1.12, p. 48-49; Attach 2, 2.21.4, p. 76-77; and Attach 3, 3.12, p. 90	Detailed information on record keeping requirements.
Soil Gas SAP	Attach 3 (p. 84-98)	Details CWL-specific sampling requirements.
Documentation of Inspections, Maintenance & Repair	Attach 4 implemented in Attach 1, 1.10 and 1.11, p. 45-48	Requirements for well and equipment inspections, maintenance, and repairs to be conducted as part of each annual sampling event (see Table 1-6).

Table B-1 CWL Permit Sections that Pertain to Soil Gas Sampling (concluded)

Requirement	Permit Section	Comments
Training Program	Attach 5, 5.0 p. 107-112	Job Titles, Qualifications & Roles and Responsibilities; Training Content, Frequency, and Techniques; Emergency Training, and Documentation Requirements all detailed in Attachment 5 of Permit.
Waste Types, Management & Spills	Attach 6, 6.0, p. 114	Hazardous waste generated at the CWL includes personal protective equipment (PPE) waste generated during the sampling of soil gas. Waste generated at the CWL will be stored and managed at the CAMU less-than-90-day waste accumulation area or another established less-than-90-day waste accumulation area.
Contingency Plan & Emergency Response	Attach 6, 6.4, p. 117-122	All field personnel must review the Contingency Plan and be familiar with its location in the CAMU Administrative Trailer and the basic emergency response process for the site.

CWL Soil Vapor Sampling Network

The CWL soil vapor sampling network consists of the following five soil vapor monitoring wells: UI-1, UI-2, D-1, D-2, and D-3. The UI designation refers to "Upper Intermediate" indicating the general depth horizon in which these wells are screened. The D designation refers to "Deep" and is similarly indicative of the screen depth interval. There are three soil vapor sampling ports associated with each of the UI series wells and five soil vapor sampling ports associated with each of the D series wells. One soil vapor screen at each sampling depth consists of a 2 ft long by 0.31 in. inner diameter stainless steel screen that is attached to a 0.215 in. stainless steel tube that extends to the surface.

CWL Equipment Setup and Sampling Process

Follow the procedure detailed in Section 6.0 of FOP 08-22 and Attachment 3 of the CWL PCCP.

Note that for the CWL, **a minimum purge time of 30 minutes per sampling port is required**. A minimum of 3 sampling tube volumes of air will be removed from each sampling port and at least 3 stable photoionization detector (or equivalent) readings shall be recorded prior to sample collection.

CWL Sampling Tube Volume and Purge Time Calculations

V of soil vapor screen = π * [(0.31 in.)^2 / 4] * 2 ft * (12 in./ft) * [1ft^3 / (12 in.)^3]= 0.0010 ft^3
V of sampling tube = π * [(0.215 in.)^2 / 4] * tube length (ft) * (12 in./ft) * [1ft^3 / (12 in.)^3]
Vapor Well Volume = (V soil vapor screen + V of sampling tube)
V to purge = 3 * (Vapor Well Volume)

The sampling locations, associated ports, corresponding sampling depths, and sampling tube volumes are presented in Table B-2.

Table B-2 CWL Purge Volume Calculations

Sampling Location	Port #	Soil Vapor Screen Volume (ft^3)	Sampling Tube Length = sample depth (ft. bgs) + riser (ft)	Sampling Tube Volume (ft^3)	Vapor Well Volume (ft^3)	Volume to purge (ft^3)
UI-1	1	0.0010	120+4.8 = 124.8	0.0315	0.033	0.098
	2	0.0010	80+4.8 = 84.8	0.0214	0.022	0.067
	3	0.0010	40+4.8 = 44.8	0.0113	0.012	0.037
UI-2	1	0.0010	136+3.1 = 139.1	0.0351	0.036	0.108
	2	0.0010	76+3.1 = 79.1	0.0199	0.021	0.063
	3	0.0010	36+3.1 = 39.1	0.0099	0.011	0.033
D-1	1	0.0010	470+4=474	0.1194	0.120	0.362
	2	0.0010	350+4=354	0.0892	0.090	0.271
	3	0.0010	240+4=244	0.0615	0.063	0.188
	4	0.0010	160+4=164	0.0413	0.042	0.127
	5	0.0010	100+4=104	0.0262	0.027	0.082
D-2	1	0.0010	470+1.7 = 471.7	0.1189	0.120	0.360
	2	0.0010	440+1.7 = 441.7	0.1113	0.112	0.337
	3	0.0010	350+1.7 = 351.7	0.0886	0.090	0.269
	4	0.0010	240+1.7 = 241.7	0.0609	0.062	0.186
	5	0.0010	120+1.7 = 121.7	0.0307	0.032	0.095
D-3	1	0.0010	480+3 = 483	0.1217	0.123	0.368
	2	0.0010	440+3 = 443	0.1116	0.113	0.338
	3	0.0010	350+3 = 353	0.0890	0.090	0.270
	4	0.0010	170+3 = 173	0.0436	0.046	0.134
	5	0.0010	120+3 = 123	0.0310	0.032	0.096

Minimum pump run time to evacuate three volumes from each sampling port is calculated as follows:

t = V to purge / Q where: t = time
V = volume
Q = flow rate (to be determined in the field based on equipment limitations)

Attachment C

Mixed Waste Landfill

Site-Specific Information

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Mixed Waste Landfill (MWL) Introduction and Status

In September 2007 the MWL Long-Term Monitoring and Maintenance Plan (LTMMP) was submitted to the New Mexico Environment Department (NMED) for review and approval. In December 2010 NMED indicated that the 2007 LTMMP would need to be revised and resubmitted after NMED approval of the Corrective Measures Implementation (CMI) Report. NMED approval of the CMI Report is pending, but anticipated in 2011. Once the CMI Report is approved, the LTMMP will be revised and submitted to NMED for review and approval. Soil vapor monitoring at the MWL will not be required until the LTMMP is approved. Based on the 2007 LTMMP and input from NMED, additional soil vapor monitoring wells will be installed at the MWL.

Once the LTMMP is revised and approved, this attachment will be updated to include the new well information and MWL-specific requirements. Information regarding the current soil vapor monitoring network at the MWL is provided below, but soil vapor sampling will not be required until the revised LTMMP is approved.

MWL Soil Vapor Sampling Network

The MWL soil vapor sampling network consists of two soil vapor monitoring wells, MWL-SV-01 and MWL-SV-02. The soil vapor implant at each location consists of a 0.5 ft long by 0.5 in. diameter stainless steel screen. It is attached to a nominal 0.25 in. diameter polyethylene tube that extends 41 ft to the ground surface and a sampling port.

MWL Equipment Setup and Sampling Process

Follow the procedure detailed in Section 6.0 of FOP 08-22, *Soil Vapor Sampling*, and any applicable information in the approved version of the LTMMP.

MWL Sampling Tube Volume and Purge Time Calculations

V of soil vapor implant = π * [(0.5 in.)^2 / 4] * 0.5 ft * (12 in./ft) * [1ft^3 / (12 in.)^3]= 0.0007 ft^3
V of sampling tube = π * [(0.25 in.)^2 / 4] * 41 ft * (12 in./ft) * [1ft^3 / (12 in.)^3] = 0.0140 ft^3
Vapor Well Volume = (V soil vapor screen + V of tubing)
V to purge = 3 * (Vapor Well Volume)

The sampling locations, associated ports, corresponding sampling depths, and purge volumes are presented in Table C-1.

Table C-1 MWL Purge Volume Calculations

Sampling Locations	Port #	Soil Vapor Implant Volume (ft^3)	Sample Depth (bgs) tubing length (ft)	Sampling Tube Volume (ft^3)	Vapor Well Volume (ft^3)	Volume to purge (ft^3)
MWL-SV-01	1	0.0007	41	0.0140	0.015	0.044
MWL-SV-02	1	0.0007	41	0.0140	0.015	0.044

Minimum pump running time to evacuate three volumes from each sampling port is calculated as follows:

t = V to purge / Q where: t = time
V = volume
Q = flow rate (to be determined in the field based on equipment limitations)

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Attachment D

Technical Area V

Site-Specific Information

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Technical Area V (TA-V) Introduction and Background

In April 2004, the New Mexico Environment Department (NMED) issued a Compliance Order on Consent (NMED April 2004) to the U.S. Department of Energy (DOE) and Sandia Corporation, that identified TA-V as an area of groundwater contamination at Sandia National Laboratories/New Mexico (SNL/NM) requiring completion of a Corrective Measures Evaluation (CME). A CME Work Plan was prepared and implemented and a CME Report was submitted by SNL/NM in July 2005. In July 2008, the NMED issued the first Notice of Disapproval (NOD) to the DOE and Sandia regarding the CME Report for the TA-V study area at SNL/NM, which required further characterization of groundwater and soil vapor at TA-V. SNL/NM prepared the *Technical Area V Groundwater Investigation Work Plan* and submitted the plan to the NMED in April 2009. SNL/NM received NODs from NMED in August 2009 and December 2009, and submitted revised work plans in November 2009 and February 2010. The NMED conditionally approved the SNL/NM February 2010 *Technical Area V Groundwater Investigation Work Plan* in May 2010.

The approved work plan included the design of the soil vapor monitoring system required to provide data regarding vadose-zone volatile organic compound (VOC) profiles with depth. The work plan also discussed soil vapor sampling field activities such as preparation, purging, VOC monitoring, sample collection, and sample shipping. As established in the regulatory-approved work plan, requirements for soil sampling are addressed by the procedures documented in FOP 08-22, *Soil Vapor Sampling*. Information on the monitoring network and soil vapor sampling specific to TA-V (necessary to fulfill the requirements of the work plan) are provided below.

TA-V Soil Vapor Sampling Network

The TA-V soil vapor sampling network consists of three soil vapor monitoring wells (TAV-SV01, TAV-SV02, and TAV-SV03), with soil vapor sampling ports at depths of approximately 50 feet (ft), 100 ft, 150 ft, 200 ft, 250 ft, 300 ft, 350 ft, 400 ft, 450 ft, and 500 ft below ground surface (bgs). The soil vapor screen at each location consists of a 1-ft long by 0.5-in. diameter stainless steel screen. It is attached to 0.25 in. outside diameter stainless steel tube that extends to the ground surface and a sampling port.

TA-V Equipment Setup and Sampling Process

The TA-V soil vapor sampling equipment includes a sampling manifold assembly and a multiport purging chamber (Figure D-1). The multiport purging chamber is equipped with individual valves, fittings, and tubing which can be connected up to ten individual sample ports. The multiport purging chamber allows up to ten sampling locations to be purged at the same time. To setup the equipment and collect samples:

1) The ten valves on the multiport purging chamber are numbered 1 through 10. Connect the valve labeled #1 to the deepest sampling port. Connect the valve labeled #2 to the

second deepest sampling port. Continue connecting in this order with the valve labeled #10 connected to the shallowest sampling port.

2) Open valve on the multiport purging chamber associated with the shallowest sampling port and begin the purging process. Purging and sample from shallow to deep, as deep sampling ports may contain groundwater.
3) Turn on pump to purge soil vapor from sample depth.
4) Use the sampling tube volume and flow rate meter value to calculate the purge time for the sampling port. Purge for length of time that allows a minimum of three volumes of the sample tube to be evacuated.
5) Monitor the VOC levels of current sampling depth by attaching the VOC monitoring instrument of the exhaust port of the vacuum pump. Continue the purging process until the VOC levels stabilize. Record stabilized VOC reading on the Soil Vapor Sampling Log (FOP 08-22, Attachment I).
6) Close valve and turn off the vacuum pump.
7) Disconnect the multiport purging chamber valve from the sampling port.
8) Attach the sampling manifold assembly to the sampling port and to a SUMMA® canister.
9) Open SUMMA® canister valve.
10) Open flow valve on sampling manifold assembly by squeezing flow valve lever.
11) When the vacuum gauge on the sampling manifold assembly reaches approximately minus 10 in. Hg, release flow valve lever and close the SUMMA® canister valve. This will prevent the canister from going to ambient pressure (0 in. Hg). (Note: The analytical laboratory, Test America, requests that approximately minus 10 in. Hg of vacuum remains in the SUMMA® canister at completion of sampling).
12) Remove sampling manifold assembly from the SUMMA® canister.
13) Fill out date and time on sample label and attach it to SUMMA® canister tag. Do not attach sample label to canister itself.
14) Verify the final vacuum reading of approximately minus 10 in. Hg on all SUMMA® canisters by connecting the vacuum gauge provided by the laboratory to the valve on top of the SUMMA® canister.
15) Record the final vacuum reading for each canister on the SUMMA® Canister Log (FOP 08-22, Attachment H).
16) Close the SUMMA® canister valve, remove vacuum gauge and replace Swagelok® dust cap.
17) Proceed to the next sampling depth by opening the corresponding valve on the multiport purging chamber.
18) Continue with steps 4) through 16) until all sampling ports have been purged and samples have been collected.
19) If more than one sampling location or sampling port are purged at the same time, then modify purge length in step 4) as the length of time that allows a minimum of three volumes from each sampling tube to be purged based upon calculated purge time for the sampling port with the greatest volume.

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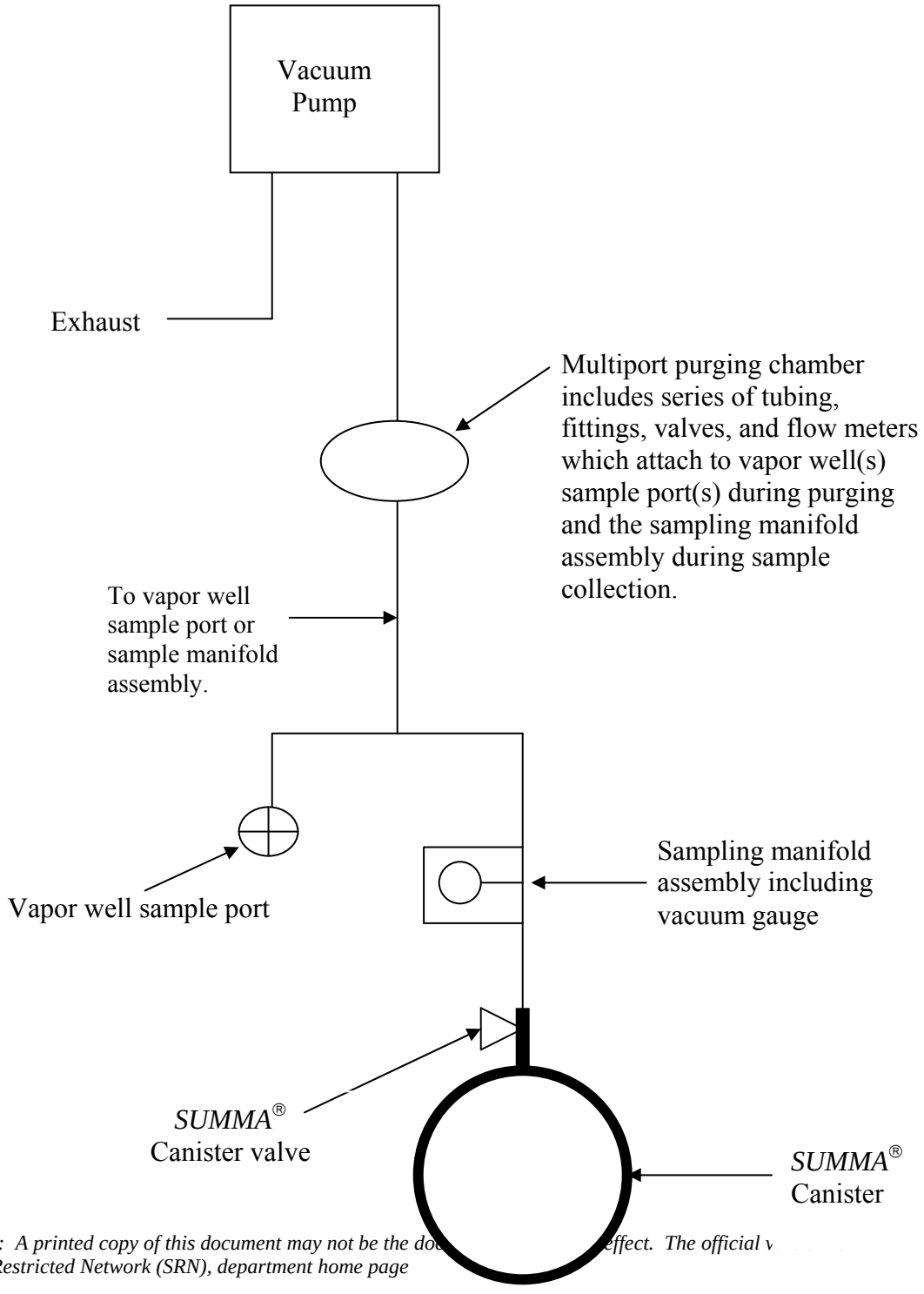
Figure D-1
TA-V Vacuum Pump and SUMMA® Setup



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TA-V Sampling Tube Volume and Purge Time Calculations

V of soil vapor screen = π * [(0.5 in.)^2 / 4] * 1 ft. * (12 in./ft.) * 1ft.^{3} / (12 in.)^3 = 0.0014 ft.^{3}
V of sampling tubing = π * [(0.25 in.)^2 / 4] * tubing length (ft.) * (12 in./ft.) * [1ft^3 / (12 in.)^3]
Vapor Well Volume = (V soil vapor screen + V of tubing)
V to purge = 3 * (Vapor Well Volume)
The sampling locations, associated ports, corresponding sampling depths, and purge volumes are presented in the table below.

Table D-1 TA-V Purge Volume Calculations

Sampling Locations	Sample Depth (bgs) tubing length (ft)	Soil Vapor Screen Volume (ft^3)	Sampling Tube Volume (ft^3)	Vapor Well Volume (ft^3)	Volume to purge (ft^3)
TAV-SV01 TAV-SV02 TAV-SV03	50	0.0014	0.0170	0.018	0.055
	100	0.0014	0.0341	0.035	0.106
	150	0.0014	0.0511	0.052	0.157
	200	0.0014	0.0682	0.070	0.209
	250	0.0014	0.0852	0.087	0.260
	300	0.0014	0.1023	0.104	0.311
	350	0.0014	0.1193	0.121	0.362
	400	0.0014	0.1364	0.138	0.413
	450	0.0014	0.1534	0.155	0.464
	500	0.0014	0.1704	0.172	0.515

Minimum pump running time to evacuate three volumes from each sampling port is calculated as follows:

t = V to purge / Q where: t = time
V = volume
Q = flow rate (to be determined in the field based on equipment limitations)

Attachment E

On-The-Job Training

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On-The-Job Training

By signature below, I affirm that the following is correct. Only those undersigned are authorized to conduct sampling as described in this plan.

Name of Trainee:	Signature	Org. / MS	Phone
Name of Trainer:	Signature	Org. / MS	Phone

Project:	**Date/Time In**	**Date/Time Out**

Job Description:

Job Description (continued):

Equipment:

Additional Comments:

Date/Time In	**Date/Time Out**	Training Equipment/Experience

Job Description:

Job Description (continued):

Equipment:

Additional Comments:

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On-The-Job Training (continued)

Date/Time In	**Date/Time Out**	Training Equipment/Experience

Job Description:

Job Description (continued):

Equipment:

Additional Comments:

Date/Time In	**Date/Time Out**	Training Equipment/Experience

Job Description:

Job Description (continued):

Equipment:

Additional Comments:

Date/Time In	**Date/Time Out**	Training Equipment/Experience

Job Description:

Job Description (continued):

Equipment:

Additional Comments:

Attachment F

Authorized User List

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Authorized User List

By signing below, I affirm that I have read and I understand this procedure, and that I agree to operate within the stated constraints. Only those undersigned are authorized to conduct the activities described in this procedure.

Name (printed)	Signature	Date	Org.
Project Leader			
Field Technician			
Field Technician			
Field Technician			
Field Technician			
Field Technician			
Field Technician			
Field Technician			
Field Technician			
Field Technician			

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Attachment G

Tailgate Safety Briefing

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TAILGATE SAFETY BRIEFING

Facility: _____ Date: _____ Time: _____

Activities: _____

_____

_____

(Anyone has the right to cease field activities for safety concerns. The buddy system will be used when needed.)

Safety Topics Presented

☐ Wear safety glasses as needed	☐ Wear leather gloves when needed
☐ Wear safety boots	☐ Be aware of electrical hazards
☐ Wear hearing protection as needed	☐ Use safe lifting practices
☐ Be aware of biohazards (snakes, spiders, etc.)	☐ Be aware of slips, trips, and falls
☐ Perform appropriate inspections for equipment used	☐ Eating or drinking allowed in designated areas only
☐ Proper housekeeping will be maintained	☐
☐	☐

Does anyone have any weight restrictions on lifting? Circle **YES** or **NO**. If answered **YES** explain.

Presenter

_____ _____
Printed Name Signature

Attendees

_____ _____
Printed Name Signature

_____ _____
Printed Name Signature

_____ _____
Printed Name Signature

_____ _____
Printed Name Signature

_____ _____
Printed Name Signature

_____ _____
Printed Name Signature

Notes

_____

_____

_____

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Attachment H

SUMMA® Canister Log

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SUMMA® Canister Log

Serial #	Date Received	Date Tested for Initial VAC	Initial VAC at 5400 ft (in. Hg)	Date Used	End VAC at 5400 ft (in. Hg)	Date Returned to SMO

SUMMA® Canister Log completed by:

Printed Name

Signature

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Attachment I

Soil Vapor Sampling Log

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Soil Vapor Sampling Log

Location	Date	Time	Canister #	PID (ppm)	Starting Vacuum (in. Hg)	Ending Vacuum (in. Hg)	Location Comments

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Attachment J

Soil Vapor Monitoring Inspection Form

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Soil Vapor Monitoring Inspection Form

1. Soil vapor monitoring site (CAMU, CWL, MWL, TA-V) _____
2. Date of Inspection _____
3. Time of Inspection _____
4. Name of Inspector _____

Mandatory requirement:

The inspector has read applicable site-specific Permits (CAMU and CWL), LTMMP (MWL) and activity related procedures in the last 12 months for the location indicated on line 1 above: (*Inspector must initial box before proceeding with the inspection.)*

Date read _____

Provide explanatory notes for each parameter not inspected or each action required. Include any remedial steps required.

SOIL VAPOR MONITORING LOCATIONS				
Inspection Parameter	***Indicate if Applicable (Yes or No)***	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Concrete pads, bollards, and protective casings in need of repair/maintenance.				
B. Above-ground enclosure in need of repair/maintenance.				
C. Well cover caps and Swagelok® dust caps in need of repair/maintenance.				
D. Sampling ports in need of repair/maintenance.				
E. Passive venting Baroballs™ in need of repair/maintenance.				
F. Monitoring wells and soil-gas sample port locations properly labeled.				
G. Locks in need of cleaning or replacement.				

Soil Vapor Monitoring Inspection Form (continued)

SAMPLING EQUIPMENT				
Inspection Parameter	***Indicate if Applicable (Yes or No)***	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Sampling pump in need of repair/maintenance				
B. Sampling manifold (tubing, gauges, and valves) in need of repair/maintenance.				

PREVIOUS DEFICIENCIES			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
Uncorrected/undocumented previous deficiencies.			

NOTES

Note Number	Description

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Soil Vapor Monitoring Inspection Form (concluded)

Action (Note Number) _____ assigned to _____Date action completed_____

Action (Note Number) _____ assigned to _____Date action completed_____

Action (Note Number) _____ assigned to _____Date action completed_____

Action (Note Number) _____ assigned to _____Date action completed_____

Action (Note Number) _____ assigned to _____Date action completed_____

Additional Comments:

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Inspector's Signature _____
Original to: Site's Operating Record
Copy to: Environmental Operations Records Center, MS-1309

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Sandia National Laboratories/New Mexico (SNL/NM)
Statement of Work
for Analytical Laboratories

Revision 6
January 2013

SANDIA NATIONAL LABORATORIES/NEW MEXICO (SNL/NM)
STATEMENT OF WORK FOR ANALYTICAL LABORATORIES

GENERAL INORGANIC, ORGANIC, RADIOCHEMICAL, BIOASSAY, IH, ASBESTOS, AND GEOTECHNICAL LABORATORY ANALYSES

Introduction

The Sandia National Laboratories (SNL) Sample Management Office is responsible for acquiring analytical services in support of SNL site activities. This statement of work (SOW) outlines the requirements for analytical services provided to Sandia Corporation by contract laboratories.

Samples obtained for chemical analysis in support of SNL activities will consist of soil, waste, groundwater, surface water, domestic supply water, air filters, demolition debris, biota, sludge, oil, organic liquids, swipes, organic and inorganic solids, air, soil gas, Industrial Hygiene (IH), and bioassay samples. In addition, samples may be acquired for airborne asbestos, bulk asbestos, or geotechnical testing. The sections below detail specific quality assurance protocols, analytical practices and procedures, analytical quality control requirements, deliverable formats, and schedule requirements. Collectively, these conventions have been established to ensure that Sandia data quality objectives are met and that data obtained from different contract laboratories are comparable.

Contract laboratories shall provide services that require processing samples with constituents including various types of chemicals and/or radioactive isotopes. Samples may include mixed waste (containing both Resource Conservation and Recovery Act hazardous and radioactive materials). Laboratories performing chemical analyses under this SOW must hold State of Utah Certification. Radioactive samples will be classified predominately as low-level waste; classification for transportation will be non-radioactive or limited quantity. Additionally, it is desirable for laboratories to have the capability to accept and analyze higher activity samples such as transuranic (TRU) waste or waste that would be classified as Type A radioactive material for transportation purposes. Laboratories must be able to comply with NVO-325 requirements per the Nevada Test Site Waste Acceptance Criteria (NTSWAC).

Laboratories' capabilities must include, at a minimum, general inorganic, organic, and radiochemical analyses. In addition, bioassay, asbestos, and geotechnical analyses may be included, or any combination thereof. Labs having IH or bioassay analysis capabilities shall perform the analyses in the primary facility or a sister laboratory within the same company. Bioassay laboratories must provide services to a U.S. Department of Energy (DOE) Laboratory Accreditation Program (DOELAP) approved site. Use of secondary laboratories shall not be permitted for bioassay analyses. Secondary laboratories will be considered for asbestos, TO-14, and geotechnical-type analyses.

Contract laboratories shall perform all analyses of samples received and obtain express written permission before sending any samples to a secondary laboratory for analysis. Prime contract laboratories, secondary, and sister laboratories may be required to successfully pass a DOE Consolidated Audit Program (DOECAP) systems audit and submit analysis results for performance evaluation samples prior to providing analytical support. Secondary and sister laboratories are required to show that they meet the requirements of this SOW. In the event that a secondary laboratory is approved and does receive samples, all delivery schedules shall remain unchanged.

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1.0 ANALYSIS REQUESTS AND SAMPLE SHIPMENT

1.1 Work orders

Approximately one week before the start of sample collection, the Sandia Corporation Delegated Representative (SDR) will notify the contractor in writing of the scheduled shipment of samples. The notification shall take the form of an electronic mail bottle order issued against the contract. The bottle order will include sampling project information, anticipated project schedule, number of samples to be submitted, sample matrix, and anticipated analysis request to be performed by the contractor. Some small projects and/or rapid analysis requests may be submitted without the advance notification discussed above in order to meet project requirements. For emergency and expedited sample processing the SDR will notify the laboratory prior to sample shipment.

1.2 Shipping charges

Sample shipping charges to contract laboratories shall be paid by Sandia.

The contractor shall be responsible for shipping charges related to return samples and bottle orders.

1.3 Itemized analytical charges

Unit prices provided by laboratories shall include the cost of all Quality Assurance(QA), Quality Control (QC), preparation, extraction, cleanup, analytical, reporting, storage, and disposal requirements specified in this statement of work (SOW). Field QC samples, such as field blanks, field duplicates, and trip blanks, shall be invoiced and paid for at the itemized prices for field samples. Accelerated turn-around times are discussed in Section 4.2.1 of this SOW.

1.4 Analyte definitions

For analyses performed under this SOW, the term “general inorganic” refers to the analytes listed in Attachment 1, the term “radiochemical” refers to the analytes listed in Attachment 2, the term “organic” refers to the analytes listed in Attachment 3, and the term “geotechnical” refers to the tests listed in Attachment 4.

1.5 Time definitions

References to days, weeks, or months are defined as calendar days, weeks, and months unless otherwise specified. Report delivery schedules are discussed in Section 4 of this SOW.

1.6 Request for reanalysis

1.6.1 Incomplete reports and errors

If a suspected analytical error is identified by comparison with historical data, if QC data are either missing or outside the control limits, or if the data are unusable for any reason, the SDR reserves the right to request delivery of the missing documentation or the reanalysis of any or all samples within the sample lot. Where some results in the suite have met the acceptance criteria, reanalysis requests will be for the affected parameters only, rather than the entire analytical suite.

1.6.2 Reimbursement for reanalysis costs

Reanalysis will be requested by telephone or e-mail. Payment for reanalysis requested by the SDR shall be made according to the following guidelines:

a) Reanalysis requested because failed QC data were reported to the SDR shall not be paid for.

b) Reanalysis that are requested because of a suspected significant error, and to confirm the original results within reasonable analytical error, shall be paid for by Sandia. The SDR will seek input from the laboratory regarding reanalysis confirmation in light of sample inhomogeneity or other special considerations.

c) Reanalyses that are requested because of a suspected significant error, and that indicate that an analytical or reporting error was made in the first analysis, shall not be paid for by Sandia.

1.7 Nonstandard analyses

1.7.1 Bids for nonstandard analyses

Sandia may find it necessary, on occasion, to request an analysis that is not explicitly covered in this SOW. When this occurs, requests for quote will be submitted to each laboratory with a description of the needed work. If one or more of the laboratories holding current contracts can perform the analysis, the laboratory selection will be made based upon the prices submitted, an assessment by the SDR of the laboratory's ability to meet the technical specifications, and the capacity of the laboratories submitting bids. The contracts for laboratories having the needed capability will then be amended by letter to include the new analysis.

1.7.2 Proposing secondary laboratories

Laboratories shall obtain express written permission before sending any samples to a secondary laboratory for analysis. If none of the laboratories, holding current contracts, have the capability to perform the needed test, laboratories will then be allowed to propose secondary laboratories outside the current contract structure. If one or more of the proposals is accepted, the laboratories shall be solely responsible for executing a contract with the proposed laboratory for the work. The SDR will assess the need to perform an audit of the proposed laboratory prior to submitting samples. However, the laboratories under contract must ensure that all the applicable requirements of this SOW are met in lower-tier contracted work. When an audit is deemed necessary, failure to submit to or pass the audit will disqualify the proposed laboratory.

1.7.3 Using secondary laboratories

Laboratories shall not be permitted to send Sandia samples to laboratories outside the original contract structure unless the conditions described in Sections 1.7.1 and 1.7.2 have been met.

1.7.4 Deliverable levels

Sandia data deliverables routinely provided by the laboratory will be “Level C” reports. Laboratories will provide “Level D” and “Level B” reports upon request, and will provide line-item pricing for their preparation in the schedule of charges submitted to the Sandia National Laboratores/Sample Management Office SNL/SMO. Reporting definitions and analytical data deliverable requirements are fully outlined in Section 4 of this document.

2.0 QUALITY ASSURANCE REQUIREMENTS

2.1 General data quality objectives

2.1.1 Methods, quality control, and documentation

a) The SDR will sometimes find, through application of the U.S. Department of Energy (DOE) Streamlined Approach for Environmental Restoration (SAFER) process for data quality objectives (DQOs), that the QC or other requirements in this document should be relaxed or tightened to suit particular project needs. Individual project needs that necessitate requirements different from those discussed in this SOW will be negotiated on a case-by-case basis by the SDR subject to the limitations in the clause titled Delegation of Authority. However, any changes affecting cost must be approved by the Sandia Contract Representative.

b) DQOs are developed by the Sandia project specifically. However, a general requirement is that industry-standard methods, such as USEPA SW-846 (Third Edition, as revised and updated), USEPA 600 series methods, Occupational Safety and Health Administration (OSHA) methods, American Society for Testing and Materials (ASTM) methods, and American Public Health Association (APHA) methods (Standard Methods) be used where possible. The analytical requests submitted to a laboratory will generally specify which methods apply. In the absence of specific direction from Sandia, laboratories must employ a suitably sensitive analytical method that meets all project-specific quantitation levels. Laboratories should assume that (1) soil and waste samples should be analyzed using SW-846 methods, (2) aqueous samples should be analyzed using methods approved under the Clean Water Act, (3) air filters should be analyzed by approved National Institute of Occupational Safety and Health (NIOSH) methods or equivalent methods, and (4) tissue samples should be analyzed using SW-846 methods, with samples prepared as specified in Section 3.2.2 (g) of this SOW. Where industry-standard methods do not address particular analytes, performance-based methods may be utilized with prior approval from the SNL/SMO. All QC requirements specified in this SOW shall be met, even if they exceed those specified in a particular requested method.

c) Laboratories must prepare complete documentation for every activity in order to facilitate review and enhance defensibility of the data. Documentation requirements include records for sample receipt/login, preparation, digestion, extraction, sample or extract cleanup, standards preparation, and sample analysis.

d) In cases for which the specific QA and QC protocols found in this SOW, the DOE Quality Systems for Analytical Services document, and Chapter 5 of the National Environmental Laboratory Accreditation Conference (NELAC) standard cannot be extended to requested parameters, professional judgment shall be employed in adhering as closely as possible to the intent of those protocols. This means that the laboratory should extend all standard documentation and QC practices to parameters, methods, and analytical techniques that are not covered in these documents, where possible. The laboratory shall formulate an approach to performance and documentation of analytical procedures in light of the fact that it is the general goal of Sandia to obtain legally and technically defensible data. Specific QC and analytical requirements are discussed in detail in Section 3 of this SOW.

2.1.2 Certification and accreditations

Unless specifically allowed exemption by the SNL/SMO, laboratories serving Sandia must be accredited by NELAC and the State of Utah, and shall have successfully passed a DOE Consolidated Audit Program (DOECAP) audit. Laboratories performing analyses in support of the Sandia industrial hygiene programs must be American Industrial Hygiene Association (AIHA)-certified, and laboratories supporting personnel monitoring programs must be DOE Laboratory Accreditation Program (DOELAP)-approved.

2.2 Laboratory quality assurance plan

2.2.1 Specific requirements

The laboratory, and any secondary laboratories accepted for participation in the contract, shall have a laboratory quality assurance plan (LQAP) that contains sections or references addressing all of the items listed below.

a) Title page with provision for approval signatures and dates of revision.

b) Table of contents.

c) Laboratory organizational structure and key personnel responsibilities.

d) Personnel training, with required training, frequency, and methods of records maintenance specified.

e) Sample receipt, custody, and management practices. This section shall specify a formal vehicle for notifying the analytical group of holding times near expiration in order to minimize occurrences of expiration prior to analysis.

f) Facilities and equipment, including a description of security procedures, sample storage practices, and a list of equipment available at the laboratory. Equipment lists shall include acquisition dates.

g) List of all laboratory analytical procedures by method number and matrix. Laboratory policy shall require that controlled copies of analytical procedures be available to the analysts.

h) General instrument calibration and calibration verification policies, including documentation of calibration standards, coefficients resulting from linear or higher order polynomial regression calculations, calibration curve correlation coefficients, and the associated acceptance criteria. The issues below shall be addressed as applicable to the type of analyses being performed.

i. Procedures shall require that linear regression calibration curve correlation coefficients (r) for general inorganic chemistry be ≥ 0.995.

ii. Conformance with organic chemistry method calibration requirements shall be required. If linear regressions are used in calibration for organic methods, the LQAP or standard operating procedures (SOPs) must specify a minimum correlation coefficient or coefficient of determination of 0.99. If higher order polynomials are used, laboratories must obtain prior approval from the SDR and must follow the applicable guidance in SW-846 Method 8000.

iii. Calibration frequency, methodologies, and documentation practices for radiochemistry counting instruments shall be discussed.

iv. Evaluation practices for non-zero intercepts shall be addressed. Procedures shall require that linear and quadratic curves for both organic and inorganic data have initial calibration Y-intercept absolute values ≤3 times the method detection limit (MDL).

i) MDLs for general inorganic chemistry and organic chemistry. - The section addressing MDLs shall specify detection limit determination methodologies and shall include both empirical MDL verification and examination of the method blank populations for each analyte. Minimum MDL study requirements are discussed in greater detail in Section 3.3.1 of this SOW. Minimum detection amount (MDA) calculation requirements for radiochemistry are given in Section 3.3.4 of this SOW.

j) Default criteria for QC sample type, analysis frequency, data acceptance, and corrective actions for failures in daily QC practices. - Where QC acceptance criteria are not given in this SOW or in the applicable method, laboratory acceptance criteria shall be established statistically with a minimum of 20 data points by QC type, method/technique, and matrix. Control limits shall be established at the three-sigma (3σ) confidence level. Where data are insufficient to statistically establish acceptance criteria, an approved fixed limit may be temporarily applied. This section shall also discuss the QC data review processes employed by the laboratory. Laboratories performing radiochemical analyses shall specify default minimum tracer and carrier recovery criteria in the LQAP. QC data requirements and acceptance criteria for Sandia work are discussed in detail in Section 3 of this SOW.

k) A description of the corrective action report (CAR) process. - A copy of a CAR form shall be provided in the LQAP. The process shall include tracking and documentation of completion of all corrective actions.

l) A description of the laboratory document-control procedures, including archiving and archive retrieval.

m) An outline of the process for data review and approval. - Provision shall be made for peer, supervisory, or QA review of all chemist worksheets. In addition, the LQAP shall outline document flow, including review steps, from chain of custody (COC) to the final analytical report.

n) A discussion of the laboratory's holding time policies and processes for pre-preservation of sample bottles, sample preservation checks, and documentation of preservation checks. - Holding times and preservation techniques for Sandia samples are outlined in Attachment 5.

o) A discussion of the frequency and method of conducting and documenting internal audits. - In addition, the LQAP shall specify the frequency and contents of QA reports to laboratory management.

p) A list of approvals and certifications from states and external agencies. - The LQAP shall specifically require client notification when accreditations or certifications are revoked or suspended.

q) Specific laboratory policies regarding rounding and the number of significant figures to be used in reporting analytical results. Also, the LQAP or an SOP shall require that leading zeroes be used for numbers less than one and that units accompany all numbers that are not dimensionless. (The significant figures requirements for this SOW can be found in Section 4.1.13.) Additionally, the LQAP or an SOP shall define appropriate error correction practices and require the use of indelible ink for records.

r) A description of procedures for material procurement, quality inspection, inventory, and storage.

s) A discussion of methods for verifying the agreement of electronic data files with hard copy reports, including both electronic data deliverables (EDDs) and electronic reproductions of reports.

2.2.2 Standard Operating Procedure support for the Laboratory Quality Assurance Plan

The LQAP sections addressing some of the issues listed above may refer to detailed SOPs. Complete and comprehensive descriptions of all the listed processes are not required in the LQAP when the specific process details are outlined in SOPs. However, the supporting SOPs should be referenced in the LQAP.

2.3 Performance evaluation sample analysis requirement

2.3.1 Schedule

If requested to do so, chemical analysis laboratories shall perform the analysis of Sandia performance evaluation (PE) samples provided to the laboratory by the

SNL/SMO. The analytical and deliverable requirements for these PE samples are the same as all Sandia samples. Payment for the analysis of PE samples shall be made according to the fees specified in the contract. Sandia will not pay for the analysis of "known" samples provided as a courtesy for QC, investigations, or method development.

2.3.2 Performance Evaluation sample analysis

The analytical techniques and SOPs used in the analysis of PE samples shall be the same as those used in routine analysis of Sandia samples.

2.3.3 Proficiency

a) The SDR may provide a summary of analytical results and theoretical values for each PE round to each laboratory after all the data for that round is completed. Any requests for CARs necessitated by laboratory PE sample failures will accompany the summary report. Initial responses to CAR requests, including the projected schedule for completion, shall be due no later than two weeks from the date of the request. The SDR reserves the right to request accelerated delivery of CARs if circumstances make this necessary. Failure to respond promptly to a request for corrective action may result in temporary suspension of the laboratory from the SDR chemical analysis program.

b) Laboratory performance information may be shared among the National Nuclear Service Administration (NNSA) Service Center facilities and entities supporting NNSA Service Center site activities. The NNSA Service Center Analytical Management Program (AMP) policy governing the sharing of contractor performance information is provided as Attachment 5.

2.4 Systems and internal audit requirements

2.4.1 Annual systems audits

The laboratory shall undergo a DOECAP quality systems audit at least once a year. DOECAP audits will serve as a key performance indicator for verifying or denying the acceptability of an analytical laboratory to provide analytical services for DOE. Acceptability will be based primarily on the ability of the laboratory to produce data of known, adequate, and consistent quality. A formal audit report will be issued by the DOECAP following this activity. Responses to audit reports will be submitted to the DOECAP as specified in the DOECAP requirements documents.

An SDR systems review may be conducted at the laboratory at the discretion of Sandia. The purpose of this review is to verify laboratory compliance with the LQAP and the specifications of this SOW. In addition, recommendations may be made to laboratory personnel regarding possible quality improvements in light of good laboratory practices and/or industry standards. A formal report or request for corrective action may be issued following this activity. In that event,

responses will be due 30 days from the date of issue unless a more rapid turnaround is necessary to safeguard data quality.

2.4.2 On-site data package review

Data package reviews may be conducted at the laboratory at the discretion of Sandia. The focus of these reviews shall be to verify contract compliance and deliverable accuracy, ensure that raw data and supporting documentation are maintained in retrievable form, and review ancillary documentation not included in deliverables. The data package to be reviewed will be chosen at the time of the review activity. A formal report or corrective action request may be issued following this activity. In that event, responses will be due 30 days from the date of issue.

2.4.3 Internal audits

The laboratory shall perform internal QA audits at least annually. A summary of the corrective actions resulting from the laboratory's internal QA audits shall be provided to the SDR in the quarterly progress report (QPR). QPRs are discussed in Section 2.14 of this SOW.

2.5 Participation in interlaboratory comparison studies

2.5.1 Required intercomparison programs

Laboratories performing inorganic or organic analyses shall participate in two single-blind, single-concentration performance testing (PT) studies per year, where available, for item (a) below. Laboratories performing radiochemical analyses shall participate in two single blind, single-concentration PT studies per year, where available, for item (b) below. Laboratories performing airborne silica, asbestos, metals, and/or organics analyses shall participate in item (c) below. Laboratories performing lead in paint analyses shall participate in item (d) below. Laboratories performing National Pollutant Discharge Elimination System analyses shall participate in item (e) below.

a) Commercial vendor programs designed to meet the requirements given in the Proficiency Testing section (Chapter II) of the NELAC standard.

b) Mixed Analyte Performance Evaluation Program (MAPEP), U.S. DOE, Idaho Operations Office, Idaho Falls, Idaho.

c) Proficiency Analytical Testing (PAT) Program, AIHA.

d) Environmental Lead Proficiency Analytical Testing Program (ELPAT), AIHA.

e) Discharge Monitoring Report--Quality Assurance Study (DMR-QA), U.S. Environmental Protection Agency (EPA) Office of Enforcement and Compliance Assurance.

2.5.2 Reporting intercomparison results

The laboratory shall report results of the intercomparison studies specified in Section 2.5.1 of this SOW to the SDR, quarterly. This report is due with the delivery of the laboratory QPR. All results received by the laboratory since the last quarterly report and more than one week before the due date shall be included in this deliverable. Results received less than one week before the due date may be held for inclusion in the next quarter's deliverable. Failure to participate in and report the results for the applicable intercomparison studies may result in suspension of the laboratory from the SDR laboratory analysis program.

Laboratories shall report all results from the participation of any approved PT program.

2.6 Employee training and documenting employee proficiency

The SDR is conscious of the value and worth of experience. Years of analytical experience may often gain equivalency to or outweigh academic achievement. It is required that laboratories have an internal analyst proficiency evaluation policy that provides a vehicle to gauge and document the competence of experienced individuals and specifies additional training and documentation practices applicable to all personnel. This policy shall include specific pass/fail criteria used for evaluations. Personnel that have not been trained and evaluated shall not participate in the handling or analysis of Sandia samples.

Evidence files must exist to demonstrate that each employee has met the laboratory's minimum training requirements and has read, has understood, and is using the latest version of the laboratory's quality documentation. Training on specific equipment, analytical techniques, and laboratory procedures shall be documented.

Evidence must also exist to demonstrate that each employee has studied and acknowledged his or her personal ethical and legal responsibilities, including the potential penalties for improper, unethical, or illegal actions.

Laboratory personnel who are involved in receiving, processing, and/or managing Sandia samples shall be trained in radiation safety practices and techniques.

2.7 Laboratory instrumentation, equipment, and reagent maintenance

2.7.1 Instrument logs and response checks

a) The laboratory shall have an SOP that specifies the requirements for maintaining logbooks. These requirements shall specifically address QA protocols for error correction, as well as schedules for peer, supervisory, or QA review of logbooks. In addition, the use of indelible ink to make logbook entries shall be explicitly required.

b) The laboratory shall maintain an instrument logbook for all major instruments (excluding pH meters, conductivity meters, and the like) used

to acquire data for the SNL/SMO. Each instrument logbook shall be clearly labeled to indicate its association with a particular piece of laboratory equipment.

c) Laboratories performing general inorganic analysis of Sandia samples shall have an SOP requiring that instrument response checks, or other appropriate instrument performance checks, be performed daily. The requirements shall include recording the results of such checks in the associated instrument maintenance log.

d) Laboratories performing organic analysis of Sandia samples shall have an SOP requiring that instrument logs contain a brief description of run failures and the file names for analysis runs. Reanalysis run entries, including those for necessary dilutions, shall reference the original run to facilitate review. Instrument logs for gas chromatography/mass spectrometry (GC/MS) volatiles shall reference the port used for each run where multiple ports exist.

e) Laboratories performing radiochemical analysis of Sandia samples shall record the data file names and dates for all calibration activities in the associated instrument logs. Procedures shall also require that the gas flow proportional counter (GFPC), alpha spectrometry, gamma spectroscopy, or alpha scintillation detector used to count each sample be logged.

2.7.2 Balances, volumetric pipettes, and sample storage refrigerators

a) Chemical and geotechnical analysis laboratories shall have a calibration SOP for analytical balances. The SOP shall specify that balances be checked daily (on all business days) against certified standards and that balances not accurate to within at least ± 1 percent be recalibrated or removed from service. The laboratory shall maintain logbooks in which the daily analytical balance calibration checks are recorded.

b) Chemical analysis laboratories shall have an SOP that requires daily temperature monitoring (on all business days) for refrigerated sample storage areas and the corrective action that will be initiated if a measurement falls outside the required range. The laboratory shall maintain logbooks for sample storage refrigeration units in which the daily temperature checks are recorded.

c) Chemical analysis laboratories shall have a calibration SOP for volumetric pipettes, other than glass pipettes, that deliver 100 microliters or more. This SOP shall specify that (1) pipettes be checked daily (on all business days) by weighing deionized (DI) water, and (2) pipettes failing to deliver to within ± 1 percent accuracy be recalibrated or removed from service.

2.7.3 Reagent water production

a) Chemical analysis laboratories shall have an SOP for reagent water or DI

water production and system maintenance. This SOP shall outline specific control criteria for reagent or DI water quality, require daily water quality measurement (on all business days), and give specific corrective actions to be taken for out-of-control events.

b) Daily records of water quality shall be kept in logbooks designated for that purpose.

2.7.4 Control of standards

Chemical analysis laboratories shall have an SOP outlining policy on shelf life, labeling, and stock maintenance for reagents, stock solutions, intermediate dilutions, and working standards. Laboratories shall maintain standards preparation logs and standard certificates of analysis in an orderly manner to facilitate retrieval.

a) The SOP shall specify a shelf life no greater than one year for stock solutions prepared in the laboratory from salts or metals.

b) The SOP shall specify a shelf life of no greater than one year for intermediate dilutions and vendor-supplied stock solutions, other than radionuclide solutions, when the constituent concentrations are 1 milligram per liter (mg/L) or higher. General inorganic analyte solutions with constituent concentrations less than one mg/L shall be defined as working standards.

The one-year shelf life shall not apply to neat materials or unopened ampoules containing solutions of organic compounds. The manufacturer's expiration date, if any, shall apply to neat materials and unopened ampoules containing organic standard solutions.

c) The SOP shall limit the shelf lives of opened ampoules and intermediate dilutions containing organic standard solutions to no greater than those given below. Shorter shelf lives given in the EPA methods shall supersede the specified guidelines.

Analyte	Shelf Life
Volatiles	7 days for gases
	180 days for non-gases
Total petroleum hydrocarbons	180 days for purgeable (gasoline range organics [GRO])
	365 days for extractable (diesel range organics [DRO])
Pesticides/PCBs/ herbicides	180 days
Semivolatiles	365 days
High explosives (HE)	365 days, ≥ 1,000 ppm, stock 30 days, all intermediate dilutions Daily prep, all working standards

d) The SOP shall specify that working standards for volatiles and general

inorganic analyses, other than multi-element radial viewing inductively coupled plasma-atomic emission spectroscopy (ICP-AES) working standards, be prepared fresh daily. The SOP shall require that ICP-MS and axial viewing ICP-AES working standards having concentrations less than one part per million (ppm) be prepared fresh daily.

e) The SOP shall specify that multi-element radial viewing ICP-AES working standards be prepared fresh at least once a month.

f) The SOP shall specify that anion and nutrient stock solutions be kept in refrigerated storage. Refrigerated storage for standards is subject to the requirements of Section 2.7.2 (b) of this SOW.

g) For laboratories doing radiochemistry, the SOP shall limit radionuclide solution shelf lives to a maximum of five years or five half-lives, whichever is less. The SOP may allow verification of expired standards against National Institute of Standards and Technology (NIST)-traceable standards or require that they be discarded. Re-verification is allowed if the following criteria are met.

   i.) At least three verification measurements of a standard shall be used to determine the mean value and standard deviation of the verification results.

   ii.) The two-sigma (2σ) value defining the 95 percent confidence interval shall not exceed 10 percent of the mean value of the three verification measurements.

   iii.) The certificate value (NOT including any uncertainty) shall lie within the 95 percent confidence interval determined from the mean and two standard deviations of the three measurements. However, if the interval defined is narrower than the mean ± 5 percent of the mean, a ± 5 percent acceptance criterion may be used.

   iv.) The methodology used, performance requirements, and documentation practices must be discussed in the SOP.

h) The SOP shall require that stock solutions and intermediate dilutions prepared in the laboratory be logged in a standards preparation log. The SOP should give specific guidelines on what information is to be included in log entries. Expiration dates for solutions prepared from multiple sources shall coincide with the earliest expiration date of the starting materials.

i) Minimum labeling requirements for stock solutions and intermediate dilutions that are intended for long-term use shall be addressed in the SOP and should include the information listed below.

   • Preparer's initials.

- Date of preparation.
- Matrix.
- Concentration of constituents, unless too many are contained to be listed on the label.
- Expiration date.
- Unique standard name that is traceable to a standards preparation log.

j) The SOP shall require that organic analysis calibration standards be prepared using high purity solvents that were accompanied by manufacturers' certificates of analysis when purchased.

k) The SOP shall require that standards for atomic spectroscopy be prepared in ASTM Type I water. The applicable ASTM standard for Type I water is the older standard that specifies a 16.67 mega ohm per centimeter (MΩ·cm) resistivity control criterion. Preparation water need not meet the newer 18.0 MΩ·cm criterion.

l) The SOP shall require that standards for radiochemistry and wet chemistry be prepared using ASTM Type II water, at a minimum.

m) The SOP shall specify that expired standards be segregated and labeled as expired while awaiting disposal.

n) Vendor-supplied solutions that are used as primary calibrants shall be NIST-traceable where possible.

2.7.5 Glassware

a) The laboratory shall have an SOP for glassware cleaning.

b) All volumetric glassware used to make standard and sample dilutions in SDR work shall be ASTM Class A glassware. Dilutions may also be accomplished by automation or by using pipettes and/or balances that are controlled in accordance with the applicable provisions of this SOW.

2.7.6 Incident tracking

Laboratories shall have a system for recording and tracking incidents involving breakage of reagents and client samples. This system is needed to help explain unexpected "hits" in samples that were analyzed during periods when the ambient air may have been contaminated. The tracking system may be implemented through facilities, health and safety, QA, or other laboratory groups.

2.8 Analytical and Quality Assurance Standard Operating Procedures

2.8.1 Control of Standard Operating Procedures

The laboratory shall maintain controlled copies of approved SOPs for each analytical method or general procedure performed by laboratory personnel. The

laboratory shall set and demonstrably adhere to a schedule of periodic review for SOPs. Changes in laboratory SOPs that significantly affect the analysis or documentation of Sandia samples shall be transmitted to the SDR for approval prior to implementation. Laboratories may seek approval by telephone for minor SOP modifications. Geotechnical laboratories may use the most recent ASTM methods instead of SOPs, provided that there are no deviations from the method in practice.

2.8.2 Availability of Standard Operating Procedures

Controlled copies of SOPs shall be readily available to all personnel performing analytical work in support of the SNL/SMO. This may be accomplished either by issuing a copy to each analyst, electronically posting SOPs, or making a library of SOPs accessible to analysts. Policies for notifying laboratory staff members of SOP updates shall be defined.

2.8.3 Analyst familiarity with Standard Operating Procedures

Analyst familiarity with SOPs shall be documented to ensure that the contents of QA and analytical SOPs are effectively communicated to personnel performing analysis of Sandia samples. Laboratory procedures shall require that method training and QA indoctrination be performed and documented in training files.

2.9 Sample receipt and storage requirements

2.9.1 Chain of Custody forms

Sandia samples received by the laboratory will be accompanied by an Analysis Request and Chain of Custody (ARCOC) form. Sample custody will be transferred to the laboratory at the time of sample receipt, after which the laboratory will be responsible for maintaining unbroken COC. By definition, a sample is in custody if it is (1) in one's possession, (2) in view, or (3) in a controlled access area. The SNL ARCOC form is provided as Attachment 7.

a) At the time of sample receipt, this form will have been partially completed by the sampling team and should indicate the ARCOC number, contract laboratory name and contact, specific project information, sample indentification (ID), sample location detail, sample matrix, bottle type and volume, sample type, chemical preservative if needed, collection dates and times, date shipped, and method of shipment.

b) Individual sample bottles are labeled with the sample ID, sampling date and time, preservation method, sampler's identity, and comments.

c) The laboratory sample custodian receiving the samples shall verify that the information listed on the ARCOC form is correct and accurately describes the contents of the shipment.

2.9.2 Acknowledgment of sample receipt

At the time of receipt, the laboratory sample custodian shall sign and date the ARCOC form in indelible ink to acknowledge sample receipt and accept custody. The sample custodian shall note discrepancies between the samples listed on the ARCOC and those actually received on the ARCOC form and sample login worksheets.

Note: The laboratory shall include all airbills in the case file where possible and shall record all freight-carrier tracking numbers on the login records when the airbills cannot be removed intact. (See Sections 4.1.1 through 4.1.3 of this SOW for reporting requirements.)

2.9.3 Documentation of anomalies

The laboratory sample custodian shall note on the ARCOC form and sample login worksheets any irregularities observed with the shipment, temperature, preservation, condition, or custody seals of samples received. Login worksheets shall specifically identify any samples affected by such irregularities.

a) The pH of all aqueous sample fractions, preserved and unpreserved, shall be checked during sample login. (Exceptions to the login pH check requirement are Rn-222, tritium, iodine, volatile organic compound [VOC], total organic halides [TOX], oil and grease, total organic carbon [TOC], and urine samples. The pH of samples submitted for the exception analyses listed here shall be checked at the time of analysis.)

b) The allowable temperature for samples requiring cooling for preservation is ≤6°C. The actual temperature of sample shipments shall be noted on login worksheets.

c) If no anomalies are encountered for a sample shipment, a brief statement of that fact shall be provided on login worksheets and in the case narrative.

d) If samples requiring preservation with nitric acid arrive unpreserved or inadequately preserved, the laboratory must contact the SDR for instruction regarding whether to proceed with the analysis. If the laboratory is instructed to adjust the sample pH, metals samples must be held for 16 hours and radionuclide samples must be held for 24 hours prior to withdrawing an aliquot for analysis.

2.9.4 Communication of anomalies

A laboratory representative shall notify the SDR immediately by telephone of any irregularities noted during the sample receiving process. In addition, the laboratory shall notify the SDR immediately if a sample shipment does not include sufficient sample volumes to meet the QC requirements of this SOW. Any problems with a sample shipment that adversely affect data quality shall be described in the case narrative that accompanies the report of analytical results for that delivery order.

2.9.5 Sample retention

The laboratory shall retain and store all Sandia samples associated with a specific delivery order for a period of 65 days after issuing the analytical report for that delivery order. The samples should be stored in such a manner that the analyses could be repeated or new analyses requested. Unused samples shall be stored in controlled and secured environments for 30 days, the lab will store the samples for an additional 35 days by whatever means is economical. ARCOC sample groupings shall be maintained.

2.9.6 Sample disposal

The laboratory is solely responsible for lawful disposal of all SDR samples after the 65-day sample storage requirement is fulfilled if the exception given in item (a) below does not apply.

a) If, due to the nature of the samples, the laboratory has no outlet for disposal or disposal is prohibitively expensive, then samples may be returned to the SNL/SMO.

b) If samples are to be returned to the SNL/SMO, the laboratory shall provide notification that includes an inventory of samples, ARCOC numbers, and radiation survey results to the SDR at least two weeks prior to shipping. Samples shall be packaged for return to SNL/SMO by ARCOC groupings and shall be returned within 95 days of report delivery at the SNL/SMO. Samples shall be returned under the exclusion provision in the Code of Federal Regulations 40 CFR 261.4. Samples shall be packaged and returned in the same manner as they were received. Samples can be returned by the most economical means available at laboratory expense. The laboratory is solely responsible for the lawful shipping of samples back to the SNL/SMO.

c) Laboratories shall not return extracts or digestates to the SNL/SMO.

d) Laboratories shall follow sample return instructions as indicated on the ARCOC when an expedited return is requested. This exception supersedes both Sections 2.9.5 and 2.9.6(b), above.

2.9.7 Return of shipping coolers and bottle orders

Laboratories shall initiate the shipment of sample coolers and blue ice back to the SDR within five days of receipt. Sample coolers can be shipped by most economical means at laboratory expense to the address shown below unless different instructions are provided by the SNL/SMO. This address shall also be used for the shipment of bottle orders.

Sandia National Laboratories
Sample Management Office
Building 928
1515 Eubank SE
Albuquerque, NM 87123

2.9.8 Laboratory-supplied sample containers

The SDR requires the laboratory to supply sample containers for most projects. The schedule of prices provided in the laboratory's proposal shall include discount prices for projects not requiring the laboratory to provide sampling containers. The SDR will initiate most sampling projects with a bottle order submitted to the laboratory. The laboratory shall provide pre-cleaned sample containers with the appropriate preservative for each analysis covered in the order. Container and preservative requirements are provided in Attachment 5 of this SOW.

2.10 Holding time requirements

2.10.1 Holding times

Analytical holding times are specified in Attachment 5.

2.10.2 Definition

Holding times are calculated in days or hours, according to the time units used in the EPA holding time requirements. If the EPA-specified holding time is given in hours, then the analysis must be complete before the end of the last hour of the holding time when calculated from the sampling time. When the holding time is given in days, the analysis must be complete before the end of the day on which the holding time would expire as calculated from the sampling day.

Holding time to extraction and holding time to analysis specifications given in EPA guidance and Attachment 5 shall be observed. Laboratories shall not meet holding times to extraction by initiating and then halting extraction procedures simply to avoid expiration of the holding time. That is, once begun, extraction procedures must be carried through. Methods that specify holding times to analysis but do not specify holding times to extraction shall have the analysis started by the expiration of the holding time. That is, samples may not be extracted and then held for later analysis simply to avoid expiration of the holding time.

2.10.3 Matrix types

Where matrix-specific holding times are not given in Attachment 5, the specified holding times shall apply to all sample matrix types.

2.10.4 Meeting holding times

It is crucial that the laboratory perform chemical analyses within the specified holding times. The laboratory shall promptly notify the SDR if it determines, upon sample receipt or thereafter, that one or more analyses cannot be performed within the holding time(s). Analyses not performed within the holding time and reported without prior explanation and SDR approval will not be paid for.

a) The SDR will make every effort to notify the laboratory when samples having less than 72 hours of the holding time remaining are to be shipped.

b) For samples with holding times greater than 48 hours, shipments arriving at the laboratory with less than 72 hours of the holding time remaining may be invoiced at the appropriate accelerated turnaround premium price. That is, when less than 72 hours remain, the 72 hour negotiated turnaround price will apply.

2.10.5 Violations

The laboratory shall provide an explanation for all holding time violations in the case narrative. Laboratories shall not allow sample analyses to be canceled because the holding times could or will be missed without prior notification of the SNL/SMO. Laboratories that repeatedly cancel analyses without notifying the SDR may be suspended from the Sandia laboratory analysis program or Sandia may cancel the contract for cause in accordance with the clause titled, “Cancellation or Termination for Convenience” (SF-6432-CS [02/01/12]).

2.11 Laboratory data verification and review requirements

2.11.1 Worksheet review

a) All analyst worksheets describing analysis of Sandia samples shall undergo supervisory or peer review. A field shall be provided on each worksheet for the reviewer's initials. The reviewer need not sign each page of a submittal; only one signature per data submittal (per analytical batch) is required.

b) Worksheet review signatures signify that the analyst has met the requirements of the method, laboratory QA policies, and this SOW.

2.11.2 Report review

All data transmitted to the SDR by the laboratory shall undergo data verification and completeness review by the laboratory's QA or technical staff. In addition, reviews shall include 100 percent verification of agreement between EDDs and hard copy reports, as defined in Section 2.2.1(s) of this SOW, until the efficacy of the EDD production process is demonstrated. Signature evidence of these reviews in the case narrative is required.

2.12 Laboratory record maintenance requirements

The laboratory shall maintain a case file containing all documents and records associated with each specific delivery order for the duration of the contract period. Alternatively, an effective system ensuring the ability to retrieve all associated records in a timely fashion may be implemented. All raw data, worksheets, run logs, digestion logs, shipping and login records, custody forms, and communication records must be included in the case file or addressed by the retrieval system discussed above. This supporting

documentation may be used to verify compliance with the requirements outlined in this document or to support the data in a court of law. The supporting documentation shall be shipped to the SDR or discarded, at the discretion of the SNL/SMO, when the contract base period and all exercised extensions expire. Charges for shipping supporting documentation will be reimbursable at cost.

If an electronic data storage system is used, the laboratory shall have an SOP that addresses creating, verifying, and tracking electronic records. The Good Automated Laboratory Practices (GALP) requirements of Section 2.17 of this SOW shall be implemented as applicable, and the records shall be in a format that is readable using common commercial software.

2.13 Corrective action for out-of-control events

2.13.1 Requests for Corrective Action Reports

The laboratory may be required to provide a CAR for any out-of-control event associated with analytical services provided to Sandia.

2.13.2 Delivery of Corrective Action Reports

As described in Section 2.3.3 of this SOW, initial responses to CAR requests, including the projected schedule for completion, shall be due no later than two weeks from the date of the request. The SDR reserves the right to request delivery of CAR responses in less than two weeks if circumstances indicate that this is necessary. Repeated failure to submit requested CARs may result in suspension of the laboratory from the Sandia laboratory analysis program or Sandia may cancel the contract for cause in accordance with the clause titled, "Cancellation or Termination for Convenience" (SF-6432-CS (02/01/12)).

2.14 Quarterly progress report requirement

2.14.1 Contents of Quality Progress Reports

The laboratory shall submit QPRs to the SNL/SMO. QPRs shall address calendar quarters and are due by the 15th day of the month following the reporting period. In addition to the quarterly reporting requirement, laboratories will notify the SDR immediately for issues relating to items (d), (e), and (f) below. Emphasis should be placed on the following:

a) List new analytical methods implemented and/or any substantive changes to existing methods. This should also include changes in capabilities due to acquisition or retirement of equipment.

b) Summarize all out-of-control incidents that occurred during the reporting period. Also, include a summary of non-conformances identified during external and internal audits. Non-conformance reports issued as a result of QC or reporting failures need not be summarized unless they involved chronic problems that necessitated formal corrective action plans.

c) Report significant changes to the LQAP, paying particular attention to those that affect the analysis or documentation for Sandia samples. If new MDLs or QC acceptance criteria were established during this period, report the new MDLs and/or acceptance criteria in QPRs. Reports on new MDL studies should include a summary of the method blank evaluation (Section 3.3.1 (c) and (d) of this SOW).

d) Discuss any management, QA personnel, key technical personnel, or supervisory changes. Any significant reduction in force or backup coverage for key positions should also be reported.

e) Report any changes in accreditation or certification, including voluntary withdrawal from any certifying program. Utah certification status and/or Nuclear Regulatory Commission license agreements are extremely important.

f) Provide all PT results that were graded during the reporting period, and include any corrective action plans initiated in response to PT failures. PT results should be reported in Microsoft Excel electronic format.

If no significant changes occurred during the reporting period, and if no CARs were generated, then a simple statement of these facts shall suffice to meet the QPR requirement.

2.14.2 Compliance

Repeated failure to comply with the QPR requirement in this SOW may result in suspension of the laboratory from the Sandia laboratory analysis program or Sandia may cancel the contract for cause in accordance with the clause titled, “Cancellation or Termination for Convenience” (SF-6432-CS (02/01/12)).

2.15 Primary contact person

2.15.1 Laboratory contact person

The laboratory shall assign a project manager to be the primary contact person for issues relating to the analysis of Sandia samples.

2.15.2 Sandia Delegated Representative contact person(s)

The technical representatives shall be the SDR(s) named in the contract.

2.15.3 Communication

Open communication between the SDR and laboratory is critical in the development of a mutually satisfactory business relationship. Laboratory technical representatives are encouraged to seek guidance in advance of performing work when any questions arise and to comment on any analytical approach they may believe to be flawed.

2.16 Radioactive materials license requirements

All participating laboratories shall have a current radioactive materials license that is appropriate to the materials they anticipate receiving under this contract. If the radioactive materials license has expired, the laboratory shall have a letter of timely renewal on file. Photocopies of new or updated licenses shall be provided to the SDR with the next QPR.

2.17 Good automated laboratory practices

The degree of dependence upon automated calculation routines and information stored in modern laboratory databases indicates a need to ensure the integrity of software and information. GALP must be used by the laboratories to ensure the reliability of data. These include traceability, accountability, standardized procedures, adequate resources, and the availability of documentation of conformance to the requirements (including setting acceptance criteria where appropriate). Chemical analysis laboratories and, to the extent applicable, laboratories performing asbestos and geotechnical tests must have procedures that address the issues listed below.

2.17.1 Laboratory management

When electronic data are collected, analyzed, processed, or maintained, the laboratory management shall:

a) Ensure that personnel clearly understand the functions they are to perform.

b) Ensure that QA staff members monitor computer activities.

c) Ensure that personnel, resources, and facilities enable work and are available.

d) Receive reports of audits of Laboratory Information Management System (LIMS) and other computer systems and ensure that corrective actions are promptly taken in response to any deficiencies.

e) Approve the SOPs setting forth the methods that ensure electronic data integrity; ensure that any deviations from SOPs and applicable GALP provisions are appropriately documented and that corrective actions are taken and documented; and approve subsequent changes to SOPs.

2.17.2 Personnel

The laboratory shall ensure that all computer support staff and users:

a) Are trained with experience to perform assigned functions.

b) Have a current summary of their training, experience, and job

description, including their knowledge relevant to LIMS design and operation, maintained at the facility.

2.17.3 Quality assurance

The laboratory shall designate QA staff to monitor computer functions and procedures. QA staff members shall:

a) Be entirely separate from and independent of LIMS personnel and shall report directly to management.

b) Have immediate access to LIMS data, SOPs, and other records pertaining to the operation and maintenance of LIMS.

c) Audit the computer systems to ensure the integrity of the electronic data and prepare audit reports. Reports shall describe the operation audited, the dates of the audit, the person performing the audit, findings and problems observed, action recommended and taken to resolve existing problems, and any scheduled dates for re-audit. QA staff shall report to laboratory management any problems that may affect data integrity.

d) Determine that no deviations from approved SOPs were made without proper authorization and adequate documentation.

e) Ensure that the responsibilities and procedures applicable to QA, the records kept by QA, and the method of indexing such records are properly documented and maintained.

f) Establish nonconformance and corrective action procedures for hardware and software failures.

2.17.4 Electronic data

Electronic data shall be managed in such a way as to ensure and/or include:

a) Electronic data storage media are identified and indexed. These processes shall be included in laboratory SOPs.

b) The individuals responsible for entering and recording data are uniquely identified when the data are recorded, and the times and dates of entry are documented.

c) The instrument transmitting electronic data is uniquely identified when the data are recorded, and the time and date of transfer are documented.

d) Procedures and practices for verifying the accuracy of data are documented and included in laboratory SOPs.

e) Procedures and practices for making changes to electronic data are

documented and provide evidence of change. Such evidence should preserve the original data, include the date of the change, indicate the reason for the change, identify the person who made the change, and, if different, identify the person who authorized the change. These procedures shall be included in laboratory SOPs.

f) Procedures and practices for backing up electronic files are documented. These procedures shall include frequency, storage, and the process for restoring files. These procedures shall be included in the laboratory SOPs.

2.17.5 Software

Software shall be managed in such a way as to ensure and/or include:

a) Approved Standard Operating Procedures exist for:

i. Verification and validation procedures to verify that all software programs accurately perform the intended functions. These procedures should address software security (cell protection, for example). When indicated, change control procedures shall include reporting and evaluating problems and implementing corrective actions.

ii. Version control procedures that document the software version currently used and its implementation date.

iii. Maintaining a historical file of software including dates of use, software operating procedures (manuals), software changes, and software version numbers.

b) Laboratory management shall ensure documentation for the issues in item (a) above is maintained and is readily available in the facility where the software is used.

2.17.6 Security

Laboratory management shall make sure security practices are in place to ensure the integrity of electronic data that:

a) Ensure calculation routines are secure from inadvertent changes.

b) Require a login password to access stored data, enter new data, and change existing data.

c) Establish access categories (read only, read/write, read/write/change) as appropriate to the duties of staff members.

2.17.7 Hardware

Laboratory management shall ensure that hardware and communications components are:

a) Well-documented with a detailed description including design and capacity.

b) Installed and operated in accordance with manufacturer's recommendations and, at installation, undergo acceptance testing. SOPs shall be established and maintained to define the acceptance criteria, testing, documentation, and approval requirements for changes to LIMS hardware and communication components.

c) Inspected and maintained on an ongoing basis. Non-routine maintenance shall be documented, including a description of the problem, the corrective action, and the acceptance testing performed to ensure that the hardware or communications components have been properly repaired.

2.17.8 Comprehensive testing

Laboratory management shall ensure that comprehensive testing of LIMS performance is conducted, at least once every 24 months or more frequently as a result of software (Section 2.17.5) or hardware (Section 2.17.7) changes or modifications. Testing will be documented and shall be retained and available for inspection or audit.

2.17.9 Records retention

Laboratory management shall ensure that SOPs for records retention are implemented and that staff members follow the SOP specifications.

2.17.10 Facilities

With regard to facilities, laboratory management shall ensure that:

a) The environmental conditions of the facility housing the hardware are appropriately regulated to protect against data loss.

b) Environmentally controlled storage capacity is provided for retention of electronic data, storage media, and records pertaining to the computer systems.

2.17.11 Standard operating procedures

Laboratory management shall ensure that:

a) Each current SOP is readily available where the procedure is performed.

b) SOPs are periodically reviewed and reviews are documented to ensure

they accurately describe the current procedures.

c) SOPs are approved and changed in accordance with laboratory QA policy.

d) A historical file of SOPs is maintained.

2.18 Records for method development and initial demonstration of proficiency

The LQAP or procedures must specify the records needed to document method development and initial demonstration of proficiency. A system for tracking and retrieving these records must be in place.

3.0 ANALYTICAL AND QUALITY CONTROL REQUIREMENTS

The QC requirements specified in this SOW represent the minimum requirements for SDR work. However, if a requested method includes QC requirements that are more restrictive than those specified in this SOW, then the more restrictive QC requirements must also be met.

3.1 Standard preparation and instrument calibration requirements

3.1.1 Working standards

Standard preparation for analysis of Sandia samples shall be performed according to the specifications in items (a) through (n) of Section 2.7.4 of this SOW. Working standard preparation information shall accompany daily analysis worksheets and shall be sufficiently detailed to demonstrate compliance. Initial calibration verification (ICV) solutions, if applicable, shall be documented in sufficient detail to make clear they were derived from a source different from that used to prepare the calibration standards.

3.1.2 Calibration

Instrument calibration shall be performed according to the specifications of the SW-846, ASTM, or other method where applicable. Calibration for analytical techniques that are not addressed in industry-standard methods shall be performed according to the specifications of the analytical procedure adaptations used by the laboratory. Minimum calibration requirements specific to this SOW are given below. The requirements in item (a) apply only when instruments are in use.

a) Instruments used to acquire general inorganic data shall be calibrated daily or once every 24 hours, and each time the instrument is set up.

i. In conformance with SW-846 Update IV Method 6010C, ICP-AES calibrations shall consist of a blank and at least three standards. Exceptions can be made for analytes that commonly have comparatively high concentrations in environmental samples, such

as Na, Ca, Mg, Fe, and Al. For trace metals analysis by axial-viewing ICP-AES, and particularly for As, Cd, Pb, Sb, Se, and Tl, suggested standard concentrations are a blank, one standard in the 50- to 100-parts per billion (ppb) range, one standard in the 250- to 500-ppb range, and a standard not exceeding 1 ppm. Laboratories may include an additional standard at a higher concentration if desired to extend the calibration range.

ii. The four-point calibration requirement specified immediately above should be applied as the minimum allowable for all general inorganic instrument calibration curves that are derived using linear regression. Where second-order polynomial regression is used, the minimum requirement is a blank and five standards. In all cases, laboratories must adhere to more restrictive requirements found in individual methods. No polynomials of order higher than two shall be used in any analysis.

iii. When inorganic anions are analyzed by ion chromatography (IC), laboratories may choose one of two approaches. Daily calibration is recommended. However, laboratories may continue to use existing calibrations provided that appropriate control criteria are met. In the latter case, continuing calibration verification (CCV) and continuing calibration blank (CCB) analyses must be conducted at the beginning of each analytical run and must meet the standard acceptance criteria specified in this SOW. In addition, the $\pm$ 10 percent retention time control limits specified in Method 9056 (Section 7.1.4) and Method 300.0 (Section 9.4) shall be used. However, laboratories shall adhere to the additional requirement that the maximum deviation for the CCV analyte peak centroids from the average retention times obtained during calibration shall be 0.5 minutes.

b) Instruments used to acquire radiochemical data shall be calibrated at the frequency specified in Section 3.6.9 of this SOW.

c) Instruments used to acquire organic data shall be calibrated at the frequency specified in the applicable EPA method or this SOW. Conflict between EPA methods (for example, SW-846 vs. 600 series methods) exists in some cases. When organic chemistry calibration requirements are given in this SOW, those requirements are the minimum allowable. When calibration criteria are not specified either in the method or in this SOW, calibration curves will be generated using at least five standards and shall have a correlation coefficient of at least 0.99. Calibration curves shall not be forced through zero. Calibration requirements for instruments used in routine organic chemistry are discussed in detail in Section 3.5.2 of this SOW.

d) Instruments used to acquire inorganic and organic data that utilize linear or quadratic curves shall have initial calibration Y-intercept absolute

values ≤3 times the MDL. If the magnitude of the concentration-axis intercept is equal to or greater than 3 times the MDL, the laboratory must (1) recalibrate, or (2) raise the MDL and Practical Quantitation Limit (PQL) by a sufficient margin to adequately address the deficiency, or (3) for organic chemistry only, apply a weighted linear calibration approach.

3.2 Sample analysis requirements

3.2.1 Worksheet requirements

Analyst worksheets used to record analytical data shall present a complete record of all information pertinent to the analysis. Analyst worksheets may be computer-generated or hand-written using indelible ink. A completed analyst worksheet that includes the information listed below is required for each analytical run.

a) The name of the person who performed the analysis.

b) The instrument used in the analysis. If the laboratory has more than one instrument of a particular model, a unique designation shall be given to each.

c) The name or initials of the peer, supervisory, or QA reviewer. (See Section 2.11.1 of this SOW for specific review requirements.)

d) Calibration information as specified in Section 2.2.1(h) of this SOW. Radiochemistry counting instrument calibration information should be limited to calibration dates, computer data file names, and a statement certifying that calibrations were successfully performed on schedule.

e) Standards information, including the name, preparation date, and expiration date of calibration and calibration verification standards, as applicable.

f) The analytical procedure and regulatory method used.

g) The equations for calculations used to obtain results. If instrument readouts give results, without the need for further mathematical manipulation, the worksheets shall include the statement “result = instrument readout.”

h) The date and time that the analysis was performed.

3.2.2 Sample preparation

Sample preparation shall be conducted according to the specifications of the analytical procedures, except as noted below.

a) Samples shall be digested/extracted according to the procedures given (or referenced) in the appropriate EPA method unless different

procedures are specified in the analysis request (see Section 2.1.1(b)). Unless specifically asked to do otherwise by the SNL/SMO, laboratories may use sonication rather than Soxhlet and separatory funnel rather than continuous liquid-liquid extraction as applicable for organic extractions. Accelerated solvent extraction (ASE) is not allowed unless rigorous method development data are submitted and approved in advance.

b) Laboratories working under general inorganic contracts shall specify prices for EPA 200.2 digestions, SW-846 digestions, total dissolution digestions (HNO_3, $HClO_4$, HF), toxicity characteristic leaching procedure (TCLP) extractions, and synthetic precipitation leaching procedure (SPLP) extractions. All metals digestions and sample dilutions shall be performed using ASTM Type I water.

Unless the SDR gives specific exemption, the 3050 digestion for soils that uses HCl (digestion for ICP-AES 6010) shall be used for Sn, Sb, and Ag. These analytes recover very poorly when HCl is not used, as in the 3050 digestion for Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) 6020. Since this is true, the 6020 digestion MDLs for these metals, as determined using aqueous spikes, are probably unreliable. If laboratories wish to use a dilution of the 6010 digestate and run by ICP-MS 6020, MDLs must be determined in advance using the exact procedure proposed.

c) Soil samples submitted for radiochemical parameter analysis by techniques other than gamma spectroscopy shall be dried, crushed to -200 mesh, and homogenized prior to analysis. Gamma spectroscopy samples shall be dried, crushed to -28 mesh, and homogenized prior to analysis. Tritium samples are exempt from this sample preparation requirement.

i. The entire sample shall be crushed and homogenized, up to a maximum of 200 grams, unless a portion is needed for another analysis that does not require this preparation. Timed grinding may be used in lieu of sieving if the contractor develops and maintains method-development data proving efficacy.

ii. Extraneous material that cannot be crushed (such as metal debris and organic matter) may be removed from samples.

iii. Solid samples that are submitted for radiochemical analysis (other than gamma spectroscopy) shall be subjected to a total dissolution digestion.

iv. The SDR will specify the sample preparation techniques for radionuclide determinations by general inorganic analytical techniques. For example, ICP-MS uranium isotopic ratio data will typically be acquired using a 3050 digestion for soils and a 3010 digestion for waters. However, uranium bound in the silicates in soil samples will not be measured if a 3050 digestion is used.

This means that the total uranium values obtained by ICP-MS from a 3050 digestate can be biased low. If accurate total uranium data are required, the SDR may request that a total digestion be used. If a total digestion is required, SW-846 method 3052 may be an option. That method does employ hydrofluoric acid (HF), but uses boric acid to consume the HF to protect instrumentation.

d) Percent moisture measurements shall be made and reported for all Sandia soil samples submitted for analyses, including tritium. Unless otherwise specified, soil sample results for all analyses shall be reported on an as-received basis.

e) Percent moisture data does not need to be included with geotechnical test results.

f) Extraction procedures for soil samples submitted for anion analysis will be selected on a case-by-case basis. The PQLs presented in Attachment 1 assume a nominal 1:20 dilution factor.

g) Percent moisture data shall be acquired for all biota samples. For metals and radionuclides, biota samples may be freeze-dried, blended, and digested for analysis. An ashing step may be added for nonvolatile radionuclides. For organic chemistry analyses (other than VOCs), the procedure described below is suggested. The procedure below may also be used for metals and radionuclides if desired.

i. Cut the samples into small pieces with clean, stainless steel tools (knife or scissors).

ii. Place the sample pieces into a clean, ceramic mortar, freeze them with liquid nitrogen (LN_2), and grind the frozen pieces with a clean, ceramic pestle. Add LN_2 as necessary to keep the sample frozen.

iii. Take aliquots of the samples by allowing them to partially thaw, mixing them for further homogenization, and then weighing them into the digestion/extraction vessels. Another aliquot of this homogeneous mixture should then be weighed and taken to complete dryness for percent moisture determination.

iv. Water loss by sublimation during the grinding step may be accounted for by weighing the sample before and after grinding. This water loss should be combined with that from step (iii) above to calculate the total percent moisture for the sample.

v. Biota samples shall be reported as fresh weight for all Sandia samples.

h) Digestion and processing requirements for swipes, filters, and bioassay

samples will be communicated to the laboratory prior to sample shipment. Special requirements for other sample matrices will be handled on a case-by-case basis.

i) The laboratory shall develop a procedure for sub-sampling and obtaining a representative aliquot. In addition, the laboratory shall be prepared to incorporate the sub-sampling procedure specified in Attachment 10, Routine Sub-sampling Procedure.

3.2.3 Initial dilution of samples

Since some Sandia samples have a high solids content, initial dilution of samples for analysis by graphite furnace atomic absorption (GFAA), ICP-AES, and ICP-MS will be allowed according to the criterion specified in item (a) below. Samples submitted for organic analyses may be initially diluted according to item (b) below.

a) Water samples having total dissolved solids (TDS) content greater than 2000 mg/L may be diluted, prior to analysis, by the smallest reasonable dilution factor required to bring the solids content down to below 2000 mg/L. If TDS analysis was not requested by the SNL/SMO, a sample's specific conductance may be used to estimate TDS. For this purpose, the specific conductance of the unpreserved sample fraction in micro ohms per centimeter (μmho/cm), multiplied by the factor 0.7, shall be considered equal to the sample TDS in mg/L.

b) For organic compound determinations, screening of samples against calibrated instruments to determine whether initial dilution is indicated shall be allowed. VOC screening methods are discussed in Section 3.5.4 (a) of this SOW. If all target analytes in the diluted sample are non-detects and no other interference is obvious, the sample will be reanalyzed at a lower dilution.

c) Samples diluted according to the criteria specified in items (a) and (b) above shall be listed and discussed in the case narrative. The MDLs and PQLs reported for such samples shall be elevated accordingly, as discussed in Section 3.3.3(b) of this SOW.

3.2.4 Analytical techniques and Standard Operating Procedures

The laboratory shall employ approved analytical techniques and SOPs in the analysis of Sandia samples. If a nonstandard technique is required to achieve a specific sampling objective, the laboratory will be asked to provide a schedule of charges for the work on a case-by-case basis.

a) The laboratory shall perform routine sample analyses using the analytical techniques and methods specified in Attachments 1 through 4. Approved adaptations of EPA, APHA, ASTM, NIOSH, OSHA, or other methods that employ the specified analytical techniques shall be used. Adaptations of such methods to the specific laboratory environment shall refer to the

parent procedures.

b) If, due to catastrophic instrument failure, the specified technique(s) cannot be used, a laboratory representative shall contact the SDR to obtain approval for the use of an alternate technique. If the proposed alternate technique will not yield results suitable to the end use of the data, instructions for shipment of samples or sample splits to another laboratory will be provided by the SNL/SMO.

c) In the event that samples or sample splits must be sent by the laboratory to another laboratory, the laboratory initiating the shipment shall be responsible for demonstrating unbroken COC up to the time of shipment and for ensuring that the samples are properly packed for shipment.

3.2.5 Chromatographic peak integration guidelines

The default integration technique that should be used for peaks that are not resolved to baseline is the drop technique, where the peak is integrated from horizontal baseline to the valley between the two peaks. This integration method results in the most accurate peak area determination for all situations, except those where two peaks are not fully resolved and there is a large difference in size between the two peaks. In these cases, large quantitative errors for the smaller peak may occur if an incorrect integration method is used. Specifically, when a large difference in relative peak size is encountered, and the smaller peak elutes after the larger peak, using an incorrect integration method will result in large positive quantitation errors[1].

When two peaks are not fully resolved and the smaller peak elutes after the larger peak, the smaller peak should be integrated using a tangential, exponential or gaussian skim technique, where the peak is integrated from the valley between the two peaks to the point where it rejoins the tailing baseline. A skim integration technique should only be used when the area ratio of the two peaks is 5% or less, based on the original integration using the drop integration technique.

3.3 Detection limits, reporting requirements, and QC exemptions

3.3.1 Method Detection Limit determination

The MDL for all organic and general inorganic parameters shall be determined, and verified (per Section 3.3.1(a)), and the results submitted to the SDR annually. Exceptions to this requirement are given in items Section 3.3.1 (a)(i) and (a)(iv) below. MDLs from the most recent MDL study shall appear on the Analysis Results forms.

a) The MDL is defined to be the point at which the observed signal can reliably be considered to be caused by the analyte being measured.

[1] Bicking, M., Integration Errors in Chromatographic Analysis, Part II: Large Peak Size Ratios, *LCGC* [Online], **2006**, 24, 1.

Unless superseded by new EPA guidance, MDL determinations shall be performed as specified in 40 CFR 136 or the latest EPA acceptable procedure. Preparation of the standard solutions shall include all preparation steps (digestion, filtration, extraction, distillation, etc.) that would be used in the preparation of environmental samples.

i. As an alternative to annual MDL determinations, laboratories may perform the MDL studies once and then perform empirical verification of MDLs quarterly thereafter. If MDL studies are performed annually, empirical MDL verifications must always be performed subsequently to show adequate sensitivity at the new MDL concentration. Empirical verifications of existing MDLs may be done with a single standard prepared at the MDL concentration (in a standard volume of water, if applicable).

    1. The laboratory's procedure for empirical MDL verification should be added to the MDL determination SOP.

    2. For future empirical verifications, the existing MDLs should be set to zero as necessary to avoid truncating low-level data at the existing MDL levels.

    3. If MDLs are set to lower levels following new empirical verifications, the populations of method blanks should be monitored to ensure ambient contamination is not subsequently reported as positive analyte detections.

    4. Guidance for determining "what a detection is" should be included in the revised MDL SOP. The recommended standard is a signal-to-noise ratio of no less than 3:1 using the average noise signal.

    5. Guidance for documenting judgment calls should be included in the revised MDL SOP.

ii. The VOC water MDL can be used for the VOC low-level soil analysis MDL.

iii. Soil sample MDL determinations for organics may be performed with or without using muffled sand, an appropriate salt, or other soil matrix substitute. The specific choice of approach to soil substitutes is left to the laboratory's discretion.

iv. Due to the precision (good or bad) that is attainable for low level standards in certain organic methods, laboratories may believe that the MDL values obtained on any particular day are of little technical value. Laboratories may suggest modified values to be used upon the likelihood of producing false positive or false negative results. In any case, if false negative results are expected (see below), the MDL study should be repeated. The

SDR will determine whether the use of alternate values for MDLs is acceptable on a case by case basis.

The SDR has encountered incorrectly calculated MDLs many times, typically resulting from one of two types of problems (see below). In addition, comparison of the MDLs derived at various laboratories for the same analyte and method shows variations of up to two orders of magnitude. Obviously, this suggests strongly that an error exists in one or more of the MDL studies.

1. In the first case, standards having inappropriately high concentrations are used in the MDL studies, resulting in MDLs that are too high (the standard deviation of large numbers is a large number). This situation is discussed explicitly in 40 CFR 136, Appendix B, paragraph (4)(b) in the procedure section. This error can result in false negative results. 40 CFR 136 suggests an iterative approach to MDL determination to address this circumstance.

2. In the second case, the combination of extraction methods that tend to yield low recoveries with analytical techniques that yield good precision at low levels can result in calculated MDLs that are too low. That is, laboratories cannot actually “see” an analyte spiked into a standard volume of water at the level of the calculated MDL. This error can result in false positive results. 40 CFR 136 does not specifically address this circumstance.

In keeping with the intent of the 40 CFR 136 language, and to address the ubiquitous MDL problems encountered in Sandia work, laboratories are required to verify their calculated MDLs empirically. A suggested approach for verification of MDLs, neglecting the possible matrix effects of real field samples, is extracting standard volumes containing target analytes at approximately 0.5, 1, 2, and 5 times the calculated MDLs. In general, laboratories should use 5:1 as the target signal-to-noise ratio for MDL concentrations. Examination of the resulting data will indicate whether the calculated MDL should be artificially elevated or the MDL study should be repeated using different analyte concentrations.

A “detection” in MDL verification is defined as a result meeting all the qualitative identification criteria in the method (for example, as discussed in Section 7.6.1 of SW-846 method 8260C). Verify the MDL on each instrument by analyzing a reference matrix spiked at a concentration very near to the MDL concentration. If the analyte is not detected, repeat the test at a spiking level 2 times higher and raise the MDL accordingly.

v. In some cases, the available wavelengths in ICP-AES may consistently yield MDLs very close to, but higher than, the detection limits specified in Attachment 1. In such an event, the laboratory may be granted permission by the SDR to report to the slightly elevated MDLs.

vi. MDL studies are not required for acidity, alkalinity, biological oxygen demand (BOD), color, corrosivity, dissolved oxygen, gravimetric oil and grease, hardness, ignitability, pH, titrimetric sulfide, conductivity, any of the solids methods, or turbidity.

b) If any MDL result is greater than the corresponding Sandia target MDL, a discussion of the problem and planned corrective action shall accompany the report deliverable. This requirement is waived where an existing prior agreement allows slightly elevated MDLs for some parameters. Failure to implement effective corrective action may render the laboratory ineligible to receive samples for which determination of that parameter is requested.

c) The reports for MDLs should be in tabular summary form and included in the QPR (Section 2.14.1). Raw data generated in the determination of MDLs shall not be included as part of the deliverable, but may be specifically requested for examination by the SDR during audit and data package assessment activities.

d) Ambient low-level contamination and other problems (such as inconsistent baseline) can make it impossible to say whether a detection above the MDL truly represents analyte in the sample. In this case, large numbers of false positives can result and the definition of MDL is not met. Laboratories shall scrutinize method blank populations for all organic and general inorganic parameters whenever MDLs are updated, or annually at a minimum. Populations of method blank data must be examined to assess the ability to reliably detect analyte at the MDL without interference from instrument noise or ambient contamination. A summary of this study should be included in the MDL study file and in the QPR.

If method blank “hits” exceed 10 percent of the total population, a new test MDL shall be derived. Unless superseded by new EPA guidance, the laboratory shall set a new test MDL at $X + \sigma$, where X is the mean of the positive method blank hits and σ is the standard deviation of the positive method blank hits. The population of method blank results shall then be reevaluated against this new MDL. If the number of hits is reduced below 10 percent, then the test MDL should be implemented. Experience has shown this approach to be effective. However, the laboratory should contact the SDR if it fails to meet the objective of reducing false positives to single-digit values.

3.3.2 Practical quantitation limits

PQLs or reporting limits (RLs) shall be reported with all organic and general inorganic analysis results. PQLs shall be defined by the lowest concentration used in the calibration curve and should be a concentration that is approximately 5 to 10 times greater than the MDL for the associated parameter. If RLs are specified, then all PQL references shall imply the RL values. For the parameters exempted from MDL determinations in Section 3.3.1(a)(vi), the applicable laboratory PQLs shall accompany analytical results in place of the MDL.

3.3.3 Reporting conventions

a) General inorganic and organic chemistry results shall be accompanied by both the MDL and PQL.

b) MDLs and PQLs shall be adjusted to reflect the conditions for the specific sample. That is, the MDLs and PQLs shall reflect dilution factors and sample aliquot sizes used in the analysis of each sample. For reporting purposes, the PQLs and MDLs shall be reported to no more than two significant figures (see Section 4.1.13).

c) Organic and general inorganic results that are less than the MDL shall be reported as Not-Detected (ND) and qualified with a “U“ flag. Results between the MDL and the PQL shall be qualified with a “J“ flag as estimated.

d) Negative sample results with absolute values > the PQL shall require sample dilution and adjustment of the MDL and PQL as directed above in Section 3.3.3(b). This requirement is intended to address significant matrix-related signal suppression.

3.3.4 Radiochemistry detection limits

The SDR requires a means by which to capture sample-specific information, such as sample weight/volume, counting time, and chemical recovery that affects a laboratory’s ability to detect radiochemical analytes. The detection limit calculations in this section incorporate data that are specific to both the sample and the detector it is counted on.

The calculations given in items (a) and (b) below apply to detectors for which at least 35 background counts can be obtained. For low-background alpha spectrometry, it is very difficult to obtain a sufficient number of background counts to support the assumption of normal distribution. In that case, the assumptions underlying the equations in items (a) and (b) break down, resulting in an inappropriately large number of false positives. If at least 35 background counts cannot be obtained, laboratories shall use the low-background detection limit calculation of item (c). Also, should they wish to do so, laboratories may apply the detection limit calculation approach of item (c) to detectors having backgrounds above 35 counts.

a) Radiochemistry laboratories shall calculate a sample-specific (concentration corrected) Critical Level (L_c) for each radiochemical parameter. The L_c values shall be calculated according to the equation below and reported with each analytical result submitted to the SNL/SMO. A sample or blank will be considered to have activity above the applicable background only when the sample or blank concentration exceeds the L_c. This calculation gives the level at which there is a 5 percent probability of reporting a false positive result for a sample or blank containing no activity.

$$L_c = \frac{1.645(2*TBC)^{1/2}}{2.22DEIVTRA}$$

Where:

TBC = total background counts
2.22 = DPM/pCi
D = decay correction factor
E = detector efficiency
I = ingrowth correction factor
V = sample volume or weight
T = sample count time
R = chemical recovery
A = emission abundance

b) Radiochemistry laboratories shall also calculate a sample-specific MDA for each radiochemical parameter. MDA values shall be calculated according to the equation below and reported with each analytical result submitted to the SNL/SMO. This calculation means that if we counted a sample containing net activity a large number of times, and if the mean result of those counts comes out equal to the MDA, then the result of a subsequent count would have a 5-percent probability of coming out below the L_c. This is the net concentration "which may be *a priori* expected to lead to detection" on a single measurement according to Curie ("Analytical Chemistry," Volume 40, Number 3, March 1968, pages 586 through 593). The contract-required MDAs are provided in Attachment 2.

$$MDA = \frac{4.65(TBC)^{1/2} + 2.71}{2.22DEIVTRA}$$

Where, the variables are defined in the same way as those in the L_c calculation of item (a).

c) Low background MDA and L_c

For low-background detectors (when at least 35 background counts cannot be obtained), laboratories shall use the equations given below to calculate MDA and L_c. These equations are based upon a blank population approach to determining signal variability, used in the case for which the standard Poisson distribution assumption in the Curie equations is inappropriate due to the low number of background counts.

Laboratories must accumulate data for each parameter, matrix, approximate count time, and digestion/separation procedure to develop blank populations. "Outlier" data should be identified and excluded from blank populations. A single blank population may be used for any digestion/separation process that is common to multiple matrices, provided that reagent volumes and counting times are comparable. As noted in Section 3.6.2 of this SOW, laboratories are not to use sand or any other matrix substitute in radiochemistry preparation blanks (PBs) associated with Sandia work. As a consequence, the digestion reagents and separation processes involved in the method define the blank type.

$$MDA = \frac{4.65S_g + 2.71}{2.22DEIVTRA}$$

$$L_c = \frac{2.33S_g}{2.22DEIVTRA}$$

In these equations, the variables in the denominators are defined in the same way as those in the L_c calculation of Section 3.3.4(a). S_g is the standard deviation of the blank counts, for which the equation is given below.

$$S_g = \sqrt{\frac{\sum_{i=1}^{n}(C_i - AC)^2}{n-1}}$$

Where:

C_i = blank counts – background counts
AC = average of the C_i
n = the number of blanks in the population

For the low background blank population MDA and L_c approach, laboratories shall count batch blanks on randomly chosen detectors. Each blank shall be subtracted for the current background of the detector it is counted on, with the resulting data (C_i) saved to a file that is specific to the parameter, matrix, approximate count time, and digestion/separation process. At approximately the beginning of each

month, the data in those files will be used to calculate new S_g values, which in turn will be used to calculate the MDA and L_c values for that month. The C_i in the data files will be updated monthly to include only data for the 20 most recent blanks of each type.

When using the low background blank population MDA approach, laboratories will discuss that fact in the case narrative of the associated data reports.

d) Radiochemical analytical results shall be reported as measured. That is, the laboratory shall report all results, regardless of concentration or sign, and shall not report any result as "less than the MDA or L_c." Results shall not be reported as ND. Reported results less than the MDA or total uncertainty (see below) shall be qualified with a "U" flag.

3.3.5 Analytical uncertainty

Radiochemical analytical results shall be accompanied by sample-specific uncertainty bounds that reflect the 95 percent confidence level. The uncertainty bounds shall include not only the measurement counting error, but also a technique-specific error term that includes uncertainty values for each contributing measurement process, and a sample-specific contribution reflecting specific chemical recoveries, detectors used, etc. Laboratories shall examine error contributions such as detector calibration, tracer standardization error, weighing and pipetting errors to calculate their contributions to uncertainty. All radiochemical result uncertainties shall incorporate terms for technique-related and sample-specific measurement errors.

The general form of the 1σ counting uncertainty (CU) equation is:

$$\mathrm{CU(cpm)} = \sqrt{\frac{\mathrm{CR_{smp}}}{\mathrm{T_{smp}}} + \frac{\mathrm{CR_{bkg}}}{\mathrm{T_{bkg}}}}$$

The general form of the sample 1σ Total Propagated Uncertainty (TPU) equation is:

$$\sigma_{\mathrm{Conc}}\left(\frac{\mathrm{pCi}}{\mathrm{g,L}}\right) = \left|\mathrm{Conc}\right| \times \sqrt{\left(\frac{\mathrm{CU}}{\mathrm{CR_{smp} - CR_{bkg}}}\right)^2 + \left(\frac{\sigma_{\mathrm{Eff}}}{\mathrm{Eff}}\right)^2 + \left\langle \left(\frac{\sigma_{\mathrm{Decay}}}{\mathrm{Decay}}\right)^2 - \mathrm{or} - \left(\frac{\sigma_{\mathrm{Ingrowth}}}{\mathrm{Ingrowth}}\right)^2 \right\rangle + \left(\frac{\sigma_{\mathrm{branch}}}{\mathrm{Branch}}\right)^2 + \left(\frac{\sigma_{\mathrm{Yield}}}{\mathrm{Yield}}\right)^2 + \left(\frac{\sigma_{\mathrm{aliquot}}}{\mathrm{Aliquot}}\right)^2}$$

where:

$$Decay = \exp\left[\frac{-\ln 2 \times \Delta T}{HL}\right]$$

$$\sigma_{Decay} = \frac{Decay \times \ln 2 \times \sigma_{HL} \times \Delta T}{HL^2}$$

$$Ingrowth = 1 - \exp\left[\frac{-\ln 2 \times \Delta T}{HL}\right]$$

$$\sigma_{Ingrowth} = \frac{(1 - Ingrowth) \times \ln 2 \times \sigma_{HL} \times \Delta T}{HL^2}$$

Note: The aliquot uncertainty includes weighing, pipetting, and dilution uncertainty.

The following abbreviations are used in the above calculations. All uncertainties are at the 1σ (68%) confidence level.

Aliquot Size of sample aliquot (in grams, liters, etc.)
$\sigma_{aliquot}$ Uncertainty of the sample aliquot
Branch Branching ratio
σ_{branch} Uncertainty in the branching ratio
CR_{smp} Gross count rate (counts per minute [cpm]) of the sample target analyte (sample + background count rates)
CR_{bkg} Background count rate (cpm) of the sample target analyte
Decay Factor used to correct for target analyte radioactive decay
σ_{decay} Uncertainty of the decay factor
Eff Counting efficiency of the detector
σ_{Eff} Uncertainty of the detector counting efficiency
HL Half-life (min) of the target analyte
σ_{HL} Uncertainty of the half-life (min)
Ingrowth Factor used to correct for target analyte radioactive ingrowth
$\sigma_{ingrowth}$ Uncertainty of the ingrowth factor
T_{bkg} Count duration (min) of the background count
T_{smp} Count duration (min) of the sample count
ΔT Time difference (min) between two events used in decay and ingrowth equations
Yield Chemical yield of the target analyte
σ_{yield} Uncertainty of the chemical yield

3.3.6 Quality Control exemption for filters

Various filter materials will be submitted for analysis. The matrix spike (MS) and replicate sample analysis requirements in this SOW shall not apply to filter materials because representative splits of these samples are generally not obtainable. All other QC criteria shall apply to the analysis of filters. However, the reanalysis requirements for certain QC failures will be waived where insufficient sample remains. A detailed discussion of that condition shall be included in the case narrative when it is encountered.

3.3.7 Quality Control exemption for physical parameters

Acidity, alkalinity, BOD, color, corrosivity, dissolved oxygen, gravimetric oil and grease, hardness, ignitability, pH, titrimetric sulfide, specific conductance, all of the solids methods, and turbidity are exempt from the general inorganic QC requirements. These analyses shall be controlled according to the method QC and/or the laboratory's QC policies.

3.3.8 Batch Quality Control requirements

The replicate and spike requirements given in this SOW apply to samples submitted by Sandia. Laboratories shall not substitute replicate and spike data that were acquired for samples submitted by other clients. If multiple Sample Delivery Groups (SDGs) from Sandia are batched together, then the relevant QC data must be included in each SDG report for validation purposes. QC data acquired outside of the SDG shall not be included on the EDD.

3.3.9 Additional requirements for fluoride run by Ion Chromatography

Laboratories that run fluoride by IC must add eluent to all standards and samples to smooth the baseline at the "water ditch" and/or use a column that separates the ditch from the fluoride peak.

3.3.10 Method detection limit elevation due to internal standard contamination

When a stable isotope analog of a target compound is used as an internal standard, the possibility exists for contamination of the extract with the associated target compound. This contamination may result in a concentration for the target analyte that is sufficient to produce an unacceptable probability of false positive detections. These situations can be identified when peaks for the target compound are observed in continuing calibration blanks. When this situation occurs, the temporary solution is to elevate the MDL for the affected analyte by an amount equal to the highest observed concentration in the continuing calibration blanks containing the contaminated internal standard. If instrument sensitivity is inadequate to determine the contamination concentration, a "best guess" should be used to elevate the MDL until an uncontaminated standard can be acquired. An investigation must be initiated to determine and correct the source of the contamination so that the MDL can be restored to the original value. Prior to elevating the MDL and reporting the data, the laboratory must attempt to contact the client to discuss the situation and gain approval, however, data package delivery should not exceed the due date for this issue. In the event that the client cannot be contacted before it is necessary to report the data package, the elevated MDL must be thoroughly discussed in the case narrative.

3.4 General inorganic analytical Quality Control requirements

Situations that make meeting the QC requirements given in this SOW difficult or impossible will arise from time to time. One such example might be replicate or spike failures where a filtered water sample contains a precipitate that cannot be brought back

into solution by warming to ambient temperature and agitation. A laboratory representative should contact the SDR to request an exemption from the reanalysis requirement for QC failures that are believed to result from unavoidable inhomogeneity or other issues relating to the nature of the sample matrix or available volume.

3.4.1 Calibration verification

Required calibration verification data are the ICVs and CCVs.

a) ICV for general inorganic analysis is conducted immediately after the instrument has been calibrated. This verification consists of analysis of a standard solution within the range of calibration. The ICV standard shall be from a source different from that used to prepare the calibration standards.

b) CCV for general inorganic analysis is conducted every 2 hours or after every tenth analytical sample, whichever is more frequent. The same standard used for calibration may be used for the CCVs. The CCV standard and a calibration blank shall be analyzed at the end of each analysis run. [The term “analytical sample” refers to all samples run other than calibration standards, calibration verifications, and calibration blanks. All method blanks or PBs, spiked samples, laboratory control samples (LCSs), Reporting Limit Verification for ICP-AES and ICP-MS Methods (CRI)/Reporting Verification for AA Methods (CRA)/Method Detection Limit Verification (MDLV) samples, interference check samples (ICS) (Solution A and Solution AB), and laboratory replicates are analytical samples. However, replicate burns in GFAA work are considered to be one analytical sample.]

c) ICV and CCV results shall be within ± 10 percent of the known value. Exceptions are cyanide (± 15 percent), perchlorate by Liquid Chromatography/Mass Spectrometry/Mass Spectrometry (LC/MS/MS) (± 15 percent), and mercury (± 20 percent).

d) In the event that either the ICV or CCV data fall outside of these limits, the instrument shall be recalibrated and all of the samples run since the last successful calibration verification shall be reanalyzed for the failed parameters.

e) No instrument calibration is employed in the methods exempted in Section 3.3.7 of this SOW. These analyses are exempt from the instrument calibration verification requirements. However, the iodine solution used in sulfide analysis shall be calibrated against a certified titrant of known normality at least once a week. The results of iodine solution calibration shall be recorded on the chemist's worksheet, but need not be reported in the QC summary.

3.4.2 Calibration blanks

Initial calibration blanks (ICBs) and CCBs shall be run immediately following the

associated calibration verification samples. The calibration blank matrix is the same as that of the calibration verification sample; that is, if the calibration standards and verification samples are digested, then the calibration blanks are also digested.

a) Calibration blanks are run with the same frequency as calibration verifications.

b) If the absolute value of the blank result for general inorganic parameters exceeds two times the MDL, the analysis shall be terminated and the problem corrected. Recalibration followed by calibration verification and blank samples shall be performed prior to resuming the analytical run.

3.4.3 Preparation blanks

PBs consisting of DI water and the appropriate reagents are included in each batch of samples requiring digestion or distillation. One PB shall be included for every 20 samples or one per batch, at a minimum.

a) PB analysis is applicable to all analyses requiring sample preparation prior to analysis, except those cases for which reagents are automatically added to all samples by an autoanalyzer. In the latter case, the ICB is equivalent to a PB.

b) If the absolute value of any analyte concentration in the blank exceeds 1/2 the PQL, the lowest reported concentration in the associated samples must be at least 10 times the concentration in the blank. All samples having that analyte's concentration at less than 10 times that of the associated value of the blank but above the PQL shall be redigested and reanalyzed.

3.4.4 Interference check samples

a) ICSs for ICP-AES and ICP-MS analyses shall be run at the beginning of each analysis run. The constituent composition of the ICSs is specified in SW-846 methods 6010 and 6020. The Sandia analytes not covered by the SW-846 methods shall be spiked into the ICS-AB solutions at 1 mg/L for ICP-AES and 0.02 mg/L for ICP-MS. The true values for ICS analytes may be calculated if diluted from certified materials.

b) The results for the trace (non-spiked) analytes in the ICS (Solution A) should be evaluated. If the absolute value of any analyte exceeds two times the MDL, the analyte should be noted in the case narrative.

c) The results for the analytes in the ICS (solution AB) shall agree within ± 20 percent of the true value. If this criterion is not met, the analyst may either terminate the analysis or continue and run the failed constituents at a later time. Analyte data obtained during an analytical run for which the ICS result does not pass the above criterion shall not be reported to the SNL/SMO.

3.4.5 Serial dilution

One serial dilution analysis shall be performed for each matrix in every batch for ICP-AES and ICP-MS analyses. The analysis is accomplished by diluting the sample(s) by a factor of five and comparing the dilution-corrected results to those for the undiluted sample(s). The serial dilution results shall agree to within ± 10 percent of the undiluted sample results where the undiluted results are greater than or equal to 10 times the PQL. Results that fail the acceptance criterion shall be qualified with an "E" when reported. No acceptance criterion applies when the undiluted sample results are less than 10 times the PQL. While this departs from the Method 6020 requirement of 100 times the reagent blank concentration, it should be much easier to implement in practice.

3.4.6 Linear range verification

In accordance with the 2004 NELAC standard, quarterly linear range verification samples may not be used to justify reporting ICP-AES and ICP-MS analytical results that exceed the calibration range. All samples that exceed the concentration of the high standard will be diluted to within the calibration range. Alternatively, laboratories may run a linear range verification sample in batches containing over-calibration samples. To be acceptable, linear range verification sample results must agree with the known values within ± 10 percent of the known value. Obviously, it is in the laboratories' best interest to design calibrations such that they cover as much of an instrument's linear dynamic range as possible. All analytical results, other than ICP-AES and ICP-MS results as described here, must be acquired within the calibration range.

3.4.7 Laboratory control samples

LCSs shall be analyzed using the same sample preparation and analysis methods used for Sandia samples, with one LCS analyzed with each batch of up to 20 samples.

a) Two exceptions to the LCS requirements are mercury in water and cyanide in both soil and water. Since the ICV is always digested for these analyses, it is equivalent to an LCS. However, solid reference materials are available and should be used as LCS samples for Hg in soil analyses.

b) Analytical results for aqueous LCS shall agree within ± 20 percent of the true value for all general inorganic parameters. The control limits shall be included in the QC portion of the deliverable.

c) Solid LCS materials shall be run with each batch of solid samples when such reference materials are available. Solid LCS results shall fall within the control limits specified by the agency that prepared the reference material or statistically derived limits. If a reference material certificate includes acceptance ranges, statistically derived limits shall not exceed

those specified on the certificate. Under no circumstances shall a solid LCS be used when the applicable acceptance criteria exceed the 30- to 150-percent recovery range. The laboratory shall include the control limits for solid LCS standards in the QC portion of the deliverable.

d) If the LCS data fail to meet the specified acceptance criterion, the analysis shall be terminated and the samples associated with that LCS shall be redigested and reanalyzed.

3.4.8 Replicate analyses

One replicate sample shall be analyzed from each batch, with a minimum frequency of one per 20 samples. If the SW-846 method explicitly requires the analysis of a matrix spike duplicate (MSD), such as is true in method 6010B, then the MSD analysis can replace the replicate requirement. In that case, the precision criteria given in this section still apply. Some SNL projects may elect to allow or require MSD analyses to replace replicate analyses. The SDR should be contacted for direction on this point.

a) The replicate relative percent difference (RPD) is the measure of precision used for all general inorganic constituents. The RPD is calculated as follows:

$$RPD = \frac{|S - R|}{(S+R)/2} \times 100\ \%$$

Where:

RPD = relative percent difference
S = sample value (original sample or MS value)
R = replicate value (or MSD value)

The RPD shall be less than or equal to 20 percent for samples with concentrations greater than or equal to 5 times the PQL. For samples with concentrations less than 5 times the PQL but greater than the PQL, the control limit is ± PQL. No precision criterion applies to samples with concentrations less than the PQL. If MS/MSD is used as the replicate analysis, then the RPD shall not be calculated using percent recovery but must be calculated using the measured concentrations. The RPD control limits shall be included in the QC portion of the deliverable.

b) If the above criteria are not met for filtered water samples, or solid samples that have been crushed and homogenized, all samples in the analytical batch must be redigested and reanalyzed. If the replicate precision criteria are not met in the second analysis, the results associated with the best replicate result shall be reported and qualified with the "*" flag as specified in Section 4.1.10(e) of this SOW. For unfiltered water samples and solid samples that have not been crushed and homogenized, results associated with a failed replicate analysis may be qualified and reported without reanalysis.

c) Samples identified as field or equipment blanks shall not be used to satisfy the replicate analysis requirement.

3.4.9 Spiked sample analyses

MS analyses are performed as a measure of the ability to recover analyte. As with replicate analyses, the minimum frequency is one per batch or one per 20 samples, whichever is more frequent. Matrix spike duplicates shall be performed when requested on the ARCOC. Matrix spike duplicates shall be reported with a calculated RPD as described in Section 3.4.8. If required by particular methods, post-digestion spikes will also be analyzed.

The percent recovery for spiked samples is calculated as follows:

$$\% \text{ Recovery} = \frac{SSR-SR}{SA} \times 100\ \%$$

Where:

SSR = spiked sample result
SR = sample result
SA = spike added

a) Matrix spikes shall be performed for all analytes except sodium, potassium, magnesium, calcium, and the parameters listed in Section 3.3.7 of this SOW. In addition to the exceptions listed here, aluminum and iron spikes are not required for soil samples.

b) If the control criteria given below in item (f) are not met for MS results for filtered water samples, or solid samples that have been crushed and homogenized, all samples in the analytical batch must be redigested and reanalyzed. If the control criteria are not met for the second MS analysis, the results associated with the best MS analysis shall be qualified “N” and reported.

A post digestion spike (PDS) shall be run for unfiltered water samples and solid samples that have not been crushed and homogenized with results associated with a failed MS analysis. Post digestion criteria are the same as that for the MS. Both MS and PDS shall be reported.

c) For IC, ion specific electrode, and colorimetric techniques for which no digestion is employed, analytical spikes shall be analyzed. If an analytical spike result is outside the control criteria specified below in item (f), all samples associated with the analytical batch shall be reanalyzed. If the control criterion is not met for the second analytical spike, the results associated with the best of the two spike analyses shall be qualified “N” and reported.

d) The spiking levels shall be at approximately the mid-point of the

calibration range except as noted in item (e) below.

e) Laboratories running As, Cd, Pb, Sb, Se, and Tl by axial-viewing ICP-AES or ICP-MS shall spike at the concentrations given below.

As	40 ppb
Cd	5 ppb
Pb	20 ppb (water)/100 ppb (soil)
Sb	100 ppb
Se	10 ppb
Tl	50 ppb

f) The MS recovery control limits are 75 to 125 percent. An exception to these control limits is made in the case for which the sample result exceeds 4 times the spike added. No control limits are applied in this case, since the spike signal rapidly becomes negligible with respect to the sample analyte signal. However, the analysis of post digestion spikes may be required under these circumstances for some projects.

g) Samples identified as field or equipment blanks shall not be used to satisfy the spike analysis requirement.

3.4.10 Reporting Limit Verification analyses

Reporting Limit Verification (RLV) standards are run at the beginning of each inorganic analysis run as a measure of accuracy near the reporting limit. For sequencing purposes, the RLVs shall be considered analytical samples. RLV standards are prepared with concentrations at approximately the PQL. If the low calibration standard is run at a level appropriate to the RLV, then the calibration standard signal may be reprocessed against the new calibration curve instead of running a separate standard. The results for these analyses are reported on Contract Laboratory Program (CLP) Form II (Part 2) or equivalent. The acceptance criterion for these analyses is 80- to 120-percent recovery. If the RLV recovery is outside the control limit, the chemist must terminate the analysis, initiate corrective action, and successfully reanalyze the RLV before proceeding.

To demonstrate sensitivity and accuracy for perchlorate by LC/MS/MS at the MDL, a MDLV standard at two times the MDL concentration is run at the beginning and end of each analysis run. For sequencing purposes, the MDLV shall be considered an analytical sample. The MDLV must recover within ± 30 percent. If an initial MDLV recovers outside the control limits, the chemist must terminate the analysis, initiate corrective action, and successfully reanalyze the MDLV before proceeding. If a final MDLV fails, the chemist must correct the problem and reanalyze all samples from that batch whose results were at or below twice the MDL concentration.

Note: It is important to remember that in LC/MS/MS perchlorate analysis, the isotope ratio value is tightly controlled as a fundamental part of the method. That means that the minor ion signal must be large enough to allow for reliable analyte identification (via the isotope ratio), and hence the

meaning of "MDL" in this context differs from the definition in 40 CFR 136.

3.4.11 Internal standards for general inorganic analyses

a) It is strongly recommended that internal standards (usually yttrium or scandium) be used in all ICP-AES work to compensate for possible transport effects.

b) Internal standards are required for ICP-MS. The method guidance provided in SW-846 Method 6020A (Rev. 1, February 2007) Section 9.6 shall be followed, except the control criteria for internal standard intensities shall be 60 - 125 percent. If the intensity of any internal standard falls outside these limits, the dilution procedure described in SW-846 Section 9.6 for internal standard matrix effect shall be followed.

3.4.12 Perchlorate analysis

Perchlorate is normally requested by EPA Method 314 with results confirmed by LC/MS/MS, SW-846 Method 6850 modified. When results are equal to or greater than the MDL of 4 ppb, the samples shall be reanalyzed using the LC/MS/MS method. Prior to the reanalysis, the laboratory shall contact the SDR for specific directions.

Daily calibration shall be performed when perchlorate is run by LC/MS/MS. Calibration shall consist of a blank and five standards, with curve definition by linear regression. The minimum acceptable correlation coefficient for calibration curves is 0.995. To be acceptable, the concentration corresponding to the absolute value of the calibration curve's Y-intercept must not exceed 50 percent of the detection limit value.

The use of an ^{18}O labeled perchlorate internal standard is recommended to assess method performance and better quantify the analyte. If the measured ^{18}O perchlorate internal standard area (or concentration) in any sample varies from the initial calibration value by more than 50 percent, the sample must be run at increasing dilutions until the $\pm$ 50 percent acceptance criterion is met.

Perchlorate analyses performed by LC/MS/MS should include the use of two barium cartridges and one hydrogen cartridge for cleanup. However, this requirement can be waived if the laboratory can demonstrate sufficient chromatographic separation of the analyte from interfering species. As an example, some researchers report that perchlorate retention times greater than 13 minutes, combined with diversion of the anion matrix to waste during the first 10 minutes, can reduce or eliminate the need for sample pretreatment. Whether sample cleanup is used or not, the laboratory should recover a standard from a matrix containing 500 ppm each of chloride, sulfate, carbonate, and bicarbonate in every batch. The concentration of this standard should be at the PQL, which is defined to be 5 times the detection limit concentration. To demonstrate that perchlorate is adequately isolated and recovered under the specific conditions used, this standard should recover within $\pm$ 20 percent of the known value.

The transitions associated with both the ^{37}Cl and ^{35}Cl perchlorate ions (m/z 101 to 85 and m/z 99 to 83 transitions) should be monitored in perchlorate analyses. Tandem mass spectrometry is required for this analysis.

The natural isotopic abundances for the chlorine isotopes give a $^{35}Cl/^{37}Cl$ ratio of approximately 3.08. Laboratories must statistically derive isotope ratio acceptance criteria to be used as an additional confirmation of analyte identity. Isotope ratio acceptance criteria should be derived using a population of perchlorate spikes in real sample matrices, QC and test sample matrices, and some DI water matrices (not DI water alone). A variety of perchlorate concentrations throughout the calibration range should be included in the isotope ratio data population. The mean of the ratio population should not deviate by more than 10 percent from the 3.08 theoretical value, and the standard deviation should not significantly exceed 0.2. Between the detection limit and the PQL, the individual sample isotope ratio control limits should be near the population mean $\pm$ 20 percent (approximately 3σ). Above the PQL, the individual sample isotope ratio control limits should be near the population mean $\pm$ 15 percent (approximately 2σ).

Analytical results that fail the isotope ratio acceptance criteria should be flagged with a qualifier to denote the existence of "presumptive evidence suggesting that the reported analyte is not present in the sample." When using such a qualifier, laboratories must provide supporting data and explanatory case narrative comments in the data package.

Recommended soil preparation is as follows: Weigh 2 grams of sample into a clean centrifuge tube. Add 20 milliliters of ASTM Type I water and agitate on a wrist shaker for 30 minutes. Centrifuge for 30 minutes, and then draw off 10 mL for cleanup (Ba and H cartridges) and analysis.

3.4.13 Uranium isotope analysis

Uranium isotopes are normally requested by alpha spectrometry. While this method allows the measurement of all uranium isotopes, the uranium-238/uranium-235 ratios tend to be biased due to uranium-234 overlap into the uranium-235 region of interest. This is not the case with ICP-MS analysis. When uranium isotopes are requested by ICP-MS, the laboratory will use the radiochemistry total digestion, including HF, unless specifically exempted by the requesting program. Uranium isotope reporting will include the reporting of the uranium-238/uranium-235 ratio. Results shall be reported as activity concentration and not as mass concentration.

The equations for uranium mass to activity conversion are:

$$pCi\ ^{235}U = (ug\ ^{235}U)/22.0$$

$$pCi\ ^{238}U = (ug\ ^{238}U)/3.33$$

3.5 Organic analytical and Quality Control requirements

Organic analytical and QC requirements are specified in this section of the SOW. The laboratory shall follow the requirements specified in SW-846 or other EPA methods as requested by the SNL/SMO. Additional general analytical and QC criteria are specified in Sections 3.5.1 through 3.5.10 of this SOW. Method-specific analytical requirements are given in Section 3.5.11. The SNL/SMO's ongoing laboratory performance assessments will be based partially upon the quality of the chromatography achieved.

3.5.1 Required target analytes and target MDLs

The target analytes and target MDLs for each method are specified in Attachment 3.

3.5.2 Instrument calibration

Unless otherwise specified in the method or this SOW, GC, GC/MS, LC/MS/MS and high performance liquid chromatography (HPLC) instrument calibration shall be performed using a minimum of five calibration standards, with the low standard at or below the PQL. All GC/MS instruments shall be tuned according to the frequency and ion abundance requirements of the applicable method. All initial calibrations will be verified using a second-source calibration verification standard. Laboratories may (1) verify the calibration using a second-source standard immediately after the initial calibration, (2) use a second-source CCV standard with each analytical run, or (3) use a second source LCS. If a second source LCS is used, the LCS must contain all of the compounds in the initial calibration, and the acceptance criteria shall be those specified for the CCV. Full list LCS samples shall be analyzed and reported unless instructed differently. Exceptions are designated below in Section 3.5.11.

a) <u>Calibration acceptance criteria</u>

Method-specific calibration criteria are specified in Section 3.5.11 of this SOW and in the analytical methods. In the absence of method-specific calibration acceptance criteria, the general calibration acceptance criteria are:

i. The percent relative standard deviation (percent RSD) for the response factors (RFs) obtained from the five or more initial calibration standards should be less than 20 percent unless otherwise specified in the method. In accordance with the new method 8000C, RSD averaging shall not be used. If the initial calibration fails these criteria, the laboratory shall follow the calibration guidance given in method 8000C.

ii. The percent difference of the daily or continuing calibration standard RF (or Calibration Factor [CF]) from the average RF (or CF) obtained from the initial calibration must be within $\pm$ 20 percent unless otherwise specified in the method. CCV recovery averaging shall not be used. If calibration verifications fail these

criteria, the laboratory shall take corrective action and perform a new initial calibration. As specified in SW-846 Method 8000C, GC and HPLC work will include a CCV sample at both the beginning and the end of each analytical run. GC/MS work will include a calibration verification analysis at least once every 12 hours. The laboratory may request exemption from this requirement for individual compounds that are known "poor performers." In this case, a compound-specific criterion should be proposed that would be used instead of the 20-percent criterion. Exemptions should not be requested on a batch basis.

Laboratories need not include all the compounds from the initial calibration if some compounds are not requested as target analytes. However, compounds that are not considered in the CCV evaluation must be listed in the case narrative as having been excluded.

iii. As described in SW-846 Method 8000C, laboratories may use least-squares regression to generate linear calibration curves, provided the correlation coefficients for the resulting curves are at least 0.990. Forcing the resulting curves through zero is not recommended. However, if the curves are forced through zero, correlation coefficients that are $\geq$ 0.995 must be obtained for the curves to be acceptable. Correlation coefficients may not be rounded up to achieve compliance with this requirement. If linear curves are generated, laboratories must have formal criteria addressing the concentration axis intercept. The concentration axis intercept shall be within ±3 times the MDL for all analytes subjected to linear calibration.

b) Low-concentration soil VOC analysis calibration

For SW-846 Methods 8021B and 8260C, a separate initial calibration shall be performed for low-concentration soil samples if the purge vessels or purge conditions used are different from those used for water. Medium-concentration soil extracts may be analyzed using the same purge vessels and initial calibration as those used for water samples.

3.5.3 Quantitation of optional compounds

The laboratory shall quantitate additional compounds, whether unlisted or listed as optional in Attachment 3, at the request of the SDR for a fixed price per method per compound. The laboratory shall calibrate the instrument using a single standard containing the specified non-target analyte(s). Under such circumstances, the SDR shall provide the laboratory with non-target compound standard material required for instrument calibration, or shall reimburse the laboratory for the purchase of a standard material at cost.

3.5.4 Sample preparation

a) Volatile Organic Compound analysis

For SW-846 Methods 8021B and 8260C, water and soil samples shall be prepared and purged into the GC instrument using Method 5030C or 5035A, as appropriate to the sample vessel provided and SDR contract requirements. The laboratory may employ the VOC screening procedures described in SW-846 Methods 3810 or 3820, to determine whether sample dilution is required.

b) Volatile Organic Compound soil and solid waste extractions

Any low-concentration soil sample analysis for which a saturated detector response is observed in SW-846 Methods 8021B and 8260C shall require a medium-concentration soil analysis. The smallest amount of soil sample on which a low-concentration analysis shall be performed is 1 gram. Medium- and high-concentration soil and solid waste samples shall be extracted using methanol as described in Method 5035A.

c) Toxicity Characteristic Leaching Procedure and Synthetic Precipitation Leaching Procedure Volatile Organic Compound extractions

For VOC TCLP or SPLP extract analyses, the laboratory shall use properly maintained and inspected zero-headspace extraction vessels, as described in SW-846 Method 1311, “Toxicity Characteristic Leaching Procedure,” and SW-846 Method 1312, “Synthetic Precipitation Leaching Procedure,” to extract samples.

d) Sample extraction and cleanup

Depending upon the characteristics of the sample matrix and the method requested, the laboratory shall use an appropriate method to extract samples and shall specifically reference the method used in the extraction log.

Unless otherwise specified in this SOW, the guidance in the methods shall be followed for cleanup procedures. Initial dilution of extracts to eliminate interferences is generally not allowed due to the attendant harm to surrogate recoveries and detection limits. Extracts shall be subjected to appropriate cleanup steps when visual inspection or surrogate failures indicate that significant matrix interferences exist. Appropriate cleanup methods for each determinative analytical method are listed below.

i.	SW-846 Method 8011	Method 3620C Florisil Cleanup Method 3640A Gel Permeation Cleanup (GPC) Method 3660B Sulfur Cleanup
ii.	SW-846 Method 8082	Method 3660B Sulfur Cleanup

			Method 3665 Sulfuric Acid/Potassium Permanganate Cleanup
	iii.	SW-846 Method 8151	Method 8151 Sec. 7.2.4 Method 3620C Florisil Cleanup
I	Iv.	SW-846 Method 8270	Method 3640A Gel Permeation Cleanup (GPC) Method 3611B Alumina Column Cleanup

3.5.5 Sample analysis acceptance criteria

The acceptance criteria for organic analyses are specified below. Samples for which the analyses fail to meet these criteria shall be reanalyzed by the laboratory at no additional cost to the SNL/SMO.

a) Sample extraction and analysis, confirmation of detection, and any required reanalysis must be performed within the holding times specified in Attachment 5.

b) The retention time of the surrogate compounds and any detected target analytes must be within the retention time acceptance windows for all columns. Unless otherwise specified in Section 3.5.11 or the analytical method, retention time windows shall be calculated using the procedure described in SW-846 Method 8000C. The retention times for all analytes in the initial CCV must be within the retention time windows established with the initial calibration.

Most of the analytical methods will include examples of the expected run times and analyte retention times for the instrumentation used in developing the method. In some cases, newer technology has allowed significant decreases in sample run times. If the laboratory implements any technology that significantly decreases the analysis time for methods that rely on retention times for all or part of the analyte identification, the laboratory must include demonstration of adequate resolution and identification of compounds that elute at similar retention times when one compound has a low concentration (at about the MDL) and one is high (at about the concentration of the high standard). In addition, retention time criteria must be adjusted accordingly to account for the shorter analytical runs.

c) Surrogate recovery acceptance criteria should be calculated according to the guidance given in SW-846 Method 8000C. The resulting calculated acceptance criteria should be within or near those given in Attachment 6 of this SOW. Laboratories will derive skewed acceptance limits if the results for nonroutine matrices (e.g., sludge for soil populations) are included in the populations from which these statistics are derived.

Similarly, routine failure to employ the method-specified extract cleanup procedures will skew the acceptance limits. The laboratory must consciously avoid these circumstances. Reported recoveries shall be accompanied by the applicable acceptance limits. If surrogate recoveries fail the acceptance criteria, the sample(s) shall be reanalyzed, typically after performing extract cleanup steps. If the surrogates fail in the second analysis, both results shall be reported and discussed in the case narrative. If the surrogates for the second analysis pass, the successful analysis results shall be reported. All analyses with target analytes reported shall have surrogates reported from that analysis.

d) A saturated detector response for target compounds must initiate dilution and reanalysis for those compounds.

e) The concentration of target analytes in the solution being analyzed must not exceed the concentration of the high calibration standard. When sample dilutions are required, chromatographic peaks chosen to quantify target analytes must be reported at between 10 and 100 percent of full scale. The scaling factor used must appear on all chromatograms. Appropriately scaled chromatograms must be provided in data reports for all dilutions for which data are reported.

f) The additional method-specific sample analysis acceptance criteria given in Section 3.5.11 must be met.

g) Manual integration must not be performed solely for the purpose of meeting QC criteria. Eliminating part of the subject peak area or including peaks not belonging to the subject peak are inappropriate manipulation of the analytical data. The laboratory must provide full explanation and documentation, including the original and manual integration, for every occurrence of manual integration, and for every analyte affected. Manually integrated data must be clearly indicated and must always include documentation, including “before” and “after” areas, clearly stating the reason the manual integration was performed, who completed the work, and the initials of the peer reviewer, group leader, or QA coordinator reviewing the manual integration.

3.5.6 Blank analysis

a) Method blank (preparation blank) analysis

The laboratory shall run a Method Blank (MB) for all methods at a frequency of once per delivery order, once per 20 analytical samples, once per sample matrix, or at the frequency specified in the method, whichever is more frequent. MBs for VOC analyses shall consist of reagent water that has been taken through the same preparation steps (as applicable) as those used for samples. For SW-846 Methods 8081B, 8082A, 8151A, and 8270D, soil MBs shall consist of a reagent blank only; the use of artificial matrices such as anhydrous sodium sulfate is strongly discouraged. MB acceptance criteria are given below in item (d). Samples associated with an unacceptable MB analysis shall be reanalyzed at no additional cost to the SNL/SMO. Method blank analyses must be performed in exactly the same manner as the samples: on the same instrument as all samples, and within 72 hours of all samples.

b) Instrument blank analysis

An instrument blank, including internal standards when the method calls for internal standard calibration, shall be run after each CCV, ICV or analysis of a sample or sample dilution that contained a target compound in greater concentration than the initial calibration range or other contaminant that saturated the instrument's detector. Blanks shall be run in the same purge inlet position (if applicable) as was the contaminated sample, and must meet the blank acceptance criteria given in item (d) below. If a blank fails the blank acceptance criteria, the instrument shall be decontaminated and additional blanks run in the same purge inlet port (if applicable) until the blank acceptance criteria are passed.

It is not practical to insert blanks for automated analytical runs. When a compound has been observed above the calibration range or a large peak was observed in the chromatogram, the sample immediately following should be carefully evaluated for carryover. If carryover is observed, the sample must be reanalyzed at no additional cost to the SNL/SMO.

c) Storage blank analysis

For SW-846 methods 8021B and 8260C, laboratories shall prepare storage blank samples and store these in the appropriate sample storage area. Each storage blank sample shall consist of a 40-mL screw-cap volatile sample vial having a Teflon®-lined septum and filled with reagent water. One storage blank shall be run at the end of each subsequent week. Target analytes measured above the associated PQL shall be reported by telephone and/or fax to the SDR within 24 hours, and discussed in the case narrative of reports for samples stored during the applicable period. The storage blank reporting requirement is waived in

the case for which all Sandia samples stored during the period were analyzed and showed no target analyte "hits."

d) Blank acceptance criteria

The acceptance criteria for all blank analyses are given below.

i. All sample analysis acceptance criteria for the specific analytical method were met.

ii. The concentration of each target analyte found in the blank must be less than the associated MDL. This blank acceptance criterion is waived in two cases: when Sandia samples show no target analyte "hits" on compounds detected in the blank, or when the associated sample results are $\geq$ 10 times the blank contaminant's concentration. In either of these circumstances, the rationale for accepting the contaminated blank must be discussed in the case narrative.

If the concentration of any compound in a blank exceeds the PQL, and the results for that compound in the associated samples also exceed the PQL, then the lowest reported concentration in the associated samples must be at least 10 times the concentration in the blank. All samples having that compound's concentration at less than 10 times that of the blank but above the PQL shall be re-extracted and reanalyzed.

e) Solvent blanks

It is expected that chemists will run solvent blanks when they encounter conditions that could adversely affect analytical work by causing carryover, causing baseline rise, etc. However, laboratories serving the SDR should not make a routine practice of running solvent blanks immediately prior to or following CCVs or other QC analyses. This practice suggests that analytical conditions are not adequate to eliminate memory effects for analytes that are within the calibration range and is not allowed. In isolated cases, solvent blanks may need to be run immediately before QC samples. The reasons for running a solvent blank before a QC sample must be discussed in the associated instrument run logs. In no case, shall multiple CCBs or solvent blanks be run immediately after a CCV.

3.5.7 Matrix Spike and Matrix Spike Duplicate analyses

a) The laboratory shall perform MS and MSD analyses for all methods except TO-13A and TO-14A at a frequency of once per delivery order, once per 20 samples, or once per sample matrix, whichever is more frequent. The laboratory shall use a Sandia sample and shall not use field blank, equipment blank, or trip blank samples to satisfy this requirement.

b) MS and MSD analyses must meet all sample analysis acceptance criteria. Unless otherwise specified in Section 3.5.11, the MS and MSD accuracy and precision acceptance criteria shall be those calculated by the laboratory using the procedure given in SW-846 Method 8000C. Calculated QC acceptance criteria shall not exceed those found in specific SW-846 methods. Laboratories will report recoveries and RPD values for MS and MSD analyses in the QC section of deliverables.

c) Laboratories shall use a full list spiking solution except as specified in Section 3.5.11. The laboratory may request exemption from this requirement for individual compounds that are known "poor performers." This is intended for implementation in the case for which a chemical incompatibility exists between calibration compounds, such as is true for benzidine. When spiking compounds are excluded, those compounds shall be listed in the case narrative.

3.5.8 Laboratory Control Sample analysis

An LCS shall be analyzed by the laboratory for all methods at a frequency of once per delivery order, once per matrix, or once per 20 analytical samples, whichever is more frequent. LCS analyses must be performed in exactly the same manner as the samples: on the same instrument as all samples, and within 72 hours of all samples. LCS analyses must meet all sample acceptance criteria. QC acceptance criteria for LCS results shall be derived statistically by each laboratory for each method using the procedure given for QC check samples in SW-846 Method 8000C unless specific criteria are given in the SW-846 method. All samples associated with an unacceptable LCS analysis, as described in the next paragraph, shall be re-extracted and reanalyzed at no additional cost to the SNL/SMO.

If used for second-source calibration verification, the LCS shall be prepared from standard materials that are independent of those used for calibration and contain all of the analytes in the initial calibration (see Section 3.5.2 of this SOW). Laboratories shall use a full list spiking solution except as specified in Section 3.5.11. The laboratory may request exemption from this requirement for individual compounds that are known "poor performers." This is intended for implementation in the case for which a chemical incompatibility exists between calibration compounds, such as is true for benzidine. When spiking compounds are excluded, those compounds shall be listed in the case narrative. Laboratories must use the following criteria when establishing LCS acceptance criteria.

a) The LCS must contain (at a minimum) the same analytes as the MS samples.

b) The concentrations of the LCS compounds shall be near the mid-point of the calibration range. The laboratory shall calculate data acceptance criteria using the procedure for QC check samples given in SW-846 Method 8000C.

c) The LCS acceptance criteria must not exceed those specified in the method.

d) Without special exemption, the recovery control limits shall not be less than 10 percent and not be greater than 150 percent.

e) If the LCS fails, corrective action (re-extraction and reanalysis) must be performed regardless of the outcome of the MS and MSD analyses. See exceptions in item (f) below.

f) LCS analytes may marginally fail the LCS acceptance criteria without initiating corrective action; however, all LCS analyte failures MUST be documented and discussed in the applicable case narrative(s). A marginal failure is defined as greater than three standard deviations but less than four standard deviations from the mean. If a large target analyte list LCS is analyzed, the following criteria may be used for LCSs that fall outside reported acceptance criteria but have >10 percent recovery:

70 to 74 compounds	5 LCS compounds may fall outside acceptance criteria with no corrective action.
60 to 69 compounds	4 LCS compounds may fall outside acceptance criteria with no corrective action.
50 to 59 compounds	3 LCS compounds may fall outside acceptance criteria with no corrective action.
40 to 49 compounds	2 LCS compounds may fall outside acceptance criteria with no corrective action.
30 to 39 compounds	1 LCS compound may fall outside acceptance criteria with no corrective action.
< 30 compounds	No LCS compounds may fall outside acceptance criteria with no corrective action.

The guidelines above should not be applied to matrix spikes. If the guidelines given above for target compound acceptability are not met, laboratories may contact the SDR to request special exemption allowing them to report the data. Such requests will be evaluated individually by the SNL/SMO.

3.5.9 Second-column or Gas Chromatography/Mass Spectrometry confirmation

Second-column or GC/MS confirmation of compound identification is required where recommended by the method. Laboratories may use a single-standard calibration passing through the origin for Method 8330 CN confirmation columns. For GC methods requiring second-column confirmation (routinely 8081, 8082, and 8151), the calibration requirements of this SOW and the applicable SW-846 methods shall be met on both columns. All confirmation results must be reported as part of the QC summary and must include estimated (8330A HPLC) or quantified (GC methods) concentrations for confirmed compounds. In addition, confirmation analyses must be discussed in the case narratives of the applicable

deliverables.

Laboratories must conduct MDL studies on the columns or separate instruments used in confirmation analyses. The MDL reported for an analysis requiring second-column or GC/MS confirmation must be the higher of those obtained on the primary column and confirmation column (or instrument).

Compounds that are detected on the primary column but not detected on the confirmation column must be discussed in the case narrative. If the RPD between primary and confirmation column results is greater than 40 percent, that fact must also be discussed in the case narrative and the associated data must be qualified with a "P" flag.

3.5.10 Process artifacts

Process artifacts (such as aldol condensates) and column degradation products (siloxanes) identified in Sandia samples shall be discussed in the case narrative in addition to any data qualification requirements.

3.5.11 Method-specific analytical requirements

The additional analytical requirements given below are organized by SW-846 method. The target analyte lists to be used are provided in the attachments of this SOW.

a) Petroleum hydrocarbons by Gas Chromatography/Flame Ionization detector (FID)

Unless otherwise specified by the SNL/SMO, petroleum hydrocarbon analysis shall be performed using a modified SW-846 Method 8015D. Regardless of the method specified, laboratories shall adhere to the QC requirements given in this SOW, SW-846 Method 8000C, and SW-846 Method 8015D. At the request of the SNL/SMO, the instrument may be calibrated for petroleum hydrocarbons based on a range of molecular weights or product type (such as GRO), or calibrated using a specific petroleum product (such as Fuel Oil No. 2). The capability to identify specific petroleum products that may be present in samples is desired but is not a requirement.

i. Analysis of a CCV, a retention time marker standard and blank is required at least once in each 12-hour period. The blank must be analyzed after the standard analyses.

ii. Modified 8015D method analyses are exempt from the sample acceptance criteria requiring extract cleanup and reanalysis based upon surrogate recovery (see Section 3.5.4.(d) in this document).

iii. It is not always possible to insert blanks for automated analytical runs. When a compound has been observed above the

calibration range or a large peak was observed in the chromatogram, the sample immediately following should be carefully evaluated for carryover. If carryover is observed, the sample must be reanalyzed at no additional cost to the SNL/SMO.

b) Organochlorine pesticides by Gas Chromatography

Unless otherwise specified by the SNL/SMO, organochlorine pesticide analysis shall be performed according to the requirements listed in SW-846 Method 8081B, "Organochlorine Pesticides by Gas Chromatography." Regardless of the method specified, laboratories shall adhere to the QC requirements given in this SOW, SW-846 Method 8000C, and SW-846 Method 8081B. Method 608 may be requested. When method 608 is requested, the laboratory will perform 8081B but report the analyte list for Method 608.

i. All soil sample extracts shall be subjected to the Florisil cartridge cleanup procedure described in SW-846 Method 3620C. Water samples shall also be subjected to the Florisil cleanup prior to reporting when MS or surrogate results fail the acceptance criteria.

ii. Soil, sediment, and biological sample extracts shall be subjected to the GPC cleanup procedure described in Method 3640A when MS or surrogate results fail the acceptance criteria. In addition, all water samples containing high molecular weight compounds that interfere with analysis of the target compounds must undergo GPC cleanup.

iii. All sample extracts that are contaminated with elemental sulfur shall be subjected to the sulfur cleanup procedure described in Method 3660B.

iv. If the system is primed prior to analysis, a solvent blank should be run before any standards or samples.

v. A CCV for multi-component analytes must be analyzed during a valid analytical sequence on the same instrument, column, and calibration within 72 hours of its detection in a sample. If the CCV fails, the extract shall be reanalyzed against a new calibration. If the instrument was not previously calibrated for the detected multi-component analyte, the extract shall be reanalyzed against a new calibration.

vi. Confirmation of all target analytes detected above the MDL is required. All calibration and method QC criteria must be met on the confirmation column used. If the RPD between the results obtained on the primary and confirmation columns is greater than 40 percent, the lower of the two shall be reported on the Form I.

vii. An LCS containing the organochlorine pesticides shall be analyzed for every 20 samples or every batch, whichever is more frequent. If chlordane and/or toxaphene are target analytes, an LCS shall be prepared and run for the appropriate multi-component analyte. LCS data acceptance criteria shall be derived by the laboratory according to the procedure for QC check samples given in SW-846 Method 8000C.

viii. Degradation problems shall be checked by injecting a standard containing only 4,4'-DDT and endrin. Presence of 4,4'-DDE, 4,4'-DDD, endrin aldehyde, or endrin ketone indicates breakdown. If degradation of either DDT or endrin exceeds 15 percent, corrective action must be taken before proceeding. Unless otherwise specified by the SNL/SMO, this test should be performed even when DDT and endrin are not target analytes for a given project.

c) Polychlorinated Biphenyls by Gas Chromatography

Unless otherwise specified by the SNL/SMO, Polychlorinated Biphenyl (PCB) analysis shall be performed according to the requirements listed in SW-846 Method 8082A. Regardless of the method specified, laboratories shall adhere to the QC requirements given in this SOW, SW-846 Method 8000C, and SW-846 Method 8082A.

i. Sulfuric acid (H2SO4)/potassium permanganate (KMnO4) cleanup (SW-846 Method 3665A) is strongly recommended for all sample extracts. Modification of the cleanup procedure to neglect the KMnO4 step is acceptable, provided that H2SO4 alone produces acceptable results. However, laboratory SOPs should provide instruction on the KMnO4 step, anticipating that the additional oxidizer will sometimes be needed.

ii. Sulfur cleanup, Method 3660B, shall be used when extracts are contaminated with elemental sulfur. Sequential cleanup steps shall be used if necessary to eliminate the interference.

iii. Laboratories shall routinely report the seven target Aroclors for this analysis. However, if the target PCB congeners are requested, decachlorobiphenyl shall be used as an internal standard by adding it to each calibration standard and sample extract, including QC samples. In this latter case, tetrachloro-meta-xylene is used as a surrogate.

iv. When these compounds are determined as aroclors, decachlorobiphenyl shall be added to each sample extract as a surrogate.

v. SW-846 Method 8082A is exempt from the full list LCS

requirements discussed in this SOW. Laboratories may use a short list of aroclors, such as 1016 and 1260, for this purpose.

vi. Confirmation of all target analytes detected above the MDL is required. All calibration and method QC criteria must be met for the confirmation column used. If the RPD between the results obtained on the primary and confirmation columns is greater than 40 percent, the lower of the two shall be reported on the Form I.

vii. If an initial calibration has not been performed for any target Aroclor for which a detected result above the MDL is obtained, the laboratory must calibrate for that Aroclor and reanalyze the extract. If an existing initial calibration has not been verified via CCV for any target Aroclor for which a detected result above the MDL is obtained, an acceptable CCV run must be obtained within 72 hours, at a minimum, if the result is to be reported.

d) Chlorinated herbicides by Gas Chromatography

Unless otherwise specified by the SNL/SMO, chlorinated herbicide analysis shall be performed according to the requirements listed in SW-846 Method 8151A. Regardless of the method specified, laboratories shall adhere to the QC requirements given in this SOW, SW-846 Method 8000C, and SW-846 Method 8151A.

i. The laboratory shall use 2,4-dichlorophenylacetic acid (DCAA) as a surrogate standard to monitor the performance of the method's extraction and analysis steps. DCAA shall be added to standards, blanks, and all analytical samples. If DCAA is expected to be present in samples, the laboratory shall use a chlorinated herbicide not present in the samples as the surrogate compound. In this case, the laboratory should consult the SDR on the selection of the surrogate compound.

ii. Sample cleanup shall be performed, as needed, to eliminate sample interferences using SW-846 Method 8151A Section 7.2.4, or the Florisil cartridge cleanup procedure described in Method 3620C.

iii. Confirmation of all target analytes detected above the MDL is required. All calibration and method QC criteria must be met for the confirmation column used. If the RPD between the results obtained on the primary and confirmation columns is greater than 40 percent, the lower of the two shall be reported on the Form I.

e) Volatile organic compound analysis by Gas Chromatography/ Mass Spectrometry

Unless otherwise specified by the SNL/SMO, VOC analysis shall be performed according to the requirements listed in SW-846 Method

8260C, "Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry." Regardless of the method specified, laboratories shall consider the QC requirements given in the SOW, SW-846 Method 8000C, and SW-846 Method 8260C to be the minimum requirements. If EPA Method 524.2, Method 624, or a 25-mL purge is requested, the laboratory must determine whether the Method 8260 analyte list is adequate to cover the site target analyte list. If a 25-mL purge is used, the laboratory must discuss that fact in the case narrative.

i. The concentration of methylene chloride in blank analyses must be less than 2.5 times the required PQL, and acetone and 2-butanone must be less than 5 times their required PQL. If these concentration limits are exceeded, laboratories shall discuss the blank contamination in the associated case narrative.

ii. No quantitation ion may saturate the instrument's detector. When this occurs, decontamination procedures must be employed as necessary to demonstrate that the system is free from contamination. If a blank has not been analyzed because the analytical run was automated, the subsequent sample must be reanalyzed if the same compound(s) that was over the calibration range in the previous sample was detected.

iii. The laboratory may be asked to tentatively identify and report up to 20 of the non-target compounds having the greatest apparent concentration in the sample and whose response is greater than 10 percent of the nearest internal standard. These compounds shall be tentatively identified and quantified following the guidelines provided within the specific analytical method being used.

iv. Laboratories shall use an industry standard spectral library to obtain reference spectra. Instrument-generated quality factors (Q factors) indicating spectral ion abundance match with library reference data shall be presented on the quantitation reports for all target compounds and tentatively identified compounds (TICs).

v. Per Section 11.4.7 of SW-846 Method 8260C, if the extracted ion current profile (EICP) area for any of the internal standards in the calibration verification standard changes by a factor of two (-50 percent to +100 percent) from that in the mid-point standard level of the most recent initial calibration sequence, the purge and trap sampler and GC/MS system must be inspected for malfunctions and corrections must be made, as appropriate. When corrections are made, samples analyzed while the system was malfunctioning must be reanalyzed.

f) Semivolatile organic compound analysis by Gas Chromatography/ Mass Spectrometry

Unless otherwise requested by the SNL/SMO, semivolatile organic compound (SVOC) analysis shall be performed according to the requirements listed in the SW-846 Method 8270D, "Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry." Regardless of the method specified, laboratories shall consider the QC requirements given in the SOW, SW-846 Method 8000C, and SW-846 Method 8270D to be the minimum requirements.

i. For soil, sediment, and biological samples, GPC cleanup using SW-846 Method 3640A or Alumina cleanup using SW-846 Method 3611B shall be used as necessary to eliminate interferences. In addition, all water samples containing high molecular weight compounds that interfere with analysis of the target compounds must also undergo GPC cleanup.

ii. As stated in SW-846 Method 8270D, the minimum average RF for all target analytes shall be 0.05. These criteria also apply to daily CCV standards.

iii. Laboratories may request permission to use statistical process control criteria for a small number of poorly performing CCV compounds. If granted, these criteria must be present on recovery reports for CCV samples or otherwise clearly presented in data deliverables. No individual recovery value shall exceed a $\pm$ 60 percent control criterion, and each individual target compound that recovers outside the $\pm$20 percent window must be called out in the case narrative.

iv. Target phthalate esters are exempt from the reanalysis requirements associated with MB contamination up to a concentration of five times the PQL.

v. No quantitation ion may saturate the instrument's detector. When this occurs, decontamination procedures must be employed as necessary to demonstrate that the system is free from contamination. If a blank has not been analyzed because the analytical run was automated, the subsequent sample must be reanalyzed if the same compound(s) that was over the calibration range in the previous sample was detected.

vi. The laboratory may be asked to tentatively identify and report up to 30 of the non-target compounds having the greatest apparent concentration in the sample and whose response is greater than 10 percent of the nearest internal standard. These compounds shall be tentatively identified and quantified following the guidelines provided in the specific analytical method being used.

vii. Laboratories shall use an industry standard spectral library to obtain reference spectra. Instrument-generated Q factors indicating spectral ion abundance match with library reference

data shall be presented on the quantitation reports for all target and Tentatively Identified Compounds (TICs).

viii. Per Section 11.4.7 of SW-846 Method 8270D, if the extracted ion current profile (EICP) area for any of the internal standards in the calibration verification standard changes by a factor of two (-50 percent to +100 percent) from that in the mid-point standard level of the most recent initial calibration sequence, the GC/MS system must be inspected for malfunctions and corrections must be made, as appropriate. When corrections are made, samples analyzed while the system was malfunctioning must be reanalyzed.

g) Polychlorinated dioxins and furans by Gas Chromatography/Mass Spectrometry

Unless otherwise specified by the SNL/SMO, all sample analysis shall be performed according to the requirements listed in SW-846 Method 8290A.

i. No quantitation ion may saturate the instrument's detector. When this occurs, decontamination procedures must be employed as necessary to demonstrate that the system is free from contamination. If a blank has not been analyzed because the analytical run was automated, the subsequent sample must be reanalyzed if the same compound(s) that was over the calibration range in the previous sample was detected.

h) Nitroaromatics and nitramines by High Performance Liquid Chromatography

Nitroaromatics and nitramines analysis shall be performed according to the requirements specified in SW-846 Method 8330B. Laboratories shall adhere to the QC requirements of this SOW, SW-846 Method 8000C, and SW-846 Method 8330B.

i. The laboratory shall use an appropriate surrogate compound that does not co-elute with any target analytes on the C18 column to monitor the performance of the analytical method. To minimize co-elution problems on both columns, it is recommended that either 1,2-dinitrobenzene or 1,4-dinitrobenzene be used as the surrogate.

ii. All target analytes detected in samples shall be confirmed on a secondary column. Secondary columns should provide a separation that is substantially different from that obtained on the primary column. The estimated analyte value, obtained using at least one standard to calibrate the secondary column, shall be reported for confirmation analyses. Co-elutions are prohibited in

secondary column calibrations. Laboratories shall only report the results obtained from the C18 column on the Form I, regardless of the RPD between the C18 and secondary column results.

iii. Solid phase extraction (SPE) is approved for HE extractions in water samples. Laboratories must perform an initial demonstration of proficiency using SPE that includes a maximum concentration per target compound and a maximum total concentration for HE target compounds. These maximum values must be set by procedure and must trigger re-extraction on a smaller sample aliquot if exceeded. Laboratory procedures must also address sample filtration to prevent reduced extraction efficiency resulting from particulates clogging the extraction media.

SPE approval applies to groundwater and surface water; application to matrices with high organic content may be inappropriate. Laboratories should demonstrate the efficacy of SPE individually, per matrix, for effluent, or waste sample matrices. Laboratories may select an early-eluting surrogate for addition to the method to indicate breakthrough or elution caused by organic substances in the samples. Laboratories must separate the phases of multi-phasic samples prior to extraction.

iv. Laboratories shall analyze and report CCVs and MBs in secondary column confirmation runs. The analysis frequency requirements for analyses using the secondary column are the same as those used for the primary column.

v. Limited spectral information is available if a diode array detector is used. This detector approach is preferred by the SDR because of the increased ability to identify false positives that it affords. However, this does not replace the requirement for secondary column confirmation.

vi. The comments of this section apply to analyte detections that have been confirmed on a secondary column. If LC/MS/MS is to be used as an additional confirmation for HPLC 8330B, the instrument will be calibrated according to the guidance in SW-846 Method 8321B and Method 8000C

1. Laboratories shall use at least two internal standards for this HE technique. In any sample analysis, the area of the internal standard peaks must be within $\pm$ 30 percent of the average internal standard areas from the initial calibration. Also in any sample analysis, the retention time of the internal standards must be within $\pm$ 30 seconds of the average internal standard retention times from the initial calibration. If internal standard areas vary by

> ± 30 percent , and/or internal standard retention times vary by more than ± 30 seconds from the average values of the most recent initial calibration sequence, the LC/MS/MS system must be inspected for malfunctions and corrections must be made, as appropriate. When corrections are made, samples analyzed while the system was malfunctioning must be reanalyzed.

2. MDLs reported for LC/MS/MS will be at such a level as to have signal-to-noise ratios of approximately five or higher.

3. CCVs and CCBs shall be analyzed at the beginning of each analytical run, at least once every 10 analytical samples, and at the end of each analytical run. If calibration verification follows a new initial calibration, then an ICV replaces the first CCV and must be a second-source standard. The ICV and CCV acceptance range is ± 20 percent. When LC/MS/MS is the primary measurement technique for high explosives, CCV acceptance criteria are as follows:

   - When CCV recovery for any compound exceeds +/- 20 percent, the associated field sample data for that compound should be qualified, with the failure discussed in the case narrative. Reanalysis is not required.

   - If the CCV recovery for any compound exceeds +/- 30 percent in any two consecutive CCVs, significant drift is indicated. Laboratories must take the appropriate corrective action (typically recalibration), but need not reanalyze the field samples associated with the ICV/CCVs. The affected field sample data shall be qualified and the failure shall be called out in the case narrative.

   - If the CCV recovery for any compound exceeds +/- 50 percent, the laboratory shall take the appropriate corrective action and shall reanalyze all field samples back to the most recent CCV for which the recovery was within +/- 30 percent.

4. The laboratory may use the same extract as that used for the HPLC analysis. In that case, except as directed in the section below, the laboratory need not prepare any additional batch QC if the PB results, surrogate recoveries, and LCS results from the HPLC analysis are acceptable.

5. For all confirmation runs, the laboratory will add an analytical spike to at least one sample that was determined in HPLC analysis to have detections at or near

the associated MDL. The analytical spike concentration will likewise be at or near the MDL. Acceptable recoveries for the analytical spike are between 70 and 130 percent of the known value.

6. The case narrative will discuss the LC/MS/MS confirmation results, and the associated LC/MS/MS data will be placed in the miscellaneous data section of the deliverable.

7. Target analytes that are detected by HPLC (both columns) but do not confirm by LC/MS/MS will still be reported. However, such results will be flagged with an "X" qualifier. All uses of the "X" qualifier must be explained in the case narrative.

8. By definition, analytes must be detected on both the C18 and the secondary columns to be reportable detections in SW-846 Method 8330B analyses. In LC/MS/MS confirmation analyses, results for analytes that have not met this criterion shall not be reported.

9. The extract holding times for SW-846 Method 8330B that are given in Attachment 5 of this SOW apply.

10. Only LC/MS/MS methods are acceptable for this work because of the high specificity of the ion transitions that are monitored for each compound. These transitions are unique to a particular molecular structure and are crucial to compound identification in this analysis. LC/MS/MS methods that do not monitor such transitions shall not be used.

vii. If HE compounds are to be analyzed by LC/MS/MS as the primary technique, then the internal standard, calibration, MDL, and calibration verification requirements of LC/MS/MS confirmation analysis apply. In this work, laboratories shall use the same extraction procedures that are used for SW-846 Method 8330B HPLC analyses.

1. To demonstrate sensitivity and accuracy for the analysis of HE by LC/MS/MS at the MDL, an MDL verification (MDLV) standard at approximately two times the MDL concentration is run with every CCV during the analytical run. The MDLV must recover within 30 percent for every compound. If any compound recoveries from the MDLV analysis are outside the control limits, the chemist must correct the problem and reanalyze all samples from that batch.

2. Surrogate recovery, MS, and LCS acceptance criteria shall

be separately established via statistical process control for HE by LC/MS/MS. The LCS and MSs shall contain the full list of target analytes.

3. MS samples shall be prepared at concentrations that result in an extract concentration that is near the midpoint of the calibration range for each target analyte and shall be analyzed at least once per batch.

4. All holding times for SW-846 Method 8330B that are given in Attachment 5 of this SOW apply.

5. As in the confirmation protocols discussed above, only LC/MS/MS (tandem quadruple) methods are acceptable for this work.

i) Volatile organic compounds in ambient air using Gas Chromatography/Mass Spectrometry

Analysis shall be performed according to the requirements specified in EPA Method TO-14A, revision 1.0.

i. A GC/MS analytical system shall be used.

ii. Canisters obtained from the laboratory shall be certified as containing less than 0.2 parts per billion by volume (ppbv) VOCs through humid zero air analysis.

iii. An acceptable daily humid zero air instrument blank shall be analyzed immediately prior to and after instrument calibration. These instrument blanks must be less than 0.2 ppbv for all target analytes before analysis may proceed.

iv. MS and MSD analyses are not required for this method.

v. The LCS shall contain all of the target analytes at concentrations near the mid-point of the calibration range. Recovery for the target analytes must be within ± 20 percent of the theoretical value.

vi. Laboratories shall use a minimum of three surrogate compounds and report the resulting surrogate recovery data with EPA Method TO-14 QC deliverables.

3.6 Radiochemistry analytical Quality Control requirements

Standards used in batch QC analyses, such as LCS and spiking standards, need not be NIST-traceable. Standards requiring NIST-traceability are discussed in Section 3.6.9 below.

3.6.1 Calibration verification

Calibration verification samples and calibration blanks are not required for radiochemistry. This statement refers only to batch QC and in no way diminishes the calibration requirements given in Section 3.6.9 of this SOW.

3.6.2 Preparation blanks

One PB shall be included for every 20 samples or one per batch, at a minimum. An empty or water-filled container for the appropriate geometry shall be run for gamma spectroscopy. Laboratories shall not use silica sand or any other matrix substitute in PBs for solid sample analyses. Artificial urine may be used in PBs for urine sample analyses.

a) PB analysis is applicable to all analyses requiring sample preparation prior to analysis. An aliquot-specific preparation blank report shall be provided, in which PB results are calculated assuming aliquot sizes comparable to the sample aliquots used in the associated batch.

b) Samples associated with any PB result that is greater than its associated MDA shall be redigested and reanalyzed. Exceptions to this requirement are samples for which the measured concentrations in the samples are greater than or equal to five times the PB value. Reanalysis is not required for such samples. PB results that are greater than their associated MDAs shall not be included in any blank population calculations.

c) PBs for alpha spectrometry, GFPC, and Lucas cell techniques shall be placed randomly or sequentially, such that the blank position varies from batch to batch. Instrument run logs shall be maintained to demonstrate compliance with this requirement.

3.6.3 Laboratory control samples

LCSs shall be analyzed using the same sample preparation and analysis methods used for the Sandia samples. One LCS shall be analyzed with each batch of up to 20 samples. LCS standards shall derive from a source different from that used to calibrate the instrument.

a) Solid LCS materials shall be analyzed with each batch of solid samples when such materials are available. A laboratory representative may call the SDR for assistance if solid LCS materials appropriate to requested analyses cannot be obtained. Aqueous LCS standards shall be analyzed if neither the laboratory nor the SDR can obtain appropriate solid LCS materials.

b) The aqueous LCS analytical results shall agree within ± 20 percent of the true value.

c) Solid LCS results shall fall within the control limits specified by the agency that prepared the reference material or statistically derived limits developed by the laboratory. The laboratory shall include the control limits in the QC portion of the deliverable.

d) If the LCS data fail to meet the applicable acceptance criterion, all samples associated with that LCS shall be redigested and reanalyzed.

e) LCS results reported with the QC data for gamma spectroscopy shall include Am-241 (59.5 kilo electron volt [keV]), Cs-137 (661.7 keV), and Co-60 (1332 keV) at a minimum.

f) The LCS for gross alpha and gross beta by GFPC shall contain solids such that the measured mass is about the mid-point of the mass attenuation curves.

3.6.4 Replicate analyses

One replicate sample shall be analyzed from each batch, with a minimum frequency of one per 20 samples.

a) The replicate error ratio (RER) is used to determine replicate precision for radiochemical results. The RER is given by:

$$RER = \frac{|S - R|}{\sigma_{95S} + \sigma_{95R}}$$

where, RER = replicate error ratio
S = sample value (original)
R = replicate sample value
σ_{95S} = sample uncertainty (95 percent)
σ_{95R} = replicate uncertainty (95 percent)

Radiochemical replicate determinations shall agree when the 95 percent confidence level uncertainties are considered. That is, the RER shall be less than or equal to 1. This control criterion is not applied, and reanalyses or data qualification are not required, when both of the measured values are less than their associated MDAs.

b) If the RER control criterion is not met for filtered water samples, or for solid samples that have been crushed and homogenized, all samples in the analytical batch must be redigested and reanalyzed (see the exception below). If the control criterion is not met for the second replicate analysis, the results associated with the best replicate analysis shall be qualified "*" and reported. For unfiltered water samples and for solid samples that have not been crushed and homogenized, results associated with a failed replicate analysis may be qualified and reported without reanalysis.

c) Samples identified as field or equipment blanks shall not be used to satisfy the replicate analysis requirement.

d) Replicate analyses may not be possible in soil tritium analysis when the moisture content is too low or the sample size is too small. A discussion of this problem shall be included in the case narrative if tritium replicates cannot be run.

e) Circumstances occasionally preclude adequate homogenization of samples. Examples of this are some plutonium analyses and samples from areas where depleted uranium munitions have been used. Laboratories that believe the reanalysis requirement should be waived in a specific case due to unavoidable inhomogeneity should seek SDR approval for suspension of the reanalysis requirement.

3.6.5 Spiked sample analyses

MS analyses are performed on field samples as a measure of the ability to recover analytes. As with replicate analyses, the minimum frequency is one per batch or one per 20 samples, whichever is more frequent.

a) If a MS result is outside the control criterion specified in item (d), all samples associated with the analytical batch shall be redigested and reanalyzed. If the control criterion is not met for the second MS analysis, the results associated with the best MS analysis shall be qualified "N" and reported. As in the section above addressing replicate analyses, unfiltered water samples and unprepared solid samples are exempt from the reanalysis requirement. Results for unfiltered water samples and unprepared solid samples for which the MS failed the acceptance criterion may be qualified and reported without reanalysis.

b) Matrix spikes are not required for gamma spectroscopy, Rn-222, or any analyses utilizing a tracer that is chemically identical to the analyte. Matrix spikes are likewise not required for analyses that utilize a standard addition for every sample (such as is commonly done for ^{3}H and ^{99}Tc). In addition, Ra-226 analyses that employ a Ba-133 tracer are exempt from the MS requirements.

c) Sample spiking levels for radiochemical analyses other than tritium shall be added at a concentration of at least 5 but not greater than 20 times the estimated MDA. Tritium samples must be spiked before the distillation step, at a level chosen by the laboratory.

d) The spike recovery control limits are ± 25 percent. An exception to these control limits is made in the case for which the sample result exceeds 4 times the spike added. No control limits are applied in this case.

e) Samples identified as field or equipment blanks shall not be used to satisfy the spike analysis requirement.

f) The considerations of Sections 3.6.4 (d) and (e) may also apply to the MS analysis and reanalysis requirements. The actions recommended in those sections should be followed if applicable.

3.6.6 Chemical recovery requirements for radionuclides

a) Correction of analytical results for radionuclide chemical recovery shall be performed sample specifically unless the SDR has given prior approval for a batch-correction procedure. Carrier recovery shall be corrected for the indigenous carrier concentration of the element in the sample.

b) Recovery guidelines for tracer and carrier results in routine matrices (soil and water) shall be 50 to 105 percent. The SDR is aware that the tracer recovery requirements cannot be met for some difficult matrices. Recoveries that do not meet the acceptance criteria given in this paragraph must be approved by the SDR prior to submission of the deliverable. If reanalysis is requested and the resulting tracer recoveries still do not pass the criterion given here, the laboratory shall report the batch having the best recoveries and discuss the results and corrective actions in the case narrative.

The tracer recovery criteria in this section exist to ensure that detection limits are not deleteriously affected by low recoveries and that analytical results that are corrected for those recoveries are not excessively uncertain (see below). In general, the SDR should approve minor variances from these criteria. More significant variances will be evaluated in the context of counting uncertainty for the tracer and the detection limits that are achieved. If an unacceptable uncertainty has not been introduced, and if the required detection limit has been meet, then the SDR should approve reporting the results without reanalysis.

c) The concentration of tracer material added shall be sufficient to result in a maximum of 5 percent uncertainty in the measured chemical recovery at the 95 percent confidence level, and at the recovery level expected for the matrix and method. This means that at least 400 counts should be acquired for tracers.

3.6.7 Blank subtraction

Blank subtraction shall be done only in liquid scintillation counting. Results for the other counting techniques shall be corrected for instrument background only, and shall not be blank subtracted.

For liquid scintillation, there are three blanks. The detector background is measured with the blank from the vendor's QC set, sample results are subtracted for calibration blank results, and random contamination is identified and reported via the PB results.

- The data from the vendor's blank are used to assess instrument background.

- The calibration blank contains the cocktail and any reagents added to the batch, and is placed in a vial from the same lot used for the samples, but is not subjected to the separation or distillation steps/apparatus. The calibration blank is used to determine the background for a particular batch of samples. This result is subtracted from all the samples in the batch.

- The PB is used to identify contamination from sample preparation processes. PBs are made in the same way the calibration blanks are, but are additionally subjected to the same separation or distillation steps used for the samples. This result is reported as PB and is not subtracted from each sample result.

3.6.8 Target Critical Levels (concentration corrected) and Minimum Detected Activities

The tables in Attachment 2 give target critical levels corrected for concentration of radionuclides by analytical technique and matrix. Laboratories shall adjust analytical conditions to meet the target L_c.

For gamma spectroscopy, Cs-137, Co-60, and Am-241 shall be reported for every sample. Analytical conditions shall be adjusted to meet the specified MDAs for those radionuclides. The analytical conditions chosen will determine the MDAs for other reported nuclides.

3.6.9 Counting instrument calibration requirements

Counting instruments are subject to a primary calibration prior to initial use, when the instrument is placed back in service after repair, and when the instrument's performance parameters exceed previously established acceptance criteria. Radionuclide analyses that do not involve nuclear disintegrations are defined to be general inorganic analyses. Such analyses are subject to the analytical and QC requirements in the appropriate section of this SOW. This applies to total and isotopic uranium determination by ICP-MS.

Primary calibration shall be performed using NIST-traceable standards except where such standards are unavailable. The words "check" and "verification" below apply to measurements performed to verify the primary calibrations. Standards used for this purpose shall be independent of the primary calibrants, and shall also be NIST-traceable or have been directly compared with NIST standards. If such verifications fail, the laboratory shall reassess all data acquired since the last successful check and notify the SDR if corrections are made.

a) Gas flow proportional counting

i. Background counts equal in duration to the longest expected sample count time and used for background corrections shall be performed at least quarterly.

ii. Daily background checks shall be performed.

iii. Calibration for detector efficiency shall be performed when daily checks (see below) fail the laboratory's acceptance criteria.

iv. Detector efficiency checks shall be performed daily before use.

v. Mass attenuation curves shall be generated at instrument setup, following major maintenance, and when detector efficiency check failures necessitate recalibration. Enough standards must be used to adequately define the curves, and at least 10,000 counts must be acquired for each calibration standard. Mass attenuation curves shall be constructed for each detector unless the laboratory can show that all detectors, or designated groups of detectors, are statistically equivalent.

vi. Voltage plateau performance checks shall be made after each gas bottle change or maintenance activity.

vii. Cross talk determinations shall be verified at least annually.

viii. Laboratory calibration procedures shall require that backgrounds be checked after counting high-activity samples.

ix. Gross Alpha/Beta Planchette Flaming: Gas proportional counting in the presence of hygroscopic salts, which thicken as they absorb moisture, inhibits alpha transmission. Flaming to red heat converts the slats to oxides which are less likely to absorb alpha particles. However, flaming to red heat drives off volatile elements (which tend to be beta emitters. Most notable losses to volatility will be cesium (Beta), polonium (alpha), and technetium (Beta)).

Gross alpha/beta is intended as a screening method that provides qualitative information. When gross alpha/beta results are used as a screening tool, prepared planchettes maintained in a desiccated environment should not require flaming prior to analysis. When gross alpha/beta results are used for regulatory purposes, or certain geological studies, a higher level of certainty is required. In these instances, a sequence of beta count, flame to dull red heat, alpha count should be employed. In all cases, the case narrative must identify when flaming is employed and specify the counting sequence associated with the flaming. This will clearly identify any possible limitations of the gross alpha/beta results. Laboratories shall have a formal procedure for the count/flame/count option available for use at the discretion of the SNL/SMO.

b) Alpha spectrometry

i. Background counts equal in duration to the longest expected sample count time shall be performed at least monthly.

ii. Energy/channel calibrations shall be verified at least weekly.

iii. Detector efficiency shall be verified at least monthly.

iv. Laboratory calibration procedures shall require that backgrounds be checked after counting high-activity samples.

v. Refer to Section 3.3.4(c) of this SOW for the blank population approach to detection limit calculation for low background detectors.

c) Gamma spectroscopy

i. Calibration background counts equal in duration to the longest expected sample count time shall be performed at least monthly, with verification performed weekly. Use of the MB for weekly background checks is acceptable, provided that the data are compared to the original calibration background.

ii. Energy/channel calibrations shall be verified on the day of use.

iii. Efficiency calibrations shall be verified on the day of use.

iv. Resolution calibrations shall be verified on the day of use.

d) Liquid scintillation

i. Daily verification checks shall be performed using a vendor supplied unquenched standard set (H-3, C-14 and blank).

ii. Each batch shall contain a calibration blank vial to be used for blank subtraction (Section 3.6.7 of this SOW).

iii. If the constant quench method of calibration is used, the quench of the sample shall be within +/- 5 percent of the quench of the efficiency standard. If this condition is not met, the sample must be reanalyzed beginning with a new sample aliquot.

e) Kinetic Phosphorescence Analysis for uranium

Kinetic Phosphorescence analysis (KPA) has been found to be unreliable due to strong susceptibility to interferences from constituents commonly found in Sandia samples. KPA shall not be used in the analysis of Sandia samples. ICP-MS is the preferred technique for total uranium determinations.

f) Alpha scintillation (Ra-226 by Rn emanation)

i. The efficiency of detector/cell combinations (cell constants) shall be determined at least annually, with verification monthly or after

maintenance activities.

ii. Detector/cell background shall be measured before counting each sample.

3.6.10 Reporting non-target radionuclides in gamma spectroscopy

The laboratory shall report any and all non-target radionuclides having activities greater than the minimum detectable concentration (MDC) that are identified using the gamma spectroscopy software without any additional charge to the SNL/SMO. Care will be taken to ensure that these non-target radionuclides are not interference from NORM or other high-activity radionuclides.

3.6.11 Reporting K-40 for soils in gamma spectroscopy

Laboratories must report the result for K-40 with those for the target analytes when soil samples are analyzed. If K-40 is not identified in any Sandia soil sample, the laboratory must include a discussion of the reasons for that fact in the case narrative. In general, corrective action will be required if the laboratory fails to identify K-40 in soil samples.

3.6.12 Reporting Radium-226 in gamma spectroscopy

The laboratory shall follow the provided guidelines when reporting radium-226 results by gamma spectroscopy.

a) Quantification using radon-222 daughter analytes

If lead-214 and/or bismuth-214 results are to be used to report radium-226 in a solid sample matrix, the sample must be prepared according to Section 3.2.2 of this SOW, along with the requirement that the sample container be completely filled with sample (i.e., no head-space) and tightly sealed such that radon gas cannot escape. The detector must be calibrated with a standard that matches this geometry. The sealed sample must undergo a 21-day ingrowth period before gamma count to allow radon-222 daughters to reach secular equilibrium with radium-226. If radium-226 is reported without meeting these conditions, it must be documented in the case narrative that the radium-226 sample result is estimated with suspected negative bias due to incomplete equilibrium with daughter nuclides.

Note: Though it is possible to report radium-226 in an aqueous matrix using the above guidelines, the more sensitive analysis by Lucas Cell is typically employed to satisfy required detection limits.

If the above conditions are met, lead-212 and/or bismuth-212 can be used to report radium-224 and/or thorium-228.

b) Quantification using the radium-226 186 keV emission line

The guidelines in Section 3.6.12 (a) are preferred for reporting radium-226 by gamma spectroscopy. For samples that have reporting turnaround times that disallow 21-day ingrowth periods, the radium-226 186 kilo electron volt (keV) emission line can be used to report radium-226 results if the following conditions are met. If a uranium-235 peak is observed at 144 keV (and possibly at 163 keV and 205 keV), the 186 keV peak must have the appropriate number of uranium-235 counts subtracted from it before it is used to quantify radium-226. The radium-226 uncertainty and MDC results must be adjusted for this interference correction. If uranium-235 is not observed in the gamma spectrum, radium-226 can be reported using the 186 keV peak without correction.

3.6.13 Tritium distillations

Soil tritium determinations shall be performed using vacuum or cryogenic distillation. The aliquot shall be taken to complete dryness during the distillation process to ensure complete removal of titrated water. For very dry samples, a second aliquot may have to be distilled. Dead water should only be added to the distillates with SDR approval and documented in the narrative.

3.7 Asbestos analysis

3.7.1 Accreditation

Laboratories must be accredited by the AIHA to be eligible to perform airborne asbestos analysis for the SNL/SMO. Laboratories must participate in and report results to the SDR for all PE rounds to demonstrate that the accreditation is current. In addition, the SDR must receive copies of each report, response, and close-out letter for audits performed by the accrediting agency.

3.7.2 Staff qualifications

Individuals performing the preparation and phase-contrast microscopy analysis of airborne asbestos filters shall have successfully completed the NIOSH 582 course. Individuals analyzing bulk samples shall have successfully completed the McCrone Research Institute course in polarized-light microscopy identification and quantitation of asbestos minerals in bulk samples.

3.7.3 Quality control

a) Laboratories performing airborne asbestos analysis shall conform to the requirements of the accrediting agency, including participation in the AIHA Airborne Asbestos Proficiency Analytical Testing (PAT) program and the interlaboratory sample exchange program. In addition, archived PAT program samples shall be analyzed with every sample batch and reported with the batch results. The known values and acceptance windows

provided by the PAT program shall be used as acceptance criteria. The laboratory QA officer or his/her designee shall periodically re-label the known samples so that they are submitted as blinds to the analyst.

b) Laboratories performing bulk asbestos analysis shall conform to the requirements of the AIHA, including participation in the AIHA Bulk Asbestos PAT Program. Participation in the NIST National Voluntary Laboratory Accreditation Program for bulk asbestos is also recommended. Laboratories are encouraged to retain samples from those programs and submit them as blinds with each batch as specified above for airborne samples. Required QC practices in the laboratory procedures shall include verification of microscope alignment and performance. Specific QC practices for particular asbestos types and matrices shall be determined by mutual agreement between the laboratory and the SNL/SMO.

3.8 Geotechnical analyses

3.8.1 Accreditation

Samples that the SDR typically sends to laboratories for geotechnical testing will not require American Association of State Highway Transportation Officials (AASHTO) certification. If the certification is required, the SDR will send those samples to a certified laboratory.

3.8.2 Facilities and training

Facilities and staff training levels for participating laboratories must comply with ASTM D3740, “Minimum Requirements for Agencies Engaged in Testing for Engineering Design and Construction.”

3.8.3 Methods

Laboratories shall use the methods in the most recent Annual Books of ASTM Standards to perform geotechnical tests. Laboratories shall adhere to the QC requirements given in the ASTM methods used.

3.8.4 Parameters

A list of geotechnical tests is included as Attachment 4. Analytical needs outside those listed in Attachment 4 will be addressed on a case-by-case basis.

4.0 ANALYTICAL DATA DELIVERABLE REQUIREMENTS

4.1 Analytical data package contents and format

Data packages shall contain the analytical data and appropriate supporting documentation for all samples. The standard SDR deliverable (Level C or D) shall consist of a hard copy and compact disc (CD) with an electronic file suitable for direct

computer input. The electronic data files shall be provided for all sample delivery groups simultaneously with the hard copy, unless specified differently on the ARCOC. The CD shall also include an electronic copy of the complete data package. The laboratory shall provide pricing for ARCOC requests where electronic deliverables are not required. Hard copy reports shall be produced from the electronic data deliverable for consistency and compatibility. Specifications for electronic data transfer are provided by Sandia in Attachment 11, Exhibit 1. All information recorded on the hard copy report shall be legible and of sufficient print quality for normal reproduction. Each page of the report shall be sequentially numbered.

4.1.1 Level C analytical reports

Items included in Level C analytical data packages provided to the SDR are discussed in items (a) through (f) below. A comprehensive case narrative is required for all data reports submitted. Data packages shall contain all of the following items:

a) A completed Deliverable Transmittal/Review form. This form must contain the SNL ARCOC number as well as the laboratory's SDG reference.

b) A case narrative that describes the contents of the data package and provides an index of samples associated with the delivery order (including both the Sandia sample IDs and the laboratory sample IDs). A description of problems encountered in sample receipt, login, and analysis shall also be included in the narrative. The case narrative shall describe the circumstances leading to the use of data qualifiers and list the affected samples. In addition, the type of digestion used shall always be clearly specified in the case narrative for general inorganic analysis of soil samples. All case narratives shall include a signed statement affirming that the analytical work and data package have been reviewed and are in compliance with the requirements of this SOW.

c) One original Analysis Results form for each sample associated with the deliverable. The required contents of each Analysis Results form are outlined in Section 4.1.4 of this document.

d) QC data deliverables consisting of completed CLP QC data reporting forms or equivalent for all sample analyses associated with the delivery order. The QC data deliverables are discussed in detail in Section 4.1.8 of this document.

e) Signed and dated original COC forms received with each sample shipment, indicating sample receipt and custody by the laboratory. Condition-on-receipt checklist and copies of air bills shall be included.

f) One EDD of the analytical data and QC results formatted as outlined in Attachment 11, Exhibit 1, of this SOW.

g) CD with the EDD file plus an electronic copy of the data package.

Shipping documents, instrument printouts, standard preparation logs, digestion logs, analyst work sheets, or other forms of "raw" data shall not be included unless specifically requested. This material will be inspected during periodic data package assessments.

Level C reports shall be on 8.5” x 11” paper, one-sided, and paginated.

4.1.2 Level D analytical reports

a) Level D analytical report formats shall include all elements required in Level C analytical reports, as described above, plus shipping and login documents, all email correspondence applicable to the data package, analyst worksheets, instrument run logs, instrument printouts, standard preparation logs, digestion and extraction logs, and other forms of raw data as necessary to support data defensibility. Analyst worksheets and logs shall meet the minimum requirements given in this SOW. If the vendor name, lot number, and expiration date is given in tabular form on the chemist worksheets for all calibration and second-source calibration verification standards, the standards preparation logs need not be included.

b) For radiochemistry, laboratories shall adhere to the spirit of the inorganic and organic chemistry reporting requirements in preparing analytical reports. This means that laboratories performing radiochemical analyses shall include analyst worksheets, instrument printouts, standard preparation logs, digestion logs, and other forms of raw data in the reports. Raw data shall include all aliquot weights/volumes, tracer/carrier recoveries, counting times, detector efficiencies, and other information necessary to re-create analytical results. Radiochemistry counting instrument calibration data shall not be included with data reports, but rather shall be maintained by laboratories as records. However, radiochemistry data packages shall include copies of the calibration verification, blank check results, and acceptance criteria associated with the sample results being reported.

c) Standards certificate of analysis information, log entries for water quality, log entries for balance calibration verification, and other similar ancillary information shall not be included in analytical reports. Such information shall be maintained by the laboratories as records.

4.1.3 Level B analytical reports

Level B analytical reports are a simplified version of the Level C package. Level B packages will include analytical results reporting forms with a QC summary page. CLP-like forms are not required. EDD is optional. Level B reports could be requested as CD deliverables only. Laboratories shall provide pricing for Level B reports.

4.1.4 Reporting forms for analytical results

a) The Analysis Results form shall be used to report parameter concentrations measured by the laboratory. The use of CLP forms is not preferred.

b) The laboratory shall specify the complete Sandia sample ID, date of sample collection, date of sample receipt at lab, date analyzed, date extracted (where appropriate), delivery order number (SDG field), report date, analytical batch number, sample matrix, and a qualitative description of sample appearance on each page of the Analysis Results form. Alternatively, laboratories may provide sample descriptions by including sample digestion/extraction logs or a tabular summary of qualitative descriptions with the deliverable. For each result, the laboratory shall provide the parameter name, parameter value, uncertainty value (where applicable), MDL and PQL, or MDA and L_c (as applicable), units of measure, data qualifier(s), method of analysis, dilution factors (default is 1), and analysis date on the Analysis Results form. Analysis Results forms shall include the extraction date (as applicable). Alternatively, a tabular summary of extraction dates may be provided immediately following the Analysis Results forms.

4.1.5 "Less than" results

Laboratories shall not use mathematical “less than” signs in reporting Sandia analytical results. Qualifiers for low-level general inorganic and organic results are discussed in Section 3.3.3 of this SOW. Radiochemical results that are less than the MDA shall be reported as measured, with a “U” qualifier, as discussed in Section 3.3.4 of this SOW.

4.1.6 Analytical uncertainties and detection limits

The analytical uncertainty values, L_c, and MDAs for radiochemical parameters shall be reported with each result on both the hard copy and the EDD.

4.1.7 Electronic Data Deliverable format

Format requirements for the EDD copy of analytical data are provided in Attachment 11 of this SOW. The data for the hard copy deliverable and the EDD shall be drawn from the same database at the same time.

4.1.8 Reporting conventions

Anion reporting conventions are as listed below:

a) Ammonium is reported as N.

b) $NO_2 + NO_3$ is reported as N.

c) Nitrate is reported as N.

d) Nitrite is reported as N.

e) Total phosphorus is reported as P.

f) Sulfate is reported as SO_4.

g) Ortho-phosphate is reported as P.

4.1.9 Quality Control deliverables

a) QC data deliverables for general inorganic chemistry shall include items listed below. The delivery order number shall be given on each page of the QC data deliverable. QC acceptance limits shall be included in the QC deliverable. All QC forms shall be clearly labeled.

i. ICV and CCV analysis data shall include the parameter name, true ICV concentration, found ICV concentration, ICV percent recovery, true CCV concentration, found CCV concentration(s), and each CCV percent recovery. The use of EPA CLP Form II-IN, or an equivalent format that presents the same information, is acceptable.

ii. ICB and CCB analysis data shall include the parameter name, ICB analysis result, and CCB analysis result(s). The use of EPA CLP Form III-IN, or equivalent, is acceptable.

iii. PB analysis data shall include the parameter name and PB results for each analytical batch. The use of EPA CLP Form III-IN, or equivalent, is acceptable.

iv. ICS analysis data shall include the parameter name, true concentration values for solutions A and AB, initial measured values for solutions A and AB, initial percent recovery for solution AB, final measured values for solutions A and AB, and the final percent recovery for solution AB. The use of EPA CLP Form IV-IN, or equivalent, is acceptable.

v. Spike analysis data shall include the parameter name, spiked sample result, sample result, spike added, and spike percent recovery for each spike analysis. In addition, include the required data qualifiers for spike analyses that fall outside the control limits. The use of EPA CLP Form V (Part 1)-IN, or equivalent, is acceptable.

vi. Replicate analysis data shall include the parameter name, sample result, replicate result, and RPD. Include the required data qualifiers for replicate analyses that fall outside the applicable control limit. The use of EPA CLP Form VI-IN, or equivalent, is acceptable.

vii. LCS analysis data shall include the parameter name, true concentration of the LCS, measured concentration of the LCS, and the percent recovery for the LCS. The use of EPA CLP Form VII-IN, or equivalent, is acceptable. Solid LCS data shall be accompanied by the applicable acceptance criteria.

viii. Standard addition results shall be reported for GFAA, as appropriate. The use of CLP Form VIII-IN, or equivalent, is acceptable.

ix. Analysis run logs shall be provided. The use of EPA CLP Form XIV-IN, or equivalent, is acceptable for all parameters.

x. Initial calibration data shall be provided and shall include the number and concentration levels of calibration standards, curve equations, and correlation coefficients.

xi. RL verification (CRI and CRA) data shall be provided (Form 2B-IN or equivalent) and shall include the parameter name, true standard concentration, measured concentration, and percent recovery value.

xii. ICP-AES serial dilution data shall be provided (Form 8-IN or equivalent) and shall include for each parameter the parameter name, parameter concentration in the sample, parameter concentration in the diluted sample (corrected for the 5X dilution), and the percent difference value.

xiii. ICP-MS tune reports shall be provided and shall include for elements representing all mass ranges of interest the mass calibration values and the full width resolution values at 10 percent peak height.

b) QC data deliverables for radiochemistry shall include items listed below. The delivery order number shall be given on each page of the QC data deliverable. QC acceptance limits shall be included in the QC deliverable. All forms shall be clearly labeled.

i. The instrument calibration date and associated calibration file names shall be provided. Alternatively, this information may be placed on chemist worksheets. All calibration files shall be archived and retrievable.

ii. PB data shall be provided for each batch and shall include the parameter name, result, and uncertainty. Aliquot size corrected blank results shall be included.

iii. MS data shall include the parameter name, spiked sample result, sample result, spike added, and spike percent recovery for each

spike analysis. Include the required data qualifiers for spike analyses that fall outside the control limits.

iv. Replicate data shall include the parameter name, sample result, replicate result, and RER value. Sample and replicate results for radionuclide and gross radiation determinations shall be accompanied by the 95 percent confidence level uncertainty values. Include the required data qualifiers for replicate analyses that fall outside the control limit.

v. LCS data shall include the parameter name, true concentration of the LCS, measured concentration of the LCS, and the percent recovery for the LCS. Solid LCS data shall be accompanied by the applicable acceptance criteria.

vi. The instrument and detector identifiers shall be provided for each sample. This is typically present on the instrument printouts. If so, it need not be repeated in the QC summary.

vii. Radionuclide tracer or carrier recoveries, or standard addition recoveries used for sample-specific chemical recovery correction, shall be reported in the QC deliverable. For recoveries that fail to meet the criteria specified in Section 3.6.6, a record of SDR approval to report shall be provided in the case narrative.

c) QC data deliverables for organic chemistry shall include items listed below. The delivery order number shall be given on each page of the QC data deliverable. QC acceptance limits shall be included in the QC deliverable. All forms shall be clearly labeled.

i. Initial calibration data, ICV data, and CCV data shall be presented. The initial calibration data shall include the average RF (or CF) and RSD, or the curve equations and correlation coefficients if regression is used. The calibration verification data shall include the percent difference values.

ii. Preparation or method blank data shall be provided for each batch and each 12-hour period, as applicable. The method blanks that follow CCVs in some GC methods shall be reported. Blank data shall include the parameter name and analysis result and shall be reported to the SDR on a CLP Form I.

iii. MS and MSD analysis data shall include the parameter name, spiked sample result, sample result, spike added, spike percent recovery, and RPD for each MS/MSD analysis. Include the required data qualifiers for MS/MSD analyses that fall outside the control limits. If the MS/MSD is run on a sample from another SDG, that SDG must be identified on the report.

iv. If replicate analyses are performed, the replicate data shall include

the parameter name, sample result, replicate result, and RPD. Include the required data qualifiers for replicate analyses that fall outside the applicable control limits. If a replicate is run on a sample from another SDG, that SDG must be identified in the report.

v. LCS analysis data shall include the parameter name, true concentration of the LCS, measured concentration of the LCS, and the percent recovery for the LCS.

vi. Analysis run logs shall be provided for all analytical runs for which data are reported.

vii. Surrogate and internal standard recoveries, and associated acceptance criteria, shall be reported in the QC deliverable. Recoveries that fail to meet the applicable criteria shall be explained in the case narrative.

viii. Laboratories shall include Form 10 or equivalent reports to describe replicate precision and second column results for all dual-column GC and HPLC work.

ix. GC/MS tune reports shall be submitted and shall include the relative abundance values and acceptance criteria.

4.1.10 General inorganic chemistry and radiochemistry data qualifiers

General inorganic chemistry and radiochemistry data qualifiers available for use by the laboratory are listed and discussed below. The use of these data qualifiers is required on the Analysis Results form, the EDD, and the QC data deliverable. Of the qualifiers discussed below, only the “H”, “U”, “N”, “X”, and “*” may be used in reporting radionuclide and gross radiation results.

a) In the event that the holding time for a particular parameter had expired prior to analysis, flag the associated results with an "H” on the Analysis Results form and the EDD.

b) Analytical results obtained for samples that required dilution prior to analysis shall be qualified with the "I" flag. This qualifier indicates that the related detection limits are elevated due to the presence of an interference or because of a high parameter value.

c) Data associated with failed ICP-AES serial dilution results shall be flagged with the "E" flag. The "E" flag shall also be used to qualify GFAA data according to the guidelines specified in the CLP SOW. In both cases, the specific requirements of the EPA CLP SOW apply to the use of this qualifier. When this flag is used, an explanatory note shall always be included in the case narrative.

d) Analytical results associated with a spike analysis that was outside control limits shall be qualified with the "N" flag.

e) Analytical results associated with a replicate analysis that was outside the control limit shall be qualified with a "*" flag.

f) General inorganic results having concentrations between the MDL and the PQL (or RL) shall be qualified with a “J” flag.

g) The “X” qualifier is used only to denote the existence of presumptive evidence suggesting that the reported analyte is not present in the sample. That is, this qualifier may be used only to indicate that the chemist believes the result to be a false positive. When the “X” qualifier is used, laboratories must provide supporting data and explanatory case narrative comments in the data package.

h) Analytical results with associated batch QC blank concentrations greater than the MDL will be qualified with a “B” flag when the sample concentration is greater than the MDL.

i) Analytical results that are less than the MDL will be qualified with a “U” flag. For radiochemistry, results less than the MDA and/or TPU will be qualified with a “U” flag.

4.1.11 Organic chemistry data qualifiers

Organic chemistry data qualifiers available for use by the laboratory are listed below. As with general inorganic chemistry and radiochemistry, the use of these data qualifiers is required on the Analysis Results form, the EDD, and the QC data deliverable.

a) The “U” flag indicates that the compound was a target but was not detected. The result was less than the MDL.

b) The “J” flag indicates an estimated value.

i. The “J” flag is used when estimating a concentration for TICs where a 1:1 response is assumed.

ii. The “J” flag is used when the mass spectral and retention time data indicate the presence of a compound that meets the volatile or semi-volatile GC/MS identification criteria, and the result is less than the PQL but greater than the MDL.

iii. The “J” flag is used when the retention time data indicate the presence of a compound that meets the GC or HPLC identification criteria, and the result is less than the PQL but greater than the MDL.

c) Analytical results associated with a spike analysis that was outside

control limits shall be qualified with the "N" flag.

d) The “B” flag is used when the analyte is found in both the associated method blank and the sample. This flag indicates probable blank contamination and warns the data user to take appropriate action. This flag shall be used for both TICs and positively identified target compounds. The combination of flags “BU” or “UB” is expressly prohibited. Blank contaminants are flagged “B” only when they are detected in the sample.

e) The “E” flag identifies compounds whose concentrations exceed the upper level of the calibration range of the instrument for that specific analysis. If one or more compounds have a response greater than the upper level of the calibration range, the sample or extract shall be diluted and reanalyzed. All such compounds with a response greater than the upper level of the calibration range shall have the concentration flagged with an “E” on CLP Form I for the original analysis.

f) Analytical results obtained for samples that required dilution prior to analysis shall be qualified with the “I” flag. This qualifier indicates that the related detection limits are elevated due to the presence of an interference or because of a high parameter concentration.

g) In the event that the required holding time to extraction or holding time to analysis was missed, flag the associated results with an "H."

h) The “X” qualifier is used only to denote the existence of presumptive evidence suggesting that the reported analyte is not present in the sample. That is, this qualifier may be used only to indicate that the chemist believes the result to be a false positive. When the “X” qualifier is used, laboratories must provide supporting data and explanatory case narrative comments in the data package.

i) Analytical results associated with a matrix spike duplicate analysis that was outside the control limit shall be qualified with a “*” flag.

j) When a sample is re-extracted and re-analyzed and both the original results and re-extracted results are reported (e.g., when surrogates fail but the re-extraction was outside the holding time), the sample number for the re-extracted results shall be uniquely identified using a re-extraction suffix.

4.1.12 Completeness

Partial deliverables shall not be submitted to the SDR unless specifically requested. In addition to the deliverable requirements given in this section, the SDR reserves the right to request run logs and chromatograms (organic chemistry only) relevant to samples from other laboratory clients that were run before or during the analytical run for Sandia samples. This is sometimes

necessary to investigate suspected carryover contamination. Laboratories that fail to submit complete responses to such requests in a timely manner will be considered unresponsive and may be suspended from the laboratory analysis program. Further, the chromatograms submitted under this SOW provision shall not be edited or altered in any way, other than to delete client-specific information, prior to submission to the SNL/SMO.

4.1.13 Significant figures

a) A maximum of three significant figures shall be used to report the final analytical result.

b) Uncertainty and detection limit values shall be reported to no more than two significant figures.

c) Analytical results, uncertainties, and detection limits may be reported to one place beyond the last significant figure given for the MDLs, PQLs, L_c, or MDAs in the attachments. For example, the MDL for antimony in water is 0.06 mg/L. A result of 0.063 mg/L may be reported, while 0.0633 mg/L would be rounded down to 0.063 mg/L.

4.1.14 Chromatographic data presentation guidelines

When presenting chromatographic data, peak integrations must be displayed with a scale that provides sufficient detail to clearly view the integration. This is particularly important when small peaks are integrated in the presence of larger peaks, a situation that skews the display scale. As guidance, if the laboratory must enlarge the scale of the chromatogram to review the integration, then the enlarged view should be present in the data package. Particular attention should be applied to those instances where a value is observed above the MDL but below the PQL, as integration errors are prevalent in these situations and may result a false positive result.

4.2 Analytical data deliverable deadlines

4.2.1 Turn around times

a) A report of analytical results is due to the SDR 30 calendar days from the date of receipt of the last sample associated with each delivery order when standard turnaround time is requested.

Turnaround times for accelerated delivery requests shall be

- 72 hours (or less as negotiated by the SDR and the contractor),
- 7 calendar days,
- 15 calendar days,
- Turnaround times shall be mutually agreed upon by the contractor and the SNL/SMO. Reports with accelerated turnaround times shall be faxed or sent as PDF electronic files to the SNL/SMO, in the laboratory's LIMS format if desired, with the full deliverable

due 15 days from receipt of samples.

- o Times are measured from the time samples are received at the laboratory to the time the SDR receives the data deliverable.

b) Reports for any requested reanalyses are due 10 working days from the date of the request unless required ingrowth times preclude this. In that case, the reanalysis reports are due no later than 15 working days from the request date. The SDR reserves the right to request expedited reanalyses when circumstances require this. Reimbursement shall be made according to the specifications of Section 1.6.2 of this SOW and will be at the standard turnaround time rates unless expedited reanalyses are requested. For reanalysis turnaround times less than 5 working days, payment will be at the applicable rate for the corresponding expedited analyses (subject to the stipulations of Section 1.6.2). Reanalysis reports shall be submitted according to the guidelines for the report level originally requested for that delivery order.

c) When report corrections are requested the laboratory must bear in mind that timely delivery is crucial from the perspective of completing data validation and making the data available to users. Simple corrections to reports, such as replacing incorrect pages or supplying omitted pages, must be delivered within no more than 24 hours. Corrections that require regeneration of data, or reassembly of the data package, are due within no more than 72 hours.

d) All correction submittals, both PDF and hard copy, must include a cover sheet that describes the deliverable to which they apply, what corrections are represented, and why the corrections were necessary.

e) The laboratory shall provide a proforma billing statement for each sample delivery group. The statement must clearly describe the number of samples, the analysis requested for each sample, unit cost, and estimated extended cost for each sample. The proforma must clearly reference the SNL ARCOC number(s) and be received by the SDR within 7 calendar days of sample receipt.

f) Invoices shall be submitted monthly on a single invoice for the sample delivery groups reported in that period. Invoices shall contain the SNL ARCOC numbers, associated sample delivery group numbers, and total cost. Proforma statements with detailed information should be attached to the invoice. A summary of attached proformas shall be included on the invoice cover page. Invoices shall be itemized and organized in such a way as to facilitate detailed review and cost verification without additional laboratory input. Costs for SDGs with unresolved problems as identified by the SDR staff shall not be invoiced until the problem is resolved. All invoices for a particular fiscal year (FY) shall be received by SNL by November 15th of the following FY. All data deliverable and billing problems shall be resolved by January 1st of the following FY. Sandia reserves the right to reject payment on late invoices due to failure to meet fiscal yearend deadlines.

4.2.2 Level D report deliverable deadlines

In specific instances, Level D deliverables may be needed after Level C reports were requested and received. The laboratory must be prepared to deliver additional records at a future time.

a) Level D documentation shall be maintained at the laboratory unless it is specifically requested for delivery to the SNL/SMO.

b) When Level D deliverables are requested to support data that have been delivered previously, the Level D deliverable shall be due 2 weeks from the date of the request.

c) The charge for the preparation of formal Level D data packages shall be specified in the itemized price list submitted by the laboratory.

4.2.3 Price reduction

a) All deliverables shall be due at the specified time unless express permission to deviate from the deliverable schedule is given by the SNL/SMO. Price reductions may be imposed for late deliverables at the discretion of the SNL/SMO, depending on the contributing circumstances, at the rate of 2 percent per working day for normal 30-day requests and 2 percent per calendar day for rush requests.

b) Unit prices will be those for the period when the deliverable arrives. However, the percent price reductions will be calculated based upon the originally requested turnaround time. That is, a report for results with a 7-day requested turn around that arrives on the 15th day will be paid for at the 15-day turn around rates less 16 percent.

c) Price reductions will not accumulate on weekends or holidays recognized by Sandia for normal 30-day requests.

d) Price reductions will be applied to particular parameters or analyses when data quality is reduced by failure to comply with the requirements of this SOW for those parameters or analyses. Sandia reserves the right to reject payment for analysis performed by the laboratory when the method-specified holding time was missed due to laboratory error. Unusable data resulting from noncompliance will not be paid for.

e) The NNSA Service Center AMP guidelines for reduction in payment are provided as Attachment 8.

4.2.4 Reporting Performance Evaluation results

The reports for PE samples submitted by the SDR shall be due as requested on the ARCOC; typically, 15, or 30 days from the date of sample receipt.

4.2.5 Reporting results for more than one analytical category

Level C reports that contain data for any combination of the major analytical categories (general inorganic, organic, radiochemistry, asbestos, or geotechnical) shall be organized by category. That is, the results forms, custody documents, and QC reports for each category shall be placed together in the deliverables. When Level D deliverables are requested, a separate deliverable shall be prepared for each analytical category unless the delivery of consolidated packages is negotiated in advance with the SNL/SMO.

5.0 LABORATORY HEALTH AND SAFETY, WASTE MANAGEMENT, AND ETHICS AGREEMENT REQUIREMENTS

The laboratory shall have the documents listed below, as applicable, and demonstrate their implementation through maintenance of employee training records.

- A chemical hygiene plan.
- A waste management plan.
- A radiological safety plan. The radiological safety plan, or a Sandia site-specific plan, shall require radiation screening during the sample receipt/login process for all samples submitted for chemical analysis.
- Ethics agreements. Laboratories shall have signed ethics agreements on file for all personnel contributing to project management, sample management, analysis, data review, and data reporting.

6.0 REFERENCES

U.S. Environmental Protection Agency, Methods for the Determination of Metals in Environmental Samples, EPA 600 4-91-010, June 1991, and Supplement 1, 1995.

U.S. Environmental Protection Agency, Contract Laboratory Program Statement of Work for Inorganic Analysis, Multi-media, Multi-Concentration, ILMO5.3, March 2004.

U.S. Environmental Protection Agency, Contract Laboratory Program Statement of Work for Organics Analysis, Multi-media, Multi-Concentration, OLMO4.2, May 1999.

U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste, Report SW-846, Third Edition, November 1986 (and updates).

U.S. Environmental Protection Agency, Methods for Chemical Analysis of Water and Wastes, EPA 600 4-79-020, December 1984.

U.S. Environmental Protection Agency, Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA/600/4-80/032, August 1980.

U.S. Environmental Protection Agency, Methods for the Determination of Organic Compounds in Drinking Water, EPA/600/4-88/039, December 1988, Revised July 1991.

Occupational Safety and Health Administration, OSHA Analytical Methods Manual, Second Edition, Part 1, Volumes 1, 2, and 3, January 1990.

Occupational Safety and Health Administration, OSHA Analytical Methods Manual, Second Edition, Part 1, Volume 4, October 1993.

Occupational Safety and Health Administration, OSHA Analytical Methods Manual, Second Edition, Part 2, Volumes 1 and 2, August 1991.

National Environmental Laboratory Accreditation Conference, NELAC Quality Systems Standard, 2003.

Department of Energy, DOE Quality Systems for Analytical Services, Revision 2.4, October 2008.

7.0 ACRONYMS

AA	Atomic Absorption
AIHA	American Industrial Hygiene Association
AMP	Analytical Management Program
APHA	American Public Health Association
ARCOC	Analysis Request and Chain of Custody
ASTM	American Society for Testing and Materials
BOD	Biological Oxygen Demand
CAR	Corrective Action Report
CCB	Continuing Calibration Blank
CCV	Continuing Calibration Verification
CF	Calibration Factor
CFR	Code of Federal Regulations
COC	Chain of Custody
CRA	Reporting Limit Verification for AA Methods
CRI	Reporting Limit Verification for ICP-AES and ICP-MS Methods
CU	Counting Uncertainty
DI	Deionized
DOE	U.S. Department of Energy
DOECAP	DOE Consolidated Audit Program
DOELAP	DOE Laboratory Accreditation Program
DQO	Data Quality Objective
DRO	Diesel Range Organics
EDD	Electronic Data Deliverables
EICP	Extracted Ion Current Profile
EPA	U.S. Environmental Protection Agency
FY	Fiscal Year
GALP	Good Automated Laboratory Practices
GC/MS	Gas Chromatography/Mass Spectrometry
GFAA	Graphite Furnace atomic Absorption
GFPC	Gas Flow Proportional Counter
GRO	Gasoline Range Organics
HE	High Explosives
HF	Hydrofluoric Acid
HPLC	High Performance Liquid Chromatography
IC	Ion Chromatography
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
ICS	Interference Check Sample
ICV	Initial Calibration Verification

ID	Identification or Identifier
KPA	Kinetic Phosphorescence Analysis
Lc	Critical Level
LC/MS/MS	Liquid Chromatography/Mass Spectrometry/Mass Spectrometry
LCS	Laboratory Control Samples
LIMS	Laboratory Information Management System
LN2	Liquid Nitrogen
LQAP	Laboratory Quality Assurance Plan
MDA	Minimum Detection Activity
MDC	Minimum Detectable Concentration
MDL	Method Detection Limit
MDLV	Method Detection Limit Verification
MB	Method Blank
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ND	Not Detected / Non-Detect
NELAC	National Environmental Laboratory Accreditation Conference
NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute of Standards and Technology
NNSA	National Nuclear Service Administration
OSHA	Occupational Safety and Health Administration
PAT	Proficiency Analytical Testing
PB	Preparation Blank
PCB	Polychlorinated Biphenyl
PDS	Post Digestion Spike
PE	Performance Evaluation
PQL	Practical Quantitation Limit
PT	Performance Testing
QA	Quality Assurance
QC	Quality Control
QPR	Quarterly Progress Report
RER	Replicate Error Ratio
RF	Response Factor
RL	Reporting Limit
RLV	Reporting Limit Verification
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
Sandia	Sandia Corporation
SDG	Sample Delivery Group
SDR	Sandia Delegated Representative
SNL	Sandia National Laboratories

SNL/SMO	Sandia National Laboratories/Sample Management Office
SOP	Standard Operating Procedure
SOW	Statement of Work
SPE	Solid Phase Extraction
SPLP	Synthetic Precipitation Leaching Procedure
SVOC	Semi-volatile Organic Compound
TIC	Tentatively Identified Compound
TCLP	Toxicity Characterization Leaching Procedure
TOC	Total Organic Carbon
TOX	Total Organic Halides
TPU	Total Propagated Uncertainty
VOC	Volatile Organic Compound

Measurements and Symbols

°C	degrees Centigrade
keV	Kilo Electron Volt
MΩ·cm	mega ohms per centimeter
µmho/cm	micro ohm per centimeter
g	gram
m	milli (1/1000)
L	Liter
ppb	parts per billion
ppm	parts per million

GLOSSARY

ASTM Type I, II Water	For the purposes of this SOW, water types are those discussed in ASTM standard D 1193-77. ASTM Type I water has conductivity less than 0.06 μmho/cm or resistivity greater than 16.67 MΩ·cm. ASTM Type II water has conductivity less than 1 μmho/cm or resistivity greater than 1 MΩ·cm.
Chemical Analysis	A term that refers to all general inorganic, organic, and radiochemical analyses. The term "chemical analysis laboratory" refers to any laboratory performing those analyses under this SOW.
Controlled Document	A document that is subject to special preparation, distribution, and tracking protocols. The document control protocols ensure that persons in possession of documents are known, so that complete incorporation of revisions or implementation of new versions can be verified against the list of document holders.
Daily Requirements	Requirements for checking refrigerators, balances, and the like; these requirements apply only to business days. Daily requirements for instrument calibration and standards preparation refer only to days when the instruments are used.
Deliverable Levels	Specifications for classes of analytical data reports.
Delivery Order	A specific request for analysis of a sample or samples under an existing contract that provides all applicable specifications. No technical specifications are included with a delivery order except when special conditions occur.
Duplicate	A sample split taken by the sampling team and submitted as a sample for the purpose of assessing both sampling and analytical precision.
EDD	The acronym for electronic data deliverable. This is the computer file containing analytical results and associated information.
Intermediate Dilution	A dilution of some stock solution that requires further dilution before use in instrument calibration or QC sample preparation. Intermediate dilutions are not used to calibrate instruments in undiluted form.
L_c	The acronym for critical level corrected for concentration. When calculated according to the equation in the SOW, the L_c, gives the level at which there is a five percent probability or reporting a false positive for a sample containing no analyte. It's calculated sample specifically using variable values from the actual analytical conditions. L_c shall be reported for all radiochemistry results.
MDA	The acronym for minimum detection amount. The MDA provides sample-specific information about analytical measurement sensitivity in radiochemistry.

GLOSSARY

MDL	The acronym for method detection limit. This is a measure of instrument sensitivity using solutions that have been subjected to all sample preparation steps for the method. Reagent contributions to the signal are thus included in the MDL.
Optional Compounds	Compounds that are not routinely required in instrument calibration or the reporting of analytical results.
PE (or PT) Samples	Samples with known constituent concentrations that are periodically submitted to test laboratory analytical and reporting performance. These samples are not submitted as blinds in each sample shipment.
PQL	The acronym for practical quantitation limit. The PQL is defined to be 5 times the MDL under this SOW.
Reagent	A chemical of known purity that is used in analytical methods. This term does not apply to materials used to calibrate instruments or to perform QC activities. Such materials are called standards.
Record	The term applied to information that is subject to special handling requirements. In this SOW, ”record” means information that must be maintained in such a way as to ensure that it can be retrieved in its entirety on demand.
Replicate	A sample split taken by the laboratory and prepared separately from the original sample for the purpose of assessing analytical precision.
SMO	The entity within Sandia that is responsible for writing technical and QA specifications for analytical chemistry, technical administration of laboratory contracts, sample shipment and tracking, and the various data verification, validation, and management functions.
SOP	The acronym for standard operating procedure. SOPs are documents prepared by a laboratory as controlled documents to describe the implementation of analytical methods in that laboratory. SOPs are also used to formally describe activities in the laboratory other than analytical processes.
Standard	Any material intended for use, possibly as a dilution, in instrument calibration or to perform QC activities.
Stock Solution	A high-concentration standard. Stock solutions are not used to calibrate instruments or as QC samples, but rather are diluted to produce the standards used to calibrate or prepare QC samples.

Working Standards	Standards used to calibrate instruments.
Worksheet	A term that refers to any form used to describe the work in a particular analytical batch. Worksheets may present the data acquired or be a cover sheet for those data.
Worksheet Review	A process for assessing the degree of compliance with laboratory and client requirements in the analysis documentation.

Attachment 1
General Inorganic Parameters and Target MDLs, PQLs

Table I. Metal Target Analytes and Required MDLs

Analyte	MDL (Method 6010/6020)		
	Water mg/L	Solid[1] mg/kg	Air Filter µg/sample
		Vegetation mg/kg	
Aluminum	0.05	3	10
Antimony	0.005	1	1
Arsenic	0.001	0.2	2
Barium	0.05	1	10
Beryllium	0.001	0.05	1
Boron	0.03	1	NA
Cadmium	0.001	0.1	1
Calcium	0.05	50	NA
Chromium	0.002	0.2	2
Cobalt	0.003	0.2	1
Copper	0.004	0.2	1
Iron	0.03	0.4	4
Lithium	0.01	1	NA
Lead	0.003	0.05	2
Magnesium	0.01	5	10
Manganese	0.002	0.2	2
Mercury (245.1, 7470A, 7471A)	0.0002	0.0002	0.005
Molybdenum	0.01	1	1
Nickel	0.01	0.07	1
Potassium	0.05	50	10
Selenium	0.002	0.1	2
Silver	0.007	0.2	1
Silica	0.05	1.5	200
Sodium	0.05	50	100
Strontium	0.003	0.1	10
Thallium	0.001	0.1	1
Tin	0.02	1.0	1
Titanium	0.02	1.0	NA
Uranium	0.001	0.01	1
Vanadium	0.005	1	1
Zinc	0.005	0.3	2

[1]Note: The solid MDLs listed require 2-gram samples for method 3050 digestions. For microwave digestions multiply the listed MDLs by 2. For hot plate digestions, multiply the listed MDLs by 4.

Attachment 1
General Inorganic Parameters and Target MDLs, PQLs

Table II. Miscellaneous General Inorganic Target Analytes, Methods, and Required PQLs

Analyte	Method Nos.	PQL	
		Water mg/L	Solid mg/kg
Acidity as $CaCO_3$	SM 2310B	10	NA
Alkalinity as $CaCO_3$	2320B	10	NA
Ammonium as N	350	0.1	2
Bicarbonate/carbonate	2320B	10	NA
Biological oxygen demand (BOD), 5 day	5210B	2	NA
Bromide	300	0.1	2
Carbon, dissolved organic (DOC)	5310	1	NA
Carbon, total organic (TOC)	5310, 9060	0.1	100
Chemical oxygen demand (COD)	410	5	NA
Chloride	300, 4500	1	20
Chlorine, Residual	4500	1	20
Chromium (VI)	218, 7196A	0.01	0.5
Color (color units)	2120	1	NA
Corrosivity (mm/year)	1110	NA	NA
Cyanide, Amenable	4500, 9010B, 9014	0.01	0.2
Cyanide, Reactive	Chapter 7, SW-846	0.01	0.2
Cyanide, total	4500, 9010B, 9014	0.01	0.2
Dissolved oxygen (DO)	4500	0.05	NA
Fluoride	300, 4500	0.1	2
Hardness as $CaCO_3$	2340	10	NA
Ignitability (°C)	1010, 1020A, 1030	1	1
Iodide	345	0.5	10
Nitrate as N	300, 353, 9210	0.1	2
Nitrate + nitrite as N	300, 353	0.1	2
Nitrite as N	300, 354	0.1	2
Oil and grease	1664, 9070, 9071A	2	100
Perchlorate (MDL)	314, 9058, LC/MS/MS	0.004	0.01
pH (unitless)	4500, 9040B	0.1	0.1
Phenols, total recoverable	420, 9065, 9066	0.005	1
o-Phosphate as P	300, 365	0.1	2
Phosphorus, total as P	365	0.01	0.2
Solids, settleable (mL/L/hr.)	2540	0.2	NA
Solids, total (TS)	2540	10	NA
Solids, total dissolved (TDS)	2540	10	NA
Solids, total suspended (TSS)	2540	3	NA
Solids, volatile	160	20	NA
Specific Conductance (μmho/cm)	120, 9050	1	NA
Sulfate	300, 375	1	20

Attachment 1
General Inorganic Parameters and Target MDLs, PQLs

Analyte	Method Nos.	PQL	
		Water	Solid
		mg/L	mg/kg
Sulfide	4500, 9030B, 9031	1	20
Sulfide, Reactive	Chapter 7, SW-846	1	20
Sulfur, Total	6010	0.1	1
Total organic halide (TOX)	9020B	0.03	NA
Total Kjeldahl nitrogen	351	0.5	10
Total petroleum hydrocarbons	418, 1664, 8440	1	20
Turbidity (NTU)	180	0.05	NA

Attachment 2
Radiochemical Parameters and Contract Required L_c, MDAs

Table I. Required Gamma Spectroscopy Radionuclides and MDAs by Matrix. Additional radionuclides may be requested for special projects.

Radionuclide	MDA				
	Water pCi/L	Solid pCi/g	Air Filter pCi/sample	Urine pCi/L	Vegetation pCi/g
^{7}Be	TBD	TBD	TBD	TBD	TBD
^{40}K	TBD	TBD	TBD	TBD	TBD
^{60}Co	10	0.03	20	20	0.03
^{137}Cs	10	0.04	20	20	0.04
^{22}Na	TBD	TBD	TBD	TBD	TBD
^{237}Np	TBD	TBD	TBD	TBD	TBD
^{223}Ra& ^{227}Th	TBD	TBD	TBD	TBD	TBD
^{224}Ra (^{212}Pb,^{212}Bi)	TBD	TBD	TBD	TBD	TBD
^{226}Ra (^{214}Pb,^{214}Bi)	TBD	TBD	TBD	TBD	TBD
^{228}Ra (^{228}Ac)	TBD	TBD	TBD	TBD	TBD
^{235}U (^{231}Th)	TBD	TBD	TBD	TBD	TBD
^{238}U (^{234}Th)	TBD	TBD	TBD	TBD	TBD
^{235}U	TBD	TBD	TBD	TBD	TBD
^{241}Am	30	0.3	25	20	0.5

Attachment 2
Radiochemical Parameters and Contract Required L_c, MDAs

Table II. Alpha Spectrometry Radionuclides and Required Critical Levels (L_c) by Matrix

Radionuclide	L_c (Concentration Corrected)					
	Water pCi/L	Solid pCi/g	Air Filter pCi/sample	Urine pCi/L	Vegetation pCi/g	Feces Ash pCi/g
^{241}Am	0.05	0.03	0.01	0.05	0.01	0.04
^{244}Cm	0.05	0.03	0.01	0.05	0.01	0.04
^{237}Np	0.05	0.03	0.01	0.05	0.01	0.04
^{210}Po	0.5	0.5	0.1	0.1	0.01	0.04
^{238}Pu	0.06	0.03	0.01	0.05	0.01	0.04
^{239}Pu	0.06	0.03	0.01	0.05	0.01	0.04
^{226}Ra	0.5	0.2	0.5	0.5	0.2	0.2
^{228}Th	0.08	0.04	0.01	0.05	0.01	0.04
^{230}Th	0.08	0.04	0.01	0.05	0.01	0.04
^{232}Th	0.08	0.04	0.01	0.05	0.01	0.04
^{234}U	0.1	0.1	0.02	0.05	0.01	0.05
^{235}U	0.1	0.1	0.02	0.05	0.01	0.05
^{238}U	0.1	0.1	0.02	0.05	0.01	0.05

Table III. Gas Proportional Counting Radionuclides and Required Critical Levels (L_c) by Matrix

Radionuclide	L_c (Concentration Corrected)			
	Water pCi/L	Solid pCi/g	Air Filter pCi/sample	Vegetation pCi/g
Gross α	1	1	1	1
Gross β	1	1	1	1
^{89}Sr	1	5	2	5
^{90}Sr	1	0.5	2	5
^{131}I	2	5	5	5
^{210}Pb	1	5	2	5
^{210}Po	1	1	2	1
^{226}Ra	1	1	2	1
^{228}Ra	0.5	0.5	1	0.5
^{99}Tc	1	5	2	5

Attachment 2
Radiochemical Parameters and Contract Required L_c, MDAs

Table IV. Liquid Scintillation Counting Radionuclides and Required Critical Levels (L_c) by Matrix

Radionuclide	L_c (Concentration Corrected)			
	Water pCi/L	Solid/Soil pCi/g	Air Filter pCi/sample	Swipe pCi/100cm^2
^{3}H	200*	200[1*] (pCi/L)	10	10
^{14}C	500	10	20	20
^{99}Tc	1	2	20	20
^{210}Pb	1.0	5	10	10
^{222}Rn	200	200		

[1]For tritium the specified solid L_c applies to the distilled water. For waste samples the required L_c is 0.01 pCi/g. *For tritium the L_c of the distilled water pulled from environmental soil or groundwater.

Attachment 3
Organic Parameters and Target MDLs

Table I. Target MDLs for Petroleum Hydrocarbons

Method Modification/Analyte	Water MDL, µg/L	Solid MDL, mg/kg
Gasoline Range Organics (GRO)	10	1
Diesel Range Organics (DRO)	10	1
Total Petroleum Hydrocarbons (TPH)	10	1

Table II. Organochlorine Pesticides Target Analyte List and MDLs

Compound Name	CAS No.	Water MDL, µg/L	Solid MDL, µg/kg
Aldrin	309-00-2	0.004	0.14
α-BHC	319-84-6	0.003	0.10
β-BHC	319-85-7	0.006	0.20
δ-BHC	319-86-8	0.009	0.30
γ-BHC (Lindane)	58-89-9	0.004	0.14
α-Chlordane	5103-71-9		
γ-Chlordane	5103-74-2		
4,4'-DDD	72-54-8	0.012	0.40
4,4'-DDE	72-55-9	0.012	0.41
4,4'-DDT	50-29-3	0.012	0.41
Dieldrin	60-57-1	0.002	0.07
Endosulfan I	959-98-8	0.014	0.48
Endosulfan II	33213-65-9	0.004	0.14
Endosulfan sulfate	1031-07-8	0.066	2.2
Endrin	72-20-8	0.006	0.20
Endrin aldehyde	7421-93-4	0.023	0.78
Endrin ketone	53494-70-5		
Heptachlor	76-44-8		
Heptachlor epoxide	1024-57-3	0.083	2.8
4,4'-Methoxychlor	72-43-5		
Toxaphene	8001-35-2	0.24	8.2

Attachment 3
Organic Parameters and Target MDLs

Table III. Polychlorinated Biphenyls (PCBs) Target Analyte List and MDLs

Compound Name	CAS No.	Water MDL, µg/L	Solid MDL, µg/kg
Aroclor - 1016	12674-11-2	1	33
Aroclor - 1221	11104-28-2	2	67
Aroclor - 1232	11141-16-5	1	33
Aroclor - 1242	53469-21-9	1	33
Aroclor - 1248	12672-29-6	1	33
Aroclor - 1254	11097-69-1	1	33
Aroclor - 1260	11096-82-5	1	33

Table IV. Chlorinated Herbicides Target Analyte List and MDLs

Compound Name	CAS No.	Water MDL, µg/L	Solid MDL, µg/kg
Acifluorfen	50594-66-6	0.096	3.2
Betazon	25057-89-0	0.2	6.6
Chloramben	133-90-4	0.093	3.1
2,4-D	94-75-7	0.2	6.6
2,4-DB	94-82-6	0.8	26
Dalapon	75-99-0	1.3	43
Dicamba	1918-00-9	0.081	2.7
3,5-Dichlorobenzonic acid	51-36-5	0.061	2.0
Dichlorprop	120-36-5	0.26	8.6
Dinoseb	88-85-7	0.19	6.3
MCPA	94-74-6		
MCPP	93-65-2		
4-Nitrophenol	100-02-1	0.13	4.3
Pentachlorophenol	87-86-5	0.076	2.5
Picloram	1918-02-1	0.14	4.6
2,4,5-T	93-76-5	0.08	2.6
2,4,5-TP (Silvex)	93-72-1	0.075	2.5

Attachment 3
Organic Parameters and Target MDLs

Table V. VOC Method Target Analyte List and MDLs in μg/L for Water Samples and μg/kg for Low-Level Solid Samples

Compound Name	CAS No.	25 ml purge MDL μg/L	5 gm purge MDL μg/kg
Acetone	67-64-1		
Acetonitrile	75-05-8		
Acrolein	107-02-8		
Acrylonitrile	107-13-1		
Allyl chloride	107-05-1		
Benzene	71-43-2	0.2	0.2
Bromobenzene	108-86-1	0.2	0.2
Bromochloromethane	74-97-5	0.2	0.2
Bromodichloromethane	75-27-4	0.2	0.4
Bromoform	75-25-2	0.2	0.6
Bromomethane	74-83-9	0.2	0.55
2-Butanone	78-93-3		
n-Butylbenzene	104-51-8	0.2	0.55
sec-Butylbenzene	135-98-8	0.2	0.65
tert-Butylbenzene	98-06-6	0.2	0.7
Carbon disulfide	75-15-0		
Carbon tetrachloride	56-23-5	0.2	1.05
Chloral hydrate	75-87-6		
Chlorobenzene	108-90-7	0.2	0.2
Chloroethane	75-00-3	0.2	0.5
Chloroform	67-66-3	0.2	0.2
Chloromethane	74-87-3	0.2	0.65
Chloroprene	126-99-8		
2-Chlorotoluene	95-49-8	0.2	0.2
4-Chlorotoluene	106-43-4	0.2	0.3

Table V. (continued) VOC Method Target Analyte List and MDLs in μg/L for Water Samples and μg/kg for Low-Level Solid Samples

Compound Name	CAS No.	25 ml purge MDL μg/L	5 gm purge MDL μg/kg
Dibromochloromethane	124-48-1	0.2	0.25
1,2-Dibromo-3-chloropropane	96-12-8	0.2	1.3
1,2-Dibromoethane	106-93-4	0.2	0.3
Dibromomethane	74-95-3	0.2	1.2
1,2-Dichlorobenzene	95-50-1	0.2	0.2
1,3-Dichlorobenzene	541-73-1	0.2	0.6
1,4-Dichlorobenzene	106-46-7	0.2	0.2
Dichlorodifluoromethane	75-71-8	0.2	0.5
1,1-Dichloroethane	75-34-3	0.2	0.2
1,2-Dichloroethane	107-06-2	0.2	0.3
1,1-Dichloroethene	75-35-4	0.2	0.6
cis-1,2-Dichloroethene	156-59-2	0.2	0.6
trans -1,2-Dichloroethene	156-60-5	0.2	0.3
1,2-Dichloroethene (total)	540-59-0		
1,2-Dichloropropane	78-87-5	0.2	0.2
1,3-Dichloropropane	142-28-9	0.2	0.2
2,2-Dichloropropane	594-20-7	0.5	1.8
1,1-Dichloropropene	563-58-6	0.2	0.5
cis-1,3-Dichloropropene	10061-01-5		
trans-1,3-Dichloropropene	10061-02-6		
1,4-Dioxane	123-91-1		
Ethylbenzene	100-41-4	0.2	0.3
Ethyl methacrylate	97-63-2		
Hexachlorobutadiene	87-68-3	0.2	0.55
2-Hexanone	591-78-6		

Table V. (concluded) VOC Method Target Analyte List and MDLs in μg/L for Water Samples and μg/kg for Low-Level Solid Samples

Compound Name	CAS No.	25 ml purge MDL μg/L	5 gm purge MDL μg/kg
Iodomethane	74-88-4		
Isobutyl alcohol	78-83-1		
Methacrylonitrile	126-98-7		
Methyl methacrylate	80-62-6		
Isopropylbenzene	98-82-8	0.2	0.75
4-Isopropyltoluene	99-87-6	0.2	0.6
Methylene chloride	75-09-2	0.2	0.2
4-Methyl-2-pentanone	108-10-1		
Naphthalene	91-20-3	0.2	0.2
2-Picoline	109-06-8		
Propionitrile	107-12-0		
n-Propylbenzene	103-65-1	0.2	0.2
Styrene	100-42-5	0.2	0.2
1,1,1,2-Tetrachloroethane	630-20-6	0.2	0.25
1,1,2,2-Tetrachloroethane	79-34-5	0.2	0.2
Tetrachloroethene	127-18-4	0.2	0.7
Toluene	108-88-3	0.2	0.55
1,2,3-Trichlorobenzene	87-61-6	0.2	0.2
1,2,4-Trichlorobenzene	120-82-1	0.2	0.2
1,1,1-Trichloroethane	71-55-6	0.2	0.4
1,1,2-Trichloroethane	79-00-5	0.2	0.5
Trichloroethene	79-01-6	0.2	0.95
Trichlorofluoromethane	75-69-4	0.2	0.4
1,2,3-Trichloropropane	96-18-4	0.5	1.6
1,2,4-Trimethylbenzene	95-63-6	0.2	0.65
1,3,5-Trimethylbenzene	108-67-8	0.2	0.65
Vinyl actetate	108-05-4		
Vinyl chloride	75-01-4	0.2	0.85
o-Xylene	95-47-6	0.2	0.55
m-Xylene	108-38-3	0.2	0.25
p-Xylene	106-42-3	0.2	0.65
Xylenes (total)	1330-20-7		

Attachment 3
Organic Parameters and Target MDLs

Table VI. SVOC Method Target Analyte List and MDLs in μg/L for Water Samples and μg/kg for Solid Samples

Compound Name	CAS No.	MDLs	
		Water μg/L	Solid μg/kg
Acenaphthene	83-32-9	5	100
Acenaphthylene	208-96-8	5	120
Acetophenone	98-86-2		
2-Acetylaminofluorene	53-96-3		
Aldrin	309-00-2	5	100
4-Aminobiphenyl	92-67-1		
Aniline	62-53-3		
Anthracene	120-12-7	5	100
Aroclor - 1016	12674-11-2		
Aroclor - 1221	11104-28-2	30	990
Aroclor - 1232	11141-16-5		
Aroclor - 1242	53469-21-9		
Aroclor - 1248	12672-29-6		
Aroclor - 1254	11097-69-1	40	1200
Aroclor - 1260	11096-82-5		
Azobenzene	103-33-3		
Benzidine	92-87-5	50	1450
Benz(a)anthracene	56-55-3	10	300
Benzo(b)fluoranthene	205-99-2	5	200
Benzo(k)fluoranthene	207-08-9	5	100
Benzo(g,h,i)perylene	191- 24-2	5	1450
Benzo(a)pyrene	50-32-8	5	1000
Benzoic acid	65-85-0		
Benzyl alcohol	100-51-6		
α-BHC	319-84-6		
β-BHC	319-85-7	5	200

Table VI. (continued) SVOC Method Target Analyte List and MDLs in μg/L for Water Samples and μg/kg for Solid Samples

Compound Name	CAS No.	MDLs	
		Water μg/L	Solid μg/kg
δ-BHC	319-86-8	10	100
γ-BHC (Lindane)	58-89-9		
Bis(2-chloroethoxy) methane	111-91-1	10	200
Bis(2-chloroethyl) ether	111-44-4	10	200
Bis(2-chloroisopropyl) ether	108-60-1	10	200
Bis(2-ethylhexyl) phthalate	117-81-7	5	100
4-Bromophenyl phenyl ether	101-55-3	5	100
Butyl benzyl phthalate	85-68-7	5	100
Carbazole	86-74-8		
Chlordane	57-74-9		
4-Chloroaniline	106-47-8		
Chlorobenzilate	510-15-6		
4-Chloro-3-methylphenol	59-50-7	5	100
2-Chloronaphthalene	91-58-7	5	100
2-Chlorophenol	95-57-8	5	150
4-Chlorophenyl phenyl ether	7005-72-3	5	150
Chrysene	218-01-9	5	100
4,4'-DDD	72-54-8	5	100
4,4'-DDE	72-55-9	10	200
4,4'-DDT	50-29-3	5	200
Demeton-O	298-03-3		
Demeton-S	126-75-0		
Diallate (cis or trans)	2303-16-4		
Dibenz(a,h)anthracene	53-70-3	5	100
Dibenzofuran	132-64-9		

Table VI. (continued) SVOC Method Target Analyte List and MDLs in μg/L for Water Samples and μg/kg for Solid Samples

Compound Name	CAS No.	MDLs	
		Water μg/L	Solid μg/kg
Di-n-butyl phthalate	84-74-2		
1,2-Dichlorobenzene	95-50-1	5	100
1,3-Dichlorobenzene	541-73-1	5	100
1,4-Dichlorobenzene	106-46-7	5	200
3,3'-Dichlorobenzidine	91-94-1	20	600
2,4-Dichlorophenol	120-83-2	5	100
2,6-Dichlorophenol	87-65-0		
Dieldrin	60-57-1	5	100
Diethyl phthalate	84-66-2	5	100
Dimethoate	60-51-5		
p-Dimethylaminoazobenzene	60-11-7		
7,12-Dimethylbenz(a)anthracene	57-97-6		
3,3'-Dimethylbenzidine	119-93-7		
2, 4-Dimethylphenol	105-67-9	5	100
Dimethyl phthalate	131-11-3	5	100
1,3-Dinitrobenzene	99-65-0		
4,6-Dinitro-2-methylphenol	534-52-1	25	800
2,4-Dinitrophenol	51-28-5	50	1500
2,4-Dinitrotoluene	121-14-2	10	200
2,6-Dinitrotoluene	606-20-2	5	100
Dinoseb	88-85-7		
Diphenylamine	122-39-4		
Di-n-octyl phthalate	117-84-0	5	100
Disulfoton	298-04-4		

Table VI. (continued) SVOC Method Target Analyte List and MDLs in μg/L for Water Samples and μg/kg for Solid Samples

Compound Name	CAS No.	MDLs	
		Water μg/L	Solid μg/kg
Endosulfan I	959-98-8		
Endosulfan II	33213-65-9		
Endosulfan sulfate	1031-07-8	10	200
Endrin	72-20-8		
Endrin aldehyde	7421-93-4		
Ethyl methanesulfonate	62-50-0		
Famphur	52-85-7		
Fluoranthene	206-44-0	5	100
Fluorene	86-73-7	5	100
Heptachlor	76-44-8	5	100
Heptachlor epoxide	1024-57-3	5	100
Hexachlorobenzene	118-74-1	5	100
Hexachlorobutadiene	87-68-3	5	50
Hexachlorocyclopentadiene	77-47-4		
Hexachloroethane	67-72-1	5	100
Hexachlorophene	70-30-4		
Hexachloropropene	1888-71-7		
Indeno(1,2,3-cd)pyrene	193-39-5	5	200
Isodrin	465-73-6		
Isophorone	78-59-1	5	100
Isosafrole	120-58-1		
Kepone	143-50-0		
Methapyrilene	91-80-5		
Methoxychlor	72-43-5		

Table VI. (continued) SVOC Method Target Analyte List and MDLs in μg/L for Water Samples and μg/kg for Solid Samples

Compound Name	CAS No.	MDLs	
		Water μg/L	Solid μg/kg
3-Methylcholanthrene	56-49-5		
Methyl methanesulfonate	66-27-3		
2-Methynaphthalene	91-57-6		
Methyl parathion	298-00-0		
2-Methylphenol	95-48-7		
3-Methylphenol	108-39-4		
4-Methylphenol	106-44-5		
Naphthalene	91-20-3	5	100
1,4-Naphthoquinone	130-15-4		
1-Naphthylamine	134-32-7		
2-Naphthylamine	91-59-8		
2-Nitroaniline	88-74-4		
3-Nitroaniline	99-09-2		
4-Nitroaniline	100-01-6		
Nitrobenzene	98-95-3	5	100
2-Nitrophenol	88-75-5	5	200
4-Nitrophenol	100-02-7	5	100
Nitroquinoline-1-oxide	56-57-5		
N-Nitrosodibutylamine	924-16-3		
N-Nitrosodiethylamine	55-18-5		
N-Nitrosodimethylamine	62-75-9		
N-Nitrosodiphenylamine	86-30-6	5	100
N-Nitroso-di-n-propylamine	621-64-7		
N-Nitrosomethylethylamine	10595-95-6		

Table VI. (continued) SVOC Method Target Analyte List and MDLs in μg/L for Water Samples and μg/kg for Solid Samples

Compound Name	CAS No.	MDLs	
		Water μg/L	Solid μg/kg
N-Nitrosomorpholine	59-89-2		
N-Nitrosopiperidine	100-75-4		
N-Nitrosopyrrolidine	930-55-2		
5-Nitro-o-toluidine	99-55-8		
2,2'-Oxybis (1-chloropropane)	108-60-1		
Parathion	56-38-2		
Pentachlorobenzene	608-93-5		
Pentachloroethane	76-01-7		
Pentachloronitrobenzene	82-68-8		
Pentachlorophenol	87-86-5	5	200
Phenacetin	62-44-2		
Phenanthrene	85-01-8	10	200
Phenol	108-95-2	5	50
1,4-Phenylenediamine	106-50-3		
Phorate	298-02-2		
2-Picoline	109-06-8		
Pronamide	23950-58-5		
Pyrene	129-00-0	5	100
Pyridine	110-86-1		
Safrole	94-59-7		
Sulfotep	3689-24-5		
1,2,4,5-Tetrachlorobenzene	95-94-3		
2,3,4,6-Tetrachlorophenol	58-90-2		
Thionazine	297-97-2		

Table VI. (concluded) SVOC Method Target Analyte List and MDLs in μg/L for Water Samples and μg/kg for Solid Samples

Compound Name	CAS No.	MDLs	
		Water μg/L	Solid μg/kg
o-Toluidine	95-53-4		
Toxaphene	8001-35-2		
1,2,4-Trichlorobenzene	120-82-1	5	100
2,4,5-Trichlorophenol	95-95-4		
2,4,6-Trichlorophenol	88-06-2	5	100
0,0,0-Triethyl phosphorothioate	126-68-1		

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Organic Parameters and Target MDLs

Table VII. Polychlorinated Dioxins and Furans Target Analyte List and MDLs

Compound Name	CAS No.	Water MDL ng/L	Solid MDL µg/kg
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1746-01-6	10	1
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	40321-76-4	25	2.5
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	39227-28-6	25	2.5
1,2,3,6,7,8-HxCDD	57653-85-7	25	2.5
1,2,3,7,8,9-HxCDD	19408-74-3	25	2.5
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	35822-46-9	25	2.5
1,2,3,4,5,6,7,8-Octachlorodibenzo-p-dioxin (OCDD)	3236-87-9	50	5
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	51207-31-9	10	1
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	57117-41-6	25	2.5
2,3,4,7,8-PeCDF	57117-31-4	25	2.5
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	70648-26-9	25	2.5
1,2,3,6,7,8-HxCDF	57117-44-9	25	2.5
1,2,3,7,8,9-HxCDF	72918-21-9	25	2.5
2,3,4,6,7,8-HxCDF	60851-34-5	25	2.5
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	67562-39-4	25	2.5
1,2,3,4,7,8,9-HpCDF	55673-89-7	25	2.5
1,2,3,4,5,6,7,8-Octachlorodibenzofuran (OCDF)	39001-02-0	50	5
Total TCDD	41903-57-5		
Total PeCDD	36088-22-9		
Total HxCDD	34465-46-8		
Total HpCDD	37871-00-4		
Total TCDF	55722-27-5		
Total PeCDF	30402-15-4		
Total HxCDF	55684-94-1		
Total HpCDF	38998-75-3		

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Organic Parameters and Target MDLs

Table VIII. Chorinated Biphenyl (CB) Congeners and EMDLs

Chlorination levels	Congener Nos.	Water EMDL, pg/L	Solid EMDL, ng/kg
MoCB (monochlorobiphenyl)	1 to 3	5	0.5
DiCB (dichlorobiphenyl)	4 to 15	5	0.5
TrCB (trichlorobiphenyl)	16 to 39	5	0.5
TeCB (tetrachlorobiphenyl)	40 to 81	5	0.5
PeCB (pentachlorobiphenyl)	82 to 127	5	0.5
HxCB (hexachlorobiphenyl)	128 to 169	5	0.5
HpCB (heptachlorobiphenyl)	170 to 193	5	0.5
OcCB (octachlorobiphenyl)	194 to 205	5	0.5
NoCB (nonachlorobiphenyl)	206 to 208	5	0.5
DeCB (decachlorobiphenyl)	209	5	0.5

Table IX. Nitroaromatics and Nitramines Target Analyte List and MDLs

Compound Name	CAS No.	Water MDL, µg/L	Solid MDL, µg/kg
2-Amino-4,6-Dinitrotoluene (2-Am-DNT)	355-72-78-2	10	250
4-Amino-2,6-Dinitrotoluene (4-Am-DNT)	1946-51-0	10	250
1,3-Dinitrobenzene (DNB)	99-65-0	10	250
2,4-Dinitrotoluene (24DNT)	121-14-2	10	250
2,6-Dinitrotoluene (26DNT)	606-20-2	5	250
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	20	1000
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	50	500
Nitrobenzene (NB)	98-95-3	10	250
Nitroglycerine (NG)			
2-Nitrotoluene (2NT)	88-72-2	10	250
3-Nitrotoluene (3NT)	99-08-1	10	250
4-Nitrotoluene (4NT)	99-99-0	10	250
Pentaerythritol tetranitrate (PETN)			
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	20	2000
1,3,5-Trinitrobenzene (135TNB)	99-35-4	10	250
2,4,6-Trinitrotoluene (TNT)	118-96-7	10	250

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Organic Parameters and Target MDLs

Table X. VOCs in Ambient Air Target Analyte List and MDLs

Compound Name	CAS No.	MDL, ppbv
Acetone	67-54-1	
Benzene	71-43-2	0.2
Benzyl chloride	100-44-7	0.2
Bromomethane	74-83-9	0.2
2-Butanone (MEK)	78-93-3	
Carbon tetrachloride	56-23-5	0.2
Chlorobenzene	108-90-7	0.2
Chloroethane	75-00-3	0.2
Chloroform	67-66-3	0.2
Chloromethane	74-87-3	0.2
1,2-Dibromoethane	106-93-4	0.2
1,2-Dichlorobenzene	95-50-1	0.2
1,3-Dichlorobenzene	541-73-1	0.2
1,4-Dichlorobenzene	106-46-7	0.2
Dichlorodifluoromethane (Freon 12)	75-71-8	0.2
1,1-Dichloroethane	75-34-3	0.2
1,2-Dichloroethane	107-06-2	0.2
1,1-Dichloroethene	75-35-4	0.2
cis-1,2-Dichloroethene	156-59-2	0.2
1,2-Dichloropropane	78-87-5	0.2
cis-1,3-Dichloropropene	10061-01-5	0.2
trans-1,3-Dichloropropene	10061-02-6	0.2
1,2-Dichloro-1,2,2,2-tetrafluoroethane (Freon 114)	76-14-2	0.2
Ethylbenzene	100-41-4	0.2
4-Ethyltoluene	622-96-8	0.2
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	354-58-5	0.2
Hexachlorobutadiene	87-68-3	0.2
Methylene chloride	75-09-2	0.2
4-Methyl-2-pentanone (MIBK)	108-10-1	
Styrene	100-42-5	0.2
1,1,2,2-Tetrachloroethane	79-34-5	0.2
Tetrachloroethene	127-18-4	0.2
Toluene	108-88-3	0.2
1,2,4-Trichlorobenzene	120-82-1	0.2
1,1,1-Trichloroethane	71-55-6	0.2
1,1,2-Trichloroethane	79-00-5	0.2
Trichloroethene	79-01-6	0.2
Trichlorofluoromethane (Freon 11)	75-69-4	0.2
1,2,4-Trimethylbenzene	95-63-6	0.2
1,3,5-Trimethylbenzene	108-67-8	0.2
Vinyl chloride	75-01-4	0.2
o-Xylene	95-47-6	0.2
m-Xylene	108-38-3	0.2
p-Xylene	106-42-3	0.2

Attachment 3
Organic Parameters and Target MDLs

Table XI. Pharmaceutical and Personal Care Products (PPCPs) Target Analyte List and MDLs

Compound Name	CAS No.	MDL ng/L	RL ng/L
1,7-Dimethylxanthine	611-59-6	67	200
Acetaminophen	103-90-2	6.9	20
Albuterol	18559-94-9	0.47	10
Atenolol	29122-68-7	33	100
Atorvastatin	110862-48-1	100	250
Bisphenol A	80-05-7	100	150
Caffeine	58-08-2	13	50
Carbadox	6804-07-5	10	50
Carbamazepine	298-46-4	2.2	10
Cotinine	486-56-6	1.4	10
DEET	134-62-3	25	25
Diphenhydramine hydrochloride	147-24-0	3	10
Fluoxetine	54910-89-3	9.8	25
Gemfibrozil	25812-30-0	11	25
Ibuprofen	15687-27-1	6.3	25
Iopromide	73334-07-3	6.9	50
Lincomycin	154-21-2	5	10
Lorazepam	846-49-1	0.8	10
Methadone	76-99-3	1.9	10
Morphine	57-27-2	9.3	100
Naproxen	22204-53-1	17	50
Ormetoprim	6981-18-6	2.8	10
Oxolinic acid	14698-29-4	6.9	20
Phenytoin	57-41-0	61	100
Primidone	125-33-7	100	250
Ranitidine	66357-35-5	3.6	10
Salicylic acid	69-72-7	50	50
Sucralose	56038-13-2	250	500
Sulfachloropyridazine	80-32-0	2.7	10
Sulfadiazine	68-35-9	1.1	10
Sulfadimethoxine	122-11-2	6	10
Sulfamerazine	127-79-7	5	10
Sulfamethazine	57-68-1	8.4	10
Sulfamethizole	144-82-1	3.4	10
Sulfamethoxazole	723-46-6	4.9	10
Sulfanilamide	63-74-1	200	200
Sulfathiazole	72-14-0	3.7	10
Thiabendazole	148-79-8	5.2	10
Triclocarban	101-20-2	3.3	10
Triclosan	3380-34-5	6.1	50

Attachment 3
Organic Parameters and Target MDLs

Table XI. (concluded) Pharmaceutical and Personal Care Products (PPCPs) Target Analyte List and MDLs

Compound Name	CAS No.	MDL ng/L	RL ng/L
Trimethoprim	738-70-5	4	10
Tris(1,3-dichloro-2-propyl)phosphate	13674-87-8	250	500
Tris(1-chloro-2-propyl)phosphate	13674-84-5	15	50
Tris(2-chloroethyl)phosphate	115-96-8	20	50
Tylosin	1401-69-0	1.1	10
Warfarin	81-81-2	6.9	20

Attachment 4
Geotechnical Methods

Table I. Geotechnical Test Methods

Method Title	ASTM No.
Atterberg Limits, Liquid Limit, and Plastic Limit	D4318
Compression Test, Unconfined Test for Rock	D2938
Consolidated-Undrained Triaxial Compression Test, Cohesive Soils	D4767
Direct Shear Test of Soils Under Consolidated Conditions	D3080
Dry Preparation of Samples for Particle-Size Analysis	D421
Laboratory Compaction Characteristics, Soil	D698
Particle-Size Analysis, Soil	D422
Preparation and Transport of Rock Samples	D5079
Preparation and Transport of Soil Samples	D4220
Specific Gravity, Soil	D854
Triaxial Compressive Strength, Rock	D2664
Water Content, Soil and Rock	D2216
Wet Preparation of Samples for Particle-Size Analysis	D2217

Note: The ASTM methods are from the 1996 Annual Books of ASTM Standards, Section 4, Construction, Volume 04.08 Soil and Rock (I) and Volume 04.09 Soil and Rock (II).

Attachment 5
Holding Times and Preservation Techniques

Method	Parameters	Matrix	Volume/Container	Preservation	Holding Times Sample	Holding Times Extract
2310B,2320B	Acidity, Alkalinity	Water	500 mL Plastic or Glass	≤6 °C	14 Days	NA
300.0, 300.1 375.2	Bromide, Chloride, Fluoride, Sulfate	Water	1 L Plastic	≤6 °C	28 Days	NA
5210B	BOD	Water	1 L Plastic	≤6 °C	48 Hours	NA
9010B, 9013, 9014, , 335.4, 4500CN-G	Total Cyanide Amenable Cyanide	Water Solid/Other	1 L Plastic 125 mL Glass Jar	≤6°C; NaOH; pH > 12 ≤6°C	14 Days 14 Days	NA NA
5310B, C or D, 9060	DOC, TOC	Water	250 mL Amber Glass	≤6 °C; H_2SO_4; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	≤6 °C	28 Days	NA
200.7, 200.8, 6010B, 6020	All metals except Cr(VI) and Hg	Water Solid/Other	500 mL Plastic 250 mL Glass Jar	HNO_3 ; pH < 2	180 Days 180 Days	NA NA
3060A 218.6 7197, 7196A	Cr(VI)	Water Water Solid/Other	500 mL Plastic 500 mL Plastic 250 mL Glass Jar	≤6 °C ≤6°C, pH 9-9.5 ≤6 °C	24 Hours 28 Days 30 Days	NA NA 7 Days
245.1, 7470A, 7471A	Hg	Water Solid/Other	500 mL Plastic 250 mL Glass Jar	HNO_3 ; pH < 2 ≤6 °C	28 Days 28 Days	NA NA
130.1	Hardness	Water		HNO_3 ; pH < 2 ≤6 °C	180 Days	NA
345.1	Iodide	Water	500 mL Plastic or Glass	≤6 °C	24 Hours	NA
353.2, 351.1 351.2, 365.4 350.1	Ammonium, Nitrate + Nitrite, Total Phosphorus, TKN	Water	1 L Plastic	≤6 °C; H_2SO_4; pH < 2 ≤6°C; not acidified	28 Days 24 Hours	NA NA
300.0 354.1	Nitrate, Nitrite, Ortho Phosphorus	Water	500 mL Plastic	≤6 °C	48 Hours	NA
365.1, 365.3	Ortho Phosphorus	Water	500 mL Plastic	≤6 °C; H_2SO_4; pH < 2	48 Hours	NA
9210/9211	Nitrate	Water Solid/Other	1 L Plastic 250 mL Glass Jar	≤6 °C; 1M Boric Acid ≤6 °C	48 Hours 48 Hours	NA NA

Attachment 5
Holding Times and Preservation Techniques

Method	Parameters	Matrix	Volume/Container	Preservation	Holding Times Sample	Holding Times Extract
314.0, 9058	Perchlorate by IC	Water	250 mL Plastic or Glass	≤6 °C	28 Days	NA
6850 (modified)	Perchlorate by LC/MS/MS	Water	250 mL Plastic or Glass	≤6 °C	28 Days	60 days
6860 (modified) 330,0, 331.0		Solid	4 oz. Wide-mouth jar	≤6 °C	28 Days	60 days
410.3, 410.4	Chemical Oxygen Demand (COD)	Water	250 mL Glass	≤6 °C; H_2SO_4; pH < 2	28 Days	NA
1664	Total Recoverable Oil and Grease	Water	1 L Glass	≤6 °C; H_2SO_4 or HCl; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	≤6 °C	28 Days	NA
9070/9071A	Total Recoverable Oil and Grease	Water	1 L Glass	≤6 °C; HCl; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	≤6 °C	28 Days	NA
ASTM D-854	Specific Gravity	Water	500 mL Plastic or Glass	None	None	
9030B/9031	Sulfide	Water	1 L Glass	≤6 °C; NaOH; Zinc acetate; pH > 9	7 Days	NA
4500S^2-D,E,F or G	NA		Solid/Other	125 mL Glass Jar	≤6 °C	7 Days
2540 B,C,D	TDS, TSS, TS	Water	1 L Plastic	≤6 °C	7 Days	NA
160.4	Volatile solids (volatile residue)	Water	Plastic or glass	≤6 °C	7 Day	NA
9020B	TOX	Water	1 L Amber Glass	≤6 °C; H_2SO_4; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	≤6 °C	28 Days	NA
9060	TOC	Water	Glass	≤6°C; H_2SO_4 or HCL; pH < 2 if analyzed >2 hours after collection	2 hours, unless acidified	N/A
418.1	TPH	Water	1 L Amber Glass	≤6 °C; HCl; pH < 2	28 Days	NA
1664	TPH	Water	1 L Amber Glass	≤6°C; H_2SO_4 or HCl; pH < 2	28 Days	NA
8440	TPH	Solid/Other	125 mL Glass Jar	≤6 °C	28 Days	NA
9065, 9066	Total Recoverable Phenols	Water	1 L Glass	≤6 °C; H_2SO_4; pH < 4	28 Days	NA
420.1, 410.4		Solid	125 mL Glass Jar	≤6 °C	28 Days	NA

Attachment 5
Holding Times and Preservation Techniques

Method	Parameters	Matrix	Volume/Container	Preservation	Holding Times Sample	Holding Times Extract
9040B 4500H^+-B	pH	Water	125 mL Plastic	≤6 °C	ASAP	NA
2120B,C or E 180.1	Color, Turbidity	Water	500 mL Plastic	≤6 °C	48 Hours	NA
120.1, 9050	Specific Conductance	Water	125 mL Plastic	≤6 °C	ASAP	NA
All radiochemical parameters		Water	1 L Plastic (2 x 2 L Preferred)	HNO_3 ; pH < 2	180 Days	NA
except Rn-222 and tritium		Solid/Other	250 mL Glass Jar		180 Days	NA
913.0	Radon 222	Water	125 mL Glass	None	72 Hours	NA
906.0	Tritium	Water	1 L Glass		180 Days	NA
		Solid/Other	Sample size will vary with moisture content		180 Days	NA
8015	Petroleum Hydrocarbons	Water	2 x 1 L Amber Glass Bottle	≤6 °C	7 Days	40 Days
(Modified)	(Diesel Range Organics)	Soil/Other	250 mL Glass Jar	≤6 °C	14 Days	40 Days
	Petroleum Hydrocarbons	Water	3 x 40 mL Glass Vial	≤6 °C; HCl; pH < 2	14 Days	NA
	(Gasoline Range Organics)	Soil/Other	125 mL Glass Jar	≤6 °C	14 Days	NA
5035A/8015	Petroleum Hydrocarbons	Soil	4 x 40 mL Glass Vial	≤6 °C, 2 Vials $NaHSO_4$	*14 days	NA
(Modified)	(Gasoline Range Organics)			1 Vial CH_3OH, 1 Vial No Preservative		
8021B	Halogenated Volatile Organics	Water	3 x 40 mL Glass Vial	≤6 °C; HCl; pH < 2	14 Days	NA
		Soil/Other	125 mL Glass Jar	≤6°C	14 Days	NA
5035A/8021B	Halogenated Volatile Organics	Soil	4 x 40 mL Glass Vial	≤6°C, 2 Vials $NaHSO_4$	*14 days	NA
				1 Vial CH_3OH, 1 Vial No Preservative		
8081	Organochlorine Pesticides	Water	4 L Amber Glass Bottle	≤6 °C	7 Days	40 Days
		Soil/Other	250 Glass Jar	≤6 °C	14 Days	40 Days
8082	PCBs	Water	4 L Amber Glass Bottle	≤6 °C	1 Year	1 Year
		Soil/Other	250 Glass Jar	≤6 °C	1 Year	1 Year
8141A	Organophosphorous Compounds	Water	4 L Amber Glass Bottle	≤6 °C; NaOH or H_2SO_4; pH 5-8	7 Days	40 Days
		Soil/Other	250 Glass Jar	≤6 °C	14 Days	40 Days

Attachment 5
Holding Times and Preservation Techniques

Method	Parameters	Matrix	Volume/Container	Preservation	Holding Times Sample	Holding Times Extract
8151A	Chlorinated Herbicides	Water	4 L Amber Glass Bottle	≤6 °C	7 Days	40 Days
		Soil/Other	250 Glass Jar	≤6 °C	14 Days	40 Days
8260C (Modified)	Volatile Organics by GC-MS	Water[1,2]	3 x 40 mL Glass Vial	≤6 °C; HCl; pH < 2	14 Days	NA
				≤6 °C; not acidified	7 Days	NA
		Soil/Other	125 mL Glass Jar	≤6 °C	14 Days	NA
5035A/8260C	Volatile Organics by GC-MS	Soil	4 x 40 mL Glass Vial	≤6 °C, 2 Vials $NaHSO_4$ 1 Vial CH_3OH, 1 Vial No Preservative	*14 days	NA
8270D	Semivolatile Organics by GC-MS	Water	4 L Amber Glass Bottle	≤6 °C	7 Days	40 Days
		Soil/Other	250 mL Glass Jar	≤6°C	14 Days	40 Days
8280A	Polychlorinated Dioxins and Furans by GC/MS	Water	4 L Amber Glass Bottle	≤6 °C	30 Days	45 Days
		Soil/Other	250 mL Glass Jar	≤6 °C	30 Days	45 Days
8290A	Dioxins and Furans By HRGC/LRMS	Water	4 L Amber Glass Bottle	≤6 °C	30 Days (1 Yr)	45 Days
		Soil/Other	250 mL Glass Jar	≤6 °C	30 Days (1 Yr)	45 Days
1613	Dioxins and Furans by Isotope Dilution HRGC/LRMS	Water	Amber Glass	≤6 °C	1 Year	1 Year
		Solid	Amber Glass Jar	≤6 °C	1 Year	1 Year
1668A	PCB Congeners by HRGC/LRMS	Water	Amber Glass	≤6 °C, H_2SO_4; pH 2-3	1 Year	1 Year
		Solid	Amber Glass Jar	≤6 °C	1 Year	1 Year
1694	PPCPs	Water[3]	Amber Glass	≤6 °C	7 Days	30 Days
		Solid	Amber Glass Jar	≤6 °C	7 Days	30 Days
8318	N-Methylcarbamate Pesticides by HPLC	Water	4 L Amber Glass Bottle	≤6 °C; 0.1 N $ClCH_2CO_2H$, pH 4 - 5	7 Days	40 Days
		Soil/Other	250 mL Glass Jar	≤6 °C	7 Days	40 Days
8330B	Nitroaromatics and Nitramines by HPLC	Water	4 L Amber Glass Bottle	≤6 °C	7 Days	40 Days
		Soil/Other	250 mL Glass Jar	≤6 °C	14 Days	40 Days
610	PAHs	Water	Amber Glass/Teflon lined cap	≤6 °C	7 Days	40 Days
TO-13A	PAHs in Filter Cartridges	PUF, Tenax, or XAD-2 Filter Cartridge		≤6 °C	7 Days	40 Days
TO-14A	VOC in Air	SUMMA® Canister			28 Days (by consensus)	

Attachment 5
Holding Times and Preservation Techniques

Method	Parameters	Matrix	Volume/Container	Preservation	Holding Times Sample	Holding Times Extract
8321(modified)	High Explosives by LC/MS/MS	Water	Amber Glass/Teflon lined cap	≤6 °C	7 Days	40 Days
		Solid	Amber Glass/Teflon lined cap	≤6 °C	14 Days	40 Days

Notes:

[1] If vinyl chloride, styrene or 2-chloroethylvinylether are analytes of interest, collect a second set of samples without preservatives and analyzed within 7 days.

[2] If acrolein and acrylonitrile are analytes of interest, adjust to pH 4-5.

[3] If residual chlorine present, preserve with ascorbic acid.

Attachment 6
Target Surrogate Recovery Control Limits

Method 8081 and 8082: Organochlorine Pesticides and PCBs as Aroclors
Required Surrogate Compounds

Surrogate Compounds	CAS No.	Acceptance Criteria	
		Water	Soil
Decachlorobiphenyl	2051-24-3	50-160%	50-160%
Tetrachloro-m-xylene	877-09-8	50-160%	50-160%

Method 8260C: Required Surrogate Compounds

Surrogate Compounds	CAS No.	Acceptance Criteria	
		Water	Soil
4-Bromofluorobenzene	460-00-4	86-115%	74-121%
1,2-Dichloroethane-d4	17060-07-0	80-120%	80-120%
Toluene-d8	2037-26-5	88-110%	81-117%
Dibromofluoromethane		86-118%	80-120%

Method 8270D: Required Surrogate Compounds

Surrogate Compounds	CAS No.	Acceptance Criteria	
		Water	Soil
2-Fluorobiphenyl	321-60-8	43-116%	30-115%
2-Fluorophenol	367-12-4	21-110%	25-121%
Nitrobenzene-d5	4165-60-0	35-114%	23-120%
Phenol-d6	13127-88-3	10-110%	24-113%
p-Terphenyl-d14	1718-51-0	33-141%	18-137%
2,4,6-Tribromophenol	118-79-6	10-123%	19-122%

Attachment 6
Target Surrogate Recovery Control Limits

Method 8330A: Nitroaromatics and Nitramines
Required Surrogate Compounds
(use either or both)

Surrogate Compounds	CAS No.	Acceptance Criteria*	
		Water	Soil
3,4-Dinitrotoluene	610-39-9	50-160%	50-160%
2-Methyl-4-nitroaniline	99-55-8	50-160%	50-160%
1,4-Dintrobenzene (recommended)	100-25-4	50-160%	50-160%
1,2-Dintrobenzene (recommended)	528-29-0	50-160%	50-160%

*Specific surrogates are not designated in the method.

Method 8151: Chlorinated Herbicides
Required Surrogate Compounds

Surrogate Compounds	CAS No.	Acceptance Criteria	
		Water	Soil
2,4-Dichlorophenylacetic Acid (DCAA)		50-160%	50-160%

Attachment 7
Analytical Request and Chain of Custody Form

Internal Lab:

Batch No.: **SMO Use** **ARCOC**

Project Name:	Date Samples Shipped:	SMO Authorization.:	☐ Waste Characterization
Project/Task Manager:	Carrier/Waybill No.	SMO Contact Phone:	☐ RMMA
Project/Task Number:	Lab Contact:		☐ Released by COC No.
Service Order:	Lab Destination:	Send Report to SMO:	☐ 4° Celsius
	Contract No.:		Bill to: Sandia National Laboratories (Accounts Payable); P.O. Box 5800, MS-0154; Albuquerque, NM 87185-0154
Tech Area:			
Building : **Room:**	**Operational Site:**		

Sample Number	Fraction	Sample Location Detail	Depth (ft)	Date/Time(hr) Collected	Sample Matrix	Container Type	Container Vol	Preser-vative	Collect Method	Sample Type	Parameter & Method Requested	Lab Sample Id

Last Chain: ☐ Yes
Validation Req'd: ☐ Yes
Background: ☐ Yes
Confirmatory: ☐ Yes

Sample Tracking **SMO Use**
Date Entered:
Entered by:
QC inits.:

Special Instructions/QC Requirements:
EDD: **Yes** ☐ **No** ☐
Turnaround Time ☐ **7 Day*** ☐ 15 Day * ☐ 30 Day
Negotiated TAT: ☐
Sample Disposal: ☐ Return to Client ☐ Disposal by Lab
Return Samples By:
Comments:
Please list as separate report.

Abnormal Conditions on Receipt
Lab Use

Sample Team Members	Name	Signature	Init.	Company/Org/Phone/Cell

1. Relinquished by	Org.	Date	Time	3. Relinquished by	Org.	Date	Time
1. Received by	Org.	Date	Time	3. Received by	Org.	Date	Time
2. Relinquished by	Org.	Date	Time	4. Relinquished by	Org.	Date	Time
2. Received by	Org.	Date	Time	4. Received by	Org.	Date	Time

***Prior confirmation with SMO required for 7 and 15 day TAT**

Attachment 8
AMP Policy for Payment Reduction
NNSA Service Center Sites

In order to ensure that adequate value is obtained for dollars spent, it is sometimes necessary to impose a payment reduction or to elect nonpayment for laboratory analytical services. At the same time, it is in the interest of the DOE to maintain good working relationships with its contract laboratories. Since payment options can be abused in the hands of inexperienced staff, senior management needs to closely monitor their use to ensure that those relationships are not needlessly damaged. Some guidelines for a payment reduction or nonpayment election are listed below.

1) If a laboratory fails to meet QC criteria, and if reanalysis is precluded by expiration of holding times, then a payment reduction or nonpayment may be appropriate.

2) If deliverables do not contain the required supporting documentation, and if the laboratory cannot deliver such documentation upon request, then the data quality is negatively affected and a payment reduction or nonpayment may be appropriate.

3) If holding times are missed, and if it can be demonstrated that the samples did arrive at the laboratory far enough in advance to allow reasonable time for the analyses, then the laboratory is responsible for reduced data quality. A payment reduction or nonpayment may be appropriate under these circumstances. However, if laboratory personnel notified the project that holding times would be missed far enough in advance to select and ship to another laboratory, then no payment reduction should be assessed. Further, if samples arrive at the laboratory very close to expiration, and if project sampling or SMO personnel did not tell the laboratory to expect this, then a payment reduction is generally inappropriate.

4) If a laboratory fails to meet deliverable schedules for analytical reports it may be necessary to impose a payment reduction. Such action should be taken only in particularly egregious or chronic cases. (Rigid contract stipulations already in place at some NNSA Service Center facilities may supersede this guideline.)

5) There are cases where a laboratory uses an unapproved analytical technique, due to catastrophic instrument failure or for some other reason, without first obtaining permission from the project. If the resulting data do not meet technical or regulatory requirements, a payment reduction or nonpayment may be appropriate.

6) If a laboratory uses an unapproved subcontract vendor to increase its capacity, any project data acquired by the unapproved vendor are subject to a payment reduction or nonpayment.

7) Failure to meet technical requirements, such as meeting detection limits, should not result in payment reduction unless the laboratory clearly made a technical error that is unrelated to the sample matrix and the error has an effect on data usability. This applies when the laboratory used an inadequate analytical technique, inappropriate wavelength, too-short count time, or excessive dilution.

8) Verified malfeasance, such as "dry-labing," should result in immediate suspension in addition to nonpayment for the analyses in question.

9) Failure to submit periodic progress reports, MDL studies, PE data, or CARs should not result in reduced payment for analysis data deliverables. Typically, laboratories are suspended pending compliance in such cases

Attachment 9
AMP Policy for Information Sharing
NNSA Service Center Sites

The NNSA Analytical Management Program (AMP) strives to improve the quality of the chemical analysis data acquired and to reduce duplication of effort by sharing performance information for subcontract laboratories. Because each project has its own set of performance criteria and areas of interest, it is necessary to establish guidelines for the assessment of this information.

There are many different issues and measurement criteria associated with laboratory performance. The purpose in sharing laboratory performance data among NNSA projects is to provide as much information as possible, as inexpensively as possible, to project personnel so that they can make informed decisions regarding the selection and use of laboratories. Therefore it will be the policy of the NNSA AMP to encourage open and timely dissemination of laboratory performance information, without imposing artificial requirements with regard to the specifics of how it must be used. However, NNSA facility personnel must bear in mind that the NNSA's (and its subcontractor's) relationships with analytical laboratories are important partnerships. It is not in NNSA's best interest to violate a laboratory's trust by frivolously publicizing isolated or trivial errors.

Performance-Related Reasons for Corrective Action or Suspension

Individual NNSA projects may request corrective action or, in extreme cases, even suspend subcontract laboratories from project chemical analysis programs for a variety of reasons. Some possible examples are listed below.

1) Failure to meet contractual obligations
   a) Failure to provide required documentation
   b) Chronic analytical quality control deficiencies
   c) Inability to meet deliverable schedules for analysis reports, periodic progress reports, MDL studies, or corrective action reports
   d) Failure to implement project quality assurance requirements

2) On-site audit or data package assessment findings
   a) Critical QA systems failure
   b) Critical technical systems failure
   c) Incorrect data reporting
   d) Inappropriate staff organization, such as conflict between QA and laboratory management duties
   e) Use of unapproved procedures without prior permission

3) Performance Evaluation Samples
   a) Very large analytical errors reported
   b) A systematic bias is indicated by all results when two or more PE samples are submitted
   c) False negative results reported
   d) Parameter is outside the acceptance interval in two consecutive PE rounds
   e) Parameter is outside the acceptance interval in more than one PE program.
   f) An analytical or reporting error is noted in an area where other problems are known to exist (chronic QC, technical, or reporting problems already identified)

4) Substantial Contamination or Incorrect Reporting
   a) It is discovered that a laboratory is contaminating facility samples through adverse ambient conditions, inadequate laboratory practices, or the residual effects of high-level samples from other clients
   b) Analyses at a laboratory are affected by incorrect integration or other method implementation errors, resulting in chronic misreporting of data
   c) Reported detection limits are too low, either for accurate integration or existing laboratory conditions, resulting in unacceptable false positive reporting rates

Non-Performance-Related Issues

In addition, there may be other (non-performance-related) reasons relating to laboratory capacity for a temporary hiatus from the routine flow of samples. Such reasons might include the sudden loss of critical laboratory staff members or over-committed laboratory facilities.

Differing Project Needs

Performance requirements in a given analytical area vary between projects, based on project-specific data quality objectives or facility contract specifications. Thus, what represents a deficiency for one project may be acceptable for another. Further, in the case for which a laboratory provides service in several areas (i.e. physical testing, radiochemistry, general inorganic, and organic chemistry), deficiencies noted in one area may not affect the services utilized in other areas. Therefore, each project must have the latitude to examine shared performance information, and take action or not, based on that project's specific needs.

Performance information may be shared among projects under the system now in place. If any project should decide to suspend a subcontract laboratory based on performance, other projects that also use that laboratory must decide how, if at all, the deficiency or deficiencies affect their work.

Attachment 9
AMP Policy for Information Sharing
NNSA Service Center Sites

Guidelines for Sharing Performance Information

With this in mind, the NNSA AMP recommends the following guidelines.

1) Information to be shared should be presented as clearly as possible, and should include the performance measurement criteria used to evaluate it for the home (original) project if applicable. This information should include any relevant quality assurance, quality control, technical, or reporting criteria.

2) Contact person(s) whose responsibility it is to transmit performance information to other NNSA facilities and/or receive transmitted information from other facilities should be designated at each project.

3) Personnel responsible for review of laboratory performance information received from other projects should be intimately familiar with all laboratory performance criteria specific to their own projects.

4) Review personnel should investigate and verify negative performance information from other projects that is applicable to their work. This will ensure that the information is completely and correctly understood before it is acted upon.

5) Follow-up information regarding resolution of deficiencies should be transmitted to other NNSA facilities as quickly as possible so that the laboratory capacity originally in question can become available again.

Attachment 10
Routine Sub-Sampling Procedure

Routine Soil Sub-sampling Procedure

General procedure:

1) Remove any twigs or rocks from the sample before drying and grinding.
2) Blend the entire sample prior to taking the first aliquot.
3) Use an aliquot of at least 20 times greater than the final required mass for the first aliquot to be sub-sampled for each preparation. For cases where the sample submitted is less than 20 times the final sample mass, use the entire sample mass and note the insufficient sample in the case narrative.
4) Use a square-shaped scoop for all sub-sampling to avoid any bias in favor of the large or small particles.

Specific procedures:

1) **SVOC type analyses (including PCBs, Pesticides, and Polynuclear Aromatic Hydrocarbons)**
   Soil samples submitted for SVOC analysis shall be prepared as follows:
   a) Using the first sample aliquot, randomly acquire five equal sub-samples using a square-shaped scoop to obtain the final sample mass.
   b) Document this sub-sampling in the hard copy data package.
   c) Proceed with the SVOC analysis.

2) **HE analysis**
   Soil samples submitted for HE analysis shall be prepared as follows:
   a) Dry the entire first sample aliquot, either by air drying or using a low temperature oven.
   b) Grind the entire first sample aliquot to pass through a 30 mesh sieve.
   c) Using the entire first sample aliquot, randomly acquire five equal sub-samples using a square-shaped scoop to obtain the final sample weight.
   d) Document this drying, grinding, and sub-sampling in the hard copy data package.
   e) Proceed with the HE analysis.

3) **Metals analysis**
   Soil samples submitted for metals analysis shall be prepared as follows:
   a) Dry the entire first sample aliquot, either by air drying or using a low temperature oven.
   b) Grind the entire first sample aliquot to pass through a 30 mesh sieve.
   c) Using the entire first sample aliquot, randomly acquire five equal sub-samples using a square-shaped scoop to obtain the final sample weight.
   d) Document this drying, grinding, and sub-sampling in the hard copy data package.

Attachment 11
SNL/SMO Electronic Deliverable Specification

Sandia National Laboratories

Albuquerque, New Mexico 87185-0729

date: August 21, 2012

to: Electronic Deliverable Specification Recipients

from: Sample Management Office
Sandia National Laboratories, MS-0729 (4142)

subject: Electronic Deliverable Specification Revision 18

Attached is the latest revision to the Electronic Deliverable Specification. Revision 18.

SANDIA NATIONAL LABORATORIES
NEW MEXICO
(SNL/NM)

SAMPLE MANAGEMENT OFFICE
ELECTRONIC DATA DELIVERABLE SPECIFICATION
DEPARTMENT 4142

08/21/2012

Attachment 11
SNL/SMO Electronic Deliverable Specification

Purpose
This specification describes the format for providing the electronic deliverable lab data for analytical laboratories to the Sandia National Laboratories New Mexico (SNL/NM) Sample Management Office (SMO).

Scope
This Electronic Data Deliverable (EDD) applies to all data delivered to the SMO from contract analytical laboratories in fulfillment of contract agreements**.**

Ownership
SNL/NM owns this Document and is responsible for all changes and corrections. Contact SMO Project Leader at (505) 844-3185 for comments.

Electronic Data Deliverable Specification

Procedure

The data shall be provided as an ASCII text file, comma delimited and with double quotations used as field qualifiers. The file will be delivered to the SMO using a CD with the PDF data-package file. Each EDD file will be comprised of one Analytical Request Chain of Custody (ARCOC). Each CD can be comprised of more than one file, only if, multiple ARCOCs were combined into one data package. The CD shall be externally labeled with the lab, date, ARCOC numbers, related Sample Delivery Group (SDG) numbers, and filename. Each CD will be accompanied by a transmittal letter that will indicate the sample delivery group, ARCOC numbers and pertinent instructions (i.e., this data is a re-submittal).

Each ARCOC will be stored in a unique file that will use the naming convention ARCOC#.snd.

Field Definitions

Column **Field Name (Maximum Field Length)** **Description**

1) **Sample Number - Fraction - ER Sample ID or Sample Location Detail (50)** This number is obtained from the Analytical Request Chain of Custody (ARCOC) and consists of two blocks on the (ARCOC), 1) the Sample No. - Fraction block and 2) the ER Sample ID or Sample Location Detail block. These two blocks should be concatenated together in the Client Sample ID field and separated by a "/". An example is given here, followed by the rules:

Sample No. - Fraction	ER Sample ID or Sample Location Detail	Correct Field Entry for EDD
012345 - 001	TA2-BH-11.5	012345-001/TA2-BH-11.5

The sample number will be six characters long, padded with leading zeros. The fraction will be three digits long and padded with leading zeros except when Sandia directs a re-run, in which case the fraction will be three characters long with the first character being an "R" (i.e., 012345-R01/TA2-BH-11.5). This field should be populated for result identifier SA; BL requested by Sandia, MS/MSD, sample replicates REP, rad chemical tracers (RCT), or SUR for associated SNL samples**.** Labs shall not alter the sample number - fraction without prior written permission from the SMO Project Leader or designee. The ER sample ID or Sample Location Detail may be truncated if it exceeds the lab's field size.

2) **Sample Collection Date (8)** (MMDDYYYY) The date a sample was taken. This information is obtained from the ARCOC. This field will only be populated for result identifier SA or BL.
3) **ARCOC Number (6)** This number is obtained from the ARCOC. The labs shall not alter or truncate the ARCOC number without prior written permission from the SNL/SMO. This field will only be populated for result identifier SA or BL.
4) **Analysis Requested (70) The** analysis requested is obtained from the ARCOC. The labs may populate this field with their own naming conventions. This field will only be populated for result identifier SA and BL.
5) **Sample Receipt Date (8)** (MMDDYYYY) The date a sample was received by the lab. This field is required for all analyses performed on SMO provided samples. This field will only be populated for result identifier SA and BL.
6) **Sample Matrix (7)** The predominant material comprising the sample. This field must be filled for every record, and it must match Appendix B.
7) **Lab Name (4)** The abbreviated name for each lab. This field must be filled for every record. (See Appendix A)

8) **Sample Disposition/Comment (15)** The final disposition of the sample at the laboratory. This field is used to report a status to SMO when no results could be obtained for a sample. Required for all SMO samples with no analytical results and must match Appendix H. Leave blank for all records with analytical results.
9) **Sample Delivery Group (SDG) (10)** Input the internal lab identifier indicating the laboratory grouping of samples in which the sample was analyzed. This number must be unique. It is used to manage the data packages for validation and it is used to uniquely identify the ASCII file names provided to SNL. This field must be filled for every record.
10) **Lab Sample Number (15)** The internal lab identifier used to track a specific sample. This number will be identical for all analyses performed within the lab on a SMO sample. This field must be filled for every record.
11) **Sample Preparation Date (8)** (MMDDYYYY) Date of sample preparation at the laboratory. Use the latest preparation date when multiple preparation dates exist. This field is required for every record that has an analysis preparation type.
12) **Sample Preparation Type (3)** This is used to indicate if the reported result is for a sample preparation that was suspended, dissolved or total. Required for all analyses performed on SMO provided samples and must match Appendix F. This field will only be populated for result identifiers SA, BL, REP, MS, MSD. Assume the preparation type is TOTAL if it is not specified on the Chain of Custody that the sample was filtered or filtration requested at the laboratory.
13) **Sample Extraction/Digestion Method (15)** The coded identifier of the method used to perform the extraction or digestion (e.g., EPA-SW846-1311). This field will only be populated for result identifier SA, BL, REP, MS, MSD, RCT.
14) **Lab Method Code (25)** The internal laboratory method code used to obtain analysis. This field is required for every record. An appendix of expected codes for each lab will be created and checked for a match. This field must be filled for every record. (Provided by each lab)
15) **Instrument (10)** The coded identifier for the instrument used to perform the analysis. Each lab develops its own code. All records with a result must have this field populated.
16) **Analyst (25)** The name of the analyst or approving authority. This field must be filled for every record.
17) **Results Identifier (3)** SMO codes that differentiate between target analytical results, laboratory quality assurance samples, and analytical re-analysis. All other quantifiable analysis runs will be identified with a different unique result identifier. There will never be two analysis runs for the same sample that has the same result identifier. This field must be filled for every record, and it must match Appendix C.
18) **Analysis Date and Time (13)** (MMDDYYYY: HHMM) Laboratory analysis date and time. This field must be filled for every record.
19) **Residual Weight (4)** The weight of material on the planchet after evaporation. Used for radionuclide analyses only when applicable. Leave blank for all other analysis.
20) **Dilution Factor (5)** When a sample is diluted, the dilution factor shall be recorded in this field. The factor shall be recorded as 5, 2.5, 10, 100, 5000 or in a similar manner. This field must be filled for every record. The default is 1.

21) **CAS Numbers (12)** (NNNNN-NN-N) The unique number assigned to an analyte by the Chemical Abstract Service. This field is required if available.

22) **Parameter Name (70)** Input the analyzed compound name. The parameter name of "UNKNOWN" may be used only for Tentatively Identified Compound (TIC) analytes where appropriate. This field must be filled for every record.

23) **Flag TICs (1)** Input a "Y" only when the reported result is a TIC. This field will remain blank in all other cases.

24) **Retention Time (7)** For tentatively identified compounds (TICs) only, the retention time must be input. Required for all identified TICs.

25) **Result (10)** The analytical result for a chemical compound. Do not use any characters in the results including commas. Scientific notation and/or negative results may be reported for RAD only.

For non-RAD non-detected results only, use the MDL for organics and inorganics. For results without MDL use the PQL. For radiochemistry the result shall be the measured concentration, whatever is determined (+ or -). For radiochemistry do not default to the L_c or the MDA**.**

Report the actual measured concentration regardless if it is a positive or negative result. Do not report the string "< MDA".

26) **Spike Reference Identifier (15)** The lot number or lab designation of the spike material used for MS/MSD, Sur, RCT, or LCS samples. The standard ID that you trace through the laboratory and which is documented on the analyst's prep worksheets**.** This field will be left blank for samples and blanks.

27) **Spike Added (8)** The known spike concentration added for MS/MSD, RCT, or LCS. The unit of measure should be the same as the unit of measure for the result.

28) **Percent Recovery (5**) Report for MS/MSD, Sur, RCT, and LCS. Do not report negative values. If a percent is calculated and the result is negative due to insufficient spiking concentrations, record a "0" (zero) in the Percent Recovery column and flag it with an "N" for non-compatible spiking concentration.

29) **QC Control Upper Limit or Lab Sample Result Upper Limit (8)** This field designates the upper acceptable control limit for an analyte. For LCS, MS, RCT and Sur this limit should pertain to accuracy (Percent Recovery, Col. 28). For MSD and REP, this limit should pertain to bias (Relative Percent Recovery for organic and inorganic analysis, Replicate Error Ratio for radiochemistry analysis, Col. 31). This field will be populated for result identifier types LCS, RCT, MS, MSD, REP, and Sur.

30) **QC Control Lower Limit or Lab Sample Result Lower Limit (8)** This field designates the lower acceptable control limit for an analyte in the sample solution. For LCS, MS, RCT, and Sur this limit should pertain to accuracy (Percent Recovery, Col. 28). For MSD and REP this limit should pertain to bias (Relative Percent Recovery for organic and inorganic analysis, Replicate Error Ratio for radiochemistry analysis, Col. 31). This field will be populated for result identifier types LCS, RCT, Sur, MS, MSD, and REP.

Col. 17 Result Identifier	Col. 28 Percent Recovery	Col. 29 QC Upper Limit	Col. 30 QC Lower Limit	Col. 31 Relative Percent Difference or RER
MS	112	125	75	
Sur	106	121	70	
MSD	105	25	0	6.45
REP (rad)		.99	0	.50
REP (non-rad)		20	0	5.00

31) **Relative Percent Difference or Replicate Error Ratio (8)** The bias between the MS and MSD, or SA and REP. This field will be populated for result identifier types MSD and REP.

32) **Unit of Measure (8)** The unit of measure for the result. For each requested analysis the units must be consistent between the sample data and the associated QC data. Inorganics should be reported in "mg/kg" for SOIL and "mg/l" for AQUEOUS, unless otherwise specified on the ARCOC**.** This field must be filled for every record except surrogates, and it must match Appendix D.

33) **Result Qualifier (5)** This field will only be used when appropriate and must match Appendix G.

34) **Radiochemistry Uncertainty (10)** Error data is provided for Radionuclide analyses only. Uncertainties will be reported in the same format and units as given for the result, with the exception that plus/minus signs will not be used. Scientific notation may be used for radionuclide analysis. This field must be filled for every RAD record.

35) **QC Lot Identifier (18)** The cross-reference of QC batch and sample grouping. This field must be filled for every record.

36) **Detection Limit (10)** The detection limit specified for the analysis type as required in the test method. For diluted samples, use detection limit corrected for dilution factor. MDA should be used to report RAD detection limits, and PQL should be used to report non-RAD detection limits. This field is required for all records except Sur.

37) **Detection Limit Type (3)** The type of detection limit specified for the analysis method. This field is required for all records except Sur, and it must match Appendix E. The detection limit unit of measure must match the result unit of measure.

38) **Method Detection Limit (MDL) (10)** The method detection limit at the time of analysis. This field is required for all records except surrogates. Use the Critical level Concentration Corrected (L_c) for RAD, MDL for organics and inorganics. The MDL or L_c unit of measure must match the result unit of measure. If the L_c or MDL is not available report the detection limits (Field 36). This field is required for all records except Sur**.**

39) **Counting Time (6) (Optional)** (Sec) The length of time the aliquot is measured. The count must be in seconds. For radiochemistry only.

40) **Aliquot Weight or Volume (4) (Optional)** The weight or volume of the aliquot used in the analysis. This field must be numeric**.** For radiochemistry only.

Address List

Send Laboratory Diskettes to:

Sandia National Laboratories
Attn: Rita Kavanaugh, Dept. 4142, MS 0729
P.O. Box 5800
Albuquerque, NM 87185-0729
Phone (505) 284-2553
Fax (505) 844-3128

Contact person is subject to change. Updates to be provided as necessary.

Appendix A

Analysis Lab ID

CODE	DESCRIPTION
BWXT	BWXT Services, Inc.
CFA	Cape Fear Analytical
GEL	GEL Laboratories, Inc.
TACA	Test America California (Air)
TAD	Test America Denver
TASL	Test America St.Louis
TATX	Test America Austin Texas (Air)

Appendix B
Sample Matrix Types

CODE	DESCRIPTION
AIR	Samples of confined air (AIR)
AQUEOUS	All water samples (DE, DIW, FDIW, FGW, FW, GW, LEA, PW, SW, WGW, WW, W)
BIOTA	All animal tissues, bodies or composite samples, including mammals, insects, fish, reptiles and amphibians (B)
FILTER	Specifically applies to air filter samples (AF)
GAS	Gas samples (SG, GAS)
OIL	Oil Samples (OIL)
SLUDGE	Chemical sludge, mixtures of which are neither solid nor particularly liquid (SLUDGE)
SOIL	All soil and sediment (SOIL)
SOLID	Solid samples
VEGETATION	All plant life, in general (V)
WIPE	Any type of material used for wipe samples (WIPE)

Appendix C
Result Identifier

CODE	DESCRIPTION
SA	Normal Sample not QC
BL	Field Blanks including trip blanks and equipment blanks
LCS	Lab Control Sample
MB	Method Blank
MSD*	Matrix Spike Duplicate
MS*	Matrix Spike
Sur	Surrogate
REP*	Sample replicate for inorganic and radiochemistry
RCT	Radiochemistry Chemical Tracer

* Do not include MS, MSD or REP data derived from samples not included in the associated SDG.

Attachment 11
SNL/SMO Electronic Deliverable Specification

Appendix D
Unit of Measure

CODE	DESCRIPTION
C/100ml	Colonies per 100 milliliters
mg/l	Milligrams per liter
uohms/cm	Microohms per centimeter
pCi/g	Picocuries per gram
pCi/kg	Picocuries per kilogram
pCi/l	Picocuries per liter
pCi/ml	Picocuries per milliliter
pCi/SA	Picocuries per sample
pCi/m3	Picocuries per cubic meter
pg/l	Picograms per liter
pH	pH units
ppb v/v	Parts per billion as a volume per volume ratio
ug/kg	Micrograms per kilogram
ug/l	Micrograms per liter
ug/WIPE	Micrograms per wipe, used for PCBs
%	For use with percent solids, percent moisture, etc. (not used for radiochemistry)
%REC	for use with percent recovery on Lab Control Samples, etc.
mg/kg	Milligrams per kilogram
mg/sample	Milligrams per sample

APPENDIX E
DETECTION LIMIT TYPE

CODE	DESCRIPTION
MDL	Method Detection Limit
PQL	Practical Quantitative Limit Required
MDA	Minimum Detectable Amount (RAD analysis)

APPENDIX F
PREPARATION TYPE

CODE	DESCRIPTION
DIS	Dissolved analysis on the filtrate only
SUS	Suspended analysis on the particulate only
TOT	Total analysis on the entire sample
LEA	Leached (Example: TCLP analysis)

APPENDIX G
QUALIFIERS

CODE	DESCRIPTION
B	Analyte found in the blank and the sample. Not for radiochemistry. Organics > MDL Inorganics > MDL or PQL
E	Concentration exceeds calibration range of instrument and/or estimated quantity due to matrix interference. For organic analysis only.
H	Analytical Holding Time was exceeded. For all analysis if applicable.
h	Sample extraction or prep holding time was exceeded. For all analysis if applicable.
I	Interference, dilution was performed, detection limits are elevated. Not for radiochemistry.
J	Estimated value < PQL but greater than MDL. Not for radiochemistry.
U	Undetected analyzed but not detected. For Organics: the result is less than the MDL. For Inorganics: the result is less than the MDL or PQL. For RAD: the result is less than the MDA.
N	Results associated with a spike analysis that was outside control limits. For all analysis if applicable.
*	Results associated with a replicate analysis that was outside control limits, includes MSD and REP. For all analysis if applicable.
X	The "X" qualifier is used only to denote the existence of presumptive evidence suggesting that the reported analyte is not present in the sample. That is, this qualifier may be used only to indicate that the chemist believes the result to be a false positive.

APPENDIX H
SAMPLE DISPOSITION

CODE	DESCRIPTION
RECD, LOST	Received by lab and then lost
RECD, NOT ANAL	Received by lab but not analyzed
EXCEEDS HOLD TM	Sample exceeded holding time
WRONG PRESERVE	Sampling team used the wrong preservative
ANALYSIS FAILED	Lab unable to obtain reportable results
LAB CHANGED	Sample was shipped to a different lab
CANCELED	Received by lab then canceled
NO RESULT	Lab could not obtain a result for this analyte
CHANGE REQUEST	Lab requested to perform analysis not on ARCOC
NOT REQUESTED	Lab changed analysis without written approval

Note: Report all dispositions per analytical test

SANDIA NATIONAL LABORATORIES
LONG TERM STEWARDSHIP DEPARTMENT (4142)

QUALITY ASSURANCE PROJECT PLAN (QAPP) for the SAMPLE MANAGEMENT OFFICE

SMO-QAPP
Revision 3

Prepared By: 11-05-2013
Lorraine Herrera — Date
SMO Project Coordinator, 4142

Prepared By: Kevin A Lambert 11.05.2013
Kevin Lambert — Date
Technical Support Specialist, 4142

Reviewed By: Bonnie Little 11-6-2013
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Reviewed By: Linda Gonzales 11/7/13
Linda Gonzales — Date
Waste Certification Official, 4144

Approved By: 11/12/13
Pam Puissant, — Date
Manager, Long Term Stewardship, 4142

Author: How frequently does this document need to be reviewed and/or revised?	Every 3 years
Manager: Does this document need to be tracked?	Yes

EFFECTIVE DATE: 11/12/13

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Revision History

Revision	Effective Date	Summary of Changes
0	December 18, 2003	New document.
1	March 28, 2007	Compare previous revision for changes.
2	April 9, 2010	Compare previous revision for changes.
3	November 12, 2013	Updated language to reflect current program elements and requirements. Attachments were revised.

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ACRONYMS AND ABBREVIATIONS

AOP	Administrative Operating Procedure
APHA	American Public Health Association
ARCOC	Analytical Request Chain of Custody
ASTM	American Society for Testing and Materials
CFR	Code of Federal Regulations
CFRC	Custom Funded Records Center
CLP	Contract Laboratory Program
CVR	Contract Verification Review
DOE	U.S. Department of Energy
DOT	U. S. Department of Transportation
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
EPA	U.S. Environmental Protection Agency
EDMS	Environmental Data Management System (STAR – Analytical Results)
ES&H	Environment, Safety and Health
IATA	International Air Transportation Administration
ISO	International Organization for Standardization
LOP	Laboratory Operating Procedure
LQAP	Laboratory Quality Assurance Plan
NNSA	National Nuclear Security Administration
OP	Operating Procedure
PE	Performance Evaluation
OSHA	Occupational Safety and Health Administration
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
RPPM	Radiological Protection Procedures Manual
SAP	Sampling and Analysis Plan
SNL	Sandia National Laboratories
SNL/NM	Sandia National Laboratories/New Mexico
SMO	Sample Management Office
SOW	Statement of Work
SPF	Sample Packaging Facility
STAR	Sample Tracking and Analytical Results

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1.0 INTRODUCTION

1.1 GENERAL INFORMATION

This document provides the quality assurance (QA) requirements for activities performed by the Sandia National Laboratories, New Mexico (SNL/NM) Sample Management Office (SMO). Part A contains program elements and requirements from U.S. Department of Energy (DOE) 414.1D, *Quality Assurance*, and the Code of Federal Regulations (CFR), 10 CFR 830 Subpart A, *Nuclear Management, Quality Assurance Requirement*s. This meets Corporate Process CG100.5, *Ensure Quality*. This Quality Assurance Project Plan (QAPP) provides information that conforms to U.S. Environmental Protection Agency (EPA) QA/R-5, *EPA requirements for QA Project Plans*. Additional QA guidance is provided in other QA documents from SMO customer programs, (i.e., Environmental Restoration, Environmental Life-cycle Management, Waste Management, Environmental Monitoring, and facilities Decontamination and Demolition programs). These documents are upper-tier documents to this QAPP. Waste management documents include, radioactive, mixed, and hazardous waste protocols.

The mission of the SMO is to provide centralized management of samples and analyses performed by contract laboratories. The primary QA objective of the SMO is to ensure that data is of adequate technical quality and content to meet programmatic data quality objectives (DQO).

For the purpose of this QAPP the words "other programs" mean various Waste Management, Environmental Monitoring, Facilities Decontamination and Demolition, and other sampling programs at SNL/NM.

2.0 Part A: DOE/SNL PROGRAM REQUIREMENTS

2.1 CRITERION 1, PROGRAM

2.1.1 Background, Purpose, Scope and Ownership

The purpose of Part A of this document is to meet requirements of QA activities within SNL/NM. This QAPP provides pointers to other QAPPs or lower tier plans and procedures written to meet project specific requirements as identified by external regulators. Lower tier activities either fall within the scope of this QAPP, or are covered by an appropriate QA program.

The SMO coordinates with customers to have samples analyzed for potential contaminants. Data from high-quality analyses is essential for environmental regulatory decision-making and critical

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for data defensibility. Commercial laboratories under contract to SMO perform analysis of samples. The SMO is responsible for procuring the contracts and continuously monitoring the data deliverables (both hardcopy and electronic) for compliance with contract and customer requirements. In order to assess the technical performance of the contract laboratories, performance evaluation samples are submitted and annual audits are performed. The SMO conducts contract verification review, electronic data processing, and manages the data validation process in accordance with SNL procedures. Additionally, the SMO provides sample packaging management services, acts as the liaison between each program and the contract laboratories and provides sample information management and data base maintenance for sample tracking and analytical results. Other tasks performed by the SMO may include sampling planning and coordination and sampling services.

Although the SMO provides sample and data management, it is not the owner of the samples or data. The final disposition of samples and data is the responsibility of the other programs that generate the samples.

During the lifetime of this QAPP, it is anticipated that some of the requirements and procedures of the SMO may change. This QAPP will be updated every three years, and changes provided to appropriate customers as required for information, concurrence, or approval. The SMO owns this document. The SMO is responsible for preparing, revising and distributing this document as necessary.

2.1.2 Applicability

This document applies to all SMO activities as outlined in Section 2.1.1.

The requirements set forth in this QAPP are applicable to personnel involved in the SMO as SNL/NM employees or as contractors. Sub-contracted activities are to be done in accordance with contract requirements, this QAPP, or covered by an appropriate QA program.

2.1.3 Requirements

SNL applicable policies, procedures, regulatory requirements, and DOE guidance that must be considered when planning and implementing activities can be found in this QAPP or other program QAPPs.

2.1.4 Functional Structure

The functional structure for the SMO is presented in Attachment I and includes position titles and lines of authority at and below the SMO Technical Lead level. Position titles, lines of authority, and management processes including planning, scheduling, and providing resources for

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work can be found in SNL Facilities, Financial and Human Resources corporate processes and procedures: FAC100.1, FIN100.2, HR100.1, and HR100.2.

2.1.5 Functional Responsibilities and Levels of Authority

SMO personnel are responsible for adherence to requirements stipulated in this QAPP that are applicable to their specific task(s). Each individual has an obligation to identify and act towards resolving conditions adverse to quality.

SMO positions with additional programmatic responsibilities are identified below.

SMO Department Manager

The SMO Department Manager is responsible for providing programmatic guidance leading to the development of this QAPP and the following:

- Reviewing and approving the QAPP.
- Acting as liaison to DOE and the National Nuclear Security Administration (NNSA)/Sandia Field Office on sample management issues.
- Ensuring that resources are available to perform tasks in compliance with this QAPP.

SMO Technical Lead

The SMO Technical Lead is responsible for the operations and activities conducted within the SMO, including those concerned with the implementation of the applicable requirements of this QAPP. The principal responsibilities of the SMO Technical Lead include the following:

- Managing contractor laboratory services, including procurement, acting as the Sandia Delegated Representative, reviewing routine performance assessments, and conducting general laboratory oversight.
- Developing and maintaining the SNL/NM *Contract Statement of Work (SOW) for Analytical Laboratories* that meets other programs' requirements.
- Developing and maintaining this QAPP.

SMO QA Coordinator

The principal responsibilities of the SMO QA Coordinator include the following:

- Providing guidance and expertise in the areas of quality assurance/quality control (QA/QC) relating to operations of the SMO.

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- Interfacing with the Records Management Coordinator for maintenance of project documentation, and resolving record management concerns for storage and maintenance of sampling and analysis records.
- Ensuring that sufficient quality checks are in place to maintain the integrity of the SMO sample information management and analytical result databases.
- Facilitating implementation of QA requirements for the SMO.
- Assisting in developing and reviewing SMO procedures and this QAPP.
- Reviewing non-conformances and initiating corrective actions.

Project Coordinator

The Project Coordinator is responsible for coordinating efforts associated with SMO analytical services. The principal responsibilities of the Project Coordinator include the following:

- Acting as a point of contact between Task/Project Leaders and the analytical laboratories.
- Obtaining appropriate sample containers from a vendor or analytical laboratory.
- Scheduling projects with contract laboratories.
- Notifying analytical laboratories of any QA, environmental, safety, health, and sample matrix requirements regarding sample handling, preparation, and analysis.
- Resolving problems, issues, non-conformances, and errors for projects with regard to analytical data.
- Performing contract verification review (CVR) to ensure appropriate quality control (QC) analyses have been performed in accordance with the SNL/NM *Contract SOW for Analytical Laboratories*.
- Performing QC of data entered into the SMO database
- Performing electronic data QC and transfer.
- Processing and follow-up on any data package corrections, both hardcopy and electronic.
- Providing technical guidance and information, as required.
- Reviewing, verifying, and processing proformas and invoices from contractors.

Database Administrator

The principal responsibilities of the Database Administrator include the following:

- Designing, operating, and maintaining the SMO database.
- Reviewing and implementing improvements to system performance, establishing system design, and determining the need for changes to the design.

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- Performing system backup and restoration functions.
- Developing new forms and reports with the Data Administrator.
- Resolving error messages generated by Oracle™.
- Establishing user accounts, passwords, and privileges within Oracle™.
- Submitting requests to administrative and support staff to establish new user accounts on the LAN.
- Assisting the SMO Technical Lead in developing electronic data deliverable (EDD) specifications for incorporation into the SNL/NM *Contract SOW for Analytical Laboratories*.
- Interfacing with SNL corporate computing regarding computer operations.

Project/Data Management

The principal responsibilities of project/data management staff include the following:

- Providing financial management support to the SMO by partnering with the center financial analyst and Program/Project Leaders.
- Tracking project/task expenditures.
- Ensuring compliance with the *SMO Data Management Plan*, Administrative Operating Procedure (AOP) 95-44.
- Tracking and maintaining sample information and performing QC on Analytical Request Chain of Custody (ARCOC).
- Receiving and processing data packages.
- Managing data flow and data storage, including both hardcopy paper records from field activities and analytical laboratories, and electronic data relating to sample tracking or analytical results.
- Reconciling data coordination QA concerns with Task/Project Leaders SMO staff, analytical laboratories, etc.
- Performing data entry including processing corrections.
- Providing backup project status reports.
- Submitting requests to the SNL Customer Funded Records Center (CFRC).

Sample Coordination and Packaging

The principal responsibilities of the sample coordination and packaging staff include the following:

- Overseeing the day-to-day operations of the SMO Sample Packaging Facility (SPF).

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- Maintaining the SPF.
- Logging in and packaging of samples, as required.
- Developing and maintaining sample packaging procedures and operations in accordance with the SNL Integrated Safety Management System (ISMS) and *Sample Handling, Packaging and Shipping*, Laboratory Operating Procedure (LOP) 94-03.
- Ensuring samples are properly stored and packaged for shipment to the analytical laboratories in accordance with this QAPP and DOE, U.S. Department of Transportation (DOT), and International Air Transportation Administration (IATA) regulations.
- Ensuring that sample custody is properly maintained and documented in accordance with this QAPP and related Operating Procedures (OPs).
- Interfacing with SNL/NM Shipping, Radiation Protection Operations, and other SNL/NM on-site organizations.
- Maintaining facilities for preparation and return of samples.

Contract Laboratories

The principal responsibilities of the contract laboratories, reflected in applicable contracts, include the following:

- Developing and maintaining QA programs and procedures that meet the SNL/NM *Contract SOW for Analytical Laboratories*.
- Performing analyses in accordance with the SNL/NM *Contract SOW for Analytical Laboratories*.
- Providing data in accordance with format requirements in the SNL/NM *Contract SOW for Analytical Laboratories*.

Laboratory Oversight/Data Validation Contractor

The principal responsibilities of the Laboratory Oversight/Data Validation Contractor, as reflected in the applicable contract, include the following:

- Performing laboratory oversight as directed by the SNL/NM SMO.
- Conducting visits to and technical system audits of contractor laboratories to ensure compliance with SNL/NM *Contract SOW for Analytical Laboratories*.
- Performing data validation in accordance with the applicable procedures.
- Communicating non-compliance issues to the SMO Technical Lead and/or SMO Project Coordinator(s).
- Verifying implementation of laboratory corrective action plans.

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2.1.6 Supporting Documents

Supporting documents are listed in Section 4.0. These are normative documents or may demonstrate compliance with QA requirements.

2.2 CRITERION 2, PERSONNEL TRAINING AND QUALIFICATION

2.2.1 Requirements

SMO personnel shall be trained and qualified to ensure they are capable of performing their assigned work. Training and qualification must be specific to the types of tasks performed. Personnel shall be provided continued training as required to ensure that job proficiency is maintained. Training shall be updated to meet required frequency schedules when specified. Training requirements and qualification shall be documented. Requirements can be found in SNL Corporate Policy, the SNL corporate Training Education and Development System (TEDS) database, or activity-specific operating procedures .

Training may consist of formal classroom training, on-line web training, or on-the-job training.

2.2.2 Responsibilities

SMO personnel are responsible for adherence to training requirements stipulated in this QAPP and in applicable sub-tier documents. SMO personnel are required to read all applicable documents and procedures and sign the Authorized Users List as evidence.

SMO management is responsible for committing resources to facilitate the qualification and training processes, for defining qualification and training requirements for personnel applicable to their specific task(s), and for ensuring personnel meet appropriate requirements.

2.2.3 Personnel Qualification or Certification

Specific qualifications or certifications identified in requirement sources such as, but not limited to, DOE, DOT, IATA orders and regulations, shall be included in the training program. An assessment of the education, experience, and any special physical capabilities that are required for a job shall be completed and the requirements shall be included in personnel criteria for job selection.

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2.2.4 Supporting Documents

Supporting documents are listed in Attachment V. These are normative documents or may demonstrate compliance with QA requirements.

2.3 CRITERION 3, QUALITY IMPROVEMENT

2.3.1 Requirements

Quality improvement requirements are included in all SMO processes. Requirements include establishing and implementing the following:

- Continuous customer feedback and open communication between SMO personnel, customers, and contract laboratories (refer to Attachments II, III, and IV for communication loops for each SMO process).
- Processes to detect and prevent quality problems.
- Methods that identify, control, and correct data, services, and processes that do not meet established requirements.

2.3.2 Compliance with Requirements

Assessments, quality checks, and other performance measures provide the mechanisms to demonstrate that items, services or processes meet their requirements within the SMO.

SMO is responsible for:

- Assisting in interpretation and clarification of appropriate regulations, orders, policies, and standards.
- Ensuring that QA assessments of the data validation contractor and laboratories are conducted on a systematic basis.
- Providing guidance on project-specific QA matters (i.e., acceptance criteria and verification of program efficiency and implementation) to ensure quality requirements are met.
- Ensuring that QA deficiencies are properly recognized and resolved.

2.3.2.1 Detection and Prevention Process

Detection and prevention processes used for quality improvement shall include:

- Periodic review and update of the SNL/NM *Contract SOW for Analytical Laboratories* and other SMO documents.

- Feedback from staff, internal and external customers to identify potential problems and to initiate corrective actions.
- Frequent project meetings to review QA information and data analyzed to identify areas needing improvement.
- Management assessments as discussed in Section 2.9.
- Internal assessments as discussed in Section 3.4.

2.3.2.2 Identification, Control, and Correction of Problems

Several types of documents and procedures shall be used for identifying, controlling, and correcting problems for quality improvement. These documents include:

- Corporate Corrective Action Procedures CG100.6.1 and CG100.6.6
- DOE NNSA *Model SOW for Analytical Laboratories*
- SNL/NM *Contract SOW for Analytical Laboratories*
- Contract Laboratory QA Plans (LQAPs)
- *Procedure for Completing the Contract Verification Review (CVR)*, SMO-05-03
- *Data Validation Procedure for Chemical and Radiochemical Data*, AOP 00-03
- Other AOPs, Sampling and Analysis Plans (SAP), and Health and Safety Plans (HASP).

2.3.3 Review and Analysis of Information to Generate Improvements

Quality problems and other quality–related information, both positive and negative, from various internal and external sources, should be reviewed and analyzed by the SMO QA Coordinator to identify improvement opportunities in the quality management system, processes, items, products or services. Implemented improvements will be reviewed annually during the management assessment (see Section 2.9) to ensure their continuing suitability and effectiveness.

2.3.4 Supporting Documents

Supporting documents are listed in Attachment V. These are normative documents or may demonstrate compliance with QA requirements.

2.4 CRITERION 4, DOCUMENTS AND RECORDS

2.4.1 Requirements

The SMO shall maintain records to document QA/QC activities and to provide support for possible evidential proceedings. Records that provide documentary evidence of quality shall be specified, prepared and maintained in accordance with SNL/NM record-keeping procedures.

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SMO records shall be transferred to the customer as well as to the Records Center for cataloging and storage in accordance with SNL Corporate Policy, IM100, *Information Management & Cyber Security*, DOE requirements, and the document control requirements of International Organization for Standardization (ISO) 9001 and ISO 14001.

2.4.2 Compliance with Requirements

Documents shall be reviewed to assure conformance with general corporate or organizational policies. The configuration of documents should be managed in accordance with AOP 09-11, *ES&H/Emergency Management Center Document Control Procedure*. The SNL/NM *Contract SOW for Analytical Laboratories* should be reviewed and updated as needed. This QAPP and applicable data review procedures shall be reviewed and updated to reflect significant changes every three years or as needed. Other relevant documents should be reviewed and updated as needed.

2.4.3 Documents and Records for Interfacing Organizations

Documents and records of interfacing organizations may include those imposed on the SMO, such as those described in the *Radiological Protection Procedures Manual* (RPPM) (MN471016) or those specified in the SNL/NM *Contract SOW for Analytical Laboratories*. The SMO will verify compliance of record-keeping requirements.

2.4.4 Supporting Documents

Supporting documents are listed in Attachment V. These are normative documents or may demonstrate compliance with QA requirements.

2.5 CRITERION 5, WORK PROCESSES

2.5.1 Requirements

SMO management and customers shall agree upon SMO work scope and processes. SMO processes are well-defined for those activities whose failure can lead to undesirable consequences and are shown in Attachments II, III, and IV. Work is documented in lower tier documents and procedures (Attachment V). SMO processes do not include items that would require Suspect/Counterfeit control requirements. Also, SMO processes do not require QA review of Safety Software. Additional information can be found in Section 3.0 Part B of this QAPP.

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2.5.2 Compliance with Requirements

OPs and desk instructions shall be used for routine work. Controlled copies of OPs and desk instructions shall be readily available to all personnel. Work activities shall be documented and records maintained. Administrative controls shall be implemented as a part of these processes to ensure that the likelihood of failure of the activities is appropriately small. There must be assurance of accuracy of the instruments or equipment used for work activities monitoring or related to data collection and reporting. Additional information can be found in Section 3.0 Part B of this QAPP.

2.5.3 Work Processes for Interfacing Organizations

The work process procedures performed by interfacing organizations are governed by the following documents:

- RPPM
- Environment, Safety and Health (ES&H) Procedures
- Procurement documents

2.5.4 Supporting Documents

Supporting documents are listed in Attachment V. These are normative documents or may demonstrate compliance with QA requirements.

2.6 CRITERION 6, DESIGN

2.6.1 Requirements

SMO processes do not include design tasks and are not subjected to these requirements.

2.6.2 Compliance with Requirements

SMO processes do not include design tasks and are not subjected to these requirements.

2.6.3 Design for Interfacing Organizations

Formal design activities are typically done as contracted activities. Design work, including changes, must incorporate applicable requirements and design bases.

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2.6.4 Supporting Documents

SMO processes do not include design tasks and are not subjected to these requirements.

2.7 CRITERION 7, PROCUREMENT

2.7.1 Requirements

The SMO follows SNL corporate QA policies and procedures provided by the Sandia Purchasing Organization. Procurement documents shall include QA requirements. SMO laboratory and data validation contracts are designated "Quality Significant" according to SCM100.2.11, *Acquire Quality Significant Items*. Contracts for major or stand-alone activities may either include a program specific to the contracted activity or may rely on the contractor's own QA program. If separate QA programs are used, they must be reviewed and approved by the SMO and must include the appropriate grading for the activity. If the contracting documents do not specify a QA program to be followed, the SMO program is required.

2.7.2 Compliance with Requirements

The SNL Procurement Center follows applicable Procurement Instructions and relevant SNL Corporate policies and procedures for procuring property, materials, and services. These policies cover the following areas:

- Procurement documents,
- Supplier qualification,
- Supplier monitoring,
- Nonconformance and corrective action,
- Inspection, and
- Product documentation.

SMO procurements also adhere to these processes and the required grading requirements.

The SMO, in conjunction with SNL/NM Purchasing, manages analytical and data validation services contracts in support of other programs. SMO develops the SOW for analytical services based on customer requirements, generates requests for proposals, and develops scoring criteria with SNL/NM Purchasing. The SMO reviews and scores laboratory qualifications and coordinates pre-award assessments, as required. The SMO makes laboratory selection based on best value for both technical and price criteria with concurrence of SNL/NM Purchasing. After contracts are placed, SMO monitors laboratory performance through periodic assessments, performance

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evaluations, and ongoing data review. The SMO is responsible for cost accounting and financial management for all contracted services provided to the other programs through the SMO.

The SNL/NM *Contract SOW for Analytical Laboratories* contains details and requirements for analytical services provided to SNL/NM by contract laboratories.

2.7.3 Supporting Documents

Supporting documents are listed in Attachment V. These are normative documents or may demonstrate compliance with quality assurance requirements.

2.8 CRITERION 8, INSPECTION AND ACCEPTANCE TESTING

2.8.1 Requirements

Inspection and testing of specified items, services and processes shall be conducted using established acceptance and performance criteria aligned with contractual and customer requirements. Qualified personnel (section 2.2.3) shall conduct inspections and tests.

Acceptance requirements for analytical data are discussed in Part B, Section 3.5, Data Validation and Usability.

2.8.2 Compliance with Requirements

The SMO shall receive sampling kits (sample bottles and coolers) from the contract laboratories per the requirements described in the SNL/NM *Contract SOW for Analytical Laboratories*. The sampling kits shall be requested using a bottle order (refer to Attachment II). Sampling kits are inspected on receipt by the packaging support staff using the criteria described on the original bottle order. Containers and analytical data shall be inspected as outlined in Part B, Section 3.3.8 and Section 3.5.

All equipment used by the SMO shall be properly maintained and inspected prior to use. Equipment requiring calibration will be performed in accordance with the manufacturer's instructions against known standards that are traceable to a national standard such as National Institute of Standard and Technology (NIST), if available. Malfunctioning equipment shall be clearly identified as being out of service and shall not be returned to service until it is demonstrated that the equipment is functioning properly.

The SMO will monitor contract laboratory services in accordance with the SNL/NM *Contract SOW for Analytical Laboratories*.

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2.8.3 Inspection and Acceptance Testing by or for Interfacing Organizations

Laboratory instrument and equipment testing, inspection, and maintenance are addressed in Section 3.3. The SMO shall verify the adequacy of contractor inspection and testing procedures during the assessment process.

2.8.4 Supporting Documents

Supporting documents are listed in Attachment V. These are normative documents or may demonstrate compliance with QA requirements.

2.9 CRITERION 9, MANAGEMENT ASSESSMENT

2.9.1 Requirements

SMO staff, as well as management personnel from programs using SMO services, shall assess SMO processes. Problems that hinder the SMO from achieving its objectives shall be identified and documented. Management assessment shall include appropriate conclusions and suggest corrective actions. Management assessment shall be conducted in accordance with CG100.6, *Assure Performance Process* and CG100.6.19, *Conduct Management Review.*

2.9.2 Compliance with Requirements

SMO staff and appropriate management personnel are responsible for management assessments and the documentation of results. The SMO shall provide assessment information to management personnel from programs using SMO services with appropriate conclusions and corrective actions as needed in compliance with CG100.6, *Assure Performance Process*.

2.9.3 Supporting Documents

Supporting documents are listed in Attachment V. These are normative documents or may demonstrate compliance with QA requirements.

2.10 CRITERION 10, INDEPENDENT ASSESSMENT

2.10.1 Requirements

The SMO shall promote the independent assessment process by assigning appropriate personnel to assist in any independent assessment and shall track and correct any non-conformances

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identified during this process in compliance with CG100.6, *Assure Performance Process* and CG100.6.3, *Determine, Plan and Perform Assessments.*

2.10.2 Compliance with Requirements

The determination of SMO processes to be examined is to be made by the requesting management. Independent assessments of processes shall be performed in accordance with a process defined by the applicable management program in compliance with CG100.6, *Assure Performance Process*. Independent assessments shall be planned and conducted to measure item and service quality, to measure the adequacy of work performance and to promote improvement. The group performing independent assessments shall have sufficient authority and freedom from the line to carry out its responsibilities. The group shall also have access to the appropriate SMO management and staff.

2.10.3 Assessments Performed by External Organizations

Independent assessments may be performed periodically by a variety of independent groups outside of SMO. These assessments may be a part of other program's QA to assess operations and work processes.

2.10.4 Supporting Documents

Supporting documents are listed in Attachment V. These are normative documents or may demonstrate compliance with QA requirements.

3.0 Part B: DATA REQUIREMENTS

3.1 DATA ACQUISITION

The SMO has the primary responsibility of ensuring that the quality of the data generated for sampling programs meet data quality requirements necessary to determine and demonstrate compliance with DOE requirements and local, state and federal environmental regulations. This QAPP addresses applicable elements from EPA QA/R-5 as they apply to the SMO and contract laboratories.

3.2 PROJECT MANAGEMENT

Project management and applicable information from EPA QA/R-5 is addressed in Section 2.1 of this QAPP.

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3.3 DATA GENERATION AND ACQUISITION

3.3.1 Sampling and Process Design

The DQO process provides a means of defining the appropriate quality of the data required to support environmental projects. Other programs define DQOs and ensure that they are met. The SMO is responsible for incorporating necessary and applicable requirements into the SNL/NM *Contract SOW for Analytical Laboratories* so that the other programs DQOs are met.

3.3.2 Sampling Method Requirements

After DQOs are developed for a particular activity, appropriate sampling strategies must be established. The SMO provides guidance to customers on sampling strategies.

Further discussion of sampling method requirements is presented in customer field operating procedures and activity-specific SAPs.

3.3.3 Sample Handling and Custody Requirements

The SMO shall have procedures that address the sample handling and custody requirements that apply to SMO-specific tasks or activities. These procedures will be readily available to all SMO personnel handling samples. The SMO shall ensure staff is trained in and follow the sample handling and custody requirements.

Each analytical laboratory participating in the analysis of SNL/NM SMO customer samples shall have Laboratory Operating Procedures (LOPs) that address activities related to sample custody (such as receiving, storing, and disposing of samples and maintaining the chain-of-custody records). The LOPs will be readily available to all appropriate laboratory personnel.

The analytical laboratories are solely responsible for lawful disposal of samples after the sample storage requirement is fulfilled. Detailed sample handling and custody requirements are discussed in the current revisions of the *Sample Management and Custody* procedure, AOP 95-16, SNL/NM *Contract SOW for Analytical Laboratories*, and DOE NNSA *Model SOW for Analytical Laboratories*.

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3.3.4 Analytical Methods

Analytical, extraction, and other preparation methods are selected and specified in accordance with the DQOs and are identified in the SNL/NM Contract SOW for Analytical Laboratories. A general requirement is that industry-standard methods, such as EPA SW-846 (Third Edition), EPA 600 series methods, Occupational Safety and Health Administration (OSHA) methods, American Society for Testing and Materials (ASTM) methods, and standard methods be used where possible. Applicable standard methods are used when appropriate or SNL/NM approved, laboratory specific methods may be substituted. New methods may be developed when required. All analytical methods must be pre-approved by the SNL/NM SMO, documented in a laboratory-approved LOP, and performed as specified in a controlled laboratory setting. Analytical results (organic, inorganic, radiochemical, and miscellaneous analytes) and non-analytical data shall be reported in the units consistent with the specified method.

The SMO shall verify that the analytical laboratories follow the SNL/NM *Contract SOW for Analytical Laboratories* as it pertains to Standard Methods. The standard methods requirements are discussed in the SNL/NM *Contract SOW for Analytical Laboratories*, DOE NNSA *Model SOW for Analytical Laboratories*, EPA SW-846 and other EPA documents, OSHA, ASTM, and American Public Health Association (APHA) documents.

All analytical laboratories will maintain controlled copies of approved LOPs for each analytical method or general procedure in accordance with the DOE NNSA *Model SOW for Analytical Laboratories*.

3.3.5 Quality Control

Laboratory analytical activities shall be subjected to QC checks using QC samples. QC sample requirements are specified in the SNL/NM *Contract SOW for Analytical Laboratories*, LQAPs, LOPs and in the published test method.

3.3.6 Instrument/Equipment Testing, Inspection, and Maintenance

Each analytical laboratory shall have procedures that address activities related to instrument/equipment testing, inspection and maintenance. Laboratory equipment shall be inspected, tested, and maintained in accordance with LOPs, LQAPs, and the SNL/NM *Contract SOW for Analytical Laboratories*.

Regular inspection and calibration is performed to ensure that the fume hood used for sample container preparation is operating correctly according to manufacture specifications.

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Maintenance is performed annually per the corporate schedule for inspection and calibration site wide. See references in procedure SMO-SH-A-001, Fume Hood Usage and Sample Container Preparation, current revision.

3.3.6.1 Preventive Maintenance Documentation

Analytical laboratory preventive maintenance activities shall be documented, and the records maintained in accordance with LOPs, LQAPs, and the SNL/NM *Contract SOW for Analytical Laboratories*.

3.3.7 Instrument/Equipment Calibration and Frequency

Each laboratory shall have procedures that address instrument/equipment calibration and frequency requirements. Instruments shall be calibrated in accordance with the SNL/NM *Contract SOW for Analytical Laboratories*, LOPs, LQAPs, and applicable analytical test method.

3.3.8 Inspection/Acceptance of Supplies and Consumables

The SMO shall ensure staff is trained in sampling kit (sample containers and cooler) requirements. SMO shall inspect sampling kits to determine that they are undamaged, match the project-specific bottle order and meet any other specific written requirements associated with the SNL/NM *Contract SOW for Analytical Laboratories*. Any errors or damage to shipping containers will be addressed in accordance with the SNL/NM *Contract SOW for Analytical Laboratories* and procurement policies.

3.3.9 Non-direct Measurement

Data and information gathered from sources outside the SMO or gathered from any source that was not collected under an approved QA program appropriate to that used for SMO shall not be approved for SMO use. Indirect measurement data reported by contract laboratories, as a result of data produced through direct measurements, shall be reviewed and designated usable if all other QC associated with the direct measurement data are acceptable.

3.3.10 Data Management

The SMO tracks sample data generated from field, shipping, analysis, data review, and validation activities. SMO data management functions include tracking sample shipments to the analytical laboratories, tracking supporting and analytical data returned from the analytical laboratories and cost accounting associated with sample analysis and data validation. The SMO receives and tracks both hardcopy data and EDD files from the analytical laboratories. The EDD file is

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checked for accuracy and compared to hardcopy data in accordance with SMO *Procedure for Electronic Data Deliverable (EDD) Processing,* SMO-05-04 and the SNL/NM *Contract SOW for Analytical Laboratories*. When data is manually entered, the hardcopy data is used and verified.

The SMO shall verify that the laboratories follow the SNL/NM *Contract SOW for Analytical Laboratories* as it pertains to data management. The analytical laboratory certifies the laboratory-generated data in accordance with the SNL/NM *Contract SOW for Analytical Laboratories*, EPA SW-846, and other standard methods. A summary report that includes analytical and QC results is prepared and approved by the analytical laboratory. Data packages shall conform to contract or procedural requirements. Data should also be validated by independent review as described in Part B, Section 3.5.

Data shall be managed through the Environmental Data Management System (EDMS) and the Sample Tracking and Analytical Results (STAR) database in accordance with the current revision of the *SMO Data Management Plan,* AOP 95-44, SMO *Procedure for Completing the Contract Verification Review (CVR),* SMO-05-03, SMO *Procedure for Electronic Data Deliverable (EDD) Processing,* SMO-05-04, and in the SNL/NM SMO *Data Validation Procedure for Chemical and Radiochemical Data,* AOP 00-03.

3.4 ASSESSMENT AND OVERSIGHT

Management and quality assurance personnel shall complete assessments of QA related activities done at various levels in the SMO organization. Assessments include but are not limited to surveillance, data audit or assessment, system audits, limited-scope audits, management review, or readiness review.

Management assessments are addressed in Part A, Section 2.9 of this QAPP. For additional details, see CG100.6, *Assure Performance Process*, and Criterion 3, Section 2.3, requirements in this QAPP.

3.4.1 Assessment and Response Actions

The SMO assessment/surveillance teams shall include personnel with the necessary expertise and knowledge of SMO processes and laboratory operations to address the requirements established in this QAPP, the SNL/NM Contract SOW for Analytical Laboratories, and other relevant documents. The SMO Technical Lead, or designee, functions as the team leader and shall be responsible for the selection of assessment/surveillance team members. Assessors shall be independent of any direct responsibility for performance of the activities that they assess. The assessors shall have the authority to stop work based on quality or safety issues

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Assessments will be regularly executed as part of SMO routine operations. The SMO Technical Lead should participate in system and performance assessments of each contract laboratory at least once during the contract term. Surveillances may be conducted at any time as determined by project requirements or in response to conditions perceived as potentially adverse to quality.

Assessment records shall include worksheets, reports, corrective action requests (if necessary), written replies, and a record of completion of corrective actions.

3.4.1.1 Laboratory Performance Assessment

Laboratory performance assessments determine the accuracy of laboratory measurement systems and include annual laboratory audits, routine performance evaluation (blind spike analysis), and data package assessments. Performance assessments shall be conducted as off-site data are generated, reduced, and analyzed. All laboratories providing support to the SNL/NM SMO shall be subject to performance assessment requirements as specified in the SNL/NM *Contract SOW for Analytical Laboratories*. Preliminary assessments should be performed as needed.
In addition, the laboratory will conduct internal assessments to verify that its operations continue to comply with the requirements of the laboratory's quality systems. All quality systems will be audited at a minimum frequency of once per year in accordance with the LQAP.

Laboratories will be subject to one data package assessment annually in accordance with the DOE NNSA *Model SOW for Analytical Laboratories*. This may be conducted during the annual systems assessment or performed as a separate assessment. Additional data package assessments may be performed as deemed necessary by the SMO.

Laboratories shall participate in analysis of performance evaluation (PE) samples or assessment samples as required by the SMO, DOE, EPA, and/or the State of New Mexico performance evaluation programs (if required in the future). In addition, laboratories may be subject to the submission of PE samples from the SMO at any time in response to a corrective action, to evaluate the performance of a new method, or other non-routine situations. Analysis results should be compared to predetermined or calculated acceptance limits. Records of performance evaluation samples shall be maintained and any problems shall be identified, corrective actions taken and performance re-evaluated prior to analysis of additional applicable samples.

3.4.1.2 Laboratory System Assessment

System assessments verify the application of the QA system and evaluate the level of compliance with the system. System assessments for SMO cover laboratory activities and final reports. Work areas, activities, activity documentation, and QA/QC procedures and the effectiveness of their implementation shall be evaluated. All analytical laboratories providing support to the

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SNL/NM SMO shall be subject to system assessment requirements as specified in the SNL/NM *Contract SOW for Analytical Laboratories*.

Prior to implementation of new off-site analytical services contracts, a pre-award assessment of the laboratory(s) shall be performed. Laboratory system assessments during the course of a contract shall include an on-site visit to the analytical laboratory(s) by SNL/NM representatives or designees.

Technical assessments to verify adherence to requirements as stated in the SNL/NM *Contract SOW for Analytical Laboratories* shall be conducted on all laboratories generating data used for regulatory compliance and decision-making purposes.

3.4.1.3 Assessment Documentation

Assessment results shall be formally documented by personnel and reported by the SMO Task Leader in accordance with the SNL/NM *Contract SOW for Analytical Laboratories* and relevant project requirements. In the event that the lead assessor is not the SMO Technical Lead, the SMO Technical Lead shall review and approve the assessment report. An assessment report contains any observations, findings, and associated corrective actions. Assessment reports shall be maintained as part of the program files and archived in the SNL CFRC when the contract has ended. Assessment and surveillance reports are considered public documents.

3.4.1.4 Response Actions

The results of assessments shall be entered into a corrective action system in compliance with CG100.6, *Assure Performance Process*.

In addition, personnel shall be responsible for identifying and reporting deficiencies and initiating the corrective action process. Documentation of nonconforming items or processes should typically be on a nonconformance record or other forms intended to detail the circumstances of the deviation.

The responsibility for monitoring the quality of analytical systems lies with contract analytical laboratory personnel. All corrective activities resulting from deficiencies occurring at the analytical laboratory shall comply with the LQAP and the SNL/NM *Contract SOW for Analytical Laboratories*. Additionally, the analytical laboratory shall notify the SMO of the deficiency and, if possible, identify potential causes and corrective action.

Deficiencies shall be reported and corrective action initiated by the SMO or contracted analytical laboratories if any of the following conditions arise:

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- Specific requirements of the analysis method or LOPs are not met,
- Data quality measurements for precision, accuracy and completeness are not achieved, or
- Lab data review indicates that data are incomplete, that improper calculations were performed, incorrect methodology or technique was employed, or that an instrument malfunction has occurred.

When corrective actions are required, it shall be the responsibility of the analytical laboratory to provide a Corrective Action Report that details planned action to correct the findings and a schedule for completion. The SMO Technical Lead, or designee, shall document that assessment findings are resolved and that the appropriate corrective actions have been implemented in a timely manner. The SMO Technical Lead shall attempt to resolve any disagreements or disputes related to assessment or surveillance findings. Root cause analysis, in compliance with CG100.6, *Assure Performance Process*, shall be completed to identify the actions necessary to prevent recurrence of the condition whenever the SMO Technical Lead decides that the severity or recurrence of a deficiency indicates it is needed. If a satisfactory resolution cannot be reached, the issue shall be elevated to the next level of contract analytical laboratory management.

See Part A, Sections 2.9 and 2.10 of this QAPP and applicable AOPs for further details on the methods by which deficiencies are identified and corrected.

3.4.2 Reports to Management

Management shall be kept apprised of project status and events impacting quality, both informally and formally. Open channels of communication shall be fostered among SMO staff, customers, and management at all times. Regularly scheduled status reports shall include a discussion of quality activities, if any. Such activities may include periodic assessment of the precision, accuracy, and completeness of measurement data, the results of any surveillance or audits and any QA problems.

The SMO shall provide reports of results of any QA/QC activities and documentation associated with the handling, shipping and analysis of samples to the Task/Project Leaders and Department Managers.

The SMO Technical Lead shall ensure that the Department Managers and customers are kept informed of, and have access to, results of system and performance assessments and data-package review activities. Any programmatic QA issues identified that adversely affect the quality of data generated shall be reported to the Department Managers immediately.

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3.5 DATA VALIDATION AND USABILITY

This section discusses guidelines for assessing data quality. QA protocols are presented for data reduction, verification, validation, and reporting activities performed as part of the SMO function.

See applicable AOPs and activity-specific QAPPs for further details on data validation and usability.

3.5.1 Data Review, Verification, and Validation

Procedures for assessing data quality, data reduction, verification, validation, and reporting activities shall comply with applicable requirements described as part of EPA SW-846 and other Standard Methods, LQAP, LOPs, the SNL/NM *Contract SOW for Analytical Laboratories*, the DOE NNSA *Model SOW for Analytical Laboratories,* and AOPs.

3.5.1.1 Laboratory Data Review

The analytical laboratory shall complete quality reviews of all data packages as specified in the SNL/NM *Contract SOW for Analytical Laboratories* prior to submitting them to the SMO.

The SMO shall verify that the contract analytical laboratories follow the SNL/NM *Contract SOW for Analytical Laboratories* relative to laboratory data review. See EPA SW-846 and other Standard Methods, LQAP, LOPs, the SNL/NM *Contract SOW for Analytical Laboratories*, the DOE NNSA *Model SOW for Analytical Laboratories* and AOPs for further details on laboratory data review and reduction requirements.

3.5.1.2 Laboratory Data Verification and Validation

The specific criteria to be reviewed in the analytical laboratory data verification and validation process depend on the sample matrix, analytical method and applicable regulatory requirements. The initial responsibility for monitoring the quality of analytical data lies with the analytical laboratory analyst. The analyst shall verify that all QC procedures specified for each analytical method are followed and that the results of QC check sample analyses are within the acceptance criteria established for the method. When results are not within control limits, corrective actions shall be taken according to EPA SW-846 and other Standard Methods, the SNL/NM *Contract SOW for Analytical Laboratories*, the LQAP, LOPs, or SMO directive.

The SMO shall verify that the analytical laboratories follow the SNL/NM *Contract SOW for Analytical Laboratories* relative to laboratory data verification and validation. See EPA SW-846

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and other Standard Methods, LQAP, LOPs, the SNL/NM *Contract SOW for Analytical Laboratories* and the DOE NNSA *Model SOW for Analytical Laboratories* for further details on the laboratory data verification and validation requirements.

SMO personnel are responsible for data verification and editing upon receipt of the data package. A CVR is conducted in accordance with SMO-05-03, *Procedure for Completing the Contract Verification Review (CVR).* The CVR checks completeness and compliance of the sample custody and laboratory report documentation, examines sample management and custody and checks technical, QC, and reporting requirements imposed upon the analytical laboratory through the SNL/NM *Contract SOW for Analytical Laboratories*. The CVR checklist provides the SMO with a record of analytical laboratory performance on each data package and allows for SMO tracking of reported deficiencies, correction requests and problem resolutions. The SMO, using the results from the CVR, monitors the performance of contracted analytical laboratories and in accordance with the SNL/NM *Contract SOW for Analytical Laboratories* adjusts payment.

The SMO shall perform a QC check on the EDD and process the file for loading into the analytical results database. This review is performed using SMO-05-04, *Procedure for Electronic Data Deliverable (EDD) Processing*. During the EDD processing, the file is compared to the hardcopy data to ensure accuracy and checked for compliance with the EDD Specification found in the SNL/NM *Contract SOW for Analytical Laboratories*. The SMO documents deficiencies, requests corrections and resolves EDD problems.

The SMO shall perform data validation if requested to do so by the customer, using AOP 00-03, *Data Validation Procedure for Chemical and Radiochemical Data*. This AOP provides instructions for the qualification (known as validation) of common laboratory analytical data. This procedure is used to determine the quality and usability of chemical (organic and inorganic) and/or radiochemical analytical data acquired in support of other programs. This procedure generally follows the guidelines and approach presented in the EPA *Contract Laboratory Program (CLP) Functional Guidelines*, and in EPA SW-846 and other standard methods, with modifications made to address analyses requested by the other programs. A data validation report shall be completed by the SMO that includes information regarding the overall quality of the data and the resulting data qualifiers. Data validation qualifiers are then imported into the analytical results database.

Qualification of data performed under the data validation procedure (AOP 00-03) does not preclude the qualification of data by the analytical laboratories due to unexpected analytical uncertainty, nor does the validation review replace any data usability review for specific project use. For details on site-specific verification/validation requirements, see activity-specific QAPPs and SAPs.

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3.5.1.3 Data Reporting

Analytical laboratory-generated data shall be reported on EDD and in hard-copy data reports as requested. All analytical laboratory data report packages for each type of analysis shall contain a case narrative that summarizes the laboratory analysis for the given set of samples. Complete data packages include sample data, QC summaries, and additional supporting data needed to perform data validation. Laboratory reporting requirements and report format shall be in accordance with the SNL/NM *Contract SOW for Analytical Laboratories*.

The SMO shall verify that the analytical laboratories follow the SNL/NM *Contract SOW for Analytical Laboratories* as it pertains to data reporting. Details on tracking data and entering it into the appropriate databases are presented in the *SMO Data Management Plan*, AOP 95-44, and the SMO *Procedure for Electronic Data Deliverable (EDD) Processing*, SMO-05-04, and other programs, procedures and documents.

All laboratory analytical reports shall be archived by the SNL CFRC.

3.5.2 Reconciliation with User Requirements

Task/Project Leaders shall review and analyze analytical laboratory-generated data prior to use and inclusion in reports. If sample results are unusable, they cannot, by definition, be used in the decision making process. If sample results that are critical to the decision making process are unusable, a determination must be made as to whether or not re-analysis or re-sampling is possible. Sample results that have restricted usability must be used cautiously in the decision making process with their restrictions clearly defined. The SMO shall work closely with analytical contract laboratories and customers to assure that laboratory-generated data meets DQOs and other data needs and that they are sufficient to support any decisions made.

4.0 SUPPORTING DOCUMENTS AND REFERENCES

AOP 95-16, *Sample Management and Custody*, current revision.
AOP 95-44, *SMO Data Management Plan*, current revision.
AOP 00-03, *Data Validation Procedure for Chemical and Radiochemical Data*, current revision.
AOP 09-11, *ES&H/Emergency Management Center Document Control Procedure*, current revision.
CG100.5, *Ensure Quality.*
CG100.6, *Assure Performance Process.*
CG100.6.1, *Manage Risks.*

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CG100.6.3, *Determine, Plan and Perform Assessments.*
CG100.6.6, *Determine and Take Action.*
CG100.6.19, *Conduct Management Review.*
ESH100.2.RAD.1, *Implement Radiation Protection Procedures,* (MN471016) *Radiological Protection Procedures Manual*, current revision.
FAC 100.1, *Plan Real Property Assets.*
FIN 100.2, *Provide Financial Project Management Services.*
HR 100.1, *Acquire Talent.*
HR 100.2, *Develop the Workforce.*
IM100, *Information Management & Cyber Security.*
LOP 94-03, *Sample Handling, Packaging and Shipping*, current revision.
SCM100.2.11, *Acquire Quality Significant Items*.
SNL/NM, *Contract SOW for Analytical Laboratories,* current revision.
SMO-SH-A-001, *Fume Hood Usage and Sample Container Preparation*, current revision.
SMO-05-03, *Procedure for Completing the Contract Verification Review (CVR),* current revision.
SMO-05-04, *Procedure for Electronic Data Deliverable (EDD) Processing*, current revision.
DOE O 414.1D *Quality Assurance*, 2011.
DOE NNSA, *Model SOW for Analytical Laboratories*, current revision.
EPA QA/R-5, *EPA Requirements for Quality Assurance Project Plans,* 2001 (Reissued 2006).
10 CFR 830 Subpart A, *Nuclear Safety Management, Quality Assurance Requirements*.
ISO 9001, *Quality Management Systems – Requirements, 2008.*
ISO 14001, *Environmental management systems -- Requirements with guidance for use, 2004.*

Developmental References

The following have been used in the development of the Sample Management Office QA Program.

AOP 04-04, *ES&H and Emergency Management Self-Improvement Process,* current revision.
AOP 09-10, *Work Planning and Controls,* current revision.
CG100.6.7 *Conduct and Manage Audits*.
ESH100, *Environment Safety & Health Corporate Policy.*
ESH100.2.GEN.2, Determine, *Complete, and Document Required ES&H Training*.
ESH100.2.GEN.3, *Develop and Use Technical Work Documents*.
ESH100.4.RPT.3, *Report Occurrences*.
ESH100.4.FI.1, *Perform ES&H Line Self-Assessment Activities*.
ESH100.4.FI.3, *Implement and Manage Corrective Actions*.
HR100, *Human Resources Management Corporate Policy.*
HR100.3.8, *Manage and Evaluate Employee Performance*.
IM100.2.1, *Control of Documents*.
IM100.2.2, *Control of Records.*
IRN Web item, Summary of the Major Processes in the Financial Information System
SCM100.2, *Acquire Property, Material, and Services* (formerly the SNL Procurement Manual).
SNL, Financial Information System Database (FIS)
SNL, *Quality-Significant Procurement Handbook,* current revision.
SNL, *Records Management Manual, current revision*.
SNL, Site-wide Personnel Training Plan for Resource Conservation and Recovery Act – Regulated Waste Management Units, Appendix D, General Part B Permit Application, SNL/NM

DOE, DOECAP, *Quality Systems for Analytical Services (QSAS),* current revision.
DOE G 414.1-2B, *Quality Assurance Program Guide*, 2011.
EPA, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846 (Third Edition), as updated. http://www.epa.gov/osw/hazard/testmethods/sw846/index.htm.
EPA 600 series methods.
EPA, *Methods for the Determination of Organic Compounds in Drinking Water*, EPA 600/4-88/039, 1988 (Revised 1991).
EPA, *CLP Functional Guidelines,* current revision.
EPA QA/G-4, *Guidance on Systematic Planning using the Data Quality Objectives Process*, 2006.
EPA QA/G-5, Guidance for *Quality Assurance Project Plans*, 2002.

APHA, *Standard Methods for the Examination of Water and Wastewater,* current revision.

IMPORTANT NOTICE: A printed copy of this document may not be the document currently in effect. The official version is located on the Sandia Restricted Network (SRN), 4100 Controlled Documents home page.

ASTM, *Annual Book of ASTM Standards*, Volumes 3 and 11.
OSHA, *OSHA Analytical Methods Manual*, current revision.

Other Developmental References

DOE, see United States Department of Energy.

EPA, see United States Environmental Protection Agency.

Gilbert, R. O., 1987. *Statistical Methods for Environmental Pollution Monitoring*, Van Nostrand Reinhold Company, Inc., New York, NY.

SNL/NM, see Sandia National Laboratories/New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), *Environmental Management System Manual* (PG47022), current revision, Environmental Programs, Sandia National Laboratories, Albuquerque, New Mexico.

United States Department of Energy (DOE), 1997. *EML Procedures Manual*, (HASL-300), 28th edition (as updated). United States Department of Energy, Environmental Measurements Laboratory, New York, New York.

United States Environmental Protection Agency (EPA), 1992. *Hazardous Waste Permit for Sandia National Laboratory*, Permit Number NM5890110518 (as updated). United States Environmental Protection Agency, Washington, D.C.

EPA, 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities*, Unified Guidance (EPA/530-R-09-007). United States Environmental Protection Agency, Office of Resource Conservation and Recovery, Washington, D.C.

EPA, 2007, *Guidance for Preparing Standard Operating Procedures (SOPs)*, EPA QA/G-6, EPA/600/B-07/001, United States Environmental Protection Agency, Office of Environmental Information, Washington, D.C.

EPA, 2005, *Waste Management System; Testing and Monitoring Activities; Final Rule: Methods Innovation Rule and SW-846 Final Update IIIB; Final Rule*, published in the Federal Register on June 14th, 2005 (70 FR 34538). United States Environmental Protection Agency, Office of Solid Waste, Washington, D.C.

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EPA, 1997, *EPA Implementation Guide for the Code of Environmental Management Principles for Federal Agencies (CEMP)*, EPA/315/B-97/001, Enforcement and Compliance Assurance, Washington, D.C.

EPA, 1993. *Determination of Inorganic Anions in Water by Ion Chromatography, Method 300.0*, United States Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Inorganic Chemistry Branch, Cincinnati, Ohio.

EPA, 1989a. *Methods for Evaluating the Attainment of Cleanup Standards, Volume 1: Soils and Solid Media, EPA/230/02-89-042*, United States Environmental Protection Agency, Office of Policy, Planning, and Evaluation, Washington, D.C.

EPA, 1989b. *Soil Sampling Quality Assurance User's Guide, EPA/600/8-89-046*, 2nd ed., United States Environmental Protection Agency, Office of Research and Development, Environmental Monitoring Systems Laboratory, Las Vegas, Nevada.

EPA, 1989c. *RCRA Facility Investigation (RFI) Guidance, Volume II of IV, Soil, Groundwater and Subsurface Gas Releases*, Interim Final, *EPA/530/SW-89-031*, Office of Solid Waste, Waste Management Division, Washington, D.C.

EPA, 1989d. *RCRA Facility Investigation (RFI) Guidance, Volume III of IV, Air and Surface Water Releases*, Interim Final, *EPA/530/SW-89-031*, Office of Solid Waste, Waste Management Division, Washington, D.C.

EPA, 1988. *Interim Report on Sampling Design Methodology, EPA/600/X-88-408*, United States Environmental Protection Agency, Environmental Monitoring Support Laboratory, Las Vegas, Nevada.

EPA, 1987a. *Data Quality Objectives Process for Superfund: Interim Final Guidance, EPA/540/R-93/071*, United States Environmental Protection Agency, Office of Emergency and Remedial Response and Office of Waste Programs Enforcement, Washington, D.C.

EPA, 1986d. *RCRA Groundwater Monitoring Technical Enforcement Guidance Document (TEGD)*, OSWER-9950.1, United States Environmental Protection Agency, Office of Waste and Emergency Response, Washington, D.C.

EPA, 1979. *Handbook for Analytical Quality Control in Water and Wastewater Laboratories, EPA/600/4-79-019*, United States Environmental Protection Agency, Office of Research and Development, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.

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EPA, 1977. *Handbook for Analytical Quality Control in Radioanalytical Laboratories*, EPA/600/7-77-088, United States Environmental Protection Agency, Office of Research and Development, Office of Energy, Minerals and Industry, Washington, D.C.

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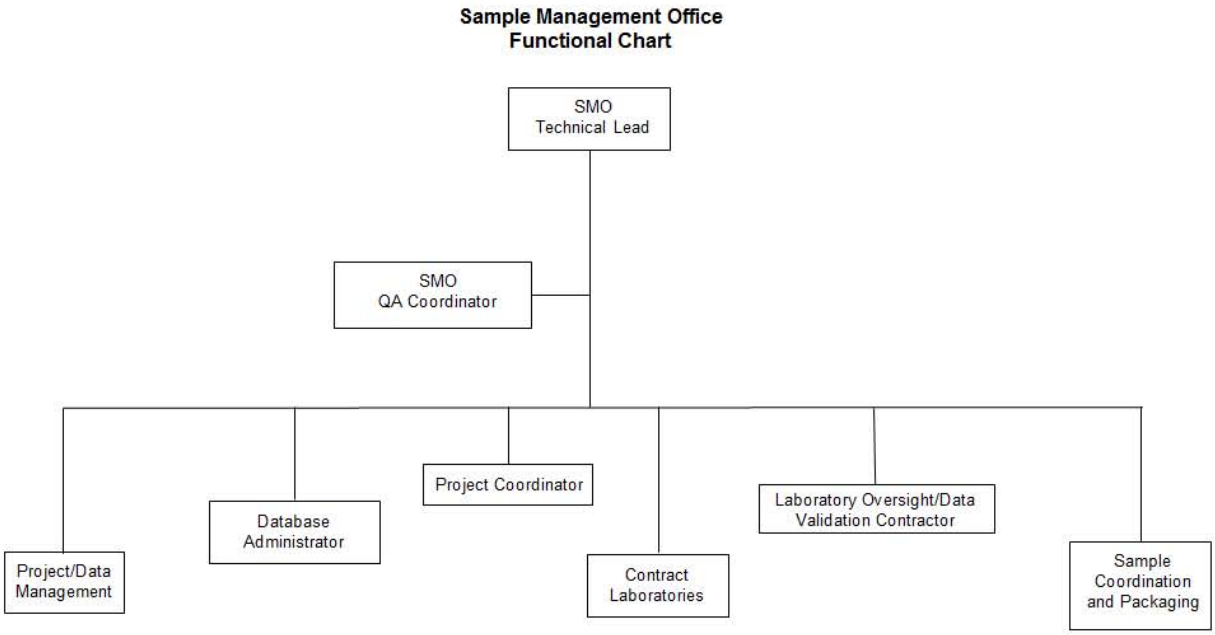
Attachment I



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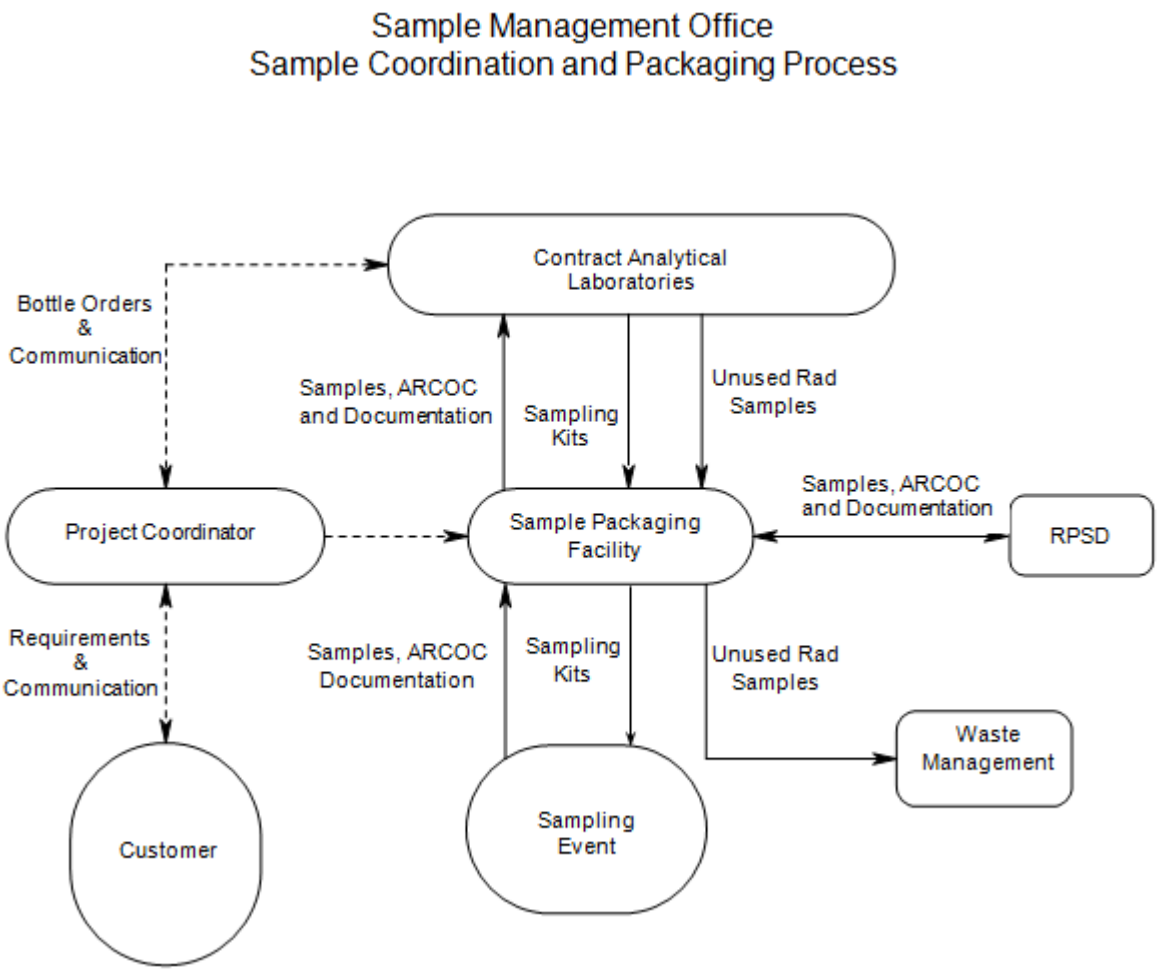
Attachment II



*The unused rad samples that are returned are only those which the laboratories can't dispose of, i.e. PCB mixed waste and Limited Quantity rad. The contract laboratories dispose of all other excess samples.

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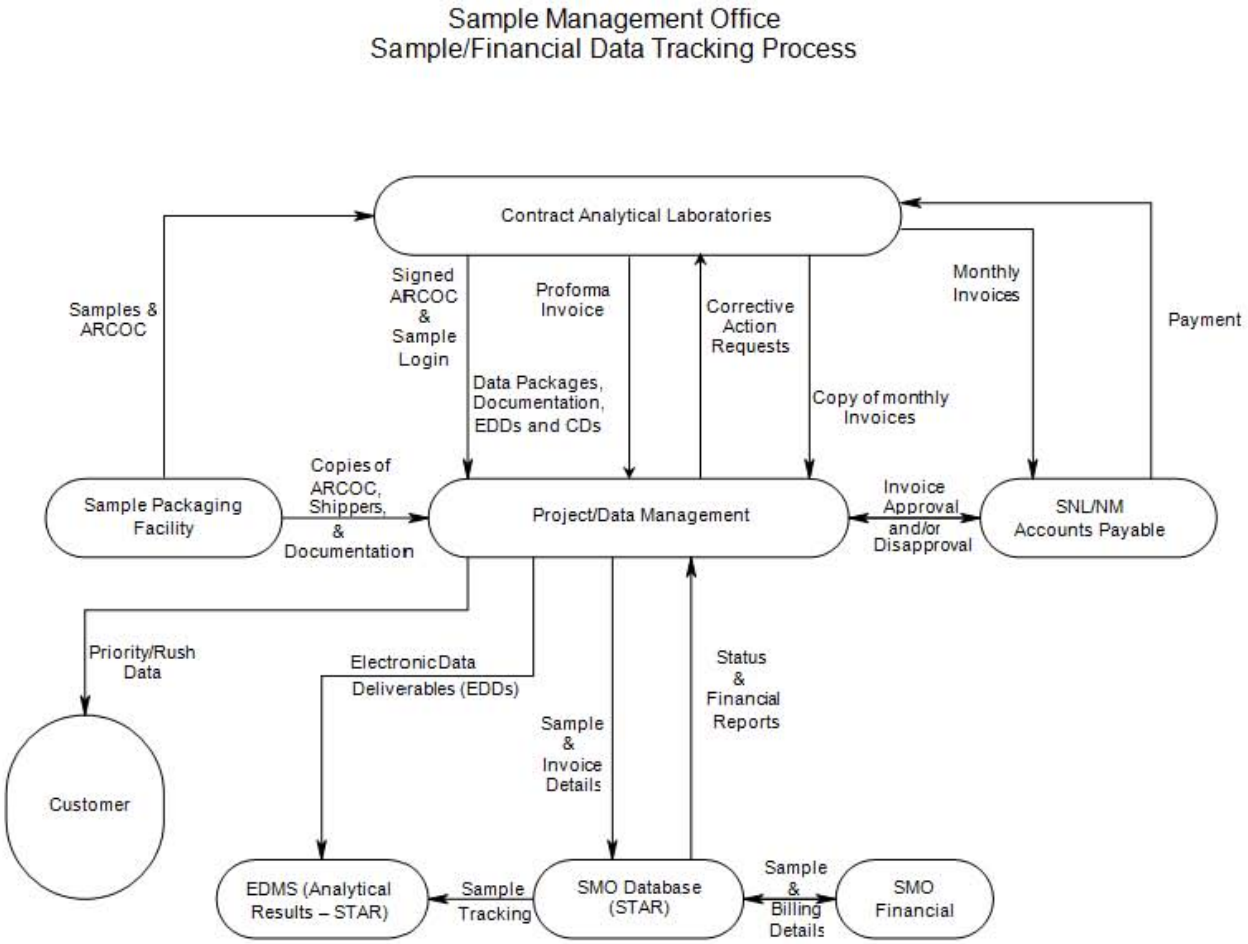
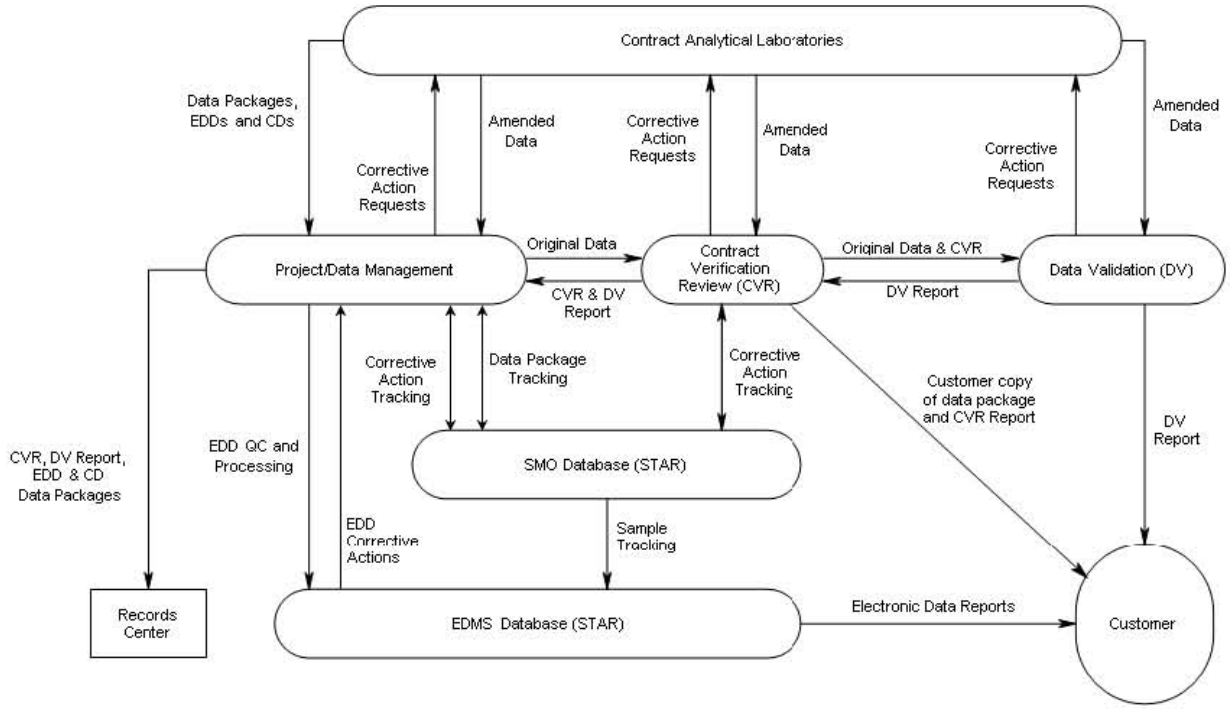
Attachment III



Attachment IV

Sample Management Office
Analytical Data Process



SANDIA NATIONAL LABORATORIES
LONG TERM STEWARDSHIP DEPARTMENT (4142)

SOIL MOISTURE DETERMINATION AT THE MIXED WASTE LANDFILL UTILIZING NEUTRON LOGGING
FIELD OPERATING PROCEDURE

FOP 10-07
Revision 1

Approved: _____ **Date:** 3/25/13
Robert Ziock, Author

Approved: _____ **Date:** 3/25/13
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Approved: _____ **Date:** 3/25/13
Donald Schofield, Field Support Operations Team Lead

Approved: _____ **Date:** 4/1/2013
Steve Farmer, Radiological Protection

Approved: _____ **Date:** 4/22/13
Pamela Puissant, Manager

Author: *How frequently does this document need to be reviewed and/or revised?*	*Every 3 years*
Manager: *Does this document need to be tracked?*	*Yes*

EFFECTIVE DATE: 4/22/13

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Revision History

Revision	Effective Date	Summary of Changes
Rev 0	2/28/2011	New Document
Rev 1	4/22/2013	Review cycle changed from 2 to 3 years. Updated to reflect the department's current formatting requirements for a FOP. Removed the following attachments: On-the-Job Training, Authorized Users List, and CPN 503 DR Hydroprobe® Moisture gauge Operating Manual. Updates were made to the following appendices: Radiological Hazardous Materials Summary; Neutron Probe (Source) Checklist for Shipping & Receiving; Mixed Waste Landfill Neutron Count Log Form.

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ACRONYMS AND ABBREVIATIONS

AOP	administrative operating procedure
cm	centimeter
CPN Probe	CPN 503 DR Hydroprobe® Moisture Depth Gauge
EDMS	Environmental Data Management System
EOC	Emergency Operations Center
ES&H	Environment, Safety and Health
ET Cover	evapotranspirative vegetative soil cover
FOP	field operating procedure
ft	foot (feet)
LTMMP MWL	Long-Term Maintenance and Monitoring Plan for the Mixed Waste Landfill
m	meter
mrem/hr	millirem per hour
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
OJT	on-the-job training
OSHA	Occupational Safety and Health Administration
PHS	primary hazard screening
RCT	Radiological Control Technician
RPPM	Radiological Protection Procedures Manual
SNL/NM	Sandia National Laboratories/New Mexico
THA	task hazard analysis
TWD	technical work document
VZ	vadose zone

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1.0 PURPOSE, SCOPE, AND OWNERSHIP

The Mixed Waste Landfill (MWL) is located at Sandia National Laboratories/New Mexico (SNL/NM) Technical Area III. The MWL is a 2.6-acre site that was established in 1959 as a disposal area for low-level radioactive and mixed waste generated by SNL/NM research facilities. The MWL accepted low-level radioactive and minor amounts of mixed waste from March 1959 through December 1988. Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies (at the time of disposal) of activity were disposed of at the MWL.

Purpose The purpose of this Field Operating Procedure (FOP) is to provide guidelines and procedures for use of the CPN503 DR Hydroprobe® Moisture Gauge (CPN probe) at the MWL. The CPN probe counts neutrons that will be used to determine soil moisture content beneath the MWL evapotranspirative vegetative soil cover (ET Cover). Neutron counts are correlated to moisture values by use of a correlation formula developed in the *Neutron-Probe Calibration Project at the Infiltration Pilot Site* (SNL/NM August 2001). Monitoring will be performed at the MWL to document levels of soil moisture in the vadose zone. This data will be used to evaluate the effectiveness of the MWL ET Cover as specified in the *Long-Term Maintenance and Monitoring Plan for the Mixed Waste Landfill* (LTMMP MWL) (SNL/NM March 2012).

Scope This FOP is applicable to all SNL employees and contractors who perform neutron logging activities at the Technical Area III MWL using a CPN probe. The work does not require a Radiological Work Permit and it will not affect other organizations.

Ownership The Long Term Stewardship Department is responsible for development, approval, distribution, revision, and control of this procedure.

2.0 RESPONSIBLE ORGANIZATION AND INDIVIDUALS

Responsible Organizations

The Long Term Stewardship Department is responsible for the following:

- Completion and documentation of soil moisture monitoring of the MWL vadose zone as outlined in the LTMMP MWL (SNL/NM March 2012).
- Performing the work in accordance with the Environment, Safety, and Health (ES&H) Radiological Protection Procedures Manual (RPPM) which implements the requirements of Corporate Procedure ESH100.2.RAD.1, Implement Radiation Protection Procedures.
- Storing and controlling access and tracking for the CPN probe.

Radiological Protection Department is responsible for providing the following:

- Providing guidance and support to Long Term Stewardship Department operation's involving radiological materials.

Responsible Individuals

The **Department Manager** is responsible for the following:

- Providing programmatic guidance leading to the development of this FOP.
- Performing assessments of MWL operations to ensure compliance to the LTMMP MWL and the ES&H RPPM.
- Reviewing and recommending approval of the procedure.
- Approving an Activity Level Work Evaluation Form (EP 2009-ALW) for activities described in this FOP as required by administrative operating procedure (AOP) AOP 09-10, *Work Planning and Control*.

The **Project Lead** (Job Coordinator equivalent in the ES&H RPPM) for vadose zone monitoring at the MWL is responsible for the following:

- Providing overall coordination and management of the monitoring activities.
- Reviewing and reporting soil moisture data.
- Transmitting soil moisture data to the Long Term Stewardship Database Administrator for inclusion in the Environmental Data Management System (EDMS).
- Reviewing and transmitting documentation forms to the Customer Funded Records Center and the Corrective Action Management Unit Administrative Trailer (Building 6920E).
- Reviewing, revising, and maintaining technical work documents (TWDs).
- Reviewing and recommending approval of this procedure.

The **Field Support Operations Team Lead** (Job Coordinator equivalent in the ES&H RPPM) is responsible for the following:

- Coordinating with the Project Lead and Field Technicians regarding monitoring activities.
- Supervising the Field Technicians.
- Reviewing training requirements for Field Technicians.
- Assigning qualified Field Technicians to conduct the activities described in this procedure.
- On-the-job training (OJT), as necessary, for new personnel performing field activities. Document training by completing on OJT Form (EP 2009-OJT).
- Providing Field Technicians with necessary equipment to conduct field work.

- Notifying the Project Lead of unusual field conditions, wells requiring maintenance, or breach of well security.
- Reviewing, revising, and maintaining technical work documents.

The **Field Technician** (Radiological Worker equivalent in the ES&H RPPM) is responsible for the following:

- Completing an Activity Level Work Evaluation Form (EP 2009-ALW) as required by AOP 09-10, *Work Planning and Control*.
- Notifying the site Radiological Control Technicians (RCTs) in SNL/NM Radiation Protection prior to using the CPN probe.
- Operating the CPN probe to obtain soil moisture data.
- Completing and reviewing field documentation forms.
- Transmitting field documentation forms to the Project Lead.
- Informing the Field Support Operations Team Lead of monitoring locations requiring maintenance or if the monitoring location has been compromised (e.g., lock has been removed, damage to protective enclosure or casing).
- Annual calibration of the CPN probe.
- Maintaining the equipment.
- Keeping training current.
- Providing recommendations for revisions to this procedure (if necessary).

The **RCT** is responsible for the following:

- Performing monthly radiation surveys of storage area for the CPN probe.
- Performing semi-annual leak surveys of the CPN probe.
- Performing shipping surveys when the CPN probe is sent to manufacturer for calibration and/or maintenance, and when it is returned to SNL/NM.
- Providing radiological protection support to the field activity in accordance with the ES&H RPPM.

The **Database Administrator** is responsible for the following:

- Importing data into EDMS.
- Maintaining the database.
- Identifying, recommending, and implementing improvements to the database.

The **Source Custodian** and **Alternate Source Custodian** responsibilities are detailed in the ES&H RPPM, Chapter 9, Control of Accountable Sealed Radioactive Sources, Source Custodian Section 9.3.3.

The **ES&H Coordinator** is responsible for assisting the staff and management in ES&H performance and compliance.

3.0 TRAINING AND MONITORING QUALIFICATIONS

Personnel conducting field activities shall complete the following:

3.1 Training

- Read SNL/NM Corporate Policy ESH100 Environment Safety & Health.
- Complete required department training and training identified in the primary hazard screening (PHS) results.
- Read PHS SNL06A00497, *Vadose Zone Monitoring at the Mixed Waste Landfill*.
- Read applicable sections of the LTMMP MWL (SNL/NM 2012).
- Pre-job briefing required by the ES&H RPPM. (Note: Signing the Authorized Users List (EP2009-AUL) suffices for the pre-job briefing required by the ES&H RPPM.)
- Read *CPN 503 DR Hydroprobe® Moisture Gauge Operating Manual*.
- Familiarity with sections in the ES&H RPPM that pertain to sealed and controlled radioactive sources.
- OJT, as necessary, for new personnel performing field activities. Document training by completing on OJT Form (EP 2009-OJT).
- Complete training courses listed in Table 1.
- Field personnel shall sign an Authorized Users List (EP2009-AUL) to affirm they have read and understand this document, and agree to operate within the stated constraints.

Table 1 - Training Course List

Course Code	Course Title
CHM100	Chemical Safety
CHM103	Site Specific Chemical Safety
ELC105	Basic Electrical Safety (> 50 volts)
ENV100	Occupational Safety and Health Administration (OSHA) Health & Safety Basic Training - General Worker (40 HR)
ENV103	OSHA Health & Safety Training Refresher (8 HR)
ENV112	Hazardous Waste & Environmental Management Training
ESH100	ES&H Awareness
MCH200	Hand and Power Tool Safety
MED102	Standard First Aid
MED104	Heartsaver CPR
OTS101	Occupational Thermal Stress
PPE106	Personal Protective Equipment Training
RAD210	Radiological Worker I Training

3.2 Monitoring

Personnel using the CPN probe are responsible for obtaining and wearing properly coded (neutron radiation) dosimeters during all operations. They are also responsible for returning the dosimeter to their Department Manager on the assigned dates.

4.0 HEALTH AND SAFETY

A task hazard analysis (THA) has been performed on the activities described in this FOP. The THA was performed in conjunction with the latest version of the PHS SNL06A00497. The PHS helps identify potential hazards that can be expected when performing the work. The THA classifies the potential hazards and rates them based on the probability of occurrence. The THA lists control measures that will be used to mitigate the potential hazards. The control measures may include courses and training that are identified as part of the PHS results. This approach to identifying, rating, and controlling hazards is consistent with the SNL Integrated Safety Management System initiative.

An exposure assessment survey for field activities was performed by an SNL/NM industrial hygienist. The exposure assessment survey report concluded that the potential for exposure to health hazards has been categorized as well-controlled; therefore acceptable.

An Activity Level Work Evaluation Form was completed and approved by the Department Manager as required by AOP 09-10. The hazards and controls to minimize the hazards are listed in Table 2.

A tailgate safety and emergency response briefing shall be conducted before the start of field activities. A Tailgate Safety Meeting Form (Appendix A) shall be completed at time of aforementioned briefing.

Table 2 – Task Hazard Analysis

Potential Hazard	Hazard Rating	Control
Radiological (see Section 4.1 for additional information) • External Radiation • Leaking Source • Contaminated materials or soil	Medium	• Personnel must be trained on the radiological hazards associated with the use of the instrument and are required to wear their radiation dosimetry during use. • The instrument (source) must be leak tested semi-annually by SNL Radiation Protection. • Work is performed outside site boundary and an ET Cover has been installed over the former disposal areas (minimum average thickness of 5.37 feet [ft]); therefore personnel will not come into contact with contaminated materials or soil. • Monitoring wells have enclosed steel casing which prevents the monitoring equipment from coming into contact with contaminated materials or soil.
Chemical	Low	• Work is performed outside site boundary and an ET Cover has been installed over the former disposal areas (minimum average thickness of 5.37 ft); therefore personnel will not come into contact with contaminated materials or soil. • Monitoring wells have enclosed steel casing which prevents the monitoring equipment from coming into contact with contaminated materials or soil.
Physical • Weather/Heat Stress & Cold Stress • Sunburn • Mechanical hazards (cable winch) • Strains, and lifting hazards • Slips, trips, falls	Low	• Monitoring activities are not physically demanding. • First Aid kit is located in sampling vehicle. • Personnel should seek shelter if lightning is observed within 5 miles (25 seconds from time of flash to thunder) or the Emergency Operations Center (EOC) issues a lightning warning (via EOC pager). Workers will be trained on heat & cold stress, and sunburn hazards. Sunscreen will be provided. • Dangling lanyards will not be worn when operating manual cable winch. • Leather work gloves will be worn when handling the cable from the winch. • Proper lifting techniques will be reinforced. • Holes will be filled or covered to eliminate slip, trip hazards.
Biological • Snakes, Rodents, Insects	Low	• Care will be taken to observe that the well casings pose a potential for insects and other animals. • Monitoring well areas will be kept clean and places of refuge for biological hazards minimized.
Fire	Low	• Fire extinguishers will be located in mobile equipment.

4.1 Radiation Hazard

The CPN probe contains a 50.0 millicurie Am241/Be neutron source. Radiation levels provided by the manufacturer are:

30 centimeters (cm): 0.1 millirem per hour (mrem/hr) gamma, 1.8 mrem/hr neutron

Contact: 0.5 mrem/hr gamma, 1.7 mrem/hr neutron
Other: up to 30 mrem/hr neutron on contact if unshielded

Detailed ES&H RPPM requirements for use and storage of the CPN probe are listed below:

Engineering Controls: None
Administrative Controls:
- Pre-Job Briefing shall be performed.
- Technical Work Documents (TWDs) (FOP, PHS, and THA).

Hold Points: None
Void Points: Contamination greater than ES&H RPPM Attachment 6-1 Radioactive Contamination Limits of 20 disintegrations per minute/100 cm^2 and radiation levels greater than 5 mrem/hr at 30 cm (gamma + neutron).
Alarming Equipment (or other special equipment): None
RCT Coverage: Intermittent
RCT required surveys:
- Semi-annual leak test (cycle group April and October)
- Monthly routine survey of storage area
- Transportation surveys when shipping CPN probe to manufacturer.
- Job coverage surveys as needed

Source Custodian required inventory: Semi-annual (cycle group April and October)
Radiological Posting:
- Radioactive Materials Area
- Controlled Area

Frisking Requirements: None
TWD (this FOP) Sign-In Requirements: Initial

For more information on the CPN probe see Radiological Hazardous Materials Summary (Appendix B).

Extreme care shall be taken to ensure safe operation in accordance with this procedure and to keep radiation exposure as low as reasonably achievable (ALARA). If the CPN probe becomes stuck in an access tube or borehole shut down work immediately , proceed as directed in section 4.2 Work Shutdown.

4.2 Work Shutdown

In the event that work is stopped due to:

- safety-related issues,
- an injury incurred while performing the tasks identified in this procedure, or
- as the result of an audit,

the Field Technician shall immediately notify the Field Support Operations Team Lead, the Project Lead, and the Department Manager. The Field Technician shall seek the assistance of the Field Support Operations Team Lead for the mitigation of the hazard and the completion of a Work Resumption Authorization Form (EP 2009-WRA) as required by AOP 09-10, *Work Planning and Control*. The Department Manager shall sign the completed form prior to the restart of work.

In the event that work is stopped due to:

- The CPN probe becoming lodged in an access tube, call Radiation Protection and inform them of the problem. An RCT will be dispatched to the site. Do not attempt to retrieve the probe in any manner that could possibly damage the probe or expose the source.
- The CPN probe sustaining extensive damage, maintain a safe distance from the probe (10 meters [m] or 33 ft). Immediately notify Radiation Protection. An RCT will be dispatched to the site.

the Field Technician shall immediately notify the Field Support Operations Team Lead, the Project Lead, and the Department Manager. The Field Technician shall seek the assistance of the Field Support Operations Team Lead for the mitigation of the hazard and the completion of a Work Resumption Authorization Form (EP 2009-WRA) as required by AOP 09-10, *Work Planning and Control*. The Department Manager shall sign the completed form prior to the restart of work.

5.0 DATA QUALITY OBJECTIVES

Refer to the LTMMP MWL (SNL/NM March 2012) for data quality objectives.

6.0 EQUIPMENT AND MATERIALS

6.1 Personal Protective Equipment

Personal protective equipment includes the following:

- safety boots
- safety glasses
- leather gloves (when handling CPN interface cable)

6.2 Neutron Logging Equipment and Materials

The CPN 503DR system consists of the following (see Appendix C for photos):

- CPN probe
- CPN probe shielded control box
- Interface cable (12 ft length used to connect CPN probe to shielded control box for standard count)
- Instrument suitcase
- CPN cable reel mounted in vehicle (spooled with 375 ft of CPN interface cable)
- Battery charger

Additional equipment and materials includes the following:

- Logbook
- Pulley fixture to be mounted to the access tube.
- Power source (12 volt DC to AC vehicle power inverter mounted in vehicle)
- Key to unlock padlock on building ERFO2 (obtain key from the Project Lead)
- Key to unlock padlocks on access tube protective casings (obtain key from Project Lead)

7.0 FIELD PROCEDURES

7.1 CPN Probe Handling Requirements

The CPN probe is stored in building ERFO2. It can only be used with the permission of the Source Custodian. The designated support RCT must also be notified prior to using the CPN probe. The Field Technician must complete the following information on the

Sign-Out/Sign-In Form (Appendix D) when using the CPN probe:

- Field Technician name
- Source Custodian contacted prior to us
- RCT contacted prior to use
- Reason for using CPN probe
- CPN probe Source ID
- Sign-out date and time
- Sign-in date and time

The probe should always remain in the shielded control box unless in use. When the probe is outside the shielded control box, use the shielding blanket to cover the probe whenever possible. The operator should minimize their time near the probe. A distance of at least a 1-m (3.3-ft) should be maintained. Do not leave the probe unattended, except when it is locked in building ERFO2 for storage. The door to ERFO2 is clearly marked with a magenta and yellow placard labeled "Caution-Radioactive Materials." The CPN shielded control box and its storage case are labeled with the appropriate radioactive material warnings. These labels must be replaced immediately if damaged, obscured, or removed. Contact Radiation Protection to assist in the

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replacement of signs and/or labels. Personnel not performing the monitoring, but in the immediate area, need to be notified of the radiation hazard. Only a government vehicle may be used to transport the CPN probe.

A leak test survey is performed on the probe by radiation protection personnel semi-annually (cycle group April and October). A source inventory is performed by the Source Custodian semi-annually (cycle group April and October). Both are requirements listed in the ES&H RPPM. A notice should be issued by the Device and Source Registrar indicating when the survey and inventory are due. In addition, a Source Status Label (Appendix E) is attached to the CPN shielded control box and its storage case stating when the leak test survey and semi-annual inventory were last performed and when they need to be updated.

If the CPN probe needs to be sent to the manufacturer for calibration and/or maintenance, follow the requirements listed in the ES&H RPPM. The Neutron Probe (Source) Checklist for Shipping & Receiving is provided in Appendix F that gives detailed directions for shipping and receiving. Update the Source Status Label (Appendix E) to "Active" or "Storage" as necessary.

7.2 Standard Count

Charge the battery in the CPN probe shielded control box prior to use. A standard count will be taken each day the CPN probe is used (see page 21 of *CPN 503 DR Hydroprobe® Moisture Gauge Operating Manual*). Take five standard counts if the CPN probe is new, has been repaired, or the probe has not been used for six months. The standard count measurement is taken with the probe in the shielded control box. Always place the probe in the same location when taking standard counts to ensure consistency.

1. Place the CPN probe storage case on a sturdy, level surface (level ground is fine) at least 3 m (10 ft) from a hydrogen source or any large vertical surface, and at least 10 m (33 ft) from any other radioactive source.
2. Place the shielded control box on top of the standard count plate (a plate on top of the probe storage case). Leave the probe in the shielded control box.
3. Connect the CPN interface cable (10-ft length) between the probe and the shielded control box.
4. Press the "CLEAR" key to display "READY."
5. Press the "STD" key to get into the standard count menu. This will display the current standard count.
6. Press the "STEP" key. This will display the previous standard count.
7. Press the "STEP" key. This will display the current Chi squared (χ^2) value.
8. Press the "STEP" key. This will display "New Standard?"
9. Press "Enter."
10. Step back to a safe distance of at least 10 ft.

The shielded control box will beep after pressing "ENTER." This indicates it has begun counting to determine a new standard count. The counting will continue for approximately 4 minutes. The shielded control box will beep three times when the standard count is completed and then display the new standard count value.

11. Press the "ENTER" key. This will save the new standard count value and display the "READY" prompt.

The new standard count is acceptable if the new χ^2 value is between 0.75 and 1.25. To display the new standard count and new χ^2 value repeat steps 5 through 7. Record the new standard count and the new χ^2 value on the Mixed Waste Landfill Neutron Count Log Form (Appendix G) if $\chi 2$ is within the acceptable range. If the new χ^2 is not between 0.75 and 1.75, begin with step 4 again. Otherwise continue with step 12. (Refer to the discussion on statistics and other standard count information contained in the CPN 503 DR Hydroprobe® Moisture Gauge Operating Manual).

12. Press the "STEP" key. This will display "New Standard?"
13. Press "CLEAR."
14. This will display the "READY" prompt.

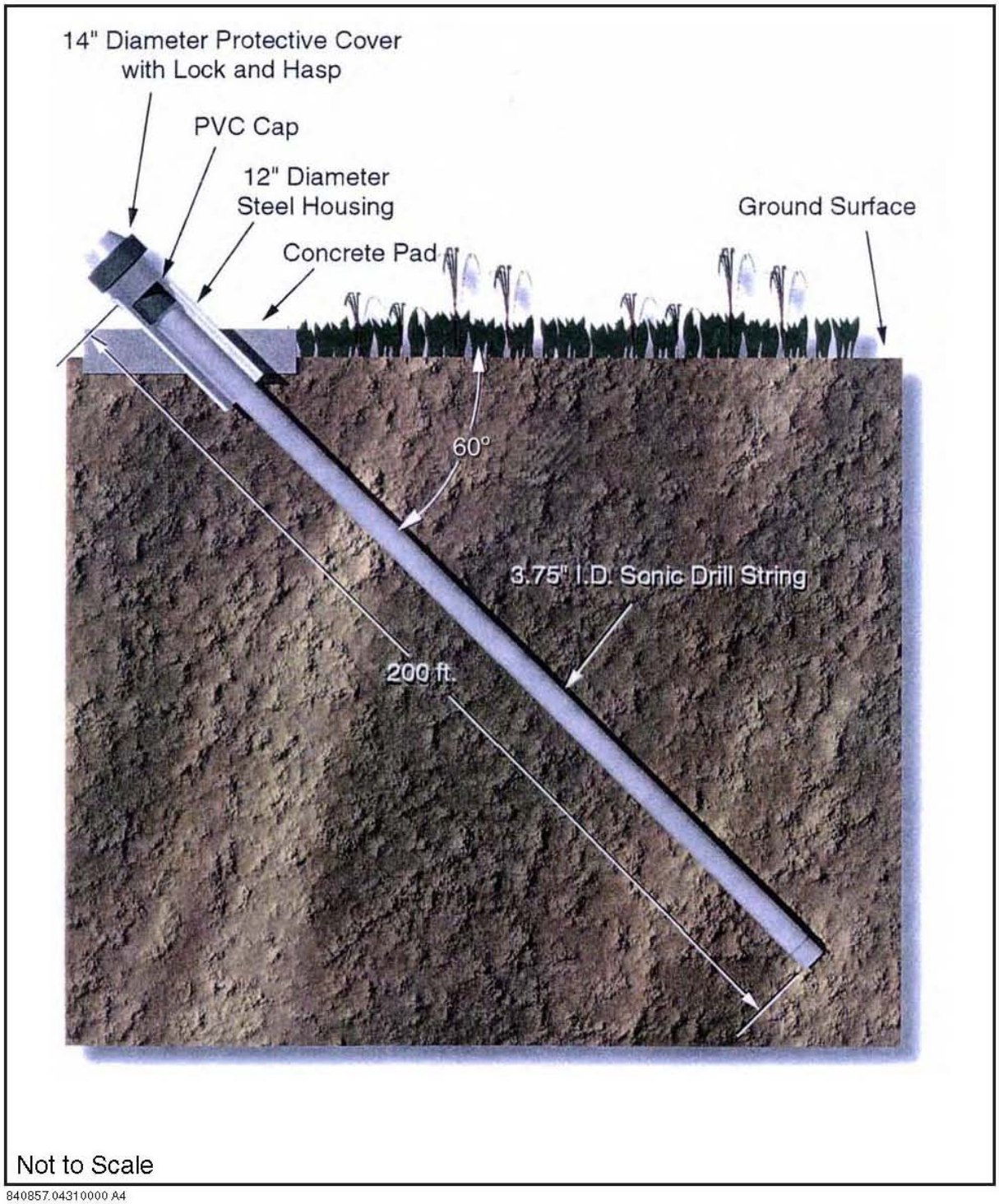
After taking the standard count verify that the sampling time is set for 30 seconds. Press the "TIME" key. If the display shows "30," press "ENTER" and the probe is ready for field measurements. If the display shows something other than "30," use the "STEP" key to scroll through the time choices until "30" is displayed. Press "ENTER," and the probe is ready for field measurements.

7.3 Neutron Logging of Access Tubes

The soil-moisture monitoring system is comprised of three access tubes drilled on a 30-degree angle from vertical to a depth of 200 linear feet and a vertical depth of 173 feet below ground surface. The access tubes are identified as vadose zone (VZ)-1, VZ-2, and VZ-3. Each access tube is cased with 4.5-inch diameter steel casing. The access tubes are open to the soil in the bottom (no end cap). Figure 1 presents a schematic of an access tube. To log neutron counts:

1. Notify the designated support RCT that the CPN probe will be used.
2. Take the standard count (refer to Section 6.2).
3. Position the CPN cable reel in line with the access tube casing.
4. Open lock and remove casing cap.
5. Attach unistrut pulley fixture to top side of casing.
6. Attach the CPN cable to probe while probe still in shielded control box.
7. Place shielded control box directly next to access tube casing.
8. Remove the probe from the shielded control box. Thread the probe through the unistrut pulley assembly and into the access tube casing.

Figure 1 – Soil Moisture Monitoring Access Tube



9. Slowly lower the CPN probe into the access tube until the bottom of the CPN probe is even with the ground level. Set the cable reel footage counter to zero.
10. Place shielded control box next to CPN cable reel and attach cable coming from cable reel hub to the shielded control box.
11. Reel out the CPN probe to the first monitoring depth.
12. Press the "COUNT" button on the shielded control box. A neutron count value will be displayed after 30 seconds.
13. Record neutron count value on Mixed Waste Landfill Neutron Count Log Form (Appendix G).
14. Continue to move the probe to each predetermined location in the access tube to collect neutron counts.

When all sample data have been collected:

15. Disconnect cable from shielded control box.
16. Place shielded control box directly next to access tube casing.
17. Remove probe from access tube casing and immediately place into shielded control box.
18. Disconnect cable from probe.
19. Close and lock the casing cap.

Repeat this procedure for the remaining access tubes. Appendix C provides photos of the equipment setup.

8.0 WASTE MANAGEMENT

No waste is generated from neutron logging activities.

9.0 DATA MANAGEMENT

9.1 Data Collection Locations and Frequency

Neutron logging data is collected from three locations (VZ-1, VZ-2, and VZ-3). There are sixty monitoring points (depths) for each of the VZ locations. See the Mixed Waste Landfill Neutron Count Log Form (Appendix G) for monitoring depths. The frequency at which the data is collected is specified in the LTMMP MWL.

9.2 Data Submittal Process

The steps of the data flow process and the personnel associated with each step are defined below.

Field Technician

1. As the neutron count data is collected and recorded on the Mixed Waste Landfill Neutron Count Log Form (Appendix G), it is compared to the previous monitoring result values to see if there are any anomalies.
2. Anomalies are noted and the Mixed Waste Landfill Neutron Count Log Form (Appendix G) is submitted to the Project Lead.

Project Lead

1. The Project Lead enters the neutron count data into a Microsoft® Excel spreadsheet that uses a previously determined correlation equation to convert neutron counts to soil moisture content (percent water content by volume).
2. Neutron count and soil moisture data are submitted to the Database Administrator after review by the Project Lead.

Database Administrator

The Database Administrator imports the data received from the Project Lead into EDMS.

10.0 REFERENCES

InstroTek, Inc. (formerly CPN Company). CPN 503 DR Hydroprobe® Moisture Gauge Operating Manual, 4057 Port Chicago Hwy STE 100, Concord, California. http://instrotek.com/

Sandia National Laboratories, Corporate Policy ESH100 Environment Safety & Health (current version), Sandia National Laboratories, New Mexico.

Sandia National Laboratories, "Neutron-Probe Calibration Project, Infiltration Pilot Site, Mixed Waste Landfill," Sandia National Laboratories, Albuquerque, New Mexico (2001).

Sandia National Laboratories, "Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill," Sandia National Laboratories, Albuquerque, New Mexico (2012).

Sandia National Laboratories, "Work Planning and Control," AOP 09-10 (current version), Sandia National Laboratories, Albuquerque, New Mexico.

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Sandia National Laboratories, MN471016, Radiological Protection Procedures Manual (current version), Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories Primary Hazard Screening, SNL06A00497 (current version), "Vadose Zone Monitoring at the Mixed Waste Landfill." Sandia National Laboratories, Albuquerque, New Mexico.

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APPENDIX A
Tailgate Safety Meeting Form

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Tailgate Safety Meeting Form

Dept: _____ Facility: MWL Date: _____ Time: _____

Activities: Soil moisture monitoring using CPN503DR Hydroprobe.

(Anyone has the right to cease field activities for safety concerns. The buddy system will be used when performing field work.)

Weather Conditions:
Temp: ____°F Wind Speed: _____MPH Humidity: ____% Wind Chill: ____°F

☐ Wear safety boots		☐ Wear leather gloves
☐ Wear safety glasses		☐ Wear sun screen
☐ Be aware of biohazards (snakes, spiders, etc.)		☐ Wear communication device (cell phone, EOC pager)
☐ Be aware of slips, trips, and falls		☐ Using safe lifting practices were discussed.
☐ Be aware of pinch points on winch		☐ Be aware of environmental conditions (heat/cold stress)
Does anyone have any weight restrictions on lifting? Circle **YES** or **NO**. If answered **YES** explain.		
☐ Practice ALARA		☐ Notify RCT when using neutron probe

ATTENDEES

Printed Name	Signature
Printed Name	Signature
Printed Name	Signature
Printed Name	Signature
Printed Name	Signature
Printed Name	Signature

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APPENDIX B
Radiological Hazardous Materials Summary

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RADIOLOGICAL HAZARDOUS MATERIALS SUMMARY

General Information

Type of device:	– Neutron Moisture Probe
Manufacturer:	– CPN International, Inc.
Model Number:	– CPN 503DR
Serial Number:	– #H30039459 (primary instrument), #H300605758 (backup instrument)
Operating parameters:	– 6.5 mA Average 1.85 gigabecquerel (50 millicurie) Americium-241:Beryllium
Type of radiation:	– Gamma, Neutron
Sandia Device and Source Registrar ID#:	– RS02625 (primary instrument), RS00661 (backup instrument)
Location of device:	– TA-III, Building ERFO2

The manufacturer's encapsulation of the source is a double sealed capsule CPN-131.
The manufacturer's shielding of the source is provided by silicon-base paraffin.

Source Custodian: Robert Ziock, Dept. 4142, 845-0485
Alternate Custodian: none

Radiation Levels (provided by manufacturer)

30 cm: 0.1 mrem/hr gamma, 1.8 mrem/hr neutron
Contact: 0.5 mrem/hr gamma, 1.7 mrem/hr neutron
Other: up to 30 mrem/hr neutron on contact if unshielded

Dosimetry

A TLD with a neutron code of 20 is required for personnel operating the CPN probe.

Training and Technical Work Documents

Operators of the CPN probe shall complete the following training:

- Field personnel shall sign an Authorized Users List (EP2009-AUL) to affirm they have read and understand this document, and agree to operate within the stated constraints.
- OJT as necessary, for new personnel performing field activities. Document training by completing on OJT Form (EP 2009-OJT).
- Read *CPN 503 DR Hydroprobe® Moisture Gauge Operating Manual*.
- OSHA 40-hr Hazardous Waste Operations Training.
- OSHA 8-hr Hazardous Waste Operations Training Refresher

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RADIOLOGICAL HAZARDOUS MATERIALS SUMMARY (continued)

- Read PHS SNL06A00497, *Vadose Zone Monitoring at the Mixed Waste Landfill*.
- RAD210 Radiological Worker 1.
- Familiarity with sections in the ES&H RPPM that pertain to sealed and controlled radioactive sources.

ALARA protocol will be performed by the field personnel when using this instrument.

Postings

Postings at storage location include: "Controlled Area" and "Radioactive Materials"

Users of the instrument will be responsible for administrative controls while the probe is in use or transport.

Surveys & Inventory

A leak survey shall be performed on the CPN probe semi-annually (cycle group April and October) by an RCT.

A leak test survey shall also be performed on the CPN probe prior to transportation by the Packaging and Transportation group from the ERFO2 storage building. This will occur only when the CPN probe is sent to the manufacturer for calibration/maintenance. Upon return to the ERFO2 storage building from the manufacturer and prior to use of the CPN probe by a Field Technician, an additional leak test survey must be performed.

> **Note**: Anytime the CPN probe is shipped to the manufacturer, the status of the source must be change from "**Active**" to "**Storage**" status prior to movement from the ERFO2 storage building. This is done via the "Device and Radioactive Source Tracking System" website at: https://webprod2.sandia.gov/dvs/. Upon return from the manufacturer and prior to use of the CPN probe by a Field Technician, the status of the source must be changed back to "**Active**" status.

Monthly routine surveys of the ERFO2 storage building are performed by an RCT.

Inventory of the CPN probe is performed semi-annually (cycle group April and October) by the Source Custodian.

RADIOLOGICAL HAZARDOUS MATERIALS SUMMARY: (concluded)

Transport

- Only within TA-III by authorized field personnel. Any other transportation will be done by the Packaging and Transportation group.
- Instrument will be transported in the manufacturer's hard shell suitcase. The suitcase will be secured in the vehicle using tie-downs.
- A "Caution Radioactive Material" label must be affixed to the outside of the suitcase.
- If the CPN probe is used in the field for more than five days (without daily storage in ERFO2) or is transferred off-site, update the source location in the Radiation Protection Source Database.

Operational As Low As Reasonably Achievable (ALARA) Screen

The Operational ALARA Screen shall be performed by evaluating the following conditions. If any of the conditions apply to the radiological work an Operational ALARA Review shall be performed. [10 Code of Federal Regulations 835.1003(b)]

- Will the highest individual dose of >100 mrem total effective dose be expected to complete the work? No.
- Will the collective dose of >500 person-mrem total effective dose be expected to complete the work? No.
- Will airborne radioactivity in the accessible work area be expected to routinely meet or exceed the criteria for an airborne radioactivity area? No airborne radioactivity.
- Will removable contamination in the accessible work area be expected to routinely meet or exceed the criteria for a high contamination area? No removable contamination.
- Will hot particles be expected in the accessible work area? No hot particles.
- Will general area dose rates in the accessible work area be expected to routinely meet or exceed the criteria for a high or very high radiation area? No.
- Are dose rates of >50 μrem/hr expected in occupied areas for a period >1 week? No.

An Operational ALARA Review is not required based on the answers to the above questions.

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APPENDIX C
Photographs of Equipment Setup

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CPN probe/shielded control box and instrument case (probe contained in shielding)

CPN probe/shielded control box and instrument case (probe removed from shielding)

Cable reel used to lower CPN probe into the VZ access tubes

Equipment setup at a VZ monitoring location

APPENDIX D
CPN Probe Sign-Out/Sign-In Form

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CPN Probe Sign-Out/Sign-In Form

Field Technician Name	Field Technician Signature	Source Custodian Contacted?	RCT Contacted?	CPN Probe Used	Purpose	Sign Out Date/Time	Sign In Date/Time
		□ Yes	□ Yes	□ RS00661 □ RS02625			
		□ Yes	□ Yes	□ RS00661 □ RS02625			
		□ Yes	□ Yes	□ RS00661 □ RS02625			
		□ Yes	□ Yes	□ RS00661 □ RS02625			
		□ Yes	□ Yes	□ RS00661 □ RS02625			
		□ Yes	□ Yes	□ RS00661 □ RS02625			
		□ Yes	□ Yes	□ RS00661 □ RS02625			
		□ Yes	□ Yes	□ RS00661 □ RS02625			
		□ Yes	□ Yes	□ RS00661 □ RS02625			
		□ Yes	□ Yes	□ RS00661 □ RS02625			
		□ Yes	□ Yes	□ RS00661 □ RS02625			
		□ Yes	□ Yes	□ RS00661 □ RS02625			
		□ Yes	□ Yes	□ RS00661 □ RS02625			
		□ Yes	□ Yes	□ RS00661 □ RS02625			
		□ Yes	□ Yes	□ RS00661 □ RS02625			

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APPENDIX E
Source Status Label

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Source Status Label

Example:

Source ID #: RS00661
Status: ACTIVE
Leak Test last performed: 4/11/05
Leak Test due by: 10/11/05
Semi-Annual Inventory Performed: 4/27/05
Semi-Annual Inventory due by: 10/27/05

Replace with "STORAGE" status tag if the unit is sent in for calibration/maintenance. Upon return, immediately have a leak test survey performed to upgrade the status to "ACTIVE" and indicate status on a new tag. Notify Device & Source Registrar of any status or storage changes: 844-3415

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APPENDIX F
Neutron Probe (Source) Checklist for Shipping & Receiving

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Neutron Probe (Source) Checklist for Shipping & Receiving
(To be completed by Source Custodian only)

Indicate Source Registrar ID # of neutron probe instrument to be shipped to manufacturer for calibration and/or repairs:

☐ RS00661 ☐ RS02625

Current status of the source indicated on instrument and instrument storage case label. (It should indicate that the source is "Active")

☐ Active ☐ Storage

Notify a Radiological Control Technician (RCT) that the instrument will be sent offsite (to the manufacturer) for calibration and/or repairs and request a "Movement" and "Shipping" survey.

☐ RCT notified

☐ RCT performed "Movement" and "Shipping" survey. Date: _____

☐ RCT informed shipper of the "Movement" and "Shipping" survey # _____

Notify "Device and Source Registrar" by e-mail devsrc@sandia.gov that there will be an offsite transfer of the source to the manufacturer for calibration and/or repairs. Request a "**Change of Status**" from "**Active**" source to "**Storage**". Be sure to specify the Source Registrar ID #. For more information go to the "Device and Source Registrar" at https://webprod2.sandia.gov/dvs/

☐ Send e-mail to devsrc@sandia.gov indicating that the source will be transferred to the manufacturer for calibration and/or repairs and request a "**Change of Status**" from "**Active**" source to "**Storage.**"

☐ Print a hardcopy of all e-mails to and from the "Device and Source Registrar" And keep with instrument's records.

☐ Date that "Device and Source Registrar" was notified: _____

Replace tag on the instrument and the instrument storage case indicating the status has been changed from "**Active**" to "**Storage**."

☐ Tag has been replaced. Date tag was replaced: _____

Complete shipping documentation (SHIPPER form) located at the following web address:

http://cfo.sandia.gov/logistics/Shipping/Page1WSF.htm

IMPORTANT NOTICE: A printed copy of this document may not be the document currently in effect. The official version is located on the Sandia Restricted Network (SRN), department home page.

Neutron Probe (Source) Checklist for Shipping & Receiving (continued)

Attach all relevant documents electronically to the SHIPPER form as instructed. This includes:

- ☐ The "Information of Hazardous Material Shipments" form (provided on the SHIPPER website). Indicate on appropriate line the material to be shipped is CLASS 7-RADIOACTIVE MATERIALS.
- ☐ The supplemental Radioactive Shipment Information form (provided on the SHIPPER website). An RCT can help provide the information requested on the form.
- ☐ The "Movement" and "Shipping" survey that was performed by the RCT.
- ☐ The most recent "SPECIAL FORM" provided by the manufacturer (see SPECIAL FORM attached to this checklist).
- ☐ Copy of letter from the National Nuclear Security Administration Sandia Site Office to SNL Radiation Protection "Exemption of Department of Energy and its Prime Contractors from Nuclear Regulatory Commission Licensing Requirements" (see letter attached to this checklist).
- ☐ Copy of U.S. Department of Transportation (Pipeline and Hazardous Materials Safety Administration) International Certificate of Competent Authority Special Form Radioactive Materials Certificate USA/0632/S-96 (see certificate attached to this checklist).
- ☐ Copy of Radioactive Material License Number 1100-07 (see license attached to this checklist.
- ☐ Copy of the Safety Data Sheet for secondary nickel-cadmium sealed cells (see Safety Data Sheet attached to this checklist).
- ☐ A statement in the form of an e-mail from a Nuclear Criticality Safety Engineer (NCSE) that certifies the material remains below the DeMinimis requirements (see e-mail attached to this checklist).

Print a hardcopy of all the forms and keep with instrument's records.

- ☐ Forms printed.

Submit the SHIPPER form and all attachments.

- ☐ Date submitted: _____

Neutron Probe (Source) Checklist for Shipping & Receiving (concluded)

A Customer Service Request (CSR) Form must be completed after the Shipper is submitted. The CSR Form can be accessed at:

https://arsprod.sandia.gov/Logistics/LogisticsNM.asp

- ☐ CSR Form completed and submitted. Date submitted: _____
- ☐ Instrument was picked up by shippers for delivery to the manufacturer. Source Custodian signed shipping form indicating instrument pickup.

The following will be completed upon return of the instrument to Sandia National Laboratories:

- ☐ The Source Custodian was notified that the instrument has been returned from the manufacturer and a delivery to the Source Custodian is arranged.
- ☐ Source Custodian signed for instrument and returned it to Building ERFO2.
  Date: _____
- ☐ Shipping papers were filed with the instrument's records.
- ☐ Source Custodian immediately notifies the "Device Source Registrar" via e-mail that the instrument has been returned from the manufacturer to regular storage location at TA-III, Building ERFO2. Date notified: _____
- ☐ Source Custodian schedules leak test with an RCT.
  Date leak test performed: _____
- ☐ Source Custodian e-mails "Device Source Registrar" a copy of the leak test results and request a "**Change of Status**" from "**Storage**" source to "**Active**" if the leak test indicates that the source is intact.
- ☐ Print a hardcopy of all e-mails to and from the "Device and Source Registrar" And keep with instrument's records.

Replace tag on the instrument and the instrument storage case indicating the status has been changed from "**Storage**" to "**Active**."

- ☐ Tag has been replaced. Date tag was replaced: _____

SPECIAL FORM

49CFR 173.476 **Approval of special form radioactive materials.**

(a) Each offeror of special form Class 7 (radioactive) materials shall maintain on file for at least one year after the latest shipment, and provide to the Associate Administrator on request, a complete safety analysis, including documentation of any tests, demonstrating that the special form material meets the requirements of Paragraph 173.469. An IAEA Certificate of Competent Authority issued for the special form material may be used to satisfy this requirement.

49CFR173.469 **Tests for special form radioactive materials**

(1) Impact Test	Free fall of capsule from a height of 9 meters onto a granite block of smooth surface. No shattering or breaking observed.
(2)Percussion Test	Capsule placed on a ¼" sheet of lead on concrete. Steel rod 25 mm in diameter by 330 mm long was dropped from a height of one meter. No shattering or breaking observed.
(3) Bending Test	Not applicable due to small length.
(4) Heat Test	Capsule heated to 800°C (1472°F) with a torch. Maintained for 10 minutes and allowed to air cool. Discoloration, but no melting or dispersement observed.

Leakage test performed after each test. No activity in excess of .005 microcuries (185 Bq) observed.

The radioactive material encapsulated in CPN International, Inc. stainless steel sealed source capsule, identified as model number **CPN-131,** has been tested for and is in compliance with the requirements for special radioactive material. IAEA Certificates of Competent Authority have been issued as follows:

CPN GAUGES	ACTIVITY & NUCLIDE	IAEA NO.
MC-1,2,3 & 501/DR	10 mCi Cs-137 and 50 mCi Am-241/Be	USA/0634/S and USA/0627/S
503/DR, MCM-2, MC-M	50 mCi Am-241/Be	USA/0627/S
MC-S-24	10 mCi Cs-137 and 50 mCi Am-241/Be	USA/0634/S and USA/0627/S
AC-2/R	100 mCi Am-241/Be	USA/0627/S

CPN International, Inc.
2830 Howe Road
Martinez, CA 94553
Phone: (925) 228-9770
Fax: (925) 228-3181

Douglas Carter
Radiation Safety Officer

September 8, 2003

A:RSO.spclform.doc

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

NOV 2 8 2007

Mr. Brad Elkins
Manager Radiation Protection
Sandia National Laboratories, Org. 10328
P.O. Box 5800, MS-1103
Albuquerque, New Mexico 87185

Subject: Exemption of Department of Energy (DOE) and its Prime Contractors from Nuclear Regulatory Commission (NRC) Licensing Requirements

Dear Mr. Elkins:

The Atomic Energy Act of 1954, as amended, exempts the DOE and its prime contractors from the NRC licensing requirements. Accordingly, 10 CFR 30.11, 30.41, 40.14, 40.51, 70.11 and 70.42 provide for the lawful receipt by DOE and its prime contractors of by-product, source, and/or special nuclear material from an NRC licensee consistent with the applicable DOE-approved 10 CFR 835 Radiation Protection Plan. Sandia Corporation, which manages and operates Sandia National Laboratories under a prime contract with the DOE, is therefore authorized to receive all present and future shipments of such material. Please note that this memorandum addresses materials only and does not address or authorize the receipt of wastes containing by-product, source, and/or special nuclear material.

If you have any questions regarding this memorandum, please contact Donald Brady of my staff at (505) 845-6164.

Sincerely,

Daniel Pellegrino
Assistant Manager
Environment, Safety, Health & Quality Assurance

Enclosure

cc:
A. Blumberg, SNL/NM, Org. 11100, MS-0141

U.S. Department of Transportation

Pipeline and Hazardous Materials Safety Administration

East Building, PHH-23
1200 New Jersey Avenue SE
Washington, D.C. 20590

IAEA CERTIFICATE OF COMPETENT AUTHORITY
SPECIAL FORM RADIOACTIVE MATERIALS
CERTIFICATE USA/0632/S-96, REVISION 5

This certifies that the sources described have been demonstrated to meet the regulatory requirements for special form radioactive material as prescribed in the regulations of the International Atomic Energy Agency[1] and the United States of America[2] for the transport of radioactive material.

1. Source Identification - QSA Global, Inc. Model Nos. AX1, X.1, and X.1/2 (All models manufactured on or after May 17, 1977).

2. Source Description - Cylindrical double encapsulations made of stainless steel and tungsten inert gas or laser seal welded. Approximate outer dimensions of all models are 7.9 mm (0.31 in.) in diameter and 10.15 mm (0.4 in.) in length. Construction shall be in accordance with attached AEA Technology QSA, Inc. Drawing No. RBA10880, Rev. E.

3. Radioactive Contents - No more than either 3.7 GBq (100.0 mCi) of Americium-241 or 13.0 GBq (351.0 mCi) of Californium-252. The Am-241 is in oxide form and mixed with beryllium powder and pressed into a solid pellet. The Cf-252 is in the form of a metal wire or an oxide solid ceramic.

4. Quality Assurance - Records of Quality Assurance activities required by Paragraph 310 of the IAEA regulations[1] shall be maintained and made available to the authorized officials for at least three years after the last shipment authorized by this certificate. Consignors in the United States exporting shipments under this certificate shall satisfy the applicable requirements of Subpart H of 10 CFR 71.

5. Expiration Date - This certificate expires on March 31, 2013.

---

[1] "Regulations for the Safe Transport of Radioactive Material, 1996 Edition (Revised), No. TS-R-1 (ST-1, Revised)," published by the International Atomic Energy Agency(IAEA), Vienna, Austria.

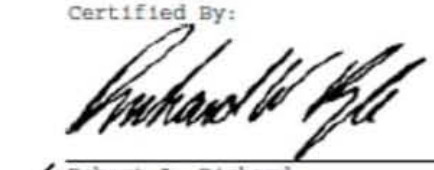
[2] Title 49, Code of Federal Regulations, Parts 100-199, United States of America.

(- 2 -)

CERTIFICATE USA/0632/S-96, REVISION 5

This certificate is issued in accordance with paragraph 804 of the IAEA Regulations and Section 173.476 of Title 49 of the Code of Federal Regulations, in response to the February 29, 2008 petition by QSA Global, Inc., Burlington, MA, and in consideration of other information on file in this Office.

Certified By:



Robert A. Richard
Deputy Associate Administrator for Hazardous Materials Safety

Mar 13 2008
(DATE)

Revision 5 - Issued to extend the expiration date.

Sent By: CPN INTERNATIONAL; 925 363 9385; Jul-26-07 2:36PM; Page 1

SAFETY DATA SHEET
SECONDARY NICKEL-CADMIUM SEALED CELLS

Date issue: November 26th, 2003, edition A

The information contained within is provided as a service to our customers and for their information only. The information and recommendations set forth herein are made in good faith and are believed to be accurate at the date compiled. Saft makes no warranty expressed or implied.

1. IDENTIFICATION

1.1 Product

Sealed secondary (or rechargeable) Cells
Trade name and model: SAFT, V... according model.
IEC designation: KR... according international standard IEC 61951-1

Electrochemical system: Nickel/Cadmium, alkaline electrolyte
Positive electrode: Nickel hydroxide
Negative electrode: Cadmium hydroxide
Electrolyte: Potassium, Sodium and Lithium hydroxide in water solution.

Nominal voltage: 1.2Volts

1.2 Supplier

Name:	SAFT
Address:	12 rue Sadi Carnot – 93170 BAGNOLET
Tel/Fax:	+33 (0)1 49 93 19 18 / +33 (0)1 49 93 19 50
Emergency contact:	SAFT local dealer.

ATTN: ROBERT

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2. COMPOSITION (Weight percentage of basic materials)

Single cell with steel container

Metals		%	Plastics		%	Other		%
Iron	Fe	25 - 37	Polyamide	PA/PP	2.5 - 3.5	Potassium	K/Na/Li	1.8 - 2.9
Nickel	Ni	20 - 28	Rubber	EPDM	< 0.05	Water	H_2O	4 – 9
Cadmium	Cd	10 - 15	Polyethylene	PE	0.2 - 0.4	OH-		8 -14
Cobalt	Co	0.4 -1.0	PVC		0.2 - 0.7			

3. HAZARDS

A- Human hazards

A sealed Nickel-Cadmium cell is not hazardous in normal use.

3.1 Physical

Nickel plated steel can do not present any risk if cells are used for its intended purpose and according to valid directions for use.

3.2 Chemical

Nickel plated steel can do not present chemical risk in normal use.

In case of misuse (abusive over charge, reverse charge, external short circuit…) and in case of default, some electrolyte can leak from the cell through the safety vent.
In these cases refer to the risk of the Alcaline hydroxides.

The toxic properties of the electrode materials are hazardous only if the materials are released by mechanical damaging the cell or if exposed to fire.

Classification of dangerous substances contained into the cells.

SUBSTANCES			CLASSIFICATION			
Name	EEC Number CAS Number	Symbol	Letter	Identification of danger	Special risk (1)	Safety advice (2)
Cadmium Hydroxide	048-001-00-5 21041-95-2	Cd(OH)2	Xn	Harmful	R 20/21/22	S 22
Nickel Hydroxide	028-008-x* 12054-48-7	Ni(OH)2	Xn	Harmful	R 20/22-43-40	S 22/36
Cobalt Hydroxide	- 21041-93-0	Co(OH)2	Xn	Harmful	R22-42/43	S22-24-37
Alcalines hydroxide	019-002-00-8 1310-58-3	KOH NaOH LiOH	C	Corrosive	R 35	S 26-37/39 -45

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(1) Nature of special risk

R 20/21/22 : Harmful by inhalation, skin contact or if swallowed.
R 20/22: Harmful by inhalation or if swallowed.
R 35: Causes serious burns.
R 40: Possible risk of irreversible effects.
R 43: May cause sensitising by skin contact.
R42/43: May cause sensitising by inhalation and skin contact.

(2) Safety advice

S 22: Do not breathe dust.
S 24: Avoid contact with skin
S 26: In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S 36: Wear suitable protection clothing.
S 37: Wear suitable gloves.
S 37/39: Wear suitable gloves and eyes/face protection.
S 45: In case of accident or if you feel unwell, seek medical advice immediately.

B- Ecological hazards

Metals used in a Ni-Cd cell, and specifically the cadmium, have to be collected and recycled.

4. FIRST AID MEASURES

In case of electrolyte solution spill (cell leakage) precautions must be taken to avoid any contact of human tissues. If it accidentally happens following must be done:

4.1 Inhalation
Fresh air. Rinse mouth and nose with water. Medical treatment.

4.2 Skin contact
Rinse immediately with plenty of water. Medical treatment.

4.3 Eyes contact
Rinse immediately with plenty of water during at least 15-30 min .Immediate hospital treatment. Consult eye specialist.

4.4 Ingestion
If the injured is fully conscious: plenty of drink, preferably milk. Do not induce vomiting. Immediate Hospital treatment.

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From: Schwers, Norman F
Sent: Thursday, October 28, 2010 3:38 PM
To: Ziock, Robert
Cc: Colborg, Shawn P; Spangler, Richie
Subject: FW: De Minimis quantity

Robert,

Based on our conversation, you would like to ship this same item /material to the manufacturer for calibration.
Based on the material type and quantity remaining the same as the previous analysis, the material remains below the DeMinimis requirements.
No NCS controls are required for this material.
I have included Shawn and Richie on this email since I assume that it will pass through 957.
Please pass this along to any of the shipping and packaging personnel or transportation personnel that may need this review.
If you have any questions about this review, please contact me.

Norm Schwers
NCSE
nfschwe@sandia.gov
845-3346

From: Schwers, Norman F
Sent: Tuesday, January 27, 2009 10:39 AM
To: Ziock, Robert; Archibeque, Edward A; Garcia, Andy J; Kidd, Carter R; Gabaldon, Glen G
Subject: De Minimis quantity

Robert,

I just received you call for the Am-241 shipment.
According to your call, the material is 1.85GBq (1.85E9 Bq) and the SNL De Minimus limit is 1.27E12 Bq.
This is less then the de Minimis quantity and can be stored in 957c with no Nuclear Criticality Safety controls required.
I am not sure who you will be working with in transportation or at 957c, so I included a few of the personnel that I know.
If you have any questions, just let me know.
Thanks
Norm Schwers
845-3346

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APPENDIX G
Mixed Waste Landfill Neutron Count Log Form

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Mixed Waste Landfill Neutron Logging Data Field Form (page 1 of 2)

Date:			Standard Count:		
Start Time:			Chi:		
Personnel:			Previous Count:		
			Count Time: 30 seconds		
Vertical Depth Below Top of Casing (ft)	**Linear Depth Along Casing (ft)**	**Winch Counter Reading (ft)**	**VZ-3 Counts (E Side)**	**VZ-2 Counts (SW Corner)**	**VZ-1 Counts (NW Corner)**
0.0	0	0			
0.9	1	9999			
1.7	2	9998			
2.6	3	9997			
3.5	4	9996			
4.3	5	9995			
5.2	6	9994			
6.1	7	9993			
6.9	8	9992			
7.8	9	9991			
8.7	10	9990			
9.5	11	9989			
10.4	12	9988			
11.3	13	9987			
12.1	14	9986			
13.0	15	9985			
13.9	16	9984			
14.7	17	9983			
15.6	18	9982			
16.5	19	9981			
17.3	20	9980			
18.2	21	9979			
19.1	22	9978			
19.9	23	9977			
20.8	24	9976			
21.7	25	9975			

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Mixed Waste Landfill Neutron Logging Data Field Form (page 2 of 2)

Vertical Depth Below Top of Casing (ft)	Linear Depth Along Casing (ft)	Winch Counter Reading (ft)	VZ-3 Counts (E Side)	VZ-2 Counts (SW Corner)	VZ-1 Counts (NW Corner)
26.0	30	9970			
30.3	35	9965			
34.6	40	9960			
39.0	45	9955			
43.3	50	9950			
47.6	55	9945			
52.0	60	9940			
56.3	65	9935			
60.6	70	9930			
65.0	75	9925			
69.3	80	9920			
73.6	85	9915			
77.9	90	9910			
82.3	95	9905			
86.6	100	9900			
90.9	105	9895			
95.3	110	9890			
99.6	115	9885			
103.9	120	9880			
108.3	125	9875			
112.6	130	9870			
116.9	135	9865			
121.2	140	9860			
125.6	145	9855			
129.9	150	9850			
134.2	155	9845			
138.6	160	9840			
142.9	165	9835			
147.2	170	9830			
151.6	175	9825			
155.9	180	9820			
160.2	185	9815			
164.5	190	9810			
168.9	195	9805			
173.2	200	9800			

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Volume VI

TAB 2

Submittal of Updated Reference Documents Cited in the

Mixed Waste Landfill Long-Term Monitoring & Maintenance Plan

From: SNL/Todd
To: NMED/Kieling

Back of Tab 2

National Nuclear Security Administration

Department of Energy
National Nuclear Security Administration
Sandia Field Office
P. O. Box 5400
Albuquerque, NM 87185

JUL 09 2014

Mr. Dave Cobrain
Manager
Permits Management Program
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Dr. East, Bldg. 1
Santa Fe, NM 87505

Subject: Submittal of Updated Reference Documents Cited in the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan for Sandia National Laboratories/New Mexico, Environmental Protection Agency Identification Number NM5890110518

Dear Mr. Cobrain:

The Department of Energy/National Nuclear Security Administration and Sandia Corporation (Sandia) are submitting the enclosed updated reference documents to the New Mexico Environment Department. This submittal is required within 30 days of the document effective date, which occurred on June 16, 2014.

This submittal includes two documents used by Sandia personnel to validate analytical data from contract laboratories and conduct activities related to sampling Mixed Waste Landfill soil-gas wells, respectively. The third document is the health and safety plan for groundwater monitoring. The updated reference documents are:

AOP 00-03 *Data Validation Procedure for Chemical and Radioactive Data*
FOP 08-22 *Soil Vapor Sampling*
PLA 05-09 *Groundwater Monitoring Health and Safety Plan*

If you have questions, please contact John Weckerle of my staff at (505) 845-6026.

Sincerely,

James W. Todd
Assistant Manager for Engineering

Enclosure
cc: See Page 2

cc w/enclosure:
William Moats
Hazardous Waste Bureau
New Mexico Environment Department
5500 San Antonio Dr. NE
Albuquerque, NM 87109

Brian Salem
Hazardous Waste Bureau
New Mexico Environment Department
5500 San Antonio Dr. NE
Albuquerque, NM 87109

Thomas Skibitski, NMED/OB
Thomas.skibitski@state.nm.us

Zimmerman Library
MSC05 3020
1 University of New Mexico
Albuquerque, NM 87101-0001

Amy Blumberg, SNL/NM, MS-0141
SNL Customer Funded Record Center, MS-0651 (**electronic copy only**)
SFO Legal File
SFO Waste Management File
John Weckerle, SFO/ENG, MS-0184
14-327-563197

Submittal of Updated Reference Documents Cited in the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan

Sandia National Laboratories
Albuquerque, New Mexico

CERTIFICATION STATEMENT

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Michael W. Hazen, Vice-President
Sandia Corporation
Albuquerque, New Mexico
Operator

26 June 2014
Date signed

James W. Todd, Assistant Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Field Office
Owner

08 July 2014
Date signed

Enclosure A

Updated Reference Documents Cited in the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan for Sandia National Laboratories/New Mexico

June 2014

AOP 00-03 Data Validation Procedure for Chemical and Radioactive Data
FOP 08-22 Soil Vapor Sampling
PLA 05-09 Groundwater Monitoring Health and Safety Plan

SANDIA NATIONAL LABORATORIES
LONG TERM STEWARDSHIP DEPARTMENT (4142)

DATA VALIDATION PROCEDURE FOR CHEMICAL AND RADIOCHEMICAL DATA for the SAMPLE MANAGEMENT OFFICE

AOP 00-03
Revision 4

Prepared By: Monica Dymerski — **Date:** 05/09/14
Monica Dymerski
Project Manager, Analytical Quality Associates, Inc.

Reviewed By: Kevin A Lambert — **Date:** 5/15/2014
Kevin Lambert
Technical Support Specialist, 4142

Reviewed By: Mike Moore — **Date:** 5/12/2014
Mike Moore
Waste Characterization Project Leader, 4144

Approved: Pam Puissant — **Date:** 6/16/14
Pam Puissant,
Manager, Long Term Stewardship, 4142

Author: *How frequently does this document need to be reviewed and/or revised?*	*Every 3 years*
Manager: *Does this document need to be tracked?*	*Yes*

EFFECTIVE DATE: _____

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Revision History

Revision	Effective Date	Summary of Changes
0	12/21/1999	New document
1	12/08/2003	Update to reflect current administrative changes
2	7/16/2007	Update to reflect current administrative changes
3	5/16/2011	EPA Method updates and references. Process changes for the automatic upload of the data validation qualifiers and the necessary QC steps associated with the new data processing procedure.
4	6/16/2014	Update to responsibilities of SMO personnel, and EPA methods and references. Clarified data validation requirements associated with mass spectra acceptability and TIC evaluation. Added language that states an MS/MSD is not required for an isotope dilution analysis. Included additional method-specific analytical requirements for Organic LC/MS/MS (PPCP) and Inorganic Anions by Ion Chromatography.

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ACRONYMS AND ABBREVIATIONS

SNL acronyms that do not need to be defined in SNL Memos

AA	Atomic Absorption
ARCOC	Analysis Request and Chain of Custody
BOD	Biological Oxygen Demand
CAS	Chemical Abstract Service
CB	Chlorinated Biphenyl
CCB	Continuing Calibration Blank
CCV	Continuing Calibration Verification
CF	Calibration Factor
CLP	Contract Laboratory Program
CRA	RLV for AA Methods
CRDL	RLV for Cyanide Methods
CRI	RLV for ICP-AES, ICP-MS, and LC/MS/MS Methods
CVR	Contract Verification Review
DL	Detection Limit
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DOE	U.S. Department of Energy
DRO	Diesel Range Organics
EB	Equipment Blank
EDD	Electronic Data Deliverable
EICP	Extracted Ion Current Profile
EPA	U.S. Environmental Protection Agency
FB	Field Blank
FWHM	Full-width Half-maximum
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
GPC	Gel Permeation Chromatography
GRO	Gasoline Range Organics
HE	High Explosive
HPLC	High-Performance Liquid Chromatography
HRGC	High Resolution Gas Chromatography
HRMS	High Resolution Mass Spectrometry

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ACRONYMS AND ABBREVIATIONS (continued)

IC	Ion Chromatography
ICAL	Initial Calibration
ICB	Initial Calibration Blank
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
ICS	Interference Check Standard
ICS A	Interference Check Sample Solution A
ICS AB	Interference Check Sample Solution AB
ICV	Initial Calibration Verification
IS	Internal Standard
LC/MS/MS	Liquid Chromatography/Mass Spectrometry/Mass Spectrometry
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOC	Level of Chlorination
LRMS	Low Resolution Mass Spectrometry
MB	Method Blank
MDA	Minimum Detectable Activity
MDC	Minimum Detectable Concentration
MDL	Method Detection Limit
MIR	Manual Integration Review
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MSDC	Mass Spectrometry Data Centre
NBS	National Bureau of Standards
NIH	National Institute of Health
NIST	National Institute of Standards and Technology
NNSA	National Nuclear Security Administration
OP	Operating Procedure
OPR	Ongoing Precision and Recovery
PAH	Polyaromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCDD	Polychlorinated Dibenzodioxin
PCDF	Polychlorinated Dibenzofuran
PPCP	Pharmaceuticals and Personal Care Products
PQL	Practical Quantitation Limit
PS	Post-digestion spike

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ACRONYMS AND ABBREVIATIONS (concluded)

QC	Quality Control
RER	Replicate Error Ratio
RF	Response Factor
RL	Reporting Limit
RLV	Reporting Limit Verification
RPD	Relative Percent Difference
RRF	Relative Response Factor
RRT	Relative Retention Time
RSD	Relative Standard Deviation
RT	Retention Time
SD	Serial Dilution
SDG	Sample Delivery Group
SMO	Sample Management Office
SNL/NM	Sandia National Laboratories/New Mexico
SOW	Statement of Work
SVOC	Semivolatile Organic Compound
SW	Solid Waste (EPA procedure number)
TAL	Target Analyte List
TB	Trip Blank
TCDF	Tetrachlorodibenzofuran
TIC	Tentatively Identified Compound
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
TPU	Total Propagated Uncertainty
VOC	Volatile Organic Compound

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MEASUREMENTS AND SYMBOLS

°C	degrees Centigrade
>	greater than
≥	greater than or equal to
<	less than
≤	less than or equal to
%	percent
%D	percent difference
%R	percent recovery
%RSD	percent relative standard deviation
±	plus or minus
X	times
σ	sigma
amu	atomic mass units
r	correlation coefficient
r^2	coefficient of determination
kev	kilo electron volt
kg	kilogram
L	liter
m/e	mass/charge ratio
ug	microgram
mg	milligram
mL	milliliter(s)
ppb	parts per billion
ppbv	parts per billion by volume

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1.0 PURPOSE

The purpose of data validation is to identify, through the evaluation of supporting documentation, those data that do not meet the expected precision and accuracy of an analytical method. This procedure presents the guidelines used to evaluate chemical (organic and inorganic) and/or radiochemical analytical data acquired in support of environmental and waste management activities. The purpose of the procedure is to consistently qualify data using defined criteria; however, it is not intended to eliminate the need for professional judgment in evaluating the data quality. The data validator may be more or less stringent in evaluating the results based on experience and familiarity with the analytical techniques, historical data, sample matrices, or intended use of the data. The product of this procedure is a data validation report that includes information regarding the overall quality of the data and the resulting data qualifiers. When variations in the application of data qualifiers are warranted, the justification and rationale will be explained in the data validation report.

2.0 SCOPE AND OWNERSHIP

2.1 Scope

This procedure specifically covers the validation of chemical or radiochemical analytical results from environmental methods required for Sandia National Laboratories/New Mexico (SNL/NM) Sample Management Office (SMO) decisions but may be used by other organizations as appropriate. The format is based on analytical techniques, standard reporting protocols used by the laboratories, and the general format followed by the U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) functional guidelines. Additions and modifications were made to address analyses requested by the SNL/NM SMO customers. Any apparent redundancies between sections, is stylistically intentional for the sake of completeness and accuracy. Qualification of data performed under this procedure does not replace any data usability review for specific project use.

2.2 Ownership

The SNL/NM SMO owns this operating procedure (OP). The SMO is responsible for maintaining and revising this OP as necessary. Any comments or suggestions for improvement should be forwarded to the SMO.

3.0 RESPONSIBLE INDIVIDUALS AND ORGANIZATIONS

This section describes the responsibilities of SNL/NM personnel and contractors regarding this OP.

3.1 Department Manager

The department manager is responsible for providing programmatic guidance leading to the development of this OP and the following:

- Reviewing and approving the OP.

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- Acting as liaison to the U.S. Department of Energy (DOE) and the National Nuclear Security Administration (NNSA)/Sandia Field Office on data validation issues.
- Ensuring that resources are available to perform tasks in compliance with this OP.

3.2 SMO Technical Lead

The SMO technical lead is responsible for the operations and activities conducted within the SMO. The principal responsibilities of the SMO technical lead include but are not limited to the following:

- Updating this OP.
- Managing the validation contract, acting as the Sandia Delegated Representative, reviewing routine performance assessments, and conducting general contract oversight.
- Providing oversight of the data review and validation process.
- Ensuring this OP is implemented for review and validation of analytical data provided by the contract laboratories when data validation is requested.
- Developing and maintaining processes that ensure the necessary documentation, to perform data review and validation, is made available to the laboratory oversight/data validation contractor.

3.3 SMO QA Coordinator

The SMO QA Coordinator is responsible for:

- Providing project data quality assurance guidance.
- Ensuring that this procedure is distributed to the appropriate personnel for project/program use.
- Ensuring that sufficient quality checks are in place to maintain the integrity of the SMO sample information management and analytical result database.
- Documenting non-conformances and corrective actions in accordance with the applicable SMO-QAPP.
- Interfacing with the Records Management Coordinator for maintenance of project documentation and to resolve record management concerns for storage and maintenance of sampling and analysis records.

3.4 SMO Project Coordinator

The SMO project coordinator is responsible for coordinating efforts associated with SMO analytical services. The principal responsibilities of the SMO project coordinator include but are not limited to the following:

- Acting as a point of contact between Task/Project Leaders, the analytical laboratories, and the laboratory oversight/data validation contractor.
- Performing the Contract Verification Review (CVR) and completing form SMO 2012-CVR on analytical data packages from the contract laboratories pursuant to "Procedure for Completing the Contract Verification Review," (SMO-05-03) and the SNL/NM Contract Statement of Work (SOW) for Analytical Laboratories (contract SOW).
- Transmitting and tracking electronically the complete analytical data package along with the CVR form to the laboratory oversight/data validation contractor.

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- Implementing and follow-up of all nonconformances and corrective actions with the contract analytical laboratories and laboratory oversight/data validation contractor.
- Processing the EDD that includes the data validation qualifiers, into the Environmental Data Management System (EDMS), pursuant to "Procedure for Electronic Data Deliverable (EDD) Processing," (SMO-05-04).
- Performing quality control (QC) checks on all data validation results by reviewing the report and comparing the results to the data validation qualifiers captured on the EDD.
- Transmitting the complete analytical data package to SMO project/data management staff for final archiving.

3.5 SMO Project/Data Management Staff

The SMO project/data management staff is responsible for:

- Ensuring compliance with the "SMO Data Management Plan," (AOP 95-44).
- Receiving and processing analytical data packages
- Managing data flow and data storage, including both hardcopy paper records from field activities and analytical laboratories, and electronic data relating to sample tracking or analytical results.
- Forwarding the complete and final analytical data package and electronic data to the SNL/NM Records Center for archiving.

3.6 Laboratory Oversight/Data Validation Contractor

The Laboratory Oversight/Data Validation Contractor is responsible for:

- Performing data validation in accordance with this OP.
- Requesting data corrections or additional information needed from the contract analytical laboratories and notifying SMO of the request.
- Notifying SMO of all data determined as rejected ("R" coded) according to this OP.
- Communicating non-compliance issues to the SMO technical lead and/or SMO project coordinator(s) and ensuring that nonconformances (e.g., incorrect or missing analytical information) are adequately addressed.
- Completing the data validation report including checklist(s) and if applicable generating validation EDD files (see Section 5.1).
- Communicating with the SMO customer or designated representative when data review and validation is complete and returning the complete data package to the SMO.
- Verifying implementation of laboratory corrective action plans.
- Performing laboratory oversight as directed by the SMO.

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4.0 PROCEDURE

Data are evaluated using common quality parameters from QC measurements specified in the methods and the SNL/NM contract SOW. These parameters are compared to statistically derived or regulatory method criteria to estimate the quality of the results. The quality parameters are measures of the analytical precision and accuracy, potential contamination both from the field and from the laboratory, sample matrix effects, and sample inhomogeneity. The laboratory may define the acceptance criteria as long as they meet or exceed those specifically defined within the method or contract. The appropriateness of acceptance criteria generated by the laboratory should be evaluated periodically by the SMO.

Qualification is based on minimal reporting requirements and does not address method or contract compliance requirements, except within the context of QC data. Complete method and contract compliance cannot generally be performed using only the laboratory data package and should be done during on-site assessments at the laboratory where all supporting documentation is available.

If any QC element for a method is not provided, the data validation report must document that the QC data are missing and any qualification is at the discretion of the data validator. A QC failure for an analyte that results in "R" coded (unusable) data due to matrix problems (e.g., matrix interference that cannot be alleviated by acceptable clean-up procedures) brings the appropriateness of the analytical method into question. As a result, the data validation report must document that analysis by another acceptable method or modification of the existing method may be necessary.

4.1 General

This section provides the portions of the method for reviewing QC data that are pertinent to both chemical (organic and inorganic) and radiochemical analytical data.

4.1.1 CVR

The SMO is responsible for conducting a CVR of analytical data packages delivered from the contract laboratories using the SMO "Procedure for Completing the Contract Verification Review," (SMO-05-03).

Criteria: A CVR form shall be included with the analytical data package that specifically addresses the Analysis Request and Chain of Custody (ARCOC), receipt of samples by the laboratory, and the technical, QC, and reporting requirements imposed upon the analytical laboratory through the contract SOW.

Evaluation	Action
The CVR form should be checked to confirm: ARCOC (SMO 2012-ARCOC) and laboratory login information have been reviewed,	Report any discrepancies and/or anomalies associated with the CVR form to SMO.

Evaluation (concluded)	Action (concluded)
missing samples and sample container irregularities are discussed, preservation and hold time deficiencies are indicated, appropriate target analyte lists (TALs) and contract-required laboratory qualifiers are used, results are reported, in correct units, for all analytes requested, all radiochemistry results include the calculated total propagated uncertainty (TPU), the required detection limits (DL) are reported and clearly defined or an explanation of why they were not met is given, all outstanding reporting issues are resolved, any request for an amended report from the laboratory has been received, and signatures and dates are present indicating CVR was completed.	

4.1.2 QC Exemptions

Various filter materials may be submitted for analysis. Matrix spike (MS) and replicate sample analysis requirements shall not apply to filter materials because representative splits of these samples are generally not obtainable. All other QC criteria shall apply to the analysis of filters.

The requirements for reanalysis for QC failures are waived when insufficient sample remains. A detailed discussion of that condition shall be included in the laboratory case narrative when it is encountered.

Acidity, alkalinity, biological oxygen demand (BOD), color, corrosivity, dissolved oxygen, gravimetric oil and grease, hardness, ignitability, pH, titrimetric sulfide, conductivity, all of the solids methods, and turbidity analyses are generally exempt from the general inorganic QC requirements.

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Criteria: The analyses referenced directly above shall be controlled according to the method QC and/or the laboratory's QC policies. In general, one or more of the following should be included:

- Blank; result less than (<) the method detection limit (MDL).
- Laboratory control sample (LCS); measured value within plus or minus (±) 20 percent (%) of known value.
- Duplicate; relative percent difference (RPD) <25%.
- Independent calibration check standard; result within ± 10% of true value.

Note: Blanks (method blank [MB]/field blank [FB])/equipment blank [EB]) are not applicable for acidity by titration, alkalinity, conductivity, flash point, pH, and specific gravity. In the Blanks section of the data validation report, document that the blank result was reported but not assessed for data validation.

Evaluation	Action
If there are any QC failures for any of the analyses listed above,	qualify sample results associated with QC failures according to the appropriate requirements in Section 4.6, Procedure for Inorganic Data Validation. **Note**: Sample results shall not be qualified due to the lack of QC data. QC exemptions shall be discussed in the data validation report.

4.1.3 Holding Times

Samples must be extracted and analyzed within EPA-specified holding times for results to be considered reflective of total concentrations. Analytical data generated outside of the specified holding time criteria must be considered to be suspect. Holding times must be evaluated to ascertain the validity of results based on the holding time of the sample from time of collection to time of analysis.

Solid materials, such as soils, that are being analyzed for radioisotopes or metals are generally exempt from qualification for exceeded holding times. The reviewer should evaluate the stability of the analyte and half-life, if applicable, and qualify based on professional judgment.

In the case of organic analyses, regulatory holding times are set by analytical method and do not address the stability of individual compounds; however, studies have been conducted to determine the stability of many of the commonly requested volatile compounds in preserved water. In some special cases, water samples for the analysis of volatile organic compounds (VOCs) are from sampling events that cannot be resampled, and rejecting non-detects may be very detrimental to the program. In these

special cases, the holding time qualification guidelines given in Appendix A may be used, but the data validation report must clearly state that the evaluation and qualification were not performed using regulatory holding time guidelines.

Criteria: All samples will be extracted and analyzed within specified holding times, per Appendix B.

Evaluation	Action
If a holding time infraction is <5% of the holding time criteria,	sample results may be accepted without qualification based on professional judgment. **Note:** Consideration should be given to the relevant holding time requirement; for example, "days" versus "hours."
If holding times are exceeded and preservation requirements are not met (see Section 4.1.4),	qualify all associated detects as "J" and all associated non-detects as "R."
If samples were analyzed after their holding time had expired but within 2 times (X) the specified holding time,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If samples were analyzed beyond 2X the specified holding time,	qualify all associated detects as "J" and all associated non-detects as "R."
If samples were analyzed within holding time and reanalyzed out of holding time due to a QC failure and…	
the original and reanalysis calibration, sample, and QC data are provided and the sample results are similar,	accept the results of the reanalysis without holding time qualification.
the original or reanalysis calibration, sample, and QC data are not provided, or the sample results of the original analysis and the reanalysis are not similar,	qualify all associated detects as "J" and all associated non-detects as "UJ."

4.1.4 Preservation (chemical and temperature)

Samples must be preserved according to EPA-specified criteria for results to be considered reflective of total concentrations. Analytical data generated outside of the specified preservation criteria must be considered to be suspect. The data validation report shall include a discussion of any preservation violations and a discussion supporting any qualifications.

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Many organic compounds and most metals and radioisotopes are not affected by temperature variations up to ambient temperature and are generally not qualified. VOCs and mercury are subject to analyte loss at elevated temperatures.

Criteria: All samples shall be preserved and shipped under conditions specified in Appendix B.

Samples for metals or radiochemical analysis that were received without the required chemical preservation but that were preserved by the laboratory after receipt generally do not require qualification if the samples were allowed to equilibrate at least 16 hours before a sample aliquot is taken.

Evaluation	**Action**
If samples were received outside the temperature criteria,	all associated detects may be qualified as "J" and all associated non-detects may be qualified as "UJ" or "R" using professional judgment (see below).
If temperature violations occur for VOCs and/or mercury,	qualify all associated detects as "J" and all associated non-detects as "UJ." Non-detects for VOCs may be qualified as "R" if extreme temperature violations occur.
If samples preserved by the laboratory upon receipt were not allowed to equilibrate after laboratory preservation or if no documentation shows the samples were allowed to equilibrate,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If samples were received without the required preservation and were not preserved by the laboratory after receipt,	qualify all associated detects as "J" and all associated non-detects as "R."

4.1.5 Calibration Points

Generally, it is not acceptable to remove points from the calibration curve unless the points are at the high or low ends of the curve. For the purpose of meeting calibration criteria, if a point is removed from the low end, the practical quantitation limit (PQL) must be adjusted accordingly. If a point is removed from the high end, the linear calibration range must be adjusted accordingly. Whenever a point is removed, it must be clearly documented in the instrument log. All initial calibration (ICAL) points must be analyzed without any changes to instrument conditions, and all points must be analyzed within 24 hours.

The laboratory may remove ICAL data points that are not the low or high points of the average or linear/quadratic curve, if the reason can be clearly documented. Acceptable reasons include

misinjection of the standard or minor instrument failure for the particular data point. Notify the laboratory project manager if no such documentation is present.

4.1.6 Calibration for QC Samples

If any QC samples are analyzed using a different ICAL than that of the field samples, the laboratory must include a calibration report from the calibration affecting the QC samples. This calibration data shall only be used to evaluate the QC samples and only if the QC samples fail to meet recovery or RPD acceptance criteria. The laboratory is not required to report calibration data associated with QC samples from another sample delivery group (SDG).

4.1.7 Blank Hierarchy

The general hierarchy for application of qualifiers due to blank contamination is 1) instrument blank, 2) preparation blank or MB, and 3) FB, EB, or trip blank (TB). As a general guideline, if the instrument blank is contaminated, then associated detected results in field samples, MB, FBs, EBs, and TBs that are analyzed in the same analytical run may be qualified. If the preparation blank is contaminated, all associated detected results in samples prepared with that blank may be qualified even if the samples are analyzed in different runs. If an FB or EB is contaminated, all associated detected results in samples collected during the same sampling event may be qualified. If a TB is contaminated, all associated detected results in samples transported in the same container (cooler) may be qualified. Professional judgment must be employed to determine the effect of multiple blank contaminations upon the quality of field sample data.

4.1.8 Blank Normalization

Because sample aliquot values (masses or volumes) seldom vary significantly within a batch, the laboratory generally assigns a representative aliquot value to the MB. When a sample has a significantly different aliquot size than that of the MB, a detected MB result needs to be normalized to the detected sample result before a comparison can be performed for blank assessment. The blank data are normalized to the sample results using the following equation:

Normalized blank concentration = (blank concentration) X (blank aliquot value/sample aliquot value)

It should be noted that the blank analyses might not involve the same weights, volumes, and/or dilution factors as the associated samples. These factors must be taken into consideration when applying the 5X and 10X criteria, such that the total amount of contamination is actually compared.

4.1.9 Field Duplicates

Field duplicate samples may be collected and analyzed as an indication of overall precision. These analyses measure both field and laboratory precision; therefore, the results may have more variability than laboratory duplicates which measure only laboratory performance. It is expected that solid or waste duplicate results will have a greater variance than water matrices due to inhomogeneity.

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If samples are identified as field duplicates, document the occurrence in the data validation report and state that there are no "required" review criteria for field duplicate analyses comparability.

4.1.10 Sample-Specific External Standard Recovery

In lieu of an internal standard (IS) addition, an addition of a known quantity of material to a second sample aliquot may be used to calculate sample results. To evaluate external standard recovery (standard addition), the spike amount and spike recovery must be reported.

Criteria: Recovery guidelines for external standard recovery shall be 50% to 105%. The quantity of external standard used should be adequate to provide a reasonable confidence level in the measured recovery; that is, the spike level should be greater than (>) the indigenous level.

Note: For samples that require dilution the evaluation uses the concentration of the diluted result not the corrected result.

Evaluation	Action
If the measured sample result is >2X the external standard spike added,	qualify all associated results as "J."
If the measured sample result is >4X the external standard spike added,	qualify all associated results as "R."
If the recovery is >105% but less than or equal to (≤) 125%,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
If the recovery is >125%,	qualify all associated non-detects as "R." Associated detects may be qualified "J-" or "R" based on professional judgment.
If the recovery is <50% but greater than or equal to (≥) 20%,	qualify all associated detects as "J+."
If the recovery is <20%,	qualify all associated non-detects as "R."

4.1.11 Rounding Rules and Significant Figures

If the figure is ≥5, round up; otherwise, round down. For example, 11.443 is rounded down to 11.44, and 11.455 is rounded up to 11.46. If a series of multiple operations is to be performed (i.e., add, subtract, divide, and/or multiply), all figures are carried through the calculations. The final answer is rounded to the proper number of significant figures. Before evaluating a number for being in control or out of control of a certain limit, the number evaluated shall be rounded using these rounding rules to the significance reported for that limit. For example, if the acceptance limit is ±10% of the true value, then a calculated percent recovery (%R) of 110.46 shall be reported as 110%, which is within the acceptance limits of 90% to 110%. On the other hand, a calculated %R of 110.50 shall be reported as 111%, which is not within the 90% to 110% acceptance limits.

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Blank qualifications with an associated numerical value should be recorded with no more than three significant figures for values ≥100, and no more than two significant figures for values <100 in the data validation report; for example, 125U, 18U, 9.9U, 0.32U or 0.032U.

4.1.12 Special Laboratory Flags

"X" Flags

Criteria: The laboratory or analyst may have reason to believe that the result for a specific analysis has a high probability of being a false positive due to interferences. In this case, the laboratory shall qualify the result as "X" and narrate the justification for the flag. Generally, use of the "X" flag is restricted to use in conjunction with additional data such as spectral matching or results from another analytical technique. The raw data and case narrative should be reviewed to determine if they agree with the identification of a false positive.

Evaluation	Action
When evaluating the "X" qualifier, if it is determined that the interference is the most significant source of the instrument response (i.e., if the detect is primarily a false positive or if it is a detect with a very high bias),	qualify detects determined to be primarily false positives as "R" and detects determined to have very high bias as "NJ+." Include a thorough discussion supporting the qualification in the data validation report.

4.1.13 Analytical Methods

The laboratory shall follow the requirements specified in the analytical methods and those specified in the contract SOW. When these requirements are not met, reanalysis is required. In those cases where reanalysis cannot occur, the failure to reanalyze will be discussed in the case narrative. This discussion should also be included in the data validation report. See Appendix C for data reporting requirements.

4.1.14 Calculations

Criteria: Laboratories will generally use commercial software whenever possible. Spreadsheets and laboratory developed software are required to be verified and uniquely identified, and shall include a revision number (i.e., be under version control). Reverification of commercial software and other software is not routinely required. Hand-calculated data or data calculated from a spreadsheet or other software not under version control must be verified by the random recalculation of some of the results. Hand calculated results and spreadsheets

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should have all required formulas and data included in the package. In addition, any spreadsheet that is not under version control should be brought to the attention of the SMO.

Evaluation	Action
If results cannot be regenerated using the reported data,	require a formal corrective action by the laboratory.
If results are verified by recalculation using reported data,	discuss the recalculation in the data validation report.

Criteria: Laboratories are required to calculate the RPD between the MS and matrix spike duplicate (MSD) using the actual results (Solid Waste [SW]-846 Method 8000C). CLP and some other programs use calculation routines, which calculate the RPD using the %Rs.

$$RPD = (MS\ \%R - MSD\ \%R)/[(MS\ \%R + MSD\ \%R)/2]$$

This does not give an equivalent result as that obtained using the SW-846 formula (see Section 6.3 below) when the sample contains indigenous analyte. When the RPD is calculated using %Rs, the results will need to be recalculated before the evaluation is performed.

Evaluation	Action
If results are recalculated using the correct data,	discuss the recalculation in the data validation report.

4.1.15 Reanalysis

The laboratory may perform a reanalysis on one or more samples because of QC failures. This may occur because of MS failures, or it may occur because a small subset such as the acid fraction in semivolatile organic compound (SVOC) analysis had QC failures for the first analysis and the second analysis was performed outside the method-specific holding time. Based on professional judgment the laboratory is to report only the best data set on the certificate of analysis (COA). All supporting documentation concerning a reanalysis will be provided in the miscellaneous data section of the analytical data package.

4.1.16 Manual Integration

Manual integration review (MIR) is typically outside the scope of routine validation. When MIR is required by the program, it must be performed in accordance with standard operating procedures.

Manual integration is used to correct improper integration performed by the instrument software, not for the purpose of meeting QC criteria. While MIR is not normally required for data validation,

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manually integrated peaks may be reviewed based on professional judgment or whenever QC problems indicate it may be necessary

Evaluation	Action
If a manual integration was not documented correctly or was performed incorrectly or does not meet one or more of the criteria given,	request confirmation from the laboratory of the need for regeneration of data. Data may be qualified as "J" or "R" based on professional judgment.

4.1.17 Failed Batch QC

Occasionally the batch QC sample (i.e., MS, LCS, blank, etc.) will fail and the individual QC sample will also fail sample-specific QC parameters (i.e., ISs, surrogates, etc.) The usefulness of the QC data from these batch QC samples is based on professional judgment for minor excursions. However, significant failures where the QC sample fails both sample parameters (i.e., surrogates, etc.) and batch parameters (e.g., analyte) require that the batch QC data be rejected and the batch be treated as if it did not include the batch QC sample. That is, the samples are qualified as if no QC sample was run with the batch.

4.1.18 MS/MSD, LCS/LCSD and Replicates

Occasionally the laboratory may analyze for replicates, matrix spike/matrix spike duplicate (MS/MSD) pairs, and/or LCS/laboratory control sample duplicate (LCSD) pairs, presenting more than one measure of precision. If the sample has little or no indigenous analyte, the MS/MSD RPD is the best indicator of precision. If the sample has significant indigenous analyte, the replicate is the best indicator of precision. As a general rule, the replicate precision is used if the indigenous analyte is >2X or 3X the MS spike concentration. The LCS/LCSD RPD should only be used as a measure of precision in the absence of both MS/MSD and replicate analyses.

More than one measurement of precision is not assessed for the same sample/analyte. The data validation report should include a discussion on which measure of precision was used for assessment and why.

4.1.19 MS/MSD

Occasionally the laboratory may dilute before spiking or may run the MS/MSD pairs at a reduced volume. For example, the sample aliquot will be 1000 milliliters (mL) while the MS aliquot is 500 ml. In this case, if the extract volume is the same for both the sample aliquot and the MS aliquot, the RPD is still a good measure of precision, but the %R is not a good measure of accuracy and matrix effect. At a minimum, this issue should be noted in the data validation report. If the final volume of the MS aliquot was adjusted for sample size (in this case, adjusted to half the sample extract volume), it should be noted that the laboratory may have adjusted the extract volume to account for a smaller sample aliquot. In this case, the MS %R is a good measure of accuracy and matrix effect.

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MS samples that require dilution due to matrix should not be used to evaluate associated sample data unless the relative dilution factor between the MS and the field samples is ≤5, in which case there is still significant sample matrix similarity between the MS and field samples. If the MS sample is not used to evaluate sample data, the sample results should be qualified for lack of accuracy and/or precision data, as applicable, if specified by the program.

Evaluation	Action
If the MS/MSD relative dilution factor is >5 compared to the samples,	qualify all associated detects as "J" and all associated non-detects as "UJ."

4.1.20 MS/MSD with Elevated Analyte Concentration Requirements

When the sample used for the MS/MSD has an analyte concentration >4X the analyte spike concentration and the MS and/or MSD %R is out of limits, sample results should be qualified due to a lack of matrix-specific accuracy data. Matrix-specific precision can still be assessed using the MS/MSD RPD. If a post-digestion spike (PS) is also performed, it can be used to assess matrix-specific accuracy data for the analytes not evaluated using the MS/MSD. The 4X rule also applies to the PS; however, its analyte spike concentration may be higher than that of the MS/MSD. The PS recovery limits are usually narrower than the MS recovery limits. The MS and MSD results may be used in conjunction with other QC results to determine the need for qualification of the data.

Evaluation	Action
If the sample used for MS/MSD has an analyte concentration >4X the analyte spike concentration and the MS and/or MSD %R for that analyte is out of limits,	qualify all associated detects as "J" and all associated non-detects as "UJ."

4.1.21 Blank Qualification with QC Failures

Data may be qualified as a non-detect (U) based on blank contamination and have other QC failures. While the general approach is to qualify the sample result as a non-detect with no further qualification, other quality issues should be considered to determine if additional qualification is warranted. For example, if the LCS had very low recovery, the actual sample result may be below the blank result because of poor recovery, not just because of blank contamination. In this case, the result may be qualified "UJ" rather than "U." In general, samples with results that are qualified "U" or "UJ" due to blank contamination are not rejected. Justification for additional qualification must be explained in the data validation report.

4.1.22 Initial Dilutions

Initial dilutions may be required due to high indigenous analyte concentrations. For multi-analyte determinations where initial dilutions are required to keep from saturating the detector, the DLs and

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reporting limits (RL) must be adjusted for the initial dilution. In addition, the matrix effect of the over-range analyte on the other analytes being measured cannot be determined.

Evaluation	Action
If all target analytes are reported from the same diluted run,	all associated detects may be qualified as "J" and all associated non-detects may be qualified as "UJ" based on professional judgment.

4.1.23 Reporting Limit Verification (RLV)

Data from independent RLV standards may be used to additionally evaluate the intercept. Acceptable RLVs may be used to minimize qualification based on professional judgment. An acceptable curve with a low standard at the RL does not meet this requirement. The RLV must be the measurement of an independent standard.

4.1.24 Filtered Samples

Water samples may be submitted as both field filtered and unfiltered aliquots. When it is evident that both a filtered and an unfiltered sample are submitted, both results will be reviewed. The analyte concentrations for the filtered portion should be ≤ the unfiltered portion.

Evaluation	Action
If the analyte concentrations of the filtered portion are generally > that of the unfiltered portion,	contact the laboratory to determine if a sample mix-up has occurred.
If the analyte concentrations of the filtered portion are generally > that of the unfiltered portion and the reason cannot be identified,	document the problem and contact the technical data support for further direction.

4.1.25 Sample Contamination

There may be instances where little or no contamination is present in the associated blank, but qualification of the sample due to contamination is deemed necessary. Contamination introduced in a diluent is one example. Although it is not always possible to determine, evidence of this occurrence can be identified when contaminants are found in the diluted sample result but are absent in the undiluted sample.

Evaluation	Action
If it is determined that the sample contamination is from a source not identified in the blank,	qualify the results for that analyte as "R" and discuss such circumstances in the data validation report.

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4.2 Procedure for Gas Chromatography/Mass Spectrometry (GC/MS) Validation

The requirements addressed within this section are applicable to all GC/MS analytical techniques.

4.2.1 Instrument Tuning for GC/MS

Tuning and performance criteria are established to ensure mass resolution, identification; and, to some degree, sensitivity. These criteria are not sample-specific. Conformance is determined using standard materials. Therefore, these criteria should be met in all circumstances.

Criteria: The GC/MS tune shall be evaluated daily. The relative abundance criteria listed in the appropriate method must be met.

Evaluation	Action
If tunes are not run daily or if all abundance criteria are not met,	contact the laboratory for immediate corrective action and use professional judgment to determine which data should be used. The following actions are suggested: qualify all associated detects as "J" and all associated non-detects as "UJ."
If multiple QC failures also occurred,	qualify all results as "R."

4.2.2 Calibration

Initial Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for compounds on the TAL. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run and of producing a linear curve. In the absence of, or in addition to, method-specific calibration acceptance criteria, the following general calibration acceptance criteria should be applied.

The laboratory may establish a calibration curve using either the linear regression (linear curve) approach or the average response factor (RF) approach. If both approaches are used to quantify and report target analytes within the same data package, calibration is to be assessed on an analyte-by-analyte basis.

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Criteria: GC/MS instrument calibration shall be performed using a minimum of five calibration standards unless otherwise specified by the method. If calibration curves are used, five standards are required for a linear (first-order) calibration model, six standards are required for a quadratic (second-order) model, and seven standards are required for a third-order polynomial. Higher order curves (second order and higher) should not normally be used. If the laboratory uses a higher-order equation to establish a calibration curve, it should be evaluated for appropriate application.

Evaluation	Action
If an insufficient number of calibration standards was used,	qualify all associated detects as "J" and all associated non-detects as "UJ."

RFs

Criteria: RFs are a measure of the slope of the calibration relationship and assumes that the curve passes through the origin. Under ideal conditions, the factors will not vary with the concentration of the standard that is injected into the instrument. In practice, some variation is to be expected.

When the variation, measured as the percent relative standard deviation (%RSD), is $\leq$15%, the use of the linear model is appropriate and the calibration curve can be assumed to be linear and to pass through the origin. This criterion is derived from SW-846 GC/MS Methods 8260B/8260C and 8270C/8270D.

As a general rule, the amount of IS should produce an instrument response (e.g., area counts) that is no more than 100X that produced by the lowest concentration of the least responsive target compound associated with the IS. This should result in a minimum RF of no <0.01 for the least responsive target compound.

The %RSD for the RFs obtained from the five ICAL standards must be $\leq$15% and the average RF shall be $\geq$ the method-specified minimum RF for each compound. The minimum RFs for the system performance check compounds per method SW-846 8260B/8260C (VOC) are:

- Bromoform 0.10
- Chlorobenzene 0.30
- Chloromethane 0.10
- 1,1-Dichloroethane 0.10
- 1,1,2,2-Tetrachloroethane 0.30

Compounds (VOC and SVOC) without specified minimum RFs will be >0.05.

Evaluation	Action
If the average RF for any target compound is < the specified minimum RF, or <0.05 if no minimum is specified,	qualify all associated detects as "J" and all associated non-detects as "UJ" if the average RF is ≥0.01 and as "R" if the average RF is <0.01.
If the %RSD for any target compound is...	
>15% but ≤40%,	qualify all associated detects as "J" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
>40% but ≤60%,	qualify all associated detects as "J" and all associated non-detects as "UJ."
>60%,	qualify all associated detects as "J" and all associated non-detects as "R."

Linear Curves

Criteria: The coefficient of determination (r^2) of the ICAL curve shall be ≥0.99 and have a slope ≥ the method-specified minimum RF for each compound. Compounds without method-specified minimum RFs shall have a slope ≥0.05. The absolute value of the intercept shall be ≤3X the MDL.

Note: The sample results may be reported with non-detects at the MDL or at the PQL value. See below for appropriate evaluation.

Note: The intercept reported in the instrument calibration report may not be in appropriate units. When the intercept is not in appropriate units, the instrument conversion routine may be needed to evaluate the intercept.

For calibrations using most commercial data system software the intercept in concentration units is:

Concentration Intercept = (b)(CIS)

Where:

b = reported intercept

CIS = concentration of IS (on-column conc. on quant. report)

Evaluation	**Action**
If the slope for any target compound is < the minimum RF, or <0.05 if no minimum is specified,	qualify all associated detects as "J" and all associated non-detects as "UJ" if the slope is ≥0.01 and as "R" if the slope is <0.01.
If the r^2 for any target compound is...	
<0.99 but ≥0.90,	qualify all associated detects as "J" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
<0.90 but ≥0.80,	qualify all associated detects as "J" and all associated non-detects as "UJ."
<0.80,	qualify all associated detects as "J" and all associated non-detects as "R."
If the intercept for any target compound is positive and > the MDL,	qualify all associated detects <3X the intercept as "J+."
When results are reported at the MDL: If the intercept for any target compound is negative with an absolute value…	
> the MDL but ≤3X the MDL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "UJ."
>3X the MDL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "R."
When results are reported at the PQL: If the intercept for any target compound is negative with an absolute value...	
> the MDL but ≤2X the PQL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "UJ."
>2X the PQL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "R."

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4.2.3 Calibration Verification

Compliance requirements for satisfactory initial and continuing instrument calibration verification are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for compounds on the TAL. Initial calibration verification (ICV) independently verifies the calibration and continuing calibration verification (CCV) establishes the 12-hour relative RFs on which the quantitations are based and checks satisfactory performance of the instrument on a day-to-day basis.

Criteria: An ICV standard must be analyzed immediately following an ICAL.

The ICV standard analysis results are not required to be reported in the data package unless the samples in the SDG were analyzed after the ICAL standard but before a CCV standard analysis was performed. In this case, the ICV percent difference (%D) is assessed according to the calibration verification criteria described below for the associated samples. If a CCV is analyzed prior to samples and ICV data are also reported in the package, both the ICV %D and the appropriate CCV %D are to be assessed as described below. If both ICV %D and CCV %D infractions occur, the worst infraction should be evaluated for result qualification. A CCV standard must be analyzed:

(1) if analysis continues for longer than 12 hours, and

(2) at the beginning of each additional 12-hour period.

The laboratory is allowed to perform corrective action and reanalyze the CCV once after a failure. If more than two CCVs were analyzed to obtain a passing CCV, then the calibration was not verified and the calibration verification frequency criteria were not met.

Evaluation	Action
If the ICV and CCV standards were not analyzed at the proper frequency, or if either a required ICV or CCV was not analyzed, or if all target compounds were not present in any ICV or CCV standard,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If all required ICVs and CCVs were not analyzed,	qualify all associated detects as "J" and all associated non-detects as "R."

RFs

Criteria: The %D between the ICV and/or CCV RFs and the average RFs obtained from the ICAL shall be calculated according to the formula in Section 6.3 and must be ≤20%.

Evaluation	Action
If the %D was reported with the wrong sign (e.g., + %D for a negative bias),	document the occurrence in the data validation report and assess any infractions using the correct sign.
If the %D between an ICAL RF and an ICV or CCV RF for any target compound is...	
>20% and positive (high bias),	qualify all associated detects as "J+."
>20% but ≤40% and negative (low bias),	qualify all associated detects as "J-" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
>40% but ≤60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
>60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "R."

Linear Curves

Criteria: The %D (see Section 6.3) between the ICV and/or CCV standard concentrations and their true values must be ≤ 20%.

Evaluation	Action
If the %D was reported with the wrong sign (e.g., +%D for negative bias),	document the occurrence in the data validation report and assess any infractions using the correct sign.
If the %D between the measured ICV and/or CCV concentrations and their true values for any target compound is...	
>20% and positive (high bias),	qualify all associated detects as "J+."
>20% but ≤40% and negative (low bias),	qualify all associated detects as "J-" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ.

Evaluation (concluded)	Action (concluded)
>40% but ≤60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
>60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "R."

4.2.4 Blanks

The purpose of laboratory (or field) blank analysis is to determine the essence and magnitude of contamination resulting from laboratory (or field) activities.

The criteria for evaluation of blanks apply to any blank associated with the samples and include MBs, and, if submitted, EBs, FBs, and TBs. Action in the case of unsuitable blank results depends on the circumstances and origin of the blank. In instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of a contaminant. For purposes of evaluating multiple blanks, each preparation batch may be considered an independent event in evaluating MBs, and each sampling event may be considered an independent event for evaluating EBs, FBs, and TBs.

The result for any compound detected in the sample (other than those listed below), that was also detected in any associated blank, must be qualified when the sample concentration is <5X the blank concentration. For the following compounds, the results are qualified when the sample concentration is <10X the blank concentration.

Common laboratory contaminants:

- Methylene chloride
- Acetone
- Toluene
- 2-butanone
- Common phthalate esters (e.g., bis(2-ethylhexyl)phthalate, di-n-octyl phthalate)

Criteria: The concentration of each target analyte found in the blank must be < the associated MDL. The sample results must not be corrected by subtracting any blank value. If QC problems with any blank exist, all data associated with the case must be carefully evaluated to determine whether there is an inherent variability in the data for the case, or if the problem is an isolated occurrence not affecting other data.

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Evaluation	Action
If a compound detected in a blank is also detected in a field sample,	qualify the sample result for that compound in accordance with the scenarios given below.
If gross contamination (e.g.., saturated peaks by GC/MS) exists,	qualify results for all affected compounds as "R" due to interference.
If inordinate numbers of target compounds are found at low levels in the blank(s),	Discuss the presence of these compounds in the data validation report as it may be indicative of a problem at the laboratory. **Note:** Similar consideration should be given to tentatively identified compounds (TICs) that are found in both the sample and its associated blank(s) (see Section 4.2.13).

The following are examples of application of the blank qualification guidelines. Certain circumstances may warrant deviations from these guidelines.

Scenario 1

The sample result is > the PQL but is <5X or 10X the blank result.

Qualification

Rule	10X	5X
Blank Result	7	7
PQL	5	5
Sample Result	30	30
Qualified Sample Result	30U	30U

In the example for the 10X rule, qualify sample results <70 (or 10 X 7) as a non-detect ("U") at the reported value. In the case of the 5X rule, qualify sample results <35 (or 5 X 7) as a non-detect ("U") at the reported value.

Scenario 2

The sample result is < the PQL, and is also <5X or 10X the blank result.

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Qualification

Rule	10X	5X
Blank Result	6	6
PQL	5	5
Sample Result	4J	4J
Qualified Sample Result	5U	5U

In the example for the 10X rule, qualify sample results <60 (or 10 X 6) as a non-detect ("U") at the PQL. In the case of the 5X rule, qualify sample results <30 (or 5 X 6) as a non-detect ("U") at the PQL.

Note: Data are not reported as 4U, as this would be reported as a DL below the PQL.

The PQL may not be reported and it may not be possible to determine the PQL from the data. In these cases, qualify the contaminated sample result as "U" at 5X (or 10X) the blank concentration.

Note: In some instances, the laboratory may adjust their MDLs to account for low-level common laboratory contaminants. In these cases, it may be possible to have a low level detection in a blank that would be considered a non-detect when compared to the adjusted MDL, resulting in the blank data being reported as a non-detect (PQL U). This may result in sample results that are above the MDL but <5X or 10X the actual blank concentration not being qualified. In instances where it is believed that there is low-level contamination of common laboratory contaminants that are not identified in the blank, the sample results may be qualified as "NJ" based on professional judgment and discussed in the data validation report.

Scenario 3

The sample result is > the PQL, and is also >5X or 10X the blank result.

Qualification

Rule	10X	5X
Blank Result	10	10
PQL	5	5
Sample Result	120	120
Unqualified Sample Result	120	120

For both the 10X and 5X rules, the sample result exceeded the adjusted blank result of 100 (or 10 X 10) and 50 (or 5 X 10), respectively. Therefore, this sample result is not qualified.

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4.2.5 Surrogate Recovery

Laboratory performance for individual samples is evaluated by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interference and high concentrations of analytes. Because the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the review and validation of data based on specific surrogate results is frequently subjective and demands analytical experience and professional judgment. In addition, surrogate recoveries can be influenced by the success in recoveries of the ISs. The evaluation of surrogate recoveries and ISs should be done concurrently. Accordingly, this section consists primarily of guidelines, in some cases with several optional approaches suggested.

Criteria: Sample and blank surrogate recoveries must be within limits specified by the laboratory. Surrogate compound recoveries shall be calculated using the procedure described in SW-846 Method 8000C. Reported recoveries shall be accompanied by the applicable acceptance limits. No qualification with respect to surrogate recovery is placed on data unless one or more of the following occurs:

1) at least two surrogates are out of specification in the base/neutral fraction or acid fraction (SVOC analysis),

2) one surrogate is out of specification in the volatile fraction (VOC analysis), or

3) any surrogate has < 10 %R.

Under these three conditions, there should be a reanalysis.

Note: The common acid fraction analytes (SVOC) are all phenols; all cresols; benzoic acid; dichlorophenoxyacetic acid; dinoseb; and hexachlorophene.

Note: When there are unacceptable surrogate recoveries followed by successful reanalysis, the laboratories are required to report only the successful run.

See Appendix D for general guidelines for surrogate recovery limits.

Note: Results from spiked or replicate QC samples that have surrogate recoveries < 10% cannot be used to evaluate associated sample results. Sample results should be qualified for lack of accuracy and/or precision data, as applicable, if specified by the program.

Evaluation	Action
If surrogate recovery acceptance criteria were not reported in the data package,	request amended data from the laboratory.

Evaluation (continued)	**Action (continued)**
If, based on professional judgment, the laboratory's internal acceptance criteria are excessively wide or biased,	notify the program manager.
If an initial dilution was performed on any sample and at least one surrogate recovery is < the lower acceptance limit but ≥10%, or all surrogate recoveries are <10% and the results for one or more compounds are ≥ the PQL,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
If an initial dilution was performed on any sample, all surrogate recoveries are <10%, and all results are non-detect,	qualify all associated sample results as "R."
If there are two or more analyses for a particular fraction at the same dilution,	determine which analysis contains the best data to report using the considerations below, qualify all data from the rejected analysis as "R," and document the reason for rejecting data from one analysis in the data validation report. Considerations should include: 1. surrogate recovery (marginal vs. gross deviation); 2. holding times; 3. comparison of the values of the target analytes reported in each fraction; and 4. performance of ISs.
For surrogate recoveries out of specification, the following approaches are suggested based on a review of all data from the batch, especially considering the apparent complexity of the sample matrix: if at least two surrogates in the base/neutral fraction or the acid fraction, or one surrogate in the volatile fraction, are out of specification low but have recoveries ≥ 10%,	qualify all detects for that fraction as "J-" and all non-detects for that fraction as "UJ."

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Evaluation (concluded)	Action (concluded)
if any surrogate recovery in a fraction is <10%,	qualify all detects for that fraction as "J-" and all non-detects for that fraction as "R."
if at least two surrogates in the base/neutral or the acid fraction, or one surrogate in the volatile fraction, are out of specification high,	qualify all detects for that fraction as "J+."

Criteria: In the case of a blank analysis with surrogates out of specification, special consideration must be given to the validity of associated sample data. The basic concern is whether the blank problems represent an isolated problem with the blank alone or whether there is a fundamental problem with the analytical process.

If one or more samples in the batch show acceptable surrogate recoveries, the blank problem may be considered an isolated occurrence. However, even if this judgment allows some use of the affected data, analytical problems remain that must be corrected by the laboratory.

Evaluation	Action
If surrogate recovery in the blank does not meet acceptance criteria,	all detects < the PQL in all samples associated with the blank may be qualified as "J" and all non-detects in all samples associated with the blank may be qualified as "UJ."

4.2.6 IS Performance

IS criteria ensure that GC/MS sensitivity and response are stable and acceptable during each analysis.

Criteria: Sample and blank IS results must be within limits given in the specific SW-846 method.

IS area counts must not vary by more than a factor of two (50% to 200%) from the average of those obtained from the calibration standards.

The retention time (RT) of the IS must not vary more than ±30 seconds from that of the associated calibration standard.

When qualification of sample results is warranted due to failure of an IS to meet RT or area count acceptance criteria, results of all target compounds associated with that IS are qualified.

Refer to Appendix E for IS/target compound correlation guidelines.

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Evaluation	Action
If there are two analyses for a particular fraction,	determine which analysis contains the best data to report using the considerations below, qualify all data from the rejected analysis as "R," and document the reason for rejecting the data from one analysis in the data validation report. Considerations should include: 1. magnitude of the RT shift; 2. holding times; 3. comparison of the values of the target compounds reported in each fraction; and 4. surrogate recovery.
If any IS area count is <50% of the average of that obtained from the calibration standards,	qualify all associated detects as "J+" and all associated non-detects as "UJ." Non-detects may be qualified as "R" based on professional judgment if the IS area counts are <25% of that of the average obtained from the calibration standards. **Note:** If extremely low area counts are reported, or if performance exhibits a major abrupt drop-off, then a severe loss of sensitivity is indicated.
If the IS area count is >200% of the average of that obtained from the calibration standards,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
If the IS RT varies by more than ±30 seconds from that of the associated CCV standard,	qualify all associated detects as "N" or "R" and all associated non-detects as "R."

4.2.7 MS/MSD

Data for MS/MSD are generated to determine long-term precision and accuracy of the analytical method on samples of various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis.

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Criteria: The MS/MSD data shall not be used to qualify field sample results unless the MS/MSD sample was from the same client and of similar matrix.

An MS and MSD sample shall be analyzed at a frequency of once per data package, once per 20 samples of similar matrix, or once per sample matrix, whichever is more frequent.

The laboratory shall not use FBs, EBs, or TBs to satisfy these requirements, if the laboratory can identify these blanks.

Unless otherwise stated in the specific method, the MS and MSD accuracy and precision acceptance criteria shall be those calculated by the laboratory using the procedure given in SW-846 Method 8000C. If the acceptance criteria are not given, recovery limits of 70% to 130% and ±30% RPD should be used as the criteria. It may be appropriate to use wider default recovery acceptance criteria for SVOC analysis based on professional judgment. For solid and waste samples, it may be appropriate to accept up to a 40% RPD based on the professional judgment. The MS and MSD %R must be within the acceptance limits, unless the sample concentration is > 4X the spike concentration (see Section 4.1.20).

The MS and MSD analyses must meet all sample analysis acceptance criteria. An effort to determine to what extent the results of the MS/MSD affect the associated data should be made. This determination should be made considering the MS/MSD sample matrix, the surrogate recoveries, and the LCS results.

Professional judgment should be used to determine if MS/MSD failure warrants qualification of only the results for the failed compounds, or if results for all the compounds associated with the failed MS compound and its associated IS are affected. Generally, unless evidence exists to warrant qualification of other compounds, only the compounds in the MS spiking mixture shall be qualified.

For programs that require application of one final qualifier to sample results, if a recovery (accuracy) infraction is identified in one or both of the MS samples along with an RPD (precision) infraction between the MS and MSD, the sample is qualified for the accuracy infraction. For example, if a compound has low MS recovery and the RPD is not within criteria, the data are qualified as "J-."

Evaluation	**Action**
If the MS/MSD analysis was from another client or of a dissimilar matrix; if the frequency of the MS/MSD did not meet specified criteria; if no MS/MSD was analyzed; or if FB, EB, or TB samples were used for MS/MSD purposes,	qualify all detects as "J" and all non-detects as "UJ."

Evaluation (concluded)	Action (concluded)
If no other measure of precision (i.e., LCSD or replicate) is available,	qualify all detects as "J" and all non-detects as "UJ."
If the surrogate, IS, and LCS %Rs are within the required acceptance criteria and… either the MS or MSD %R for any target compound is > the upper acceptance limit,	qualify all associated detects as "J+."
either the MS or MSD %R for any target compound is < the lower acceptance limit,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the recovery is ≥10% and as "R" if the recovery is <10%.
If the RPD for any target compound does not meet the acceptance criteria or %Rs fail both high and low,	qualify all associated detects for that compound as "J" and all associated non-detects as "UJ."

Note: The laboratory may analyze TBs in a separate batch than that of soil samples due to differences in sample matrices. In this situation, the laboratory may not analyze an MS/MSD for the batch associated with the TBs. The TB results should then be assessed for accuracy and precision using an LCS/LCSD.

4.2.8 Replicate

Replicate analyses are indicators of laboratory precision based on each sample matrix. If a replicate was performed instead of an MSD, the following criteria are applied. If insufficient sample was submitted to analyze an MS/MSD or replicate, the laboratory may run a LCSD to measure precision. LCSD precision shall be assessed as described in Section 4.2.7.

Criteria: A replicate sample shall be analyzed at a frequency of once per data package, once per 20 samples of similar matrix, or once per sample matrix, whichever is more frequent. All sample acceptance criteria must be met in the replicate analysis.

Samples identified as FBs, EBs, or TBs should not be used for replicate sample analysis.

Unless otherwise stated in the specific method, the replicate precision acceptance criteria shall be those calculated by the laboratory using the procedure given in SW-846 Method 8000C. When no laboratory-derived control limits are reported, a control limit of 30% for the RPD shall be used for

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sample values ≥5X the PQL. For solid and waste samples, it may be appropriate to accept up to a 40% RPD based on the professional judgment.

A control limit of ± the PQL shall be used for sample values < 5X the PQL, including the case when only one of the replicate sample values is <5X the PQL.

No precision criteria apply when both replicate sample values are < the PQL.

Evaluation	**Action**
If no replicate sample, no MSD, and no LCSD were analyzed for each matrix or for each data package,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."
If an FB, EB, or TB was used for the replicate analysis and no MSD or LCSD was run,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."
If the original result and replicate result for target compound are both ≥5X the PQL, and the RPD exceeds the appropriate control limit,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."
If the original and/or replicate result for any target compound is <5X the PQL (including non-detects) and the difference between the original result and replicate result is > the PQL,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."

4.2.9 LCS

Data for LCSs are generated to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation.

Criteria: An LCS should be analyzed for all methods at a frequency of once per data package, once per matrix, or once per 20 analytical samples, whichever is most frequent. The LCS should have recoveries for all target analytes; however, for very large analyte lists or for known poor performers, the laboratory may have received an exemption for one or more analytes.

The LCS must meet all sample acceptance criteria. If surrogate and IS acceptance criteria are not met in the LCS analysis, the LCS must be reanalyzed. The LCS should meet all method-specific LCS requirements and acceptance criteria. If the recovery acceptance criteria are not reported, the reviewer should use the criteria in Appendix F, or 70% to 130% as the criteria.

If the laboratory analyzed an LCS/LCSD as a measure of precision both the LCS and LCSD must meet recovery acceptance criteria.

General laboratory precision and accuracy can be evaluated using the LCS acceptance criteria and the interlaboratory comparison data given in Appendix F. Individual LCS recoveries may be evaluated against the criteria in Appendix F if the laboratory's criteria are significantly different from those in the tables.

For volatile organics in an aqueous matrix, a successful **second source** CCV meets the LCS requirements.

Evaluation	**Action**
If, based on professional judgment, the laboratory's internal acceptance criteria are excessively wide or acceptable recoveries are significantly biased,	notify the program manager.
If the frequency of the LCS did not meet the specified criteria,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If results are reported for target compounds that are not in the LCS,	detects for those compounds may be qualified as "J" and non-detects for those compounds may be qualified as "UJ" based on professional judgment. Compounds missing under an exemption may be qualified based on professional judgment.

If the LCS criteria were not met and reanalysis was not performed, then the laboratory performance and method accuracy are in question. Professional judgment should be used to determine if data should be qualified for all target compounds or just those compounds associated with the failed LCS compound and its associated IS. The following may be used as guidance in qualifying data.

If a full or large TAL LCS is analyzed, the following criteria may be used for LCS %Rs which fall outside reported acceptance criteria but are >10%:

70 to 74 compounds	$\leq$ 5 LCS fall outside acceptance criteria - no qualification
60 to 69 compounds	$\leq$ 4 LCS fall outside acceptance criteria - no qualification
50 to 59 compounds	$\leq$ 3 LCS fall outside acceptance criteria - no qualification
40 to 49 compounds	$\leq$ 2 LCS fall outside acceptance criteria - no qualification
30 to 39 compounds	$\leq$ 1 LCS fall outside acceptance criteria - no qualification
< 30 compounds	No LCS fall outside acceptance criteria - no qualification

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Evaluation	Action
If the LCS %R is > the upper acceptance limit,	qualify all associated detects as "J+."
If the LCS %R is < the lower acceptance limit,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the %R is ≥10% and as "R" if %R is <10%.
If %Rs for more than half of the compounds in the LCS analysis are below the acceptance range,	qualify all detects as "J-" and all non-detects as "UJ" if the failures are marginally low and as "R" if %Rs are significantly below acceptance limits. **Note**: If recoveries of more than half of the compounds in the LCS analysis are below the acceptance range, the laboratory has not shown that it can actually meet program required DLs.
If %Rs for more than half of the compounds in the LCS analysis are above the acceptance range,	qualify all detects as "J+."
If %Rs for more than half of the compounds in the LCS analysis are outside the acceptance range, both above and below, or if an LCS/LCSD pair was analyzed and recoveries of any target compound are both above and below acceptance criteria,	qualify all detects in all associated samples as "J" and all non-detects in all associated samples as "UJ."

4.2.10 Sample Carry-over

Sample carry-over may occur when a high-concentration sample is analyzed immediately prior to another field sample. Steps must be taken to avoid introduction of false positive results in the second sample analysis due to instrument contamination.

Criteria: The absence of sample carry-over must be determined and verified. If examination of the run logs indicates that any samples in the analytical run of interest required dilution, and there is no documentation of a rinse or blank analysis immediately following the original undiluted analysis then sample carry-over may be suspected in the subsequent sample.

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Evaluation	Action
If any target compound found in the sample requiring dilution exceeded the high calibration standard and was also found in the following sample at a concentration <5X the PQL,	qualify the result for that compound in the second sample as "R" or "NJ" based on professional judgment.
If no data are available for the sample that required dilution and the laboratory has not documented that carry-over was evaluated, and the compound was also found in the following sample at a concentration <5X the PQL,	qualify the results for that compound in the second sample as "N."

4.2.11 Dilutions

Criteria: The PQLs must be adjusted to reflect all sample dilutions, concentrations, splits, clean-up activities, and dry weight factors that are not accounted for by the method.

Samples must be diluted and reanalyzed when any analytes exceed the calibration range.

Data from original samples should be included when any sample requires dilution due to one or more compounds exceeding the calibration range.

The original undiluted results document the actual MDLs for non-detects.

Evaluation	Action
If the PQLs have not been properly adjusted,	request an amended report from the laboratory.
In some cases, initial dilutions are required because of expected high concentrations of non-target analytes or because one or more target analyte is expected to greatly exceed the instrument working range. In these instances, the laboratory may not be able to analyze the undiluted sample.	note the dilution and elevated MDLs in the data validation report.
If any target compound exceeds the calibration range and… the original undiluted sample result was reported,	qualify all detects from the undiluted analysis that exceeded the calibration range as "J."

Evaluation (concluded)	Action (concluded)
the sample was diluted and reanalyzed, and the diluted sample data were reported, the original undiluted sample data were not provided,	qualify all non-detects from the diluted analysis as "UJ." request this information from the laboratory.
If data from the original sample run are unavailable,	refer to Section 4.2.5 for assessment of initially diluted samples with low surrogate recovery.

Criteria: The laboratory shall strive to make dilutions in such a way that the final concentration is measured in the mid-range of the calibration curve and that results are not reported from measurements below the lowest concentration standard.

Evaluation	Action
If the instrument response (reported result / dilution factor) from a diluted sample is < that of the lowest concentration standard,	qualify all associated detects from the diluted analysis as "J."

Criteria: The extraction efficiency for extremely high concentrations of analytes has generally not been determined for most methods. If the analysis requires an extraction and dilutions of >100,000:1 the efficiency of the extraction may be suspect.

Evaluation	Action
If dilutions of >100,000:1 was required,	qualify all associated detects as "J-."

4.2.12 Mass Spectra Acceptability

Mass spectra review is typically outside the scope of routine data validation and should not be performed unless it is specifically requested by the SMO. When mass spectra review is required by the program, it must be performed by a validator experienced in the interpretation of mass spectra.

The laboratory is to identify mass spectra using either the National Bureau of Standards (NBS) /EPA/Mass Spectrometry Data Centre (MSDC) library or the National Institute of Standards and Technology (NIST)/EPA/National Institutes of Health (NIH) library. The laboratory must identity and document peaks and reference spectra for all target compounds with concentrations above the MDL. While it is not the function of the validator to determine if the analyst correctly identified a

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compound, an evaluation of how well the analyte peak matches the reference spectra may be requested. To evaluate analyte spectra, the guidelines in Appendix G shall be used.

Evaluation	Action
If the laboratory does not identify mass spectra using a nationally recognized standard library,	notify the program manager.
If the sample spectrum does not match the reference spectrum, the extracted ion current profiles (EICPs) RT or relative retention time (RRT) does not meet criteria, or several guideline failures were observed,	qualify all associated results as "R."
If the analyte is not identifiable due to gross interference or apparent instrument instability,	qualify all associated results as "R."
If the analyte was misidentified by the laboratory,	request an amended report from the laboratory.
If identification of the analyte was hampered by interferences such that it is not certain that a positive identification could be made,	qualify all associated results as "N" based on professional judgment or request additional data from the laboratory.

4.2.13 TICs

Chromatographic peaks that are not target analytes, surrogates, or ISs are potential TICs. TIC evaluation is typically outside the scope of routine data validation and should not be performed unless specifically requested by the SMO. When TIC evaluation is required by the program, it must be performed by validators with experience in mass spectra interpretation**.**

Criteria: For each sample, the laboratory may be requested to conduct a mass spectral search of either the NBS/EPA/MSDC library or the NIST/EPA/NIH library. The laboratory may report the possible identity for up to 20 of the largest VOC fraction peaks and the 20 largest SVOC fraction peaks which are not surrogate, IS, or target compounds, but which have an area/height >10% of the size of the area/height of the nearest IS.

It should be noted that common laboratory artifacts/contaminants and their sources (i.e., aldol products, solvent preservatives/reagent contaminants, etc.) may be present in blanks and not reported as sample TICs.

Examples:

- Common laboratory contaminants: CO_2 (mass/charge ratio (m/e) 44), siloxanes (m/e73), diethyl ether, hexane, certain freons (1,1,2-trichloro-1,2,2-trifluoroethane or fluoro-trichloromethane), phthalates at levels < 100 micrograms per liter (ug/L) or 4,000 micrograms per kilogram (ug/kg).

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- Solvent preservatives: cyclohexene is a methylene chloride preservative. Related by-products include cyclohexanone, cyclohexenone, cyclohexanol, cyclohexenol, chlorocyclohexene, chlorocyclohexanol.
- Aldo reaction products of acetone include 4-hydroxy-4-methyl-2-pentanone, 4-methyl-2-penten-2-one, 5,5-dimethyl-2(5H)-furanone.

Evaluation	Action
If a low-level non-target compound that is a common artifact or laboratory contaminant is detected in a sample,	verify that TIC peaks present in samples are not found in blanks. Blank chromatograms should be examined for peaks that are <10% of the IS height but are present in the sample chromatogram at similar RRT.
If sample TIC results are not sufficiently above the level in the blank and the results are reported,	the results may be qualified as "R" (dilutions and sample size must be taken into account when comparing the amounts present in blanks and samples).
If a result is identified as a TIC,	qualify that result as "NJ."
If a compound is not found in any blanks, but is a suspected artifact or common laboratory contaminant,	identify the compound as such in the data validation report. Compounds that are suspected artifacts or common laboratory contaminants result may be qualified as "R" based on professional judgment.

It should be noted that common laboratory calibration practices, along with limitations of some commercial software could result in compounds being detected and not reported in either the Form I or the TIC Summary Report. Review all quantitation reports to verify that all detected compounds are reported whenever a TIC Summary is included.

Evaluation	Action
If a compound is identified on the quantitation report but are not reported as target detect or as a TIC,	request a corrected report from the laboratory.

4.2.14 Method-specific Analytical Requirements–Organic GC/MS

The additional analytical requirements addressed below are organized by SW-846 Method. These requirements should be checked if the level of deliverable (level III or level IV) allows.

4.2.14.1 Method 8260B or 8260C, VOC Analysis by GC/MS

Criteria: The analysis of 2-chloroethyl vinyl ether in water must be performed on an unacidified sample.

Evaluation	Action
If 2-chloroethyl vinyl ether was reported for an acidified water sample,	qualify all associated detects as "NJ-" and all associated non-detects as "R."

4.2.14.2 Method 8270C or 8270D, SVOC Analysis by GC/MS

Criteria: Gel permeation chromatography (GPC) cleanup shall be used as necessary to eliminate interferences. In addition, all water samples containing high molecular weight compounds that interfere with the analysis of the target compounds must also undergo GPC cleanup.

Evaluation	Action
If the runlog notations, spectral data, IS %Rs, or surrogate %Rs indicate potential interferences,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If appropriate extract cleanup was not performed,	note this on the data validation report.

4.2.14.3 Method 8280B, Polychlorinated Dioxins and Furans by High Resolution Gas Chromatography/Low Resolution Mass Spectrometry (HRGC/LRMS)

Sample analysis shall be performed according to the requirements listed in SW-846 Method 8280B. Evaluation of tuning reports is not required for this method.

Criteria: Initial calibration shall be performed using the five calibration solutions listed in Table 1 of the method. The %RSD for the ISs and the target compounds for the five calibration standards must be <15%.

Calibration verification shall be performed using the standards solution given in Table 4 of the method. The calibration verification analysis must meet the criteria given in Section 7.13.3.6 of the method.

Evaluation	Action
If the %RSD is >15% for any IS or target compound,	qualify all associated detects as "J" and all associated non-detects as "UJ."

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Evaluation (concluded)	Action (concluded)
If the CCV acceptance criteria were not met for any target compound,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Sample Analysis

Criteria: For identification of any compound, the ion abundance ratios must be within the limits specified in Table 9 of the method.

For 2,3,7,8-substituted compounds that have an isotopically labeled IS or recovery standard present in the sample extract, the RT must be –1 to +3 seconds of the isotopically labeled standard. For 2,3,7,8-subtituted compounds that do not have an isotopically labeled IS or recovery standard present in the sample extract, the RT must fall within 0.005 RRT units of the RRT measured in the continuing calibration.

For non-2,3,7,8-substituted compounds, the RT must be within the corresponding homologous RT windows established by analyzing the column performance check solution.

Evaluation	Action
If ion abundance ratio criteria were not met for any compound,	qualify all associated results as "R."
If the RT of any compound is outside of the RT window,	qualify all associated results as "R."

Criteria: IS %R for analytical samples must be $\geq$25% and $\leq$150%. IS recovery guidelines are discussed in Section 7.15.5 of the method.

The LCS shall contain all of the target compounds at concentrations near the midpoint of the calibration range.

Evaluation	Action
If the recovery of any IS solution compound is >150%,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
If the recovery of any IS solution compound is <25%,	qualify all associated detects as "J+" and all associated non-detects as "UJ" if the recovery is ≥10% and as "R" if the recovery is <10%

Evaluation (concluded)	Action (concluded)
If results are reported for target compounds that are not in the LCS,	qualify all associated detects as "J" and all associated non-detects as "UJ."

GC Column Performance

Criteria: The GC column performance solution is used for defining the homologous GC RT windows and to document the chromatographic resolution. Column performance must be evaluated at the beginning of each 12-hour analytical period and must meet method acceptance criteria (see Section 7.12 of the method) before sample analysis may begin.

Evaluation	Action
If GC column performance was not evaluated at the required frequency or if method criteria were not met,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Confirmation of 2,3,7,8-Tetrachlorodibenzofuran (TCDF) Detects

Criteria: The DB-5 GC column generally used for polychlorinated dibenzodioxin (PCDD) and polychlorinated dibenzofuran (PCDF) analyses does not adequately separate 2,3,7,8-TCDF from its closest eluting isomer. If 2,3,7,8-TCDF is detected in a sample, the result must be confirmed on a second column capable of separating 2,3,7,8-TCDF from all other TCDF homologues (as proven by successful analysis of the GC column performance mix with <25% valley between 2,3,7,8-TCDF and its closest eluting isomer).

Evaluation	Action
If 2,3,7,8-TCDF was detected in a sample and the result was not confirmed on a second column with successful analysis of the GC column performance mix,	qualify all associated detects as "NJ."

4.2.14.4 Method 8290A, PCDD and PCDF by HRGC/High Resolution Mass Spectrometry (HRMS)

Initial Calibration

Criteria: A 5-point calibration is prepared for each labeled and unlabeled compound. The relative response factor (RRF) %RSD for the unlabeled standards must be

≤20%. For the labeled compounds, the %RSD must be ≤30%. Ion abundance ratios must meet the criteria listed in Table 8 of the method.

Evaluation	Action
If the %RSD is: >20% for any unlabeled calibration standard or >30% for any labeled calibration standard, but ≤ 40%, >40% but ≤60% for either a labeled or unlabeled calibration standard, >60% for either a labeled or unlabeled calibration standard,	 qualify all associated detects as "J" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ." qualify all associated detects as "J" and all associated non-detects as "UJ." qualify all associated detects as "J" and all associated non-detects as "R."
If the ion abundance criteria is not met for any compound,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Continuing Calibration

Criteria: Calibration must be verified for both unlabeled and labeled compounds at the beginning and end of each 12-hour shift during which analysis is performed.

The measured RFs must be ≤20% of the mean values established during ICAL for unlabeled compounds and ≤30% of the mean values established during ICAL for labeled compounds. The ion abundance must be within the limits in Table 8 of the method.

For the calibration verification analyzed at the beginning of a 12-hour shift, the effect on data quality of a standard that does not meet criteria must be assessed using professional judgment. Guidance is provided in Section 7.7.4.4 of the method. For the calibration verification analyzed at the end of a 12-hour shift, a %D of 25% for unlabeled compounds and 35% for labeled compounds is acceptable; however, in this instance, the mean RFs from the beginning and ending daily calibration runs are used to calculate analyte concentrations instead of the RFs obtained from the ICAL. If the %D of the ending calibration is >25% for any unlabeled compound and/or >35% for any labeled compound, then successful performance of another ICAL must be analyzed within two hours of sample analysis for the data to be acceptable. In this case, the mean RFs from the beginning and ending daily calibration runs are still used to calculate analyte concentrations.

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Evaluation	Action
If the ion abundance ratio for any compound is outside of the method limits,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If the %D criteria are not met for any CCV compound at the beginning of a 12-hour shift, and… the %D is positive, the %D is negative,	 qualify all associated detects as "J+." . qualify all associated detects as "J-" and if any other calibration criteria have been exceeded for that compound, qualify all associated as "UJ."
If the %D criteria were <u>not</u> met for any compound at the end of a 12-hour shift, a new ICAL was analyzed within two hours of sample analysis, and… the %D is positive, the %D is negative,	 qualify all associated detects as "J+." qualify all associated detects as "J-" if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
If the %D criteria were not met for any compound at the end of a 12-hour shift and a new ICAL was <u>not</u> analyzed within two hours of sample analysis,	qualify all sample data analyzed during that 12-hour shift as "R."

Sample Preparation

Criteria: Extract cleanup shall be performed to eliminate interferences. The laboratory shall first partition the sample extract, followed by silica/alumina column cleanup and carbon column cleanup.

Evaluation	Action
If the documentation on the run log, spectra data, and/or IS or labeled compound %Rs indicate interferences and extract cleanup was not performed,	qualify all associated detects as "J" and all associated non-detects as "UJ."

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Sample Analysis

Criteria: For identification of any compound, the ion abundance ratios must be within the limits specified in Table 8 of the method.

For 2,3,7,8-substituted compounds which have an isotopically labeled IS or recovery standard present in the sample extract, the RT must be -1 to +3 seconds of the isotopically labeled standard. For 2,3,7,8-substituted compounds that do not have an isotopically labeled IS or recovery standard present in the sample extract, the RT must fall within 0.005 RRT units of the RRT measured in the continuing calibration.

For non-2,3,7,8-substituted compounds, the RT must be within the corresponding homologous RT windows established by analyzing the column performance check solution.

Evaluation	Action
If ion abundance ratio criteria are not met for any compound,	qualify all associated results as "R."
If the RT of any compound is outside of the RT window,	qualify all associated results as "R."

Mass Spectrometer Performance Criteria

Criteria: Performance criteria are established to ensure mass resolution, identification and, to some degree, sensitivity. These criteria are not sample specific.

Conformance is determined using standard materials. These criteria should be met in all circumstances. Mass spectrometer performance must be checked at the beginning and end of each analytical period in accordance with the method criteria (see Section 8.2 of the method).

Evaluation	Action
If mass spectrometer performance was not checked at the required frequency or if method criteria were not met,	qualify all associated detects as "R" and all associated non-detects as "UJ."

Replicate Samples

Criteria: A replicate sample should be extracted and analyzed with each batch of samples. The RPDs between results (i.e., between the recoveries for the labeled 2,3,7,8-substituted compounds and between the concentrations for the non-labeled 2,3,7,8-substituted compounds) should be ≤25%.

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Note: An MS/MSD is not required for this method since it is an isotope dilution analysis. A replicate sample or LCS/LCSD will suffice to demonstrate batch precision.

Evaluation	Action
If a replicate sample or LCSD were not analyzed for each matrix or for each data package,	qualify all detects of the same matrix as "J" and all non-detects of the same matrix as "UJ."
If the RPD between the sample (or LCS) and its replicate (or LCSD) for any compound falls outside the appropriate control window,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."

ISs

Criteria: The laboratory must spike all samples with the sample fortification solution and all sample extracts with recovery standard solution. The %R of each compound must be within 40% to 135%.

Evaluation	Action
If the %R for any sample fortification solution compound is <40%,,	qualify all detects for that sample fraction as "J+" and all non-detects for that sample fraction as "UJ" if the %R is ≥10% and as "R" if the %R is <10%.
If the %R for any sample fortification solution compound is >135%,	qualify all detects for that sample fraction as "J-" and all non-detects for that sample fraction as "UJ."

Gas Chromatography (GC) Column Performance

Criteria: The GC column performance solution is used for defining the homologous GC RT windows and to document the chromatographic resolution. Column performance must be checked at the beginning of each analytical analysis period and must meet method acceptance criteria (see Section 8.2 of the method) before sample analysis may begin.

Evaluation	Action
If GC column performance is not checked at the required frequency or if method criteria is not met,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Confirmation of 2,3,7,8-TCDF Detects

Criteria: The DB-5 GC column generally used for PCDD and PCDF analyses does not adequately separate 2,3,7,8-TCDF from its closest eluting isomer. If 2,3,7,8-TCDF is detected in a sample, the result must be confirmed on a second column capable of separating 2,3,7,8-TCDF from all other TCDF homologues (as proven by successful analysis of the GC column performance column mix with <25% valley between 2,3,7,8-TCDF and its closest eluting isomer).

Evaluation	Action
If 2,3,7,8-TCDF was detected in a sample and the result was not confirmed on a second column with successful analysis of the GC column performance mix,	qualify all associated detects as "NJ."

4.2.14.5 Method TO-14A and TO-15, VOCs in Ambient Air using GC/MS

Analysis shall be performed according to the requirements specified in EPA Method TO-14A, *"Determination of VOCs in Ambient Air Using SUMMA® Passivated Canister Sampling and Gas Chromatographic Analysis,"* Revision 1.0 or TO-15, "*Determination of VOCs in Air Collected in Specially Prepared Canisters and Analyzed by GC/MS."* In general, validate these analyses according to Section 4.2.

Surrogates, an MS/MSD, and TICs are not required for these methods.

MDLs are not used for TO-15, detects are only reported above the PQL.

Instrument Tuning for GC/MS

See Section 4.2.1 for tuning and performance criteria.

Initial Calibration

Criteria: Instrument calibration shall be performed using at least three standard concentration levels (five standards for TO-15) and a humid zero air standard (not required for TO-15). In addition, a zero air certification for the sampling apparatus is to be provided.

Evaluation	Action
If an insufficient number of standards were used,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Evaluation (concluded)	Action (concluded)
If a zero air certification is not provided,	document the occurrence in the data validation report

RFs

Criteria: The %RSD for the RFs must be ≤30% and the average RF shall be ≥ the method-specified minimum RF for each compound. Compounds without specified minimum RFs will be >0.05.

Evaluation	Action
If the average RF for any target compound is < the specified minimum RF, or <0.05 if no minimum is specified,	qualify all associated detects as "J" and all associated non-detects as "UJ" if the average RF is ≥0.01 and as "R" if the average RF is <0.01.
If the %RSD for any target compound is...	
≤30%,	qualify all associated detects as "J" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
>45% but ≤60%,	qualify all associated detects as "J" and all associated non-detects as "UJ."
>60%,	qualify all associated detects as "J" and all associated non-detects as "R."

Calibration Verification

Criteria: Prior to analysis of samples, a calibration standard must be analyzed immediately following an ICAL to ensure that the instrument continues to remain under control.

A calibration standard must be analyzed:

(1) daily and

(2) contain all target compounds.

The laboratory is allowed to perform corrective action and reanalyze once after a failure. If more than two calibration standards were analyzed to obtain a passing calibration standard, then the calibration was not verified and the calibration verification frequency criteria was not met.

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Evaluation	Action
If the calibration standard was not analyzed at the proper frequency, or if all target compounds were not present in any calibration standard,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If the required calibration standard was not analyzed,	qualify all associated detects as "J" and all associated non-detects as "R."

RFs

Criteria: The %D between RFs and the average RFs obtained from the ICAL shall be calculated according to the formula in Section 6.3 and must be ≤30%.

Evaluation	Action
If the %D was reported with the wrong sign (e.g., + %D for a negative bias),	document the occurrence in the data validation report and assess any infractions using the correct sign.
If the %D between an ICAL RF and continuing calibration RF for any target compound is...	
>30% and positive (high bias),	qualify all associated detects as "J+."
>30% but ≤45% and negative (low bias),	qualify all associated detects as "J-" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
>45% but ≤60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
>60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "R."

Blanks

Criteria: A daily humid zero air instrument blank (not required for TO-15) shall be analyzed immediately prior to and after instrument calibration. These instrument blank results must be <0.2 parts per billion by volume (ppbv) in all target analytes before analysis may proceed.

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Evaluation	Action
If a humid zero air instrument blank was not analyzed at the required frequency,	qualify all associated detects <5X the PQL as "J."
If any target compound was detected in the instrument blank at a level ≥ the MDL but <0.2 ppbv,	qualify all results as discussed in Section 4.2.4.

IS Performance

Criteria: IS area counts must not vary by more than ±40% from the average of those obtained from the calibration standards.

The RT of the IS must not vary more than ±0.33 minutes (20 sec.) from that of the associated calibration standard.

When qualification of sample results is warranted due to failure of an IS to meet RT or area count acceptance criteria, results of all target compounds associated with that IS are qualified.

Refer to Appendix E for IS/target compound correlation guidelines.

Evaluating previous CCV IS areas are not required for this method.

Evaluation	Action
If there are two analyses for a particular fraction,	determine which analysis contains the best data to report using the considerations below, qualify all data from the rejected analysis as "R," and document the reason for rejecting the data from one analysis in the data validation report. Considerations should include: 1. magnitude of the RT shift; 2. holding times; 3. comparison of the values of the target compounds reported in each fraction.
If any IS area count is <40% of the average of that obtained from the calibration standards,	qualify all associated detects as "J+" and all associated non-detects as "UJ." Non-detects may be qualified as "R" based on professional judgment if the IS area counts are <20% of that of the average obtained from the calibration standards.

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Evaluation (concluded)	Action (concluded)
	Note: If extremely low area counts are reported, or if performance exhibits a major abrupt drop-off, then a severe loss of sensitivity is indicated.
If the IS area count is >140% of the average of that obtained from the calibration standards,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
If the IS RT varies by more than ±0.33 minutes from that of the associated calibration standard,	qualify all associated detects as "N" or "R" and all associated non-detects as "R."

LCS/LCSD

See Section 4.2.9 for LCS/LCSD criteria.

4.2.14.6 Method 1668A, Chlorinated Biphenyl Congeners

Initial Calibration

Criteria: Isotope dilution shall be used for calibration of the toxics and beginning and ending level of chlorination (LOC) chlorinated biphenyls (CBs). A 5- or 6-point calibration is prepared for each native congener. The RRF %RSD for any native toxics/LOC CBs must be <20%. If a linear curve is used for ICAL, the r^2 of the curve must be >0.99.

Evaluation	Action
If the %RSD for any target compound is…	
>20% but ≤40%,	qualify all associated detects as "J" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
>40% but ≤60%,	qualify all associated detects as "J" and all associated non-detects as "UJ."
>60%,	qualify all associated detects as "J" and all associated non-detects as "R."

Evaluation (concluded)	Action (concluded)
If the r^2 for any target compound is…	
<0.99 but ≥0.90,	qualify all associated detects as "J" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
<0.90 but ≥0.80,	qualify all associated detects as "J" and all associated non-detects as "UJ."
<0.80,	qualify all associated detects as "J" and all associated non-detects as "R."

Criteria: Calibration using ISs is used for determination of native CBs for which a labeled compound is not available. For these CBs, calibration is performed at a single point. Compounds should be quantitated using the appropriate reference IS listed in Table 2 of the method. Ion abundance ratios must meet the criteria in Table 8 of the method or must be within 15% of the theoretical ratio of the ion monitored.

Evaluation	Action
If the ion abundance criteria were not met for any calibration compound,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Continuing Calibration

Criteria: At the beginning of each 12-hour shift during which analyses are performed, calibration is verified for all native CBs and labeled compounds. The ion abundance ratios for all CBs must be within the limits in Table 8 and all compounds must meet the calibration verification recovery limits listed in Table 6 of the method.

RRTs of native CBs and labeled compounds in the calibration verification must be within ± 0.5% of the mean RRT determined in the ICAL or most recent calibration verification standard. The diluted combined 209-congener solution must be analyzed as a final step in the calibration verification and must meet minimum analysis and resolution specifications of the method.

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Evaluation	Action
If the ion abundance ratio for any compound is outside of the method limits,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If the verification limits are not met for any calibration verification compound and…	
the %R is above the verification limits,	qualify all associated detects as "J+."
the %R is below the verification limits,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the recovery is ≥10% and as "R" if the recovery is <10% .
If the RRT of any compound is outside of the RRT window,	qualify all associated results as "R."

RT Calibration

Criteria: The absolute RT of CB 209 must be ≥55 minutes if the SPB-octyl column is used. If a GC column or column system alternate to the SPB-octyl column is used, the absolute RT of CB 209 must be ≥ the laboratory-established minimum RT for CB 209. If the laboratory has not established a minimum RT value for CB 209, the RT for CB 209 must be ≥55 minutes.

Evaluation	Action
If an SPB-octyl column was used, and the absolute RT of CB 209 is <55 minutes,	qualify all associated results as "R."
If a GC column or column system alternate to the SPB-octyl column was used and the absolute RT is < the laboratory-established minimum RT for CB 209, or <55 minutes if the laboratory has not established a minimum RT,	qualify all associated results as "R."

Ongoing Precision and Recovery (OPR)

Criteria: OPR must be established for every batch of samples extracted and analyzed and must meet the recovery and %RSD limits listed in Table 6 of the method. If the OPR criteria are not met and reanalysis was not performed, then the laboratory performance and method accuracy are in question.

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Evaluation	Action
If the frequency of the OPR did not meet the specified criteria,	note the deficiency in the data validation report.
If the OPR %R is > the upper acceptance limit,	qualify all associated detects as "J+."
If the OPR %R is < the lower acceptance limit,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the %R is ≥ 10% and as "R" if the %R is < 10%.
If %Rs for more than half of the compounds in the OPR analysis are below the acceptance range,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the failures are marginally low and as "R" if %Rs are significantly below acceptance limits. **Note**: If recoveries for more than half of the compounds in the OPR analysis are below the acceptance range, the laboratory has not shown that it can actually meet program required DLs.
If %Rs for more than half of the compounds in the OPR analysis are above the acceptance range,	qualify all associated detects as "J+."
If %Rs for more than half of the compounds in the OPR analysis are outside the acceptance range, both above and below,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Sample Preparation

Criteria: CBs may be bound to suspended particles in aqueous samples; therefore, the preparation of aqueous samples is dependent upon the solids content of the sample. A direct extraction is used for aqueous samples containing <1% solids. For aqueous samples containing >1% solids, the sample is agitated, allowed to settle and the liquid is decanted and discarded prior to extraction of the solids. The particle size for all solid samples should be determined prior to preparation. Particle size must be 1 millimeter or less prior to sample preparation.

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Evaluation	Action
If % solids and particle size were not determined prior to sample preparation or if the proper preparation method was not performed,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Criteria: Extract cleanup shall be used as necessary to eliminate interferences. The laboratory may employ GPC, acid, neutral, or base silica gel; florisil; carbopak/celite; or high-performance liquid chromatography (HPLC) cleanup methods or anthropogenic isolation column for lipids (tissue extracts only).

Evaluation	Action
If the documentation on the run log, spectra data, and/or IS or labeled compound recoveries indicate interferences and applicable cleanup was not performed,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Sample Analysis

Criteria: For identification of any CB or labeled compound, the ion abundance ratios must be within the limits specified in Table 8 of the method or ±15% of the calibration verification standard. The RRT of each CB must be within ±0.5% of the mean RRT determined in the ICAL or ±0.5% of the RRT from the most recent calibration verification standard.

Evaluation	Action
If ion abundance ratio criteria are not met for any compound,	qualify all associated results as "R."
If the RRT of any CB is outside of the RRT window,	qualify all associated results as "R."

Mass Spectrometer Performance Criteria

Criteria: Performance criteria are established to ensure mass resolution, identification, and, to some degree, sensitivity. These criteria are not sample specific. Conformance is determined using standard materials. These criteria should be met in all circumstances.

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Evaluation	Action
If mass spectrometer performance was not checked at the required frequency or if method criteria were not met,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Labeled Compounds

Criteria: To assess method performance on the sample matrix, the laboratory must spike all samples with the labeled toxics/LOC/window defining standard spiking solution and all sample extracts with the labeled cleanup standard spiking solution. The recovery of each labeled compound must be within the limits listed in Table 6 of the method.

Evaluation	Action
If the %R for any labeled toxics/LOC/window defining standard compound is below acceptance limits,	qualify all detects for that sample fraction as "J+" and all non-detects for that sample fraction as UJ" if the recovery is ≥10% and as "R if the recovery is <10%.
If the %R for any labeled toxics/LOC/window defining standard compound is above acceptance limits,	qualify all detects for that sample fraction as "J-" and all non-detects for that sample fraction as "UJ."
If the %R for any labeled cleanup standard compound is below acceptance limits,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the recovery is ≥10% and as "R" if the recovery is <10%.
If the %R for any labeled cleanup standard compound are above acceptance limits,	qualify all associated detects as "J+."

4.2.14.7 California Environmental Protection Agency Air Resources Board; Method 428, PCDD, PCDF, and Polychlorinated Biphenyl (PCB) Emissions from Stationary Sources

Initial Calibration

Criteria: A 5-point calibration is prepared for each compound (see Tables 3, 5, and 10 of the method for standard concentrations). The RRF RSD for any compound must be ≤15%.

Evaluation	Action
If the %RSD for any compound is…	
>15% but ≤40%,	qualify all associated detects as "J" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
>40% but ≤60%,	qualify all associated detects as "J" and all associated non-detects as "UJ."
>60%,	qualify all associated detects as "J" and all associated non-detects as "R."

Continuing Calibration

Criteria: At the beginning and end of each 12-hour shift during which analyses are performed, calibration is verified for all compounds. The measured RFs must be ≤30% of the mean values established during ICAL. The relative abundance must meet the requirements specified in Tables 7 and 13 of the method.

Evaluation	Action
If the mass ratio for any compound is outside of the method limits,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If the %D criteria were not met for any compound and…	
the %D is positive,	qualify all associated detects for that compound as "J+."
the %D is negative,	qualify all associated detects as "J-" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."

GC Column Performance

Criteria: The GC column performance solution is used for defining the homologous GC RT windows, to document the chromatographic resolution, and to check relative ion abundance criteria. Column performance must be checked at the beginning and end of each 12-hour analysis period and must meet method acceptance criteria (see Sections 5.3.5 and 6.3.5 of the method). If the laboratory operates during consecutive 12-hour shifts, analysis of the performance check solution at the beginning of each 12-hour period and at the end of the final 12-hour period is sufficient.

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Evaluation	Action
If GC column performance was not checked at the required frequency or if method criteria is not met,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Sample Preparation

Criteria: Extract cleanup shall be performed to eliminate interferences. The laboratory shall first partition the sample extract and then follow with an appropriate cleanup procedure.

Evaluation	Action
If sample spectra and/or IS and/or surrogate recoveries indicate interferences and documentation of extract cleanup was not provided,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Sample Analysis

Criteria: For identification of any compound, the mass ratios must be within ±15% of the mass ratios listed in Tables 7 and 13 of the method. The RRT of each compound must be within ±0.006 RRT units of the standard RRT.

Evaluation	Action
If mass ratio criteria are not met for any compound,	qualify all associated results as "R."
If the RRT of any compound is outside of the RRT window,	qualify all associated results as "R."

ISs

Criteria: To assess method performance on the sample matrix, the laboratory must spike all samples with known concentrations of stable isotopically labeled ISs prior to extraction.

The laboratory must spike all samples with known concentrations of recovery ISs prior to injection. The %R of each IS must be within 40% to 120% of the known value and the absolute RTs must be within ±10 seconds of those measured during the last previous continuing calibration check.

If IS %Rs are outside of the acceptable limits, the signal to noise ratio of the IS must be $\geq$10.

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Evaluation	Action
If the %R for any IS compound is below acceptance limits,	qualify all associated detects for that sample fraction as "J+" and all associated non-detects for that sample fraction as "UJ" if the recovery is ≥10% and as "R" if the recovery is <10%.
If the %R for any IS compound is above acceptance limits,	qualify all associated detects for that sample fraction as "J-" and all associated non-detects for that sample fraction as "UJ."

Matrix Blank

Criteria: Portions of the sample matrix (resin and filter) shall be analyzed at a frequency of every extraction set of 20 or fewer samples. All samples must be associated with an uncontaminated matrix blank. An uncontaminated matrix blank is defined as not having any compounds detected at a concentration ≥ the MDL. The sample results must not be corrected by subtracting blank values.

Matrix blanks should be evaluated in the same manner as an MB. Blank qualification guidelines are discussed in Section 4.2.4.

Blank Sampling Train

Criteria: There shall be a least one blank train submitted to the laboratory for each series of three or fewer test runs. For sources with air pollution control devices, there shall be at least one blank train assembled at the inlet, and one at the outlet of the air pollution control devices for each set of three or fewer runs at each location. All samples must be associated with an uncontaminated blank train. An uncontaminated blank train is defined as not having any compound detected at a concentration ≥ the MDL. The sample results must not be corrected by subtracting blank values.

Blank sampling trains should be evaluated in the same manner as an MB. Blank qualification guidelines are discussed in Section 4.2.4.

LCS

Criteria: An LCS must be extracted and analyzed with every batch of 20 samples or less and it must contain at least one representative of each chlorinated class of compounds to be determined in the samples. Accuracy is considered acceptable if the %R is within 60% to 140%.

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Note: If the LCS criteria are not met and reanalysis was not performed, then the lab performance and method accuracy are in question.

Evaluation	Action
If the frequency of the LCS did not meet the specified criteria,	note the deficiency in the data validation report.
If there was not at least one compound associated with each chlorinated class of compounds,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If the %R for an LCS compound is >140%,	qualify all associated detects as "J+."
If the %R for an LCS compound is <60%,	qualify all associated detects as "J-", and all associated non-detects as "UJ" if the %R is ≥10% and as "R" if the %R is <10%.
If %Rs for more than half of the compounds in the LCS analysis are below the acceptance range,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the failures are marginally low and as "R" if %Rs are significantly below acceptance limits. **Note**: If %Rs for more than half of the compounds in the LCS analysis are below the acceptance range, the laboratory has not shown that it can actually meet program required DLs.
If %Rs for more than half of the compounds in the LCS analysis are above the acceptance range,	qualify all associated detects as "J+."
If %Rs for more than half of the compounds in the LCS analysis are outside the acceptance range, both above and below,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Mass Spectrometer Performance Criteria

Performance criteria are established to ensure mass resolution, identification and, to some degree, sensitivity. These criteria are not sample specific. Conformance is determined using standard materials. These criteria should be met in all circumstances.

Criteria: Mass spectrometer performance must be checked every 12 hours of analysis in accordance with the method criteria. All compounds in all ICAL and continuing calibration standards must be within the QC limits listed in Tables 7 and 13 of the method for their respective isotopic ratios.

Evaluation	Action
If mass spectrometer performance was not checked at the required frequency or if method criteria are not met,	qualify all associated detects as "R" and all associated non-detects as "UJ."

QC Check Sample

Criteria: A QC check sample must be extracted and analyzed with every batch of 20 samples or less. Accuracy is considered acceptable if the %R is within 60% to 140% and precision is acceptable if the RPD is ≤30%.

Note: If the QC check sample criteria are not met and reanalysis was not performed, then the lab performance and method accuracy are in question.

Evaluation	Action
If the frequency of the QC check sample did not meet the specified criteria,	note the deficiency in the data validation report.
If any QC check sample RPD is > 30%,	qualify all associated detects of the same matrix as "J" and all associated non-detects as "UJ."
If the QC check sample %R is >140%,	qualify all associated detects as "J+."
If the QC check sample %R is <60%,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the %R is ≥10% and as "R" if the %R is <10%.
If %Rs for more than half of the compounds in the QC check sample analysis are below the acceptance range,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the failures are marginally low and as "R" if %Rs are significantly below acceptance limits.

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Evaluation (concluded)	Action (concluded)
	Note: If %Rs for more than half of the compounds in the QC check sample analysis are below the acceptance range, the laboratory has not shown that it can actually meet program required DLs.
If %Rs for more than half of the compounds in the QC check sample analysis are above the acceptance range,	qualify all associated detects as "J+."
If %Rs for more than half of the compounds in the QC check sample analysis are outside the acceptance range, both above and below,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Spiked Sampling Trains

Criteria: Surrogate standards must be spiked into each sampling train as a means of estimating the precision and accuracy of the sampling train for collecting and recovering PCDDs, PCDFs, and PCBs in the stack gas sample. Surrogate recovery is considered acceptable if the %R is within 60% to 140%.

Evaluation	Action
If the surrogate %R is >140%,	qualify all associated detects as "J+."
If the surrogate %R is <60%,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the %R is ≥10% and as "R" if the %R is <10%.

4.2.14.8 Method 1613B, Tetra- through Octa-Chlorinated Dioxins and Furans by HRGC/HRMS

Note: An MS/MSD analysis is not required for this method.

Initial Calibration

Criteria: A combined 5-point calibration is prepared for the 2,3,7,8-substituted PCDDs and PCDFs for which labeled compounds are added to the samples (isotope dilution) and for 1,2,3,7,8,9-HxCDD, OCDF, and any non-2,3,7,8-

substituted compounds (ISs). The RRF %RSD for the compounds calibrated using isotope dilution must be ≤20%. For the compounds calibrated using ISs, the %RSD must be ≤35%. Ion abundance ratios must meet the criteria listed in Table 9 of the method.

The laboratory may use alternative ions for quantitation to eliminate interferences. In this case, the ion abundance ratios must meet the criteria set by the laboratory.

Evaluation	Action
If the %RSD is...	
>20% for any compound calibrated by isotope dilution, or >35% for any compound calibrated by IS, but ≤40%,	qualify all associated detects as "J" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
>40% but ≤60% for any compound,	qualify all associated detects as "J" and all associated non-detects as "UJ."
>60% for any compound,	qualify all associated detects as "J" and all associated non-detects as "R."
If the ion abundance criteria were not met for any compound,	qualify all associated results as "R."

Continuing Calibration

Criteria: At the beginning of each 12-hour period during which analysis is performed, calibration is verified for all compounds. The measured concentration of each compound must be within the limits set in Table 6 of the method. The ion abundance must be within the limits in Table 9 of the method.

The absolute RTs of the ^{13}C-1,2,3,4-TCDD and ^{13}C-1,2,3,7,8,9-HxCDD ISs must be within ±15 seconds of the RTs obtained during the ICAL. The RRTs of the PCDDs/PCDFs and labeled compounds must be within the limits given in Table 2 of the method.

The evaluation of RTs and subsequent qualification of sample data requires professional judgment. If RRT criteria have not been met but absolute RTs between the CCV and the ICAL and between the CCV and the sample meet criteria, qualification of data may not be necessary. If RRT criteria and absolute RT criteria are not met, this may be an indication of instrument instability warranting qualification of sample data.

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Evaluation	Action
If the ion abundance ratio criteria were not met for any compound,	qualify all associated detects as "J."
If the measured concentration criteria were not met for any compound at the beginning of a 12-hour period and…	
the measured concentration is > the upper acceptance limit,	qualify all associated detects as "J+."
the measured concentration is < the lower acceptance limit,	qualify all associated detects as "J-" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."

Sample Preparation

Criteria: The cleanup standard $^{37}Cl_4$-2,3,7,8-TCDD shall be added to all extracts prior to cleanup to measure the efficiency of the cleanup process. The recovery of the cleanup standard shall be within the limits set in Table 7 of the method.

Evaluation	Action
If the cleanup standard was not added to a sample, MB, or QC sample extract,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If the recovery of the cleanup standard is > the upper acceptance limit,	qualify all associated detects as "J."
If the recovery of the cleanup standard is < the lower acceptance limit,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Sample Analysis

Criteria: For identification of any compound, the ion abundance ratios must be within the limits specified in Table 9 of the method.

The recoveries of the labeled compounds must be within the limits specified in Table 7 of the method.

The RRTs of the PCDDs/PCDFs and labeled compounds must be within the limits specified in Table 2 of the method.

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Evaluation	Action
If the ion abundance ratio criteria were not met for any compound,	qualify all associated results as "R."
If the recovery of any labeled compound is > the upper acceptance limit,	qualify all detects for the corresponding unlabeled compound as "J."
If the recovery of any labeled compound is < the lower acceptance limit,	qualify all detects for the corresponding unlabeled compound as "J" and all non-detects for the corresponding unlabeled compound as "UJ".
If the RT of any compound is outside of the RT window,	qualify all associated results as "R."

Mass Spectrometer Performance Criteria

Criteria: Performance criteria are established to ensure mass resolution; identification; and, to some degree, sensitivity. These criteria are not sample specific. Conformance is determined using standard materials. These criteria should be met in all circumstances. System performance must be evaluated at the beginning of each 12-hour period in which analysis is performed.

Evaluation	Action
If mass spectrometer performance was not evaluated at the required frequency or if method criteria were not met,	qualify all associated detects as "R" and all associated non-detects as "UJ."

GC Column Performance Mix

Criteria: The GC column performance solution is used for defining the homologous GC RT windows and to document the chromatographic resolution. Column performance must be evaluated at the beginning of each 12-hour analytical period and must meet method acceptance criteria (see Section 15.4 of the method) before sample analysis may begin.

Evaluation	Action
If GC column performance was not evaluated at the required frequency or if method criteria were not met,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Confirmation of 2,3,7,8-TCDF Detects

Criteria: The DB-5 GC column generally used for PCDD and PCDF analyses does not adequately separate 2,3,7,8-TCDF from its closest eluting isomer. If 2,3,7,8-TCDF is

detected in a sample, the result must be confirmed on a second column capable of separating 2,3,7,8-TCDF from all other TCDF homologues (as proven by successful analysis of the GC column performance column mix with <25% valley between 2,3,7,8-TCDF and its closest eluting isomer).

Evaluation	Action
If 2,3,7,8-TCDF is detected in a sample and the result is not confirmed on a second column with successful analysis of the GC column performance mix,	qualify all associated detects as "NJ."

4.3 Procedure for GC and HPLC Validation

The requirements covered within this section are applicable to all GC and HPLC analytical techniques, including SW-846 Methods 8081B, 8082A, and 8330B.

4.3.1 Calibration

Initial Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for compounds on the TAL. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve.

When methods require confirmation of target analytes on a second, fully-calibrated column, the calibrations of both columns must be assessed.

The laboratory may establish a calibration curve using either the linear regression (linear curve) approach or the calibration factor (CF) approach. If both approaches are used to quantify and report target analytes within the same data package, calibration is to be assessed on an analyte-by-analyte basis.

Criteria: GC and HPLC instrument calibration shall be performed using a minimum of five calibration standards unless otherwise specified by the method. If calibration curves are used, five standards are required for a linear (first-order) calibration model, six standards are required for a quadratic (second-order) model, and seven standards are required for a third-order polynomial. Higher-order curves should not normally be used. If the laboratory uses a higher order equation to establish a calibration curve, it should be evaluated for appropriate application.

ISs shall not be used for quantitation.

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Evaluation	Action
If an insufficient number of calibration standards were used,	qualify all associated detects as "J" and all associated non-detects as "UJ."

CFs

Criteria: In the absence of or in addition to, method-specific calibration acceptance criteria, the following general calibration acceptance criteria should be applied.

The %RSD for the CFs obtained from the five ICAL standards must be ≤20%.

Evaluation	Action
If any target compound has a %RSD:	
>20% but ≤40%,	qualify all associated detects as "J" and, all associated non-detects as "UJ" if any other calibration criteria have been exceeded for that compound.
>40% but ≤60%,	qualify all associated detects as "J" and all associated non-detects as "UJ."
> 60%,	qualify all associated detects as "J" and all associated non-detects as "R."

Linear Curves

Criteria: The r^2 of the ICAL curve shall be ≥0.99. The absolute value of the intercept shall be ≤3X the MDL.

Note: The sample results may be reported with non-detects at the MDL or at the PQL value. See below for appropriate evaluation.

Evaluation	Action
If any target compound has a r^2:	
<0.99 but ≥0.90,	qualify all associated detects as "J" and, all associated non-detects as "UJ" if any other calibration criteria have been exceeded for that compound.
<0.90 but ≥0.80,	qualify all associated detects as "J" and all associated non-detects as "UJ."

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Evaluation (concluded)	**Action (concluded)**
<0.80,	qualify all associated detects as "J" and all associated non-detects as "R."
When results are reported at the MDL: If the intercept for any target compound is negative with an absolute value…	
> the MDL but ≤3X the MDL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "UJ."
>3X the MDL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "R."
When results are reported at the PQL: If the intercept for any target compound is negative with an absolute value...	
> the MDL but ≤2X the PQL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "UJ."
>2X the PQL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "R."
If the intercept for any compound is positive and > the MDL,	qualify all associated detects <3X the intercept as "J+."

4.3.2 Calibration Verification

Compliance requirements for satisfactory initial and continuing instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for compounds on the TAL. The ICV independently verifies the calibration, and the CCV establishes the relative CFs on which the quantitations are based and checks satisfactory performance of the instrument on a day-to-day basis.

Criteria: An ICV must be run immediately following an ICAL. The ICV standard analysis results are not required to be reported in the data package unless the samples in the SDG were analyzed after the ICAL standards but before a CCV

standard analysis was performed. In this case, the ICV %D is assessed according to the calibration verification criteria described below for the associated samples. If a CCV is analyzed prior to samples and ICV data are also reported in the package, both the ICV %D and the appropriate CCV %D are to be assessed as described below. If both ICV %D and CCV %D infractions occur, the worst infraction should be evaluated for result qualification.

A CCV must be run:

(1) at the beginning of each analytical run,

(2) at least once every 20 samples (preferably every 10), and

(3) at the end of each analytical run.

The laboratory is allowed to perform corrective action and reanalyze the CCV once after a failure. If multiple CCVs were analyzed (more than two) to obtain a passing CCV, then the calibration was not verified and the calibration verification frequency was not met. This is applicable to both CFs and linear curves. The evaluation of CCV data applies to all CCVs that bracket samples of interest.

A closing CCV is not required for toxaphene or chlordane if these compounds are non-detect in all samples.

Evaluation	**Action**
If the ICV/CCV standards were not analyzed at the proper frequency, or if either a required ICV or CCV was not analyzed, or if all target compounds were not present in any ICV or CCV standard,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If all required ICVs and CCVs were not analyzed,	qualify all associated detects as "J" and all associated non-detects as "R."

CFs

Criteria: The %D (see Section 6.3) between the ICV and/or the daily or continuing calibration standard CFs and the average CFs obtained from the ICAL must be ≤15%.

Evaluation	**Action**
If the %D was reported with the wrong sign (e.g., +%D for negative bias),	document the occurrence in the data validation report and assess any infractions using the correct sign.

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Evaluation (concluded)	Action (concluded)
If the %D between ICV and/or CCV CF and the average CF obtained from the ICAL is…	
>15% and positive (high bias),	qualify all associated detects as "J+."
>15% but ≤40% and negative (low bias),	qualify all associated detects as "J-." May qualify all associated non-detects as "UJ" if any other calibration criteria have been exceeded for that compound.
>40% but ≤60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
>60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "R."

Linear Curves

Criteria: The %D (see Section 6.3) between the daily or continuing calibration standard concentrations and their true values must be ≤15%.

The %D shall be calculated according to the formula in Section 6.3.

Evaluation	Action
If the %D was reported with the wrong sign (e.g., +%D for negative bias),	document the occurrence in the data validation report and assess any infractions using the correct sign.
If the %D between a measured ICV and/or CCV concentration and its true value is…	
>15% and positive (high bias),	qualify all associated detects as "J+."
>15% but ≤40% and negative (low bias),	qualify all associated detects as "J-." May qualify all associated non-detects for that compound as "UJ" if any other calibration criteria have been exceeded for that compound.
>40% but ≤60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
>60% and negative,	qualify non-detects for that compound as "R."

4.3.3 Blanks

The purpose of laboratory (or field) blank analysis is to determine the essence and magnitude of contamination resulting from laboratory (or field) activities.

The criteria for evaluation of blanks apply to any blank associated with the samples and include MBs, and, if submitted, EBs, and FBs. Action in the case of unsuitable blank results depends on the circumstances and origin of the blank. In instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of a contaminant. For purposes of evaluating multiple blanks, each preparation batch may be considered an independent event in evaluating MBs, and each sampling event may be considered an independent event for evaluating FBs and EBs.

The result of any compound detected in the sample, which was also detected in any associated blank, must be qualified when the sample concentration is <5X the blank concentration

Criteria: The concentration of each target analyte found in the blank must be < the associated MDL. The sample results must not be corrected by subtracting any blank value. If QC problems exist with any blank, all data associated with the case must be carefully evaluated to determine whether there is an inherent variability in the data for the case, or if the problem is an isolated occurrence not affecting other data.

Evaluation	Action
If a compound found in a blank is also found a sample,	qualify the sample result for that compound in accordance with the scenarios given below.
If gross contamination exists,	qualify results for all compounds affected as "R" due to interference.
If inordinate numbers of other target compounds are found at low levels in the blank(s),	discuss the presence of these compounds in the data validation report as it may be indicative of a problem at the laboratory.

The following are examples of application of the blank qualification guidelines. Certain circumstances may warrant deviations from these guidelines.

Scenario 1

If the sample result is > the PQL but is <5X the blank result.

Qualification

Blank Result	7
PQL	5
Sample Result	30
Qualified Sample Result	30U

Qualify sample result <35 (or 5 X 7) as non-detect ("U") at the reported value.

Scenario 2

If the sample result is < the PQL and is also <5X the blank result.

Qualification

Blank Result	6
PQL	5
Sample Result	4J
Qualified Sample Result	5U

Qualify sample result <30 (or 5 X 6) as non-detect ("U") at the PQL.

Note: Data are not reported as 4U, as this would be reported as a DL below the PQL.

The PQL may not be reported and it may not be possible to determine the PQL from the data. In these cases, qualify the contaminated sample result as "U" at 5X the blank concentration. If an MDL is reported, the PQL may be 5X the MDL.

Scenario 3

If the sample result is > the PQL and is also >5X the blank result.

Qualification

Blank Result	10
PQL	5
Sample Result	60
Unqualified Sample Result	60

Sample result exceeded the adjusted blank result of 50 (or 5 X 10). Thus, this sample result is not qualified.

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4.3.4 Surrogate Recovery

Laboratory performance for individual samples is established by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interference and high concentrations of analytes. Because the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the review and validation of data based on specific surrogate results is frequently subjective and demands analytical experience and professional judgment.

Criteria: Sample and blank surrogate recoveries must be within limits specified by the laboratory. Surrogate compound recoveries shall be calculated using the procedure described in SW-846 Method 8000C. Reported recoveries shall be accompanied by the applicable acceptance limits.

Note: Results from spiked or replicate QC samples that have surrogate %Rs <10% cannot be used to qualify sample results. Samples should be qualified for lack of accuracy and/or precision data, as applicable, if specified by the program.

Evaluation	**Action**
If surrogate recovery acceptance criteria are not reported in the packages,	request amended data from the laboratory.
If, based on professional judgment, the laboratory's internal acceptance criteria are excessively wide or biased,	notify the program manager.
If an initial dilution was performed on any sample and at least one surrogate has %R < the lower acceptance limit but ≥10%, or all surrogates have <10 %R and the results for one or more compounds were ≥ the PQL,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
If an initial dilution was performed on any sample, all surrogate %Rs are <10%, and all results are < the PQL,	qualify all associated sample results as "R."
If there are two or more analyses for a particular fraction at the same dilution,	determine which analysis contains the best data to report using the considerations below, qualify all data from the rejected analysis as "R," and document the reason for rejecting data from one analysis in the data validation report.

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Evaluation (concluded)	Action (concluded)
	Considerations should include: 1. surrogate recovery (marginal vs. gross deviation); 2. holding times; and 3. comparison of the values of the TALs reported in each fraction.
For surrogate recoveries out of specification, the following approaches are suggested based on a review of all data from the case, especially considering the apparent complexity of the sample matrix.	
If any surrogate %R is out of specification low,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the recovery is ≥10% and as "R" if the recovery is <10%.
If a surrogate %R is out of specification high,	qualify all associated detects as "J+."

Criteria: In the case of a blank analysis with surrogates out of specification, special consideration must be given to the validity of associated sample data. The basic concern is whether the blank problems represent an isolated problem with the blank alone or whether there is a fundamental problem with the analytical process.

If one or more samples in the batch show acceptable surrogate recoveries, the blank problem may be considered to be an isolated occurrence. However, even if this judgment allows some use of the affected data, analytical problems remain that must be corrected by the laboratory.

Evaluation	Action
If surrogate recovery in the blank does not meet acceptance criteria,	all detects < the PQL in all samples associated with the blank may be qualified as "J" and all non-detects in all samples associated with the blank may be qualified as "UJ."

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4.3.5 MS/MSD

Data for MS/MSD are generated to determine long-term precision and accuracy of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis.

Criteria: The MS/MSD data shall not be used to evaluate field sample results unless the MS/MSD sample was from the same client and of similar matrix.

An MS and MSD sample shall be analyzed at a frequency of once per data package, once per 20 samples of similar matrix, or once per sample matrix, whichever is more frequent. The MS must have recoveries calculated for all single-component target compounds. The presence of multi-component target compounds in the spiking solution is recommended but not required.

The laboratory shall not use FBs or EBs to satisfy this requirement if the laboratory can identify these blanks.

Unless otherwise stated in the specific method, the MS and MSD accuracy and precision acceptance criteria shall be those calculated by the laboratory using the procedure given in SW-846 Method 8000C. If the acceptance criteria are not given, recovery limits 70% to 130% and ±30% RPD should be used as the criteria. For solid and waste samples, it may be appropriate to accept up to a 40% RPD, based on the professional judgment.

The MS %Rs must be within the limits, unless the sample concentration is >4X the spike concentration (see Section 4.1.20).

The MS and MSD analyses must meet all sample analysis acceptance criteria. The MS and MSD results may be used in conjunction with other QC results to determine the need for qualification of the data. An effort to determine to what extent the results of the MS/MSD affect the associated data should first be made. This determination should be made considering the MS/MSD sample matrix, the surrogate recoveries, and the LCS results.

Professional judgment should be used to determine if MS/MSD failure warrants qualification of only the results for the failed compounds, or if results for all the compounds associated with the failed MS compound are affected. Generally, unless evidence exists to warrant qualification of other compounds, only the compounds in the MS spiking mixture shall be qualified.

For programs that require application of one final qualifier to sample results, if a recovery (accuracy) infraction is identified in one or both of the MS samples along with an RPD (precision) infraction between the MS and MSD, the sample is qualified for the accuracy infraction. For example, if a compound has a low MS recovery and the RPD is not within criteria, the data are qualified as "J-."

Evaluation	Action
If the program requires MS/MSD analysis for all matrices and all target compounds	

Evaluation (concluded)	**Action (concluded)**
and the MS/MSD sample was from another client or of a dissimilar matrix; the frequency of the MS/MSD did not meet specified criteria; no MS/MSD was analyzed or an FB- or EB was used for MS/MSD analysis,	qualify all detects as "J" and all non-detects as "UJ."
If no other measure of precision(i.e., LCSD or replicate) is available,	qualify all detects as "J" and all non-detects as "UJ."
If results are reported for single-component target compounds that are not in the MS,	all associated detects may be qualified as "J" and all associated non-detects may be qualified as "UJ" based on professional judgment
If any multi-component target compound is missing from the MS,	note the discrepancy in the data validation report.
If the surrogate and LCS recoveries are within the required acceptance criteria and… either MS or MSD %R for any target compound is > the upper acceptance limit, either MS or MSD %R for any target compound is < the lower acceptance limit,	 qualify all associated detects as "J+." qualify all associated detects as "J-" and all associated non-detects as "UJ" if the recovery is ≥10% and as "R" if the recovery is <10%.
If the RPD for any target compound does not meet the acceptance criteria or %Rs fail both high and low,	qualify all associated detects f as "J" and all associated non-detects as "UJ."

4.3.6 Replicate

Replicate analyses are indicators of laboratory precision based on each sample matrix. If a replicate was performed instead of an MSD, the following criteria are applied. If insufficient sample was submitted to analyze an MS/MSD or replicate, the laboratory may run an LCS/LCSD to measure precision. LCSD precision will be assessed as described in Section 4.3.5.

Criteria: Replicate samples shall be analyzed at a frequency of once per data package, once per 20 samples of similar matrix, or once per sample matrix, whichever is more frequent. All sample acceptance criteria must be met in the replicate analysis.

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Samples identified as FBs or EBs shall not be used for replicate sample analysis.

Unless otherwise stated in the specific method, the replicate precision acceptance criteria shall be those calculated by the laboratory using the procedure given in SW-846 Method 8000C. When no laboratory-derived control limits are reported, a control limit of 30% for the RPD shall be used for sample values >5X the PQL. For solid and waste samples, it may be appropriate to accept up to a 40% RPD, based on the professional judgment.

A control limit of ± PQL shall be used for sample values <5X the PQL, including the case when only one of the replicate sample values is <5X the PQL.

No precision criteria apply when both replicate sample values are < the PQL.

Evaluation	Action
If no replicate sample, no MSD, and no LCS/LCSD was analyzed for each matrix or for each data package,	qualify all associated detects of the same matrix as "J" and all associated non-detects as "UJ."
If an FB or EB was used for the replicate analysis and no MSD or LCSD was run,	qualify all associated detects of the same matrix as "J" and all associated non-detects as "UJ."
If the original result and replicate result are both >5X the PQL, and the RPD falls outside of appropriate control limits,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."
If the original and/or replicate result is <5X the PQL (including non-detects) and the difference between the original result and replicate result is > the PQL,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."

4.3.7 LCS

Data for LCSs are generated to provide information on the accuracy of the analytical method and on laboratory performance, including sample preparation.

Criteria: An LCS should be analyzed for all methods at a frequency of once per data package, once per matrix, or once per 20 analytical samples, whichever is most frequent.

The LCS must have recovery calculated for all single-component compounds or at least one multi-component compound, if applicable. For very large analyte lists or for known poor performers, the laboratory may have received an exemption for one or more analytes. Analytes with exemptions will be identified in the case narrative.

The LCS must meet all sample acceptance criteria. If surrogate acceptance criteria are not met in the LCS analysis, the LCS must be reanalyzed. The LCS

should meet all method-specific LCS requirements and acceptance criteria. If the recovery acceptance criteria are not reported, the criteria in Appendix F or 70% to 130% should be used as the criteria.

If the laboratory analyzed an LCS/LCSD as a measure of precision, both the LCS and LCSD must meet the acceptance criteria.

General laboratory precision and accuracy can be evaluated using the LCS acceptance criteria and the interlaboratory comparison data given in Appendix F. Individual LCS recoveries may be evaluated against the criteria in Appendix F if the laboratory's criteria are significantly different from those in the tables.

Evaluation	**Action**
If, based on professional judgment, the laboratory's internal acceptance criteria are excessively wide or acceptable recoveries are significantly biased,	notify the program manager.
If the frequency of the LCS did not meet the specified criteria,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If results are reported for target compounds that are not in the LCS,	may qualify detects for these compounds as "J" and non-detects as "UJ" based on professional judgment. Compounds missing under an exemption may be qualified based on professional judgment.

If the LCS criteria are not met and reanalysis was not performed, then the laboratory performance and method accuracy are in question. Professional judgment should be used to determine if data should be qualified for all target compounds or just those compounds associated with the failed LCS compound. The following may be used as guidance in qualifying data.

Evaluation	**Action**
If the LCS %R is > the upper acceptance limit,	qualify all associated detects as "J+."
If the LCS %R is < the lower acceptance limit,	qualify all associated detects for that compound as "J-" and all associated non-detects as "UJ" if the %R is ≥10% and as "R" if the %R is <10%.

Evaluation (concluded)	Action (concluded)
If %Rs for more than half of the compounds in the LCS analysis are below the acceptance range,	qualify all associated detects as "J-", and all associated non-detects as "UJ" if the failures are marginally low and as "R" if %Rs are significantly below acceptance limits. **Note**: If %Rs for more than half of the compounds in the LCS analysis are below the acceptance range, the laboratory has not shown that it can actually meet program required DLs.
If %Rs for more than half of the compounds in the LCS analysis are above the acceptance range,	qualify all associated detects as "J+."
If %Rs for more than half of the compounds in the LCS analysis are outside the acceptance range, both above and below,	qualify all associated detects as "J" and all associated non-detects as "UJ."

4.3.8 TAL Compound Identification

These criteria are established to ensure that adequate chromatographic resolution and instrument sensitivity is achieved by the chromatographic system.

Criteria: The laboratory must report RT window data for each GC column used to analyze samples. The RT of the ICV (or the first CCV of the day) should fall within the RT window established by the ICAL. RTs of subsequent CCVs should fall within the RT window established by the ICV or the first CCV of the day.

Evaluation	Action
If RT windows were not reported,	request an amended report from the laboratory.
If RT windows are not available, or if an RT for a standard exceeds the associated windows,	qualify all associated detects as "NJ" and all associated non-detects as "R." Emphasize the possibility of either false negatives or false positives, as appropriate, in the data validation report.

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4.3.9 Sample Carry-over

Sample carry-over may occur when a high-concentration sample is analyzed immediately prior to another field sample. Steps must be taken to avoid introduction of false positive results in the second sample analysis due to instrument contamination.

Criteria: The absence of sample carry-over must be determined and verified. If examination of the run logs indicates that any samples in the analytical run of interest required dilution, and there is no documentation of a rinse or blank analysis immediately following the original undiluted analysis then sample carry-over may be suspected in the subsequent sample.

Evaluation	Action
If any target compound found in the sample requiring dilution exceeded the high calibration standard and was also found in the following sample at a concentration <5X the PQL,	qualify the results for that compound in the second sample as "R" or "NJ", based on professional judgment.
If no data are available for the sample that required dilution and the laboratory has not documented that carry-over was evaluated, and the compound(s) was (were) also found in the following sample at concentrations <5X the PQL,	qualify the results for that compound in the second sample as "N."

4.3.10 Dilutions

Criteria: The PQLs must be adjusted to reflect all sample dilutions, concentrations, splits, clean-up activities, and dry weight factors that are not accounted for by the method.

Samples must be diluted and reanalyzed when any analytes exceed the calibration range. Data from original sample runs should be included when any sample requires dilution due to one or more compounds exceeding the calibration range.

The original undiluted results document the actual MDLs for non-detects.

Evaluation	Action
If the PQLs have not been properly adjusted,	request an amended report from the laboratory.

Evaluation (concluded)	Action (concluded)
If an initial dilution was required because of expected high concentrations of non-target analytes or because one or more target analyte were expected to greatly exceed the instrument working range and the laboratory was not able to analyze the undiluted sample,	note the dilution and elevated MDLs in the data validation report.
If any target compound exceeded the calibration range and… the original undiluted sample result was reported, the original undiluted sample run were not provided, the sample was diluted and reanalyzed and the diluted sample data were reported,	 qualify all detects which exceeded the calibration range as "J." request this information from the laboratory. qualify all non-detects from the diluted analysis as "UJ."
If data from the original sample run are unavailable,	refer to Section 4.3.4 for assessment of initially diluted samples with low surrogate recovery.

Criteria: The laboratory shall strive to make dilutions in such a way that the final concentration is measured in the mid-range of the calibration curve, and that results are not reported from measurements below the lowest concentration standard.

Evaluation	Action
If the instrument response (reported result / dilution factor) of any detect from diluted samples is < that of the lowest concentration standard,	qualify all associated detects from the diluted analysis as "J."

Criteria: The extraction efficiency for extremely high concentrations of analytes has generally not been determined for most methods. If the analysis requires an extraction and dilutions of > 100,000:1 the efficiency of the extraction may be suspect.

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Evaluation	Action
If dilutions of > 100,000:1 was required,	qualify all associated detects as "J-."

4.3.11 Quantification and Confirmation

Criteria: Detected compound results must be confirmed using a second GC/HPLC column. The laboratory shall report RPDs between the results obtained from the two GC/HPLC columns. RPDs are not evaluated if the analyte is not detected on the primary column. (see note below)

Evaluation	Action
If the results from the second column confirmation are not reported,	qualify all detects as "NJ."
If the RPD between detects for a particular analyte from two analytical columns is >40% and ≤ 75%…	
for PCB, pesticide, and herbicide analyses,	qualify the reported result as "J."
for high explosive (HE) analysis,	report the result from the C-18 column and qualify it as "J."

An RPD between results for a particular analyte from two analytical columns that is >75% may indicate that there is a significant coelution or interference problem. As applied here, a coelution is two target analytes, or one target and one non-target analyte, that have peaks at the same RT, and an interference is a non-target analyte with a peak at a target analyte RT. That is, a coelution is a quantity that cannot be verified, and an interference is a result that is a false positive.

A general review of the actual spectra may be required to determine the best qualification. If the spectrum includes a significant number of extraneous peaks outside of the target analyte RT windows, interferences are likely on one or both of the columns. Non-symmetrical peak shape is indicative of coelution, and shifts in RTs may indicate either coelution or interference. A review of the beginning and ending CCV RTs will give the reviewer an indication of instrument stability during the analysis.

If one of the results is < the PQL and the other is much > the PQL, suspect interference or a false positive. Values around the PQL should be evaluated using both RPD and absolute differences. For example, results of 1 ug/L and 5 ug/L have an RPD of 133% but would not be significantly different from each other for analyses with a PQL of 5 ug/L. An attempt should be made to determine if the peak is primarily due to interference or if the peak has a significant contribution from the target analyte.

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Note: It is not uncommon to find MDLs for GC/HPLC methods as determined using 40 CFR 136 to be artificially low, which may result in false positives due to random instrument noise for concentrations below the PQL.

In general, rejection of data with results much > the PQL will require additional supporting analytical information such as GC/MS or diode array spectral matching (see Appendix G).

Evaluation	**Action**
If the RPD is >75% and…	
one result is <5X the PQL and the other result is > the PQL and >10X the first result,	qualify the reported result as "R."
both results are <5X the PQL…	
for PCB, pesticide, and herbicide analyses,	qualify the reported result as "NJ."
for HE analysis,	report the result from the C-18 column and qualify it as "NJ."
both results are much > the PQL, one or both peaks may have contribution due to coelution, and…	
it is apparent that the peak is primarily due to the target analyte,	qualify the reported result as "J+."
it is not apparent that the peak is primarily due to the target analyte,	qualify the reported result as "NJ+."
If rejecting data where both results are much > the PQL,	include a complete description of the justification and supporting data used in the data validation report.

In waste-type samples, the separation techniques may not completely isolate the analytes of concern from other compounds and the spectra may contain multiple extraneous peaks. The more peaks there are in the spectra, the more likely it is that false positives will be reported.

Evaluation	**Action**
If a large number of unidentified peaks are seen in the spectra or if several additional peaks are located near a reported analyte RT in both spectra,	results may be qualified as "N" using professional judgment.

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Criteria: Although confirmation is not required for non-detects it is a common laboratory practice to use a dual column system and perform the confirmation analysis on all samples. Occasionally, there may be QC failures that occur on one of the columns that are acceptable on the other column. Laboratories may choose to report the analytes with acceptable results from one column and the remaining analytes from the other column. The following guidelines should be used when this occurs.

This practice may only be used for reporting non-detects from both columns.

All QC elements must be reported for both columns.

This can only be used when no primary column is specified, such as in SW-846 Method 8082A. When a primary column is specified, such as in SW-846 Method 8330B, all QC for the primary column must be acceptable.

The QC must be completely acceptable for each analyte on one or the other column. That is, the laboratory cannot use an acceptable LCS for an analyte on one column and an acceptable CCV for that analyte on the other column to justify acceptable performance.

Evaluation	Action
If both results are reported and qualification is required,	use the results from the column with the best performance.

4.3.12 Method-specific Analytical Requirements–Organic GC and HPLC

The additional analytical requirements given below are organized by SW-846 method. These requirements should be checked if the level of deliverable (level III or level IV) allows.

4.3.12.1 Method 8081B, Organochlorine Pesticide by GC

If discussion of water sample clean-up procedures was not included in the data package, it can be assumed that clean-up was not necessary and no discussion is required in the data validation report. For soil analysis, Florisil clean-up is required for all sample extracts.

Criteria: The laboratory must include a discussion of any clean-up procedures performed on the samples.

An instrument blank consisting of clean solvent containing only the surrogate compounds shall be analyzed at the beginning and end of each analytical run, and once every 20 analytical samples.

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Evaluation	Action
If discussion of sample clean-up procedures is missing or incorrect,	notify the laboratory and note the discrepancy in the data validation report.
If clean-up procedures were documented in the data package,	discuss the clean-up procedures used in the data validation report.
If no instrument blank was run, or if frequency criteria were not met,	may qualify detects <5X the MDL as "J" based on professional judgment.

Criteria: The total % breakdown for both dichlorodiphenyltrichloroethane (DDT) and endrin must each be ≤15%.

Evaluation	Action
If DDT breakdown is > 15%,	beginning with the samples following the last *in-control* standard, qualify all detects for DDT as "J" and all detects for dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE) as "NJ."
If DDT breakdown is >15% and DDT was not detected in any sample analyzed after the last in-control standard but DDD and DDE were detected in any of those samples,	qualify the result for DDT in the sample with DDD and DDE detects as "R."
If endrin breakdown is >15%,	beginning with the samples following the last *in-control* standard, qualify all detects for endrin as "J" and detects for endrin ketone and endrin aldehyde as "NJ."
If endrin breakdown is >15% and endrin was not detected in any sample analyzed after the last in-control standard, but endrin aldehyde and endrin ketone were detected in any of those samples,	qualify the result for endrin in the sample with the endrin aldehyde and endrin ketone detects as "R."

Note: A closing CCV is not required for toxaphene or chlordane if these compounds are non-detect in all samples.

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4.3.12.2 Method 8082A, PCB Aroclors by GC

Criteria: PCB analysis shall be performed according to the requirements listed in SW-846 Method 8082A.

The laboratory must include a discussion of any clean-up procedures performed on the samples. If discussion of sample clean-up procedures was not included in the data package, it can be assumed that clean-up was not necessary and no discussion is required in the data validation report. The laboratory case narrative shall include a thorough discussion of any problems encountered regarding target compound recognition and/or quantitation and especially addressing suspected environmental degradation of compounds. Reported results shall be justified with such discussion and supporting documentation.

PCBs reported as total PCBs or as individual congeners are qualified in accordance with the Section 4.2.14.6.

Evaluation	Action
If clean-up procedures were documented in the data package,	discuss the clean-up procedures used in the data validation report.
If the discussion does not appear to justify the results reported by the laboratory,	notify the laboratory; more supporting documentation may be required from the laboratory.
If the laboratory identifies any aroclors as degraded,	qualify all associated detects as "J."

4.3.12.3 Method 8151A, Chlorinated Herbicides by GC

Criteria: Chlorinated herbicide analysis shall be performed according to the requirements listed in the SW-846 Method 8151A.

The LCS shall contain each of the specified target chlorinated herbicides at concentrations near the midpoint of the calibration range.

Evaluation	Action
If results are reported for target compounds that are not in the LCS,	may qualify all associated detects as "J" based on professional judgment.
If LCS analytes are not at concentrations near the midpoint of the calibration range,	note the finding in the data validation report and notify the laboratory.

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4.3.12.4 Confirmation of Polyaromatic Hydrocarbon (PAH) by Method 8310

The primary analysis should be done by HPLC on a C18 column using a diode array detector. Confirmation is done qualitatively using spectral matching and/or quantitatively using a fluorescence detector. This method presupposes a high expectation of detecting the compounds. When used as a screening tool both confirmation methods should be employed. If a co-eluting compound is present that is detected by both the diode array detector and the fluorescence detector, the primary method of determining if interference is present is the spectral match from the diode array detector.

An effort to determine if the peak is primarily from the target compound or due to interference should be made. This is determined by comparison of the sample diode array spectra to the reference spectra in accordance with Appendix G.

Evaluation	**Action**
If the diode array spectra were used for confirmation and no diode array spectra were included in the data package,	qualify the result as "NJ."
If the sample absorption spectra does not match the standard absorption spectra or the percent difference spectra does not exhibit a relatively straight line,	qualify the result as "R."
If the analyte was misidentified by the laboratory,	request an amended report from the laboratory.
If identification of the analyte was hampered by interferences such that it is not certain that a positive identification could be made or that the quantification may be biased high,	qualify all associated results as "N" or "NJ" based on professional judgment or request additional data from the laboratory.

The second evaluation compares the calculated values from the two detectors when a two-detector system is used. When one of the results is < the PQL and the other is much > the PQL (i.e., near or above the mid-point in the calibration curve), suspect interference or a false positive. Values around the PQL should be evaluated using both the RPDs and absolute differences. For example, results of 1 ug/L and 5 ug/L have an RPD of 133% but would not be significantly different from each other for analyses with a PQL of 5 ug/L.

Evaluation	**Action**
If results from the second column confirmation were not reported,	qualify all detects as "NJ."
If the RPD between detects for a particular analyte from two analytical columns is >40% and ≤75%,	report the result from the diode array detector and qualify it as "J."

Evaluation (concluded)	Action (concluded)
If the RPD is > 75% and…	**Note**: If the RPD is >75%, one or both peaks may be due to coelution.
one result is <5X the PQL and the other result is > the first result,	qualify the result as "R."
both results are <5X the PQL,	qualify the result as "NJ."
both results are >5X the PQL and it appears that the peak is primarily due to the target analyte (spectral match),	qualify the result as "J+."
both results are >5X the PQL and it is not apparent that the peak is primarily due to the target analyte,	qualify the result as "NJ+."
If rejecting data where both results are much > the PQL,	include a complete description of the justification for the rejection and supporting data used in the data validation report. **Note**: In general, rejection of data with results >5X the PQL will require additional supporting analytical information such as GC/MS spectral matching.

4.3.12.5 Method 8015C or 8015D, Non-halogenated Organics Using GC/Flame Ionization Detector (Gasoline Range Organics/Diesel Range Organics)

Confirmation on a second column is not typically required for gasoline range organics (GRO) and diesel range organics (DRO) reported by this method.

GRO and DRO results represent all peaks detected over a designated RT range on the chromatogram. The RT assessment is performed as described in Section 4.3.8 for all reported RT markers.

Evaluation	Action
If RT windows are exceeded,	qualify all associated detects as "J" and all associated non-detects as "UJ."

4.4 Procedure for Liquid Chromatography/Mass Spectrometry/Mass Spectrometry (LC/MS/MS) Validation

The requirements addressed within this section are applicable to all LC/MS/MS analytical techniques. LC/MS/MS is a highly selective analysis that utilizes four means of compound discrimination: chromatographic separation, negative ion generations (where applicable), mass selection, and daughter fragmentation. It is theoretically possible that two different compounds could have the same RT and generate the same ion, but it is highly unlikely that these two compounds would fragment to the same daughter ion.

4.4.1 Instrument Calibration for LC/MS/MS

Initial Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for compounds on the TAL. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run and of producing a linear curve. In the absence of or in addition to, method-specific calibration acceptance criteria, the following general calibration acceptance criteria should be applied.

If an IS is used to calculate analytical results, the slope or RF values are evaluated as directed below. If the analysis does not use an IS to quantitate analytical results, the value of the slope or CF is not evaluated.

The laboratory may establish a calibration curve using either the linear regression (linear curve) approach or the RF approach. If both approaches are used to quantify and report target analytes within the same data package, calibration is to be assessed on an analyte-by-analyte basis.

Criteria: LC/MS/MS instrument calibration shall be performed using a minimum of five calibration standards. The lowest point of the curve must be at or below the PQL.

If calibration curves are used, five standards are required for a linear (first-order) calibration model, six standards are required for quadratic (second-order) model, and seven standards are required for third-order polynomial. Higher order curves should not normally be used. If the laboratory uses a higher-order equation to establish a calibration curve, it should be evaluated for appropriate application.

Daily instrument calibration is required for perchlorate analysis.

Evaluation	Action
If an insufficient number of calibration standards were used, the PQLs were incorrect or all points were not analyzed within a 24-hour period:	qualify all associated detects as “J” and all associated non-detects as “UJ.”

Evaluation (concluded)	Action (concluded)
If the instrument for perchlorate analysis was not calibrated daily,	qualify all associated detects as "J" and all associated non-detects as "UJ."

RFs

Criteria: The %RSD for the RFs obtained from the five ICAL standards must be ≤20%.

Evaluation	Action
For analyses using an IS for analyte quantitation, if the average RF for any target analyte is < the specified minimum RF, or <0.05 if no minimum is specified,	qualify all associated detects as "J" and all associated non-detects as "UJ" if the RF is ≥0.01 and as "R" if the RF is <0.01.
If any target compound has a %RSD…	
>20% but ≤40%,	qualify all associated detects as "J" and, may qualify all associated non-detects as "UJ" if any other calibration criteria have been exceeded for that compound.
>40% but ≤60%,	qualify all associated detects as "J" and all associated non-detects as "UJ."
> 60%,	qualify all associated detects as "J" and all associated non-detects as "R."

Linear Curves

Criteria: The r^2 of the ICAL curve shall be ≥0.99 and have a slope ≥0.05 for each compound. The absolute value of the intercept shall be ≤3X the MDL.

Note: The sample results may be reported with non-detects at the MDL or at the PQL value. See below for appropriate evaluation.

For perchlorate, forcing the calibration curve through a zero intercept is an acceptable practice and usually results in more accurate quantitation for low level results.

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Evaluation	**Action**
For analyses using an IS for analyte quantitation, if the slope for any target analyte is < the specified minimum RF, or <0.05 if no minimum RF is specified,	qualify all associated detects as "J" all associated non-detects as "UJ" if the slope is ≥0.01 and as "R" if the slope is < 0.01.
If any target compound has a r^2:	
<0.99 but ≥0.90,	qualify all associated detects as "J" and may qualify all associated non-detects as "UJ" if any other calibration criteria have been exceeded for that compound.
<0.90 but ≥0.80,	qualify all associated detects as "J" and all associated non-detects as "UJ."
< 0.80,	qualify all associated detects as "J" and all associated non-detects as "R."
If the intercept for any target analyte is positive and > the MDL,	qualify all associated detects <3X the intercept as "J+."
When results are reported at the MDL: If the intercept for any target compound is negative with an absolute value...	
> the MDL but ≤3X the MDL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "UJ."
>3X the MDL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "R."
When results are reported at the PQL: If the intercept for any target compound is negative with an absolute value...	
> the MDL but ≤2X the PQL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "UJ."

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Evaluation (concluded)	Action (concluded)
>2X the PQL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "R."

4.4.2 Calibration Verification

Compliance requirements for satisfactory initial and continuing instrument calibration verification are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for target compounds. The ICV independently verifies the calibration, and CCV establishes the 12-hour relative RFs on which the quantitations are based and checks satisfactory performance of the instrument on a day-to-day basis.

The evaluation of CCV data applies to all CCVs that bracket samples of interest.

Criteria: An ICV standard is analyzed immediately following an ICAL. For perchlorate analysis, the ICV is always evaluated for %D criteria. For HE analysis, the ICV standard analysis results are not required to be reported in the data package unless the samples in the SDG were analyzed after the ICAL but before a CCV standard analysis was performed. In this case, the ICV %D is assessed according to the calibration verification criteria described below for the associated samples. If a CCV is analyzed prior to samples and ICV data are also reported in the package, both the ICV %D and the appropriate CCV %D are to be assessed as described below. If both ICV %D and CCV %D infractions occur, the worst infraction should be evaluated for result qualification.

A CCV standard must be analyzed:

1) at the beginning of each analytical run;
2) at least once every 10 samples; and
3) and at the end of each analytical run.

If multiple CCVs were analyzed to obtain a passing CCV, the calibration is not verified and the calibration frequency is not met.

Evaluation	Action
If the ICV/CCV standards were not analyzed at the proper frequency, or if either a required ICV or CCV was not analyzed, or if all target compounds were not present in any ICV or CCV standard,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If all required ICVs and CCVs were not analyzed,	qualify all associated detects as "J" and all associated non-detects as "R."

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RFs

Criteria: The %D between the ICV and/or CCV RFs and the average RF obtained from the ICAL shall be calculated according to the formula in Section 6.3 and must be ≤20% for HE and ≤15% for perchlorate. The evaluation of CCV data applies to all CCVs that bracket samples of interest.

Evaluation	Action
If the %D was reported with the wrong sign (e.g., +%D for a negative bias),	document the occurrence in the data validation report and assess any infractions using the correct sign.
If the %D between an ICAL RF or CF and an ICV or CCV RF or CF for any target analyte is...	
>20% for HE or >15% for perchlorate and positive (high bias),	qualify all associated detects as "J+."
>20% for HE or >15% for perchlorate but ≤40% and negative (low bias),	qualify all associated detects as "J-" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
>40% but ≤60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
>60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "R."

Linear Curves

Criteria: The %D between the ICV or CCV standard concentrations and their true values shall be calculated according to the formula in Section 6.3 and must be ≤20% for HE and ≤15% for perchlorate. The evaluation of CCV data applies to all CCVs that bracket samples of interest.

Evaluation	Action
If the %D was reported with the wrong sign (e.g., +%D for negative bias),	document the occurrence in the data validation report and assess any infractions using the correct sign.

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Evaluation (concluded)	Action (concluded)
If the %D between a measured ICV and/or CCV concentration and its true value for any analyte is...	
>20% for HE or >15% for perchlorate and positive (high bias),	qualify all associated detects as "J+."
>20% for HE or >15% for perchlorate but ≤40% and negative (low bias),	qualify all associated detects as "J-" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."
>40% but ≤60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
>60% and is negative,	qualify all associated detects as "J-" and all associated non-detects as "R."

4.4.3 RLV

A RLV standard (i.e., RLV for ICP-AES, ICP-MS, and LC/MS/MS methods [CRI]), of the same origin as the calibration standard must be analyzed at the beginning and end of each perchlorate analysis run and at the beginning only if each HE analytical run as a measure of accuracy near the PQL. This analysis may be referred to as a PS. Analysis of a CRI is required for both HE and perchlorate methods. CRI standard concentrations are at 2X the MDLs for perchlorate analysis, and at no more than 2X the PQL for HE analysis.

The laboratory may run more than the required CRIs in a batch. In this case, the bracketing CRIs for perchlorate and the CRI immediately preceding the samples for HE will be used for the CRI evaluation.

Criteria: The advisory recovery acceptance criteria for perchlorate analysis are 70% to 130%. For HE analysis, recoveries must be within limits specified by the laboratory. If recovery acceptance criteria are not reported, the recovery acceptance range shall be 70% to 130%.

Evaluation	Action
If frequency criteria are not met,	qualify all detects <5X the PQL as "J" and all non-detects as "UJ."
If the %R is >130%,	qualify all associated detects <5X the PQL as "J+."

Evaluation (concluded)	**Action (concluded)**
If the %R is <70% but ≥30%,	qualify all associated detects <5X the PQL as "J-" and all associated non-detects as "UJ."
If the %R is <30%,	qualify all associated detects <5X the PQL as "J-" and all associated non-detects as "R."

4.4.4 Blanks

For perchlorate analysis, refer to Section 4.5.3 for assessment of blanks.

The following applies for HE analysis.

The preparation batch consists of a group of no more than 20 samples of the same matrix processed on the same day. All samples in a batch must be initiated on the same day. Each batch must contain a MB.

An initial calibration blank (ICB) must be analyzed to verify the baseline immediately following calibration and prior to analytical sample analysis. A continuing calibration blank (CCB) must be analyzed after each CCV and at the end of every analytical sequence in order to bracket all sample analyses. All CCBs that bracket samples of interest shall be reported and assessed. If a bracket has an ICB and no CCB, then the ICB should be treated as a CCB for validation purposes.

The purpose of laboratory (or field) blank analysis is to determine the essence and magnitude of contamination resulting from laboratory (or field) activities.

The criteria for evaluation of blanks apply to any blank associated with the samples and include MBs and, if submitted, EBs and FBs. Action in the case of unsuitable blank results depends on the circumstances and origin of the blank. In instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of a contaminant. For purposes of evaluating multiple blanks, each preparation batch may be considered an independent event in evaluating preparation blanks, and each 12-hour run sequence may be considered an independent event for evaluating FBs and EBs.

The result of any compound detected in the sample, which was also detected in any associated blank, must be qualified when the sample concentration is <5X the blank concentration.

Criteria: The concentration of each target analyte found in the blank must be < the associated MDL. The sample results must not be corrected by subtracting any blank value. If QC problems exist with any blank, all data associated with the. case must be carefully evaluated to determine whether there is an inherent

variability in the data for the case, or if the problem is an isolated occurrence not affecting other data

Evaluation	Action
If a compound found in a blank is also found in the field sample,	qualify the sample result for that compound in accordance with the scenarios given below.
If gross contamination exists,	qualify results for all compounds affected as "R" due to interference.
If inordinate numbers of other target compounds are found at low levels in the blank(s)	discuss the presence of those compounds in the data validation report as it may be indicative of a problem at the laboratory.

The following are examples of application of the blank qualification guidelines. Certain circumstances may warrant deviations from these guidelines.

Scenario 1

Sample result is > the PQL but is <5X the blank result.

Qualification

Blank Result	7
PQL	5
Sample Result	30
Qualified Sample Result	30U

Sample results <35 (or 5 X 7) would be qualified as non-detects ("U") at the reported value.

Scenario 2

The sample result is < PQL and is also <5X the blank result.

Qualification

Blank Result	6
PQL	5
Sample Result	4J
Qualified Sample Result	5U

Qualify sample results <30 (or 5 X 6) as non-detect ("U") at the PQL.

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Note: Data are not reported as 4U, as this would be reporting a DL below the PQL.

The PQL may not be reported and it may not be possible to determine the PQL from the data. In these cases, qualify the contaminated sample result as "U" at 5X the blank concentration.

Scenario 3

The sample result is > the PQL and is also >5X the blank result.

Qualification

Blank Result	10
PQL	5
Sample Result	60
Unqualified Sample Result	60

Sample result exceeded the adjusted blank result of 50 (or 5 X 10). Thus, this sample result is not qualified.

4.4.5 Surrogate Recovery – HE analysis only

Laboratory performance on individual samples is established by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interference and high concentrations of analytes. Because the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the review and validation of data based on specific sample results is frequently subjective and demands analytical experience and professional judgment. The evaluation of surrogate recoveries and ISs should be performed concurrently. Accordingly, this section consists primarily of guidelines, in some cases with several optional approaches suggested.

Criteria: Sample and blank surrogate recoveries must be within limits specified by the laboratory. Surrogate compound recoveries shall be calculated using the procedure described in SW-846 Method 8000C. Reported recoveries shall be accompanied by the applicable acceptance limits.

Results from spiked or replicate QC samples that have surrogate %Rs < 10% cannot be used to evaluate associated sample results. Associated samples should be qualified for lack of accuracy and/or precision data as applicable.

Evaluation	Action
If the surrogate recovery acceptance criteria were not reported in the data package,	request amended data from the laboratory.

Evaluation (concluded)	**Action (concluded)**
If, based on professional judgment, the laboratory's internal acceptance criteria are excessively wide or biased,	notify the program manager.
If an initial dilution was performed on any sample and at least one surrogate recovery is < the lower acceptance limit but ≥10%, or all surrogate recoveries are <10% and the results for one or more compounds are > the PQL,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
If an initial dilution was performed on any sample, any surrogate %R is <10%, and all results are non-detect,	qualify all sample results as "R."
If there are two or more analyses for a particular fraction at the same dilution,	determine which contains the best data to report using the considerations below, qualify all data from the rejected analysis as "R" and document the reason for rejecting data from one analysis in the data validation report. Considerations should include: 1. surrogate recovery (marginal vs. gross deviation); 2. holding times; 3. comparison of the values of the target analytes reported in each fraction; and 4. performance of ISs.
For surrogate spike recoveries out of specification, the following approaches are suggested based on a review of all data from the batch, especially considering the apparent complexity of the sample matrix.	
If the surrogate is out of specification low,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the recovery is ≥10% and as "R" if the recovery is <10%.
If the surrogate is out of specification high,	qualify all detects as "J+."

Criteria: In the case of a blank analysis with surrogate out of specification, special consideration must be given to the validity of associated sample data. The basic

concern is whether the blank problems represent an isolated problem with the blank alone or whether there is a fundamental problem with the analytical process.

If one or more samples in the batch show acceptable surrogate recovery, r the blank problem may be considered to be an isolated occurrence. However, even if this judgment allows some use of the affected data, analytical problems remain that must be corrected by the laboratory.

Evaluation	Action
If surrogate recovery in the blank does not meet acceptance criteria,	may qualify all detects < the PQL in all samples associated with the blank as "J" and all non-detects in all samples associated with the blank as "UJ."

4.4.6 IS Performance

IS criteria ensure that instrument sensitivity and response are stable and acceptable during each analysis.

Criteria: The laboratory may use an IS to calculate the result, or it may use the IS as a RT check only (perchlorate). If the IS is used for quantification, the IS area counts must not vary by more than 70% to 130% and the RT of the IS must not vary by more than ±30 seconds from the average of those obtained from the calibration standards or from the mid-level calibration standard.

If the IS is only used as an RT check, the RRT of the IS must fall within the acceptance range of 0.98 to 1.02, and the IS recovery should be evaluated using the surrogate criteria. If recovery acceptance limits are not reported in the data package, recovery should be evaluated based on reported MS acceptance limits.

Evaluation	Action
If there are two analyses for a particular sample,	determine which contains the best data to report based on the considerations below, qualify all data from the rejected analysis as "R" and document the reason for rejecting data from one analysis in the data validation report. Considerations should include: 1. magnitude of the RT shift; 2. holding times; 3. comparison of the values of the target compounds reported in each sample; and. 4. surrogate recovery.

Evaluation (concluded)	**Action (concluded)**
If the IS was used for quantification and...	
its area count is >130% of the average of that obtained from the calibration standards,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
its area count is <70% of the average of that obtained from the calibration standards,	qualify all associated detects as "J+" and all associated non-detects as "UJ" if the area count is ≥25% and as "R" if the area count is <25%. **Note:** If extremely low area counts are reported, or if performance exhibits a major abrupt drop-off, then a severe loss of sensitivity is indicated.
its RT varies by more than ±30 seconds,	qualify all associated detects as "N" or "R" and all associated non-detects as "R."
If the IS was used as an RT check and the RRT does not fall within the acceptance range,	qualify all associated detects as "N" or "R" and all associated non-detects as "R."
If the IS was used as an RT check,	evaluate the IS area counts according to Section 4.4.5.

4.4.7 MS/MSD

Data for MS/MSD pairs are generated to determine long-term precision and accuracy of the analytical method on samples various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis.

Criteria: The MS/MSD data shall not be used to evaluate associated field sample results unless the MS/MSD sample was from the same client and of similar matrix.

An MS and MSD sample shall be analyzed at a frequency of once per data package, once per 20 samples of similar matrix, or once per sample matrix, whichever is more frequent.

The laboratory shall not use FBs or EBs to satisfy these requirements if the laboratory can identify these blanks.

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For HE, the MS and MSD accuracy and precision acceptance criteria shall be those calculated by the laboratory using the procedure given in SW-846 Method 8000C. If the recovery acceptance criteria are not given, recovery limits of 70% to 130% and 30% RPD should be used as the criteria. For solid and waste samples, it may be appropriate to accept up to a 40% RPD, based on the professional judgment of the reviewer.

For perchlorate, the MS/MSD recovery acceptance criteria are 75% to 125% and 20% RPD. For solid and waste samples, it may be appropriate to accept up to a 30% RPD, based on the professional judgment.

The MS and MSD %R must be within the limits, unless the sample concentration is >4X the spike concentration (see Section 4.1.20).

The MS and MSD analyses must meet all sample analysis acceptance criteria. The MS and MSD may be used results in conjunction with other QC results to determine the need for qualification of the data. An effort to determine to what extent the results of the MS/MSD affect the associated data should first be made. This determination should be made considering the MS/MSD sample matrix, the surrogate and IS %Rs, and the LCS results. Professional judgment should be used to determine if MS/MSD failure warrants qualification of only the results for the failed compounds or if results for all the compounds associated with the failed MS compound and its associated IS are affected. Generally, unless evidence exists to warrant qualification of other compounds, only the compounds in the MS spiking mixture shall be qualified.

For programs that require application of one final qualifier to sample results, if a recovery (accuracy) infraction is identified in one or both of the MS samples along with an RPD (precision) infraction between the MS and MSD, the sample is qualified for the accuracy infraction. For example, if an analyte has low MS recovery and the RPD is not within criteria, the data are qualified as "J-."

Evaluation	**Action**
If the MS/MSD sample was from another client or of a dissimilar matrix; the frequency of the MS/MSD did not meet specified criteria; no MS/MSD was analyzed; an FB or EBs was used for MS/MSD purposes.	qualify all detects as "J" and all non-detects as "UJ."
If no other measure of precision (i.e., LCSD or replicate) is available,	qualify all detects as "J" and all non-detects as "UJ."
If the surrogate, IS and LCS %Rs are within the required acceptance criteria and…	

Evaluation (concluded)	Action (concluded)
either %R for any target compound is > the upper acceptance limit,	qualify all associated detects as "J+."
either %R for any target compound is < the lower acceptance limit, and ≥ 10%,	qualify all associated detects as "J-" and all associated non-detects as UJ" if the recovery is ≥10% and as "R" if the recovery is <10%.
If the RPD for any target compound does not meet the acceptance criteria or %Rs fail both high and low,	qualify all associated detects as "J" and all associated non-detects as "UJ."

4.4.8 Replicate

Replicate analyses are indicators of laboratory precision based on each sample matrix. If a replicate was performed instead of a MSD, the following criteria are applied. If insufficient sample was submitted to analyze a MS/MSD or replicate, the laboratory may run an LCSD to measure precision.

Criteria: A replicate sample shall be analyzed at a frequency of once per data package, once per 20 samples of similar matrix, or once per sample matrix, whichever is more frequent. All sample acceptance criteria must be met in the replicate analysis.

Samples identified as FBs or EBs should not be used for replicate sample analysis.

For HE values ≥5X the PQL, the replicate precision acceptance criteria shall be that calculated by the laboratory using the procedure given in SW-846 Method

8000C. If the acceptance criteria are not given, an RPD of ≤30% should be used as the acceptance criteria. For solid and waste samples, it may be appropriate to accept up to a 40% RPD, based on the professional judgment.

For perchlorate, the replicate precision acceptance criteria is 20% RPD for sample values ≥5X the PQL. For solid and waste samples, it may be appropriate to accept up to a 30% RPD, based on the professional judgment.

For both HE and perchlorate analysis, a control limit of ± the PQL shall be used for sample values > the PQL but <5X the PQL, including the case when only one of the replicate sample values is > the PQL but <5X the PQL.

No precision criteria apply when both replicate sample values are < PQL.

Evaluation	Action
If a replicate sample, MSD, and LCS/LCSD were not analyzed for each matrix or for each data package,	qualify all detects of the same matrix as "J" and all non-detects of the same matrix as "UJ."

Evaluation (concluded)	Action (concluded)
If an FB or EB was used for the replicate analysis and no MSD or LCSD was run,	qualify all detects of the same matrix as "J" and all non-detects of the same matrix as "UJ."
If the original result and replicate result for any target compound are both ≥5X the PQL, and the RPD exceeds the appropriate control limit,	qualify all associated detects of the same matrix as "J" and all associated non-detects all associated as "UJ."
If the original and/or replicate result for any target compound is > the PQL but <5X the PQL (including non-detects) and the difference between the original result and replicate result is > the PQL,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."

4.4.9 LCS

Data for LCSs are generated to provide information on the accuracy of the analytical method and on laboratory performance including sample preparation.

Criteria: An LCS should be analyzed for all methods at a frequency of once per data package, once per matrix, or once per 20 analytical samples, whichever is most frequent.

The LCS must meet all sample acceptance criteria and all method-specific LCS requirements. The LCS for HE must meet laboratory-derived acceptance criteria. If surrogate and IS recovery acceptance criteria are not met for the LCS analysis, the LCS must be reanalyzed. If the recovery acceptance criteria are not reported, the criteria in Appendix F or 70% to 130% should be used as the criteria.

The recovery acceptance limits for perchlorate are 85% to 115%.

If the laboratory analyzed an LCS/LCSD as a measure of precision, both the LCS and LCSD must meet the acceptance criteria.

Evaluation	Action
If, based on professional judgment, the laboratory's internal acceptance criteria are excessively wide or acceptable recoveries are significantly biased,	notify the program manager.
If the frequency of the LCS did not meet the specified criteria,	qualify all detects as "J" and all non-detects as "UJ."

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Evaluation (concluded)	Action (concluded)
If results are reported for target compounds that are not in the LCS,	may qualify detects for those compounds as "J" and non-detects for those compounds may be qualified as "UJ" based on professional judgment.

If the LCS criteria are not met and reanalysis was not performed, then the laboratory performance and method accuracy are in question. The following may be used as guidance in qualifying data.

Evaluation	Action
If the LCS %R is > the upper acceptance limit,	qualify all associated detects as "J+."
If the LCS %R is < the lower acceptance limit,	qualify all associated detects as "J-" and all associated non-detects as "UJ" if the %R is ≥ 10% and as "R" if %R is < 10%.
For HE analysis, if %Rs for more than half of the compounds in the LCS analysis are below the acceptance range,	qualify all detects as "J-" and all non-detects as "UJ" if the %Rs are marginally low and as "R" if %Rs are significantly below acceptance limits.
For HE analysis, if %Rs for more than half of the compounds in the LCS analysis are above the acceptance range,	qualify all detects as "J+."
For HE analysis, if %Rs for more than half of the compounds in the LCS analysis are outside the acceptance range, both above and below, or if an LCS/LCSD pair was analyzed and the recoveries of any target analyte are both above and below acceptance criteria,	qualify all detects as "J" and non-detects as "UJ."

4.4.10 Sample Carry-over

Sample carry-over may occur when a high-concentration sample is analyzed immediately prior to another field sample. Steps must be taken to avoid introduction of false positive results in the second sample analysis due to instrument contamination.

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Criteria: The absence of sample carry-over must be determined and verified. If examination of the run logs indicates that any samples in the analytical run of interest required dilution and there is no documentation of a rinse or blank analysis immediately following the original undiluted analysis then sample carry-over may be suspected.

Evaluation	Action
If any compound found in the sample requiring dilution exceeds the high calibration standard and was also found in the following sample at concentration <5X the PQL,	qualify the results for that compound in the second sample as "R."
If no data are available for the sample that required dilution and the laboratory has not documented that carry-over was evaluated, and any compound was also found in the following sample at concentration <5X the PQL,	qualify the results for that compound in the second sample as "N."

4.4.11 Dilutions

Criteria: The PQLs must be adjusted to reflect all sample dilutions, concentrations, splits, clean-up activities, and dry weight factors that are not accounted for by the method.

Samples must be diluted and reanalyzed when any analyte exceeds the calibration range.

Original sample runs should be included when any sample requires dilution due to one or more compounds exceeding the calibration range.

The original undiluted results document the actual MDLs for non-detects.

Evaluation	Action
If the PQLs have not been properly adjusted,	request an amended report from the laboratory.
If an initial dilutions was required because of expected high concentrations of non-target analytes or because one or more target analytes were expected to greatly exceed the instrument working range and the laboratory was not be able to analyze the undiluted sample.	note the dilution and evaluated MDLs in the data validation report.

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Evaluation (concluded)	Action (concluded)
If any target compound exceeds the calibration range and…	
the original undiluted sample result was reported,	qualify all detects from the undiluted analysis that exceed the calibration range as "J."
the sample is diluted and reanalyzed, and the diluted sample data were reported,	qualify all non-detects from the diluted analysis as "UJ."
the original undiluted sample data was not provided,	request this information from the laboratory.
If data from the original sample run are unavailable,	refer to Section 4.2.5 for assessment of initially diluted samples with low surrogate recovery.

Criteria: The laboratory shall strive to make dilutions in such a way that the final concentration is measured in the mid-range of the calibration curve, and that results are not reported from measurements below the lowest concentration standard.

Evaluation	Action
If the instrument response (reported result / dilution factor) from diluted sample is < that of the lowest concentration standard,	qualify all detects from the diluted analysis as "J."

4.4.12 Perchlorate Chlorine Ratios

Criteria: The natural isotopic abundances for the chlorine isotopes give a $^{35}Cl/^{37}Cl$ ratio of approximately 3.08. Laboratories must statistically derive isotope ratio acceptance criteria to be used as an additional confirmation of analyte identity.

When the laboratory does not specify acceptance criteria the mean of the ratio population shall not deviate by more than 10% from the 3.07 theoretical value, and the standard deviation shall not significantly exceed 0.2. Between the MDL and the PQL, the individual sample isotope ratio control limits shall be near the population mean ±20% (approximately 3σ). Above the PQL, the individual sample isotope ratio control limits shall be near the population mean ±15% (approximately 2σ).

When isotope ratio acceptance criteria are not met, the laboratory must provide supporting data and explanatory case narrative comments in the data package.

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Evaluation	Action
If the isotope ratios were not reported,	calculate the ratio if the raw data were supplied or request an amended report from the laboratory if the raw data were not supplied.
If the isotope ratios are outside acceptance limits,	qualify detects as "NJ" or "R" based on professional judgment.
If supporting data and explanation were not provided,	request an amended report from the laboratory.

4.4.13 Perchlorate Interference Check Standard

Criteria: The laboratory shall analyze an interference check standard (ICS) from a matrix containing 500 ppm each of chloride, sulfate, carbonate, and bicarbonate in every batch. The concentration of this standard will be at the PQL. To demonstrate that perchlorate is adequately isolated and recovered under the specific conditions used, this standard should recover within ±20% of the known value.

Evaluation	Action
If frequency criteria were not met,	note the deficiency in the data validation report.
If the recovery is not within ±20% of the known value,	note the deficiency in the data validation report.

4.4.14 Method-specific Analytical Requirements – Organic LC/MS/MS

The additional analytical requirements addressed below are organized by method. These requirements should be checked if the level of deliverable allows.

4.4.14.1 Method 1694: Pharmaceuticals and Personal Care Products (PPCP) in Water, Soil, Sediment, and Biosolids by HPLC/MS/MS

Validation is to be performed as data deliverables allow.

Note: MS/MSD and replicate analyses are not required for Method 1694.

Initial Calibration

Criteria: If isotope dilution calibration is used, the %RSD must be <20%. If IS calibration is used, the %RSD must be <35%. Absolute RTs for last-eluting compounds in each of the four calibration groups must be ≥ the reference RT listed in Tables 3, 5, 7, and 9 of Method 1694.

Evaluation	Action
If the %RSD is: >20% for any compound calibrated using isotope dilution method or >35% for any compound calibrated using IS calibration, but ≤ 40%, >40% but ≤60% for either a labeled or unlabeled calibration standard, >60% for either a labeled or unlabeled calibration standard,	 qualify all associated detects as "J" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ." qualify all associated detects as "J" and all associated non-detects as "UJ." qualify all associated detects as "J" and all associated non-detects as "R."
If the RT of the last eluting compound in any of the four analysis groups is < the reference RT,	qualify all associated detects as "J" and all associated non-detects as "UJ."

Calibration Verification

Criteria: A QC Check Sample (from a second source vendor, similar to an ICV) shall be analyzed at least quarterly. The CCV %D must be ±30% of the ICAL response factor for all labeled and unlabeled compounds. The LC peaks for all native and labeled compounds must be present with a signal to noise ratio of at least 10. The retention times of the native and labeled compounds must be within 15 seconds (0.25 minutes) of the respective RTs in the most recent calibration verification standard.

Evaluation	Action
If there is no evidence in the data package of a QC Check sample (ICV) analysis,	note in the data validation report without qualification.
If the %D between an ICAL RF and an ICV or CCV RF for any labeled or unlabeled compound is... >30% and positive (high bias), >30% and negative (low bias),	 qualify all associated detects as "J+." qualify all associated detects as "J-" and, if any other calibration criteria have been exceeded for that compound, qualify all associated non-detects as "UJ."

Evaluation (concluded)	**Action (concluded)**
>40% but ≤60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
>60% and negative,	qualify all associated detects as "J-" and all associated non-detects as "R."

Evaluation	**Action**
If the LC peaks for all native and labeled compounds do not have a signal to noise ratio of ≥10,	qualify detects as "J_" and non-detects as "UJ."
If the LC peaks for all native and labeled compounds do not have a signal to noise ratio of ≥3,	qualify detects as "J-" and non-detects as "R."

Evaluation	**Action**
If any native or labeled compound RT has shifted more than 15 seconds (0.25 minutes) from the RT of the most recent calibration verification standard,	qualify detects as "J_" and non-detects as "R".

Labeled Compound Recovery

Criteria: Labeled Compound recovery must meet criteria given in Table 12 of the method for LCS (OPR) samples, and field samples.

Evaluation	**Action**
If the labeled compound %R is < method acceptance criteria lower acceptance limit but >2.5%,	qualify all associated detects for that sample fraction as "J+" and all non-detects for that sample fraction as "UJ."
If the labeled compound %R for is <2.5%,	qualify all results for the associated result as "R."
If the %R for any sample fortification solution compound is > the upper limit of the method acceptance criteria	qualify all detects for that sample fraction as "J-" and all non-detects for that sample fraction as "UJ."

Surrogate Recovery

Follow criteria listed in Section 4.4.5.

IS Performance

An IS performance criterion is not given in Method 1694.

Target Analyte Identification

Criteria: The signal to noise ratio for each native compound identified above the MDL in a sample, MB, or LCS must be ≥2.5, and ≥10 in associated calibration standards, except for the lowest ICAL standard, which must have a signal to noise ratio of 3. The RT of the peak for all identified compounds must be ±15 seconds (0.25 minutes) of the most recent CCV.

Evaluation	Action
If signal to noise ratio and/or RT criteria are not met for any reported compound,	notify the program manager and request an amended report.

4.5 Validation Guidelines for Confirmation by LC/MS/MS

These guidelines are for qualification of the original data based on the confirmation data obtained by LC/MS/MS and apply to HE by SW-846 Method 8330B and perchlorate by EPA Method 314. It should be noted that no confirmation LC/MS/MS results are qualified. If the original sample result is a detect, and the corresponding LC/MS/MS result is a detect, the original result is considered to be confirmed, although confirmation qualifiers may be applied. As with all validation guidelines, professional judgment is the final criteria.

4.5.1 Required LC/MS/MS Data

The laboratory is expected to include all calibration and QC data normally supplied in a level 4 data package; however, only the following information is necessary to evaluate the confirmation.

1) Form I Sample Results
2) CRI Summary
3) CCV %D Summary
4) IS Recovery
5) MB results

4.5.2 LC/MS/MS QC are Acceptable

The laboratory is expected to meet all QC acceptance criteria when performing confirmation by LC/MS/MS. **Note:** Multiple QC failures should result in "NJ" or no qualification to original results.

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If all LC/MS/MS QC acceptance criteria are met:

Evaluation	Action
If the original result is ≥ the PQL and the LC/MS/MS result is non-detect,	qualify the original result as "R."
If the original result is < the PQL and the LC/MS/MS result is non-detect,	qualify the original result as "R."
If the original result and the LC/MS/MS result are > the PQL, and… the %D is >40%,	 qualify the original result as "J."
If the original result is ≥ the PQL and the LC/MS/MS result is < the PQL,	qualify the original result as "NJ+."
If the original result is < the PQL and the LC/MS/MS result is ≥ the PQL,	qualify the original result as "J-."

4.5.3 Method Blank

The MB performed on LC/MS/MS should be < the MDL.

Evaluation	Action
If the LC/MS/MS MB concentration is ≥ the MDL and…	
the original result is > the PQL, but <5X the MB concentration,	qualify the original result as "R."
the original result is < the PQL and <5X the MB concentration,	qualify the original result as "NJ+."

4.5.4 Continuing Calibration

If the original result is a detect and the LC/MS/MS result is a non-detect and the LC/MS/MS CCV is outside acceptance criteria:

Evaluation	Action
If the CCV %D is positive (high bias), >20% and…	

Evaluation (concluded)	Action (concluded)
the original result is ≥ the PQL,	qualify the original result as "R."
the original result is < the PQL,	qualify the original result as "R."
If the CCV %D is negative (low bias), >20% and…	
the original result is ≥ the PQL,	qualify the original result as "R."
the original result is < the PQL,	qualify the original result as "NJ."

4.5.5 PS/CRI

If the original result is a detect, the LC/MS/MS result is a non-detect, and the LC/MS/MS PS/CRI are outside acceptance criteria:

Evaluation	Action
If the spike %R is > the upper limit and…	
the original result is ≥ PQL,	qualify the original result as "R."
the original result is < PQL,	qualify the original result as "R."
If the spike %R is < the lower limit and…	
the original result is ≥ the PQL,	qualify the original result as "R."
the original result is < the PQL,	qualify the original result as "NJ."

4.5.6 IS Performance

In the case of confirmation analysis, IS performance is assessed only as it reflects instrument sensitivity, not calculated bias; and only applies if the IS is used for quantification.

If the original result is a detect; the LC/MS/MS result is a non-detect; and the IS is outside acceptance criteria:

Evaluation	Action
If the IS %R is > the upper limit and…	
the original result is ≥ the PQL,	qualify the original result as "R."

Evaluation (concluded)	Action (concluded)
the original result is < the PQL,	qualify the original result as "R."
If the IS %R is < the lower limit and…	
the original result is ≥ the PQL,	qualify the original result as "R."
the original result is < the PQL,	qualify the original result as "NJ."

4.6 Procedure for Inorganic Data Validation

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for target analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run, and CCV documents that the ICAL is still valid.

4.6.1 Initial Calibration

Criteria: Instruments used for all analyses except ion chromatography (IC) must be calibrated daily and each time the instrument is set up as noted below.

Inductively coupled plasma-atomic emission spectroscopy (ICP)-AES) radial-viewing analysis: A blank and at least one standard must be used in establishing the analytical curve. **ICP-AES axial-viewing analysis:** A blank and at least three standards must be used in establishing the analytical curve.

This requirement specifically addresses the trace analysis of arsenic, cadmium, lead, antimony, selenium, and thallium using axial-viewing ICP-AES instead of graphite furnace atomic absorption for samples with analyte concentrations below 500 parts per billion (ppb).

Inductively coupled plasma-mass spectrometry (ICP-MS) analysis: A blank and at least one standard must be used in establishing the analytical curve.

Mercury analysis by cold vapor atomic absorption: A blank and at least four standards must be used in establishing the analytical curve.

Cyanide analysis: A blank and at least three standards, one of which must be at the PQL, must be used in establishing the analytical curve.

IC analysis: A blank and at least three standards, one of which must be at the PQL, must be used in establishing the analytical curve. Daily calibration is not required if acceptable calibration verification is performed prior to the analytical run.

Flow Injection and Colorimetric analysis: A blank and at least three standards, one of which must be at the PQL, must be used in establishing the analytical curve.

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Evaluation	Action
If the minimum number of standards was not used for ICAL,	qualify all detects as "J" and all non-detects as "UJ."
If the instrument was not calibrated at the proper frequency,	qualify all sample results as "R."
If only one standard was used for trace axial view ICP-AES,	notify the laboratory and the program that the laboratory was not compliant with the contract SOW.

Criteria: The correlation coefficient (r) of the ICAL curve shall be ≥0.995, and the absolute value of the intercept shall be ≤3X the MDL.

Note: The sample results may be reported with non-detects at the MDL or at the PQL value. See below for appropriate evaluation.

The r assessment need only be performed on those curves established using at least three standards and a blank (four-point curve).

The intercept shall be assessed for all inorganic calibration curves, with the following exception: The laboratory may report two calibration lines for some inorganic analytes. In this case, qualifiers should be applied if the r criteria are not met for either reported calibration. The intercepts for these curves should not be evaluated.

Evaluation	Action
If any compound has a r:	
<0.995 but ≥0.90,	qualify all associated detects as "J" and all associated non-detects may be qualified as "UJ" if any other calibration criteria have been exceeded for that analyte.
<0.90 but ≥0.80,	qualify all associated detects as "J" and all associated non-detects as "UJ."
<0.80,	qualify all associated detects as "J" and all associated non-detects as "R."

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Evaluation (concluded)	Action (concluded)
When results are reported at the MDL: If the intercept for any target compound is negative with an absolute value...	
> the MDL but ≤3X the MDL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "UJ."
>3X the MDL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "R."
If any compound has an intercept that is positive and > the MDL,	qualify all associated detects <3X the intercept as "J+."
When results are reported at the PQL: If the intercept for any target compound is negative with an absolute value...	
> the MDL but ≤2X the PQL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "UJ."
>2X the PQL,	qualify all associated detects <3X the absolute value of the intercept as "J-" and all associated non-detects as "R."

4.6.2 CCV

Criteria: ICV and CCV: An ICV standard must be analyzed after instrument calibration and prior to sample analysis. A CCV standard must be analyzed once every 10 injections or every two hours, whichever is more frequent. The evaluation of CCV data applies to all CCVs that bracket samples of interest.

ICV and CCV analysis results must be within the recovery acceptance criteria of 90% to 110% of the true value for all analytes except mercury and cyanide.

ICV and CCV analysis results for mercury must fall within the recovery acceptance criteria of 80% to 120% of the true value.

ICV and CCV analysis results for cyanide must fall within the recovery acceptance criteria 85% to 115% of the true value.

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Evaluation	Action
If the ICV and CCV standards were not analyzed at the proper frequency, or if either a required ICV or CCV was not analyzed, or if all target compounds were not present in any ICV or CCV standard,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If all required ICVs and CCVs were not analyzed,	qualify all associated detects as "J" and all associated non-detects as "R."
If the ICV or CCV %R is…	
<90% but ≥75% (mercury: <80% but ≥65% and cyanide: <85% but ≥70%),	qualify all associated detects as "J-" and all associated non-detects as "UJ."
>110% but ≤125% (mercury: >120% but ≤135%, cyanide: >115% but ≤130%),	qualify all associated detects as "J+."
<75% (mercury: <65%, cyanide: <70%),	qualify all associated detects "J-" and all associated non-detects as "R."
>125% (mercury: >135%, cyanide: >130%),	qualify all associated detects as "R."

4.6.3 Blanks

Blank analysis results are assessed to determine the existence of contamination problems. The criteria for evaluation of blanks apply to any laboratory blank associated with the samples. See Section 4.1.2 for general chemistry QC exemptions.

Criteria: An ICB must be analyzed to verify the baseline immediately following calibration and prior to analytical sample analysis. A CCB must be analyzed after each CCV and at the end of every analytical sequence in order to bracket all sample runs. All CCBs that bracket samples of interest shall be reported and assessed.

A minimum of one MB (or preparation blank) should be analyzed for every 20 samples. The same reagents used for the sample digestion must be used to prepare the MB. In those cases for which reagents are automatically added to all samples by an autoanalyzer, the ICB is equivalent to a preparation blank. FBs and EBs are treated as preparation blanks.

If any QC problems exist with any blank, all data associated with the batch must be evaluated to determine whether there is an inherent variability in the data for the batch, or if the problem is an anomaly not affecting other data.

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If the absolute value of the ICB or CCB result is > the PQL, the analysis should have been terminated and the problem corrected by the laboratory. If any analyte concentration in the blank is > the PQL, the lowest reported concentration in the associated samples must be ≥10X the concentration in the blank. Samples having analyte concentrations <10X that of the blank but > the PQL shall be re-digested and/or reanalyzed.

No contaminants ≥ MDL should be present in the blanks.

When there is blank contamination and reanalysis is not possible, the data may need to be qualified. Use the blank (ICB, CCB, MB, FB, or EB) with the highest concentration associated with the samples of interest to qualify data. If a CCB is used to qualify data, it must bracket the sample of interest.

The effect of MB values versus ICB/CCB values on sample results is not straightforward and will vary depending on analytical method. Professional judgment is required to properly assess the effect of blank data on sample results. As a general guideline, in the case of conflicting positive and negative MB and ICB/CCB values, the MB values will take precedence over ICB/CCB values when applying qualifications to associated sample results.

Evaluation	**Action**
If blank frequency criteria were not met,	note the deficiency in the data validation report.
If any associated blank value is positive and is ≥ the MDL but ≤ the PQL,	qualify all associated detects ≥ the MDL but <5X blank value as "U" at 5X the blank value. All associated detects >5X blank may be qualified "J+" based on professional judgment.
If any ICB/CCB value is positive and > the PQL,	qualify all associated sample results < the PQL as "U" at the PQL and all associated detects > the PQL but <5X the blank value as "UJ" at 5X the blank value or as "R" based on professional judgment. All associated detects >5X blank value may be qualified "J+" or "R" based on professional judgment.
If any MB, FB, or EB value is positive and > the PQL,	qualify all associated detects <5X the blank value and all associated non-detects as "UJ" at 5X the blank value. All associated detects >5X the blank value may be qualified "J+" or "R" based on professional judgment.

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Evaluation (concluded)	Action (concluded)
If the absolute value of the negative blank is > the MDL but ≤ the PQL,	qualify all associated detects <5X the MDL as "NJ-" and all associated non-detects as "UJ."
If the absolute value of a negative ICB/CCB value is > the PQL, and the analysis was not terminated by the laboratory,	notify the laboratory and qualify all associated detects <10X the PQL as "NJ-" or "R" and all associated non-detects as "R."
If the absolute value of the negative MB, FB, or EB value is > the PQL, and the analysis was not terminated by the laboratory,	notify the laboratory and qualify all associated detects <5X the blank value as "UJ" or "R" based on professional judgment and all associated non-detects as "R." Sample results >5X the blank value may be qualified as "J-" or "R" based on professional judgment.

4.6.4 MS

The MS sample analysis is performed as a measure of the ability to recover analytes in a particular matrix.

Criteria: The MS data shall not be used to evaluate data unless the MS sample was from the same client and of similar matrix.

An MS sample shall be analyzed at a frequency of once per data package, once per 20 samples of similar matrix, or once per sample matrix, whichever is more frequent.

Samples identified as FBs and EBs cannot be used for MS analysis.

Spiking levels shall be approximately at the mid-point of the calibration range.

The MS recovery acceptance criteria are 75% to 125%, unless the sample concentration is >4X the spike concentration (see Section 4.1.20).

MS analysis shall be performed for all analytes other than sodium, potassium, magnesium, and calcium.

For methods, which require a digestion, PSs are occasionally performed. The recovery acceptance criteria on a PS are 85% to 115%. For methods which do not require digestion (i.e. IC, ion-specific electrode, and colorimetric techniques), MSs shall be analyzed. These spikes may be referred to as a post spikes or analytical spikes. These should be evaluated using the recovery acceptance criteria of a MS, 75% to 125%.

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Evaluation	Action
If the MS sample was from another client or of a dissimilar matrix, the frequency of the MS did not meet specified criteria, an MS was not analyzed, or an FB or EB was used for MS analysis,	qualify all detects as "J" and all non-detects as "UJ."
If an MS %R is…	
>125%,	qualify all associated detects as "J+."
<75% but ≥30%,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
<30%,	qualify all associated detects as "J-" and all associated non-detects as "R."
If an MS/MSD pair was analyzed and recoveries of any target analyte are both above and below acceptance criteria,	qualify all detects as "J" and all non-detects as "UJ."
If the PS %R is…	
>115%,	qualify all associated detects as "J+."
If the PS %R is < the acceptance criteria,	qualify all associated detects as "J-" and all associated non-detects as UJ" if the recovery is ≥10% and as "R" if the recovery is <10%.

4.6.5 Replicate

Replicate analyses are indicators of laboratory precision based on each sample matrix.

Criteria: One replicate must be analyzed for each matrix or each batch, with a minimum frequency of one per 20 samples.

Samples identified as FBs or EBs should not be used for replicate or MSD analysis.

An acceptance limit of 20% for the RPD shall be used for sample values ≥5X the PQL. For solid and waste samples, it may be appropriate to accept an RPD of up to 35% based on professional judgment.

A control limit of ± the PQL shall be used for sample values > the PQL but <5X

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the PQL, including the case when only one of the replicate sample values is > the PQL but <5X the PQL.

No precision criteria apply when both replicate sample values are < the PQL.

When a replicate was not performed but an MSD was analyzed, the MS/MSD RPDs are evaluated as specified in Section 4.3.5. If neither a replicate nor an MS/MSD were analyzed, the laboratory may run an LCSD to measure precision. LCS/LCSD RPDs are evaluated as specified in Section 4.3.5.

Evaluation	**Action**
If no replicate sample, MSD, or LCSD were analyzed for each matrix or for each data package, or if an FB or EB was used for the replicate analysis,	qualify all detects of the same matrix as "J" and all non-detects of the same matrix as "UJ."
If the original result and replicate result are both ≥5X the PQL and the RPD exceeds the appropriate control limit,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."
If the original and/or replicate result is > the PQL but <5X the PQL (including non-detects) and the difference between the original result and replicate result is > the PQL,	qualify all associated detects of the same matrix as "J" and all associated non-detects of the same matrix as "UJ."

4.6.6 LCS

Data for LCSs are generated to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation.

Criteria: LCSs shall be analyzed using the same sample preparation and analysis methods used for samples, with one LCS analyzed with each batch of up to 20 samples.

Multiple LCS analyses may not be used to meet acceptance criteria; that is, if multiple LCSs are analyzed for a batch and any failures occur, the failed LCS will be used to qualify the data. For all aqueous LCS results, the recovery acceptance criteria are 80% to 120%, except antimony and silver. The recovery acceptance criteria for silver and antimony are laboratory-specified. LCS failures for silver and antimony shall be discussed in the data validation report but shall not be subject to the reanalysis requirement.

For all solid LCS results, the recovery acceptance criteria are established by the agency that prepared the reference material or statistically-derived criteria developed by the laboratory. The laboratory should report these acceptance

criteria on the LCS reporting form. If solid LCS acceptance criteria are not provided, then 30% to 150% should be used to assess soil results. If this situation occurs, it should be noted in the data validation report. A solid LCS should be analyzed for mercury in solid analyses.

An aqueous LCS is not required for mercury or cyanide analyses. Since the ICV is always digested/distilled for these analyses, it is equivalent to an LCS.

Evaluation	**Action**
If an LCS was not analyzed,	qualify all detects as "J" and all non-detects as "UJ."
Aqueous LCS If the LCS %R is…	
>120%,	qualify all associated detects as "J+."
<80% but ≥50%,	qualify all associated detects as "J-" and all associated non-detects "UJ."
<50%,	qualify all associated detects as "J-" and all associated non-detects as "R."
Solid LCS If the LCS %R is…	
> the upper control limit,	qualify all associated detects as "J+."
≥30% but < the lower control limit,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
<30%,	qualify all associated detects as "J-" and all associated non-detects as "R."
If an LCS/LCSD pair was analyzed and recoveries for any target analyte are both above and below acceptance criteria,	qualify all detects as "J" and all non-detects as "UJ."
If an aqueous LCS was analyzed for soil matrices,	qualify all detects as "J" and all non-detects as "UJ."

4.6.7 RLV

Criteria: RLV standards (i.e., RLV for atomic absorption [AA] methods [CRA], RLV for cyanide methods [CRDL], and CRI) are analyzed at the beginning of each analytical run as a measure of accuracy near the RL. CRA and CRDL standards

are prepared with concentrations at the PQLs, and CRI standards are prepared with concentrations at twice the PQLs.

The advisory recovery acceptance criterion for these analyses is 70% - 130%.

Evaluation	Action
If the RLV recovery is…	
>130%,	qualify all associated detects <5X the PQL as "J+."
<70% but ≥30%,	qualify all associated detects <5X the PQL as "J-" and all associated non-detects as "UJ."
<30%,	qualify all associated detects <5X the PQL as "J-" and all associated non-detects as "R."

4.6.8 Method-specific analytical requirements (inorganic)

4.6.8.1 ICP-AES and ICP-MS Methods

ICS

The ICP-AES and ICP-MS ICSs (interference check sample solution A (ICS A) and interference check sample solution AB (ICS AB)) verify the instrument's interelement and background correction factors.

Criteria: An ICS A must be analyzed at the beginning of each sample analysis run.

Absolute values for all ICS A target analytes, except those in the ICS A solution, must be ≤ the MDL.

Evaluation	Action
If the ICS A sample was not analyzed at the required frequency,	note the deficiency in the data validation report.
If the sample concentrations of aluminum, calcium, iron, and/or magnesium are < their respective concentrations in the ICS A solution,	accept the sample results without qualification.

Evaluation (concluded)	**Action (concluded)**
If the sample concentrations of aluminum, calcium, iron, and/or magnesium are comparable to or > their respective concentrations in the ICS A solution, and the ICS A result for a non-spiked analyte is...	
positive and ≥ the MDL,	qualify all associated sample detects < 50X the ICS A result as "J+."
negative and the absolute value of the result is > the MDL but ≤2X the MDL,	qualify all associated detects <50X the absolute value of the ICS A result as "J-" and all associated non-detects as "UJ."
negative and the absolute value of the result is >2X the MDL,	qualify all associated detects <50X the absolute value of the ICS A result as "J-" and all associated non-detects as "R."

Criteria: An ICS AB must be analyzed at the beginning of each sample analytical run.

ICS AB results for the target analytes in the ICS AB solution must be within 80% to 120% of the true value.

If the recovery criteria are not met, the analyst may either terminate the analysis or continue and re-analyze the failed constituents at a later time.

Evaluation	**Action**
If the ICS AB was not analyzed at the required frequency,	note the deficiency in the data validation report.
If the concentrations of aluminum, calcium, iron, and magnesium in the sample are < their respective concentrations in the ICS AB solution,	accept the sample results without qualification.
If the sample concentrations of aluminum, calcium, iron, and magnesium are comparable to or > their respective concentrations in the ICS AB solution and the ICS AB recovery for an analyte is...	
>120%,	qualify all associated detects as "J+."

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Evaluation (concluded)	Action (concluded)
<80% but ≥50%,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
<50%,	qualify all associated detects as "J-" and all associated non-detects as "R."

ICP Serial Dilution (SD)

The ICP SD monitors physical or chemical interferences that may exist in each sample matrix.

Criteria: A SD must be analyzed for each matrix in an analytical run. If the undiluted results for the sample used for SD are ≥50X the MDL, then the %D between a 5X dilution result and the original result must agree within 10%.

Samples with elevated concentrations that require dilutions >50X or that require multiple dilutions must also meet these requirements. However, care should be used in evaluating the result from the undiluted sample since it may be above the linear range of the instrument and would not apply.

No acceptance criterion applies when the undiluted sample result is <50X the MDL.

Evaluation	Action
If frequency requirements are not met,	qualify all detects ≥50X the MDL as "J."
If the result for any analyte in the sample used for SD analysis is ≥50X the MDL and the %D is >10%,	qualify detects for all samples of the same matrix in the batch as "J" and non-detects all samples of the same matrix in the batch as "UJ."

Instrument Tuning for ICP-MS

Tuning and performance criteria are established to ensure mass resolution and identification. These criteria are not sample specific. Conformance is determined using standards. Therefore, these criteria should be met in all circumstances.

Criteria: The ICP-MS tune shall be evaluated daily. The tuning solution must contain elements representing all of the regions of interest. The mass calibration must be within 0.1 atomic mass units (amu) of the true value. The resolution must be verified to be <0.9 amu full width at 10% peak height.

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Evaluation	Action
If tunes were not run daily or if all mass calibration and resolution criteria were not met,	use professional judgment to determine which data should be used. It is suggested that all associated detects should be qualified as "J" and all associated non-detects should be qualified as "UJ."
If multiple QC failures also occurred,	qualify all results as "R."

IS Performance for ICP-MS

IS criteria ensure that ICP-MS sensitivity and response are stable and acceptable during each analysis. They also allow for monitoring of indigenous quantities of the ISs.

Criteria: The intensity of the IS in the samples must fall within 60% to 125% of the intensity of the IS in the ICAL standard. The intensity of the IS in the bracketing CCVs and CCBs must fall within 80% to 120% of the intensity of the IS in the ICAL standard.

Evaluation	Action
If no IS was used,	qualify all results as "R."
If the IS intensity for a sample is…	
≥30% but <60% of the intensity of the IS in the calibration standard,	qualify all associated detects as "J+" and all associated non-detects as "UJ."
>125% but ≤160% of the intensity of the IS in the calibration standard,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
<30% or >160 % of the intensity of the IS in the calibration standard,	qualify all associated results as "R."
If both the CCV and CCB have IS intensities outside of the recovery limits,	all associated sample results may be qualified as "J/UJ" due to instrument drift based on professional judgment.

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4.6.8.2 Total Organic Carbon (TOC) by SW-846 Method 9060

Criteria: Quadruplicate analyses are required. The average is to be reported.

Evaluation	Action
If quadruplicate analyses were not run,	qualify all detects as "J" and all non-detects as "R."

4.6.8.3 Total Cyanide and Cyanide Amenable to Chlorination

After evaluation of total cyanide data (and application of appropriate qualifiers) using Sections 4.6.1 through 4.6.7, proceed to the following guidance for further evaluation of analytical data for total and amenable cyanide,

Criteria: Sample preparation includes distillation of the samples. In addition to the field samples, the QC samples and one standard and the ICV must be distilled. The LCS meets the requirement for distillation of one standard if the concentrations of the LCS and ICV are different.

Evaluation	Action
If the samples, appropriate QC samples, and appropriate standards were not distilled,	qualify all results as "R."
If the field samples were distilled but the QC samples and/or standards were not distilled,	qualify all associated detects as "J" and all associated non-detects as "UJ."

The remainder of this section is provided as guidance for the assessment of data for cyanide amenable to chlorination. Total cyanide data are to be reviewed according to the guidance in Sections 4.6.1 through 4.6.6.

Cyanide amenable to chlorination (decomposed by chlorination) is derived by measuring the total cyanide and the cyanide remaining after chlorination. The amenable cyanide is calculated as the difference between the total and chlorinated. Biases in the cyanide after chlorination will result in a bias in the opposite direction for the calculated amenable result.

The actual analysis of the sample is the same for the total and the chlorinated analysis; only the sample preparation is different. The laboratory will generally run the total and the chlorinated samples together in the same batch and will use the same calibration and calibration checks for both the total and chlorinated cyanide samples. The laboratory should identify which sample is the total sample and which sample is the chlorinated sample.

LCS and MS solutions are generally of the form that will not decompose with chlorination giving a %R of zero for chlorinated cyanide. When the chlorinated cyanide recovery is 0%, the reported amenable cyanide recovery is equal to the total cyanide recovery. Alternatively, the LCS and MS

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solutions may not decompose with chlorination and will give a recovery of 0% for amenable cyanide. The laboratory should discuss in the case narrative the form of solution that was used for LCS and MS analyses. The chlorinated cyanide LCS and MS recoveries may not be reported. In this case, the chlorinated cyanide LCS and MS recoveries can be determined from the raw data. The amenable cyanide LCS and MS data should be evaluated using the criteria given for total cyanide.

When total and amenable cyanide are analyzed together in the same run, all initial and continuing calibration qualification applied to the total cyanide results should also be applied to the amenable cyanide results. When total and chlorinated cyanide are not analyzed in the same run, qualifications applied to the total and chlorinated cyanide results should also be applied to the amenable cyanide results. Signed qualification for chlorinated cyanide results should be reversed for amenable cyanide results; that is, a "J+" for chlorinated cyanide results would be a "J-" for the associated amenable cyanide.

Major differences in total and chlorinated results are generally attributed to incomplete destruction of cyanide complexes such as thiocyanide. Non-detects for total cyanide with significant cyanide results for chlorinated cyanide (negative amenable cyanide) may indicate a significant presence of thiocyanide or other cyanide complexes in the sample.

Criteria: A CCV standard must be analyzed once every 10 injections or every two hours, whichever is more frequent. The evaluation of CCV data applies to all CCVs that bracket samples of interest.

The recovery acceptance criteria for CCV analysis results must be within 85% to 115%.

Evaluation	**Action**
If a chlorinated cyanide CCV %R is…	
<85% but ≥70%,	qualify all associated detects for amenable cyanide as "J+."
>115% but ≤130% and the amenable cyanide result is < the total cyanide result,	qualify all associated detects for amenable cyanide as "J-" and all associated non-detects for amenable cyanide as "UJ."
<70%,	qualify all associated detects for amenable cyanide as "R."
>130% and the amenable cyanide result is < the total cyanide result,	qualify both detects and non-detects for amenable cyanide as "R."

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Criteria: A minimum of one MB should be analyzed for every 20 samples. The same reagents used for the sample must be used to prepare the MB. A CCB must be analyzed after each CCV and at the end of every analytical sequence. All CCBs that bracket samples of interest shall be reported and assessed.

If cyanide is detected in an MB or CCB, the chlorinated sample results must be assessed to determine the impact on amenable cyanide results.

No contaminants ≥ the MDL should be present in the blanks.

Evaluation	Action
If a chlorinated cyanide MB or CCB value is positive and ≥ the MDL and the chlorinated sample result is a detect <5X the MB/CCB value,	qualify all associated detects for amenable cyanide as "J-"and, if the total cyanide result is > the MDL, qualify all associated non-detects for amenable cyanide as "UJ."
If the absolute value of the negative chlorinated cyanide MB or CCB value is > the MDL and the chlorinated sample result is < 5X the MDL or non-detect,	qualify all associated detects for amenable cyanide <5X the MDL as "J+."

Criteria: The absolute value of a negative amenable cyanide result must be <3X the MDL.

Note: Laboratories will generally report the amenable cyanide as non-detect when the chlorinated result is > the total cyanide result. The raw data may need to be reviewed to determine the actual negative amenable cyanide result.

Evaluation	Action
If the absolute value of a negative amenable cyanide result is >3X the MDL and the total cyanide is a non-detect,	note in the data validation report but do not qualify any results.
If the absolute value of a negative amenable cyanide result is >3X the MDL and the total cyanide is a detect,	qualify the amenable cyanide result as "UJ" if the absolute value of the amenable cyanide result is >3X but ≤10X the MDL and as "R" if the absolute value of the amenable cyanide result is >10X the MDL.

4.6.8.4 Total/Partial Inorganic Analyte Results

Several inorganic analytes are analyzed and reported as total and partial results, (i.e. total chromium/hexavalent chromium, total kjeldahl nitrogen (TKN)/ ammonia, hardness/calcium and magnesium, total alkalinity/carbonate and bicarbonate, total cyanide/amenable cyanide, and total

phosphorus/phosphate. In these cases, it is expected that the partial value will be ≤ the total value. These reported values may or may not be obtained from the same analytical method. When the reported result for the partial analyte is > the result for the total analyte, one or both results are suspect. The extent the quality of the data is affected must be determined. The following criteria should be used for guidance.

Note: Comparisons are made at the elemental level, that is, total nitrogen should be > the nitrogen in ammonia not > the ammonia.

Criteria: When both a partial and a total result are reported, the result for the partial analyte must be ≤ the result for the total analyte.

If the partial result is > the total result, the laboratory should be contacted for further information. If the laboratory cannot be contacted or cannot provide sufficient explanation, the following criteria apply.

If the partial result is > the total result and both results are ≥5X the PQL, then the RPD between the two values should be ≤20%.

If the partial result is > the total result and one or both results are <5X the PQL, then the difference between the two values should be ≤ the partial analyte's PQL.

Evaluation	**Action**
If the partial result is > the total result, and…	
both the total and partial results are ≥5X the PQL and the RPD is >20%,	may qualify one or both results as "R" or "J" based on professional judgment.
one or both results are <5X the PQL and the difference between the two results is > the partial analyte's PQL,	may qualify one or both results as "R" or may qualify all associated detects as "J" (with or without bias) or may qualify all associated non-detects as "UJ" based on professional judgment.

Partial Analyte Conversions

To Convert	To	Multiply By
O-phosphate	Phosphorus	0.326
Ammonia	Nitrogen	0.824
Ca Mg	Hardness Hardness (total hardness is the sum of the calculated Ca and Mg hardness results)	2.497 (2.5, if titrated) 4.118 (4.12, if titrated)

Alkalinity Relationships

The results obtained from the phenolphthalein and total alkalinity determinations offer a mean for stoichiometric classification of the three principal forms of alkalinity present in many waters.

- Carbonate alkalinity is present when the phenolphthalein alkalinity is not zero and is not < the total alkalinity.
- Hydroxide alkalinity is present if the phenolphthalein alkalinity is > half the total alkalinity.
- Bicarbonate alkalinity is present if the phenolphthalein alkalinity is < half the total alkalinity.

Result of Titration	Hydroxide Alkalinity as $CaCO_3$	Carbonate Alkalinity as $CaCO_3$	Bicarbonate Alkalinity as $CaCO_3$
P=0	0	0	T
P< ½ T	0	2P	T-2P
P= ½ T	0	2P	0
P> ½ T	2P-T	2(T-P)	0
P=T	T	0	0

P- phenolphthalein alkalinity; T- total alkalinity

Phenolphthalein alkalinity is the term traditionally used for the quantity measured by titration to pH 8.3. It is not routinely reported by the laboratories but could be calculated using the amount of titrant used to reach pH 8.3. There is usually a column on the alkalinity worksheet that contains this information. Since total alkalinity is reported, it should be verified that the carbonate, bicarbonate, and hydroxide values do not exceed the total.

No conversion is required to compare hexavalent chromium to total chromium.

The calculation for amenable cyanide is detailed in Section 4.6.8.3.

4.6.8.5 Data Validation for Analyses by NIOSH Method 7300

This procedure is for the analysis of elements capable of detection by ICP-AES analysis, including Be, in air samples. The samples are collected onto filters at a flow rate of 1 to 4 L/min. The working range of this method is 0.005 to 2.0 milligrams (mg) per cubic meter (2.5-1000 ug/sample) for each element in a 500-L air sample.

The laboratory must follow the requirements specified in NIOSH 7300 as well as any requirements specified in the AHIA Accreditation Requirements. Compliance requirements for satisfactory data reporting include:

- Case narrative
- Initial calibration data
- Continuing calibration data

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- Media blanks, FBs, and preparation blank data
- LCS/LCSDs
- Sample results
- Instrument run logs

Initial Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analysis run, and CCV documents that the ICAL is still valid.

Criteria: Calibrate the spectrometer according to the manufacturer's recommendations. Typically, an acid blank and a 10 ug/mL multi-element***** working standard is used.

*****refer to method for chemically compatible combinations of elements

Evaluation	**Action**
If the minimum number of standards as defined in the criteria section was not used for ICAL,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If the instrument was not calibrated as required,	qualify all associated detects and all associated non-detects as "R."

Calibration Verification

Criteria: A CCV standard must be analyzed for every 10 samples. The recovery acceptance criteria for analysis results must be within the 90% to 110% of the true value for all analytes.

Evaluation	**Action**
If the CCV frequency criteria were not met	qualify all associated detects as "J" and all associated non-detects as "R."
If the ICV or CCV %R is…	
$\geq$75% but <90%,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
$\geq$110% but <125%,	qualify all associated detects as "J+."

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Evaluation (concluded)	Action (concluded)
If the ICV or CCV %R is…	
<75%,	qualify all associated detects as "J-" and all associated non-detects as "R."
>125%,	qualify all associated detects as "R."

Blanks

Blank analysis results are assessed to determine the existence of contamination. During sampling, two to ten FBs are collected per sample set. During sample preparation a reagent blank (MB) and media blanks are included with the samples during the digestion process. The average media blank result (ug/mL) is subtracted from the sample result (ug/mL) in the final calculation. In instances where more than one blank (FB or MB) associated with a given sample is $\geq$ the MDL, qualification is to be performed using the associated blank with the highest concentration of contaminant.

Criteria: The same reagents used for the sample digestion must be used to prepare the MB. No contaminants > the MDL may be present in the blanks.

Evaluation	Action
If the frequency criteria were not met,	note the deficiency in the data validation report.
If problems with any blank exist,	all data associated with the batch must be evaluated to determine whether there is an inherent variability in the data for the batch or if the problem is an anomaly not affecting other data.
If any analyte concentration in the blank is in excess of the PQL,	the lowest reported concentration in the associated samples must be > 10X the concentration in the blank or results must be qualified or rejected.
If a blank value is $\geq$ the MDL,	qualify all associated detects <5X the blank concentration as "J."

LCS/LCSD

The LCS/LCSD serves as a measure of the overall performance of all steps in the analysis, including sample preparation.

Criteria: The LCS/LCSD must be analyzed using the same preparation and analysis methods used for samples, with one LCS/LCSD analyzed for each batch of up to 10 samples.

All LCS/LCSD results for air filters must fall within the recovery and RPD control limits established by the agency that prepared the reference material or by statistically-derived limits developed by the laboratory. The laboratory is to include these limits on the LCS/LCSD reporting form.

Professional judgment may be used to determine the need for qualification of sample results based on whether or not the LCS, LCSD, or both meet QC acceptance criteria.

Evaluation	Action
If the LCS/LCSD was not analyzed,	qualify all associated detects as "J" and all associated non-detects as "UJ."
If the %R is…	
> upper control limit,	qualify all associated detects as "J+."
>30% and < the lower control limit,	qualify all associated detects as "J-" and all associated non-detects as "UJ."
<30%,	qualify all associated detects as "J-" and all associated non-detects as "R."
If RPD criteria were not met,	qualify detects for associated compounds as "J" and non-detects as "UJ.

Dilutions

The PQLs must be adjusted to reflect all sample dilutions. Original undiluted results document the actual MDLs for non-detected compounds.

Criteria: It must be determined that the laboratory strove to make dilutions in such a way that the final concentration was measured in the mid-range of the calibration curve, and that the laboratory did not report results from measurements above the highest concentration standard.

Evaluation	Action
If any samples required dilution because one or more analytes exceeded the calibration range, and…	

Evaluation (concluded)	Action (concluded)
the original undiluted results were reported, only the diluted results were reported,	qualify all associated detects > the high standard as "J." qualify all associated non-detects as "UJ."

4.6.8.6 Method 300.0/9056A, Determination of Inorganic Anions by Ion Chromatography

Criteria: RTs for ICV and CCV analyses must be within 30 seconds (0.5 minutes) of those in the ICAL midpoint.

Evaluation	Action
If any target analyte RT in the CCV varies by more than ±30 seconds from that of the associated ICAL standards,	qualify all associated detects as "J" and all associated non-detects as "UJ."

4.7 Procedure for Radiochemical Analyses Validation

4.7.1 Quantification

Criteria: Radiochemical analytical results shall be reported as measured and shall include the TPU at the 95% confidence level (2-σ).

Note: Some programs may request the result be reported with the 1-σ uncertainty. When this is the case the reported uncertainty must be multiplied by two for evaluation of quantitation and replicate error ratio (RER).

The laboratory shall report all results regardless of concentration or sign and shall not report any result as "less than."

The laboratory shall include a sample minimum detectable activity (MDA) calculated using sample-specific parameters.

For programs that require application of one final qualifier to sample results, if the "BD" qualifier is applied to a sample result, the result shall not be further qualified as "J" due to other QC failures.

Note: Some programs may request the "U" qualifier instead of the "BD" qualifier.

Extremely large errors/uncertainties may indicate inappropriate error calculation. If large errors/uncertainties are reported with the results, the laboratory should verify the calculations.

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Evaluation	Action
If the sample result is < the 2-σ TPU,	qualify the result as "BD."
If the sample result is < the MDA,	qualify the result as "BD."
If the sample result is ≥ the MDA but <3X the MDA,	qualify the result as "J."
If the absolute value of a negative result (excluding gamma spectroscopy, addressed below) is > the MDA,	qualify the result as "R."
Gamma Spectroscopy: If the absolute value of a negative sample result is >2X the MDA,	qualify the result as "R."

If the "BD" qualifier is applied to a sample result, the result shall not be further qualified as "J" due to other QC failures.

4.7.2 Blanks

Blank analysis results are assessed to identify contamination. The criteria for evaluation of blanks apply to all blanks associated with the samples.

Criteria: One MB (or preparation blank) must be analyzed for each matrix and each batch, or for every 20 samples, whichever is most frequent.

MB analysis is required for all analyses requiring sample preparation.

Samples associated with any preparation blank result that is ≥ the MDA shall be redigested and reanalyzed. Exceptions to this requirement are samples for which the measured sample concentration is ≥10X the preparation blank value.

Evaluation	Action
If the prep blank was not analyzed at the proper frequency and there are sample concentrations ≥ the MDA but <5X the MDA,	qualify those results as "J."
If the blank result is positive and is statistically >0.0 (i.e., > the 2-σ TPU and ≥ the MDA),	qualify all associated sample results ≥ the MDA but <5X the blank value as "NJ+."

Evaluation (concluded)	Action (concluded)
If the absolute value of a negative blank result is > the MDA,	qualify all associated detects ≥ the MDA but <5X the MDA as "NJ-." The program may require results < the MDA to be qualified "UJ."
If the absolute value of a negative blank result is >5X the MDA,	notify the laboratory and qualify all associated sample results as "R."
If the absolute value of the negative blank result is > 5X the MDA for liquid scintillation analyses such as tritium, where the calibration blank is subtracted from the result,	notify the laboratory and qualify all sample results <5X the MDA as "R."

4.7.3 Sample-Specific Chemical/Tracer Recovery

An addition of a known quantity of radioactive or chemically similar material to a sample prior to chemical separation is used to determine the amount of the analyte recovered.

Criteria: Recovery guidelines for tracer and carrier results shall be 50% to 105%. Optionally, low tracer recoveries may be evaluated from the total area counts. Samples with low recoveries but with tracer area counts >400 counts may or may not be qualified based on professional judgment.

The quantity of tracer material used should be adequate to provide a maximum of 10% uncertainty at the 95% confidence level in the measured recovery.

Evaluation	Action
If a recovery for a chemical carrier or tracer isotope is... >105% but ≤125%,	qualify all associated results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."
If a recovery for a chemical carrier or tracer isotope is... >125%,	qualify all associated results as "R."

Evaluation (concluded)	**Action (concluded)**
If a recovery for a chemical carrier is...	
<50% but ≥20%,	qualify all associated results ≥ the MDA as "J+."
<20%,	qualify all associated results ≥ the MDA as "J+" and all associated results < the MDA as "R."
If a recovery for a tracer isotope is...	
≥10% but <50%,	qualify all associated results ≥ the MDA as "J+."
<10%,	qualify all associated results ≥ the MDA as "J+" and all associated results < the MDA as "R."

4.7.4 MS

MS analyses are performed on field samples, except as noted below, as a measure of the ability to recover the analyte from a particular matrix.

Criteria: The MS data shall not be used to evaluate sample data unless the MS sample was from the same client and of similar matrix.

The recovery acceptance criteria for MS results must be within 75% to 125% unless the sample result is >4X the spike added (see Section 4.1.20).

One MS sample shall be analyzed from each batch, with a minimum frequency of one per 20 samples.

Samples identified as FBs or EBs shall not be used to satisfy the spike analysis requirement.

If an MS result fails to meet recovery criteria, all associated samples shall be redigested and reanalyzed. Unfiltered water samples and unprepared solid samples are exempt from the reanalysis requirement. Results for unfiltered water samples and unprepared solid samples for which the MS failed the acceptance criteria may be reported and qualified without reanalysis.

MSs are not required for gamma spectroscopy, radon-222, or any analyses utilizing standard addition spike or a tracer or carrier that is chemically identical to the analyte. In addition, radium-226 analyses that employ a barium-133 tracer

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are exempt from the MS requirements. For radium-228 analysis, an MS is required if the final actinium separation, which is not traced by barium-133, does not incorporate a carrier recovery.

Evaluation	Action
If the MS sample was from another client or of a dissimilar matrix, the frequency criteria of the MS was not met, no MS was analyzed, or an FB or EB was used for the MS,	qualify all results ≥ the MDA as "J." The program may require results < the MDA to be qualified "UJ."
If an MS %R is…	
<25%,	qualify all associated results ≥ the MDA as "J-" and all associated results < the MDA as "R."
<75% but ≥25%,	qualify all associated results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."
>125% but ≤150%,	qualify all associated results ≥ the MDA as "J+."
>150%,	qualify all associated results as "R."

4.7.5 Replicate

Replicate analyses indicate laboratory precision based on each sample matrix.

If an MS/MSD was analyzed in place of a replicate, the following criteria are applied to the MS/MSD results. If insufficient sample was submitted to analyze a replicate or MS/MSD, the laboratory may analyze an LCS/LCSD to measure precision using the following criteria for evaluation.

Criteria: One replicate sample shall be analyzed from each batch with a minimum frequency of one per 20 samples. The replicate data shall not be used to evaluate associated sample data unless the replicate sample was from the same client and of similar matrix.

The RER calculated using the 2-σ TPU is used to determine replicate precision for radiochemical results.

The radiochemical replicate determinations shall agree when the 95% confidence level uncertainties are considered. That is, the RER shall be <1.0.

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Samples identified as FBs or EBs shall not be used to satisfy the replicate analysis requirement.

No precision criteria applies to samples with activities < the MDA, including those where one result is > the MDA and one result is < the MDA.

Replicate analyses may not be possible in tritium analyses when the moisture content is too low or the sample size is too small. A discussion of this problem shall be included in the laboratory case narrative, with no qualifiers applied.

Evaluation	**Action**
If no replicate sample, no MSD, and no LCSD was analyzed for each matrix or for each data package,	qualify all results ≥ the MDA of the same matrix as "J." The program may require results < the MDA to be qualified "UJ."
If frequency criteria are not met, or if an FB or EB was used for the replicate,	qualify all results ≥ the MDA as "J." The program may require results < the MDA to be qualified "UJ." **Note**: Some programs may not require replicate evaluation on non-client samples. For these programs, note this in the data validation report, with no qualifications applied.
If the RER is >1.0 and ≤3.0,	qualify all associated results ≥ the MDA as "J." The program may require results < the MDA to be qualified "UJ."
If the RER is >3.0,	qualify all associated results for that analyte as "R." **Note:** Tritium in soils are not qualified "R" when the RER is >3.0.

4.7.6 LCS

The LCS serves as a measure of the overall performance of all steps in the analysis, including sample preparation.

Criteria: One LCS shall be analyzed for each batch up to 20 samples.

For aqueous LCS analytical results, the recovery acceptance criteria shall be within 80% to 120% of the true value. For solid LCS results, the recovery acceptance criteria shall be within the control limits specified by the agency

that prepared the reference material or statistically-derived limits developed by the laboratory. The laboratory shall report the control limits in the QC portion of the deliverable. Multiple LCS analyses may not be used to meet acceptance criteria; that is, if multiple LCSs are analyzed for a batch and any failures occur, the failed LCS will be used to qualify the data.

Evaluation	**Action**
If LCS frequency criteria are not met,	note the deficiency in the data validation report.
If the LCS %R for any analyte is…	
<30% or >150%,	qualify all associated sample results as "R."
< the lower control limit but ≥30%,	qualify all associated sample results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."
> the upper control limit but ≤150%,	qualify all associated sample results ≥ the MDA as "J+."
If an LCS/LCSD pair was analyzed and recoveries of any target analyte were both above and below acceptance criteria,	qualify all results ≥ the MDA as "J."
If an aqueous LCS was used for solid matrices,	qualify all associated results≥ the MDA as "J." The program may require results < the MDA to be qualified "UJ."

4.7.7 Instrument Control Charts

In general, there are four types of control charts used to monitor radiochemistry instrumentation performance: efficiency, resolution, centroid, and background.

Efficiency Control Charts: Used for all instrumentation. A radioactive control source (that does not have to match the counting geometry of the samples) is counted and decay-corrected counts, count rate, activity or efficiency of the source is plotted. Displayed on the same plot are the average, ±2-σ control limits, and ±3-σ control limits, or just simply upper and lower control limits. Since the frequency of instrument calibration typically ranges from monthly to annually, a control

source is counted to show that the instrument response is stable and that the efficiency calibration is valid for the sample count.

Resolution Control Charts: Used for instrumentation that utilize multi-channel analyzers to create spectra (with the exception of liquid scintillation counters). The full-width half-maximum (FWHM) of one or multiple peaks of the control source are plotted. Displayed on the same plot are the upper and lower FWHM control limits. This plot shows that there is no increase in instrument noise to negatively impact spectral resolution for the sample count.

Centroid Control Charts: Used for instrumentation that use multi-channel analyzers to create spectra (with the exception of liquid scintillation counters). The centroid of one or multiple peaks of the control source is plotted. Displayed on the same plot are the upper and lower centroid control limits. This plot shows that the instrument gain is stable and that drift that could lead to poor peak integration or misidentification of peaks has not occurred.

Background Control Charts: Used for most instrumentation, though has limited value for data validation. An instrument background is performed and the counts or count rate is plotted. Displayed on the same plot are the average, ±2-σ limit, and ±3-σ control limits, or just simply upper and lower control limits. This plot shows that the detector has not become contaminated with radioactivity or that the instrument noise has not increased to the point to cause unwanted counts.

For evaluation, a data point outside the control limit means outside the ±3-σ control limit when the laboratory provides σ-type control charts.

Instead of control charts, the laboratory may provide control summaries that provide control data of multiple detectors and/or types of charts. This is acceptable as long as all the information needed to evaluate instrument control is provided in the summary.

4.7.7.1 All Radiochemistry Instrumentation

Criteria: The instrument raw data will clearly contain the detector ID and count start date and time for all samples. The control charts will list the detector IDs and list the range of dates plotted. The date range must be current up to the count start date of the sample. For controls that are counted daily or before use, the charts must be updated to the actual date of sample count. For controls that are counted weekly/monthly, the charts must be updated to within a week/month of the sample count. See the specific instrumentation criteria below for control count frequency requirements.

In general, only the control chart data point appropriate for the sample count start date is evaluated. If the next control chart data point is plotted and shows an extreme outlier, the stability of the counter during the time of the sample count may need to be investigated.

The laboratory should have made an attempt to recount the sample (if possible) and verify the original count results. Professional judgment is needed in this situation, especially if the sample result looks suspect.

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Evaluation	Action
If the control chart is missing from the data package or not updated,	request an amended report from the laboratory.
If instrument control frequency was not met for the sample count,	note the deficiency in the data validation report.

4.7.7.2 Gas Proportional Instrumentation

Criteria: Alpha and beta control sources will be counted daily or before counter use and plotted using efficiency control charts. A background will be counted daily or before counter use and plotted using alpha and beta background control charts.

If the sample analyte is an alpha-emitter, only the alpha control charts are evaluated. If the sample analyte is a beta-emitter, only the beta control charts are evaluated.

Evaluation	Action
If the efficiency control point is…	
above the upper control limit,	qualify all associated results ≥ the MDA as "J+"
below the lower control limit,	qualify all associated results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."
If the background control point is…	
above the upper control limit,	qualify all associated results ≥ the MDA but <3X the MDA as "J+."
below the lower control limit,	qualify all associated results ≥ the MDA but <3X the MDA as "J-." The program may require results < the MDA to be qualified "UJ."

4.7.7.3 Liquid Scintillation Instrumentation

Criteria: Vendor supplied unquenched H-3, C-14, and blank control sources will be counted daily or before counter use and plotted using efficiency and background control charts.

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For low-energy beta analysis, (such as H-3, Ni-63 or Pu-241) only the H-3 efficiency and background control charts are evaluated. For mid- to high-energy beta analysis, (such as C-14, Cl-36, Sr-90 or Tc-99) only the C-14 efficiency and background control charts are evaluated.

Evaluation	Action
If the efficiency control point is…	
above the upper control limit,	qualify all associated results ≥ the MDA as "J+."
below the lower control limit,	qualify all associated results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."
If the background control point is…	
above the upper control limit,	qualify all associated results ≥ the MDA but < 3X the MDA as "J+."
below the lower control limit,	qualify all associated results ≥ the MDA but <3X the MDA as "J-." The program may require results < the MDA to be qualified "UJ."

4.7.7.4 Lucas Cell Instrumentation

Criteria: A control source will be counted daily or before counter use and plotted using efficiency control charts.

Evaluation	Action
If the efficiency control point is…	
above the upper control limit,	qualify all associated results ≥ the MDA as "J+."
below the lower control limit,	qualify all associated results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."

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4.7.7.5 Alpha Spectrometer Instrumentation

Criteria: If calibrated monthly, the calibration standard can also be used as the control source for generating efficiency control chart data. If a semi-annual or annual calibration is performed, a control source will be counted at least monthly and plotted using efficiency control charts. Only one peak is necessary to control chart. The laboratory should perform pulser control checks at least weekly (preferably daily or before use). The pulser checks will confirm that the instrument gain and resolution are stable. Backgrounds will be counted at least weekly and monitored by the laboratory for contamination. Pulser check results and background control charts do not have to be included or evaluated in the data package.

Evaluation	Action
If the efficiency control point is outside of the control limits and the tracer is measured simultaneously with the analyte,	note the deficiency in the data validation report. **Note:** Although the analyte results will not be biased, the reported tracer yield may be biased.
If an efficiency control point is above the upper control limit and a tracer is not measured simultaneously with the analyte (Ba-133, Np-239 or Th-234),	qualify all associated results ≥ the MDA as "J+."
If an efficiency control point is below the lower control limit and a tracer is not measured simultaneously with the analyte (barium-133, neptunium-239, or thorium-234),	qualify all associated results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."
If the detector background was not counted within one week of the sample count start date,	note the deficiency in the data validation report.

4.7.7.6 Gamma Spectroscopy Instrumentation

Criteria: A source will be counted daily or before counter use and plotted using efficiency control charts. At a minimum, two peaks need to be control charted for efficiency, resolution (FWHM), and centroid. These peaks are a low-energy peak (< 100 kilo electron volts [kev]) and a high-energy peak (> 1000 kev). Backgrounds will be counted at least weekly and monitored by the

laboratory for contamination; however, background control charts do not have to be included or evaluated in the data package.

If the low-energy efficiency control point is outside control limits and the high-energy control point is within limits, technically only the low-energy gamma emitting target analytes need qualification. Since the determination of what energy range requires qualification is not straightforward and requires professional judgment, it is acceptable to qualify all target analytes in this situation.

Evaluation	Action
If the efficiency control point is…	
above the upper control limit,	qualify all associated results≥ the MDA as "J+."
below the lower control limit,	qualify all associated results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."
If the resolution control point is outside (above or below) of the control limits,	notify the laboratory and qualify all associated sample results as "R."
If the centroid control point is outside (above or below) of the control limits,	note the deficiency in the data validation report.
If the detector background was not counted within one week of the sample count start date,	note the deficiency in the data validation report.

4.7.8 Method-Specific Analytical Requirements – Radiochemical

4.7.8.1 Gamma Spectroscopy

The laboratory may rejection of a specific gamma spectroscopy analyte result due to various analytical quality issues (e.g., interference, low abundance, no valid peak, or uncertain identification). This data shall be assessed based on professional judgment.

Criteria: The laboratory qualifiers shall be reviewed for "X"- qualified data.

Evaluation	Action
If the result is recommended for rejection by the laboratory,	may qualify the result as "R" based on professional judgment.

4.7.8.2 Gross Alpha Beta

The flaming of planchets in the gross alpha beta method may result in the loss of beta emitters. The omission of the flaming step may result in the interference of alpha particle transmission.

Criteria: The sample preparation documentation shall be examined to determine whether the planchets were flamed.

Evaluation	Action
If the planchets were flamed prior to counting for gross beta,	qualify all beta results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."
If the planchets were not flamed,	qualify all alpha results ≥ the MDA as "J-." The program may require results < the MDA to be qualified "UJ."

4.7.8.3 Total/Partial Radiochemical Results

Occasionally radiochemical analytes are analyzed and reported as total and partial results, for example, total radium by gross alpha and radium-226 by radon emanation. These reported values are necessarily not obtained from the same analytical method. The following criteria should be used for guidance.

Criteria: When both a partial and a total result are reported, the result for the partial analyte must be ≤ the result for the total analyte. If the reported result for the partial analyte is > the result for the total analyte, one or both results are suspect.

The extent the quality of the data is affected must be determined.

Evaluation	Action
If the partial result is > the total result,	the laboratory should be contacted for further information.
If the laboratory cannot be contacted or cannot provide sufficient explanation, the following criteria apply: If the total result is ≤ the MDA and the partial result is > MDA but < 2X MDA,	 no qualification (other than "BD" or "J" due to quantification) of either result is warranted as the results are statistically similar enough.

Evaluation (concluded)	Action (concluded)
If the total result is ≤ the MDA and the partial result is > 2X MDA,	qualify the total result as "J-."
If both results are > MDA and the total result is < the partial, and the RER between the two results is >1.0,	qualify the total result as "NJ-" due to a suspected false negative.

5.0 DATA VALIDATION REPORTS

A data validation report shall be produced to discuss the data review and validation; and to document, based on instrumentation and methodology, the QC elements examined. The SMO or Program Manager uses the data validation report to evaluate and determine if nonconformance, corrective actions, or penalties should be pursued. If this procedure is modified based on the professional judgment of the data validator, the data validation report must document the adjustments. Any method-specific QC requirements not addressed in this document must be documented by the data validator in the data validation report or included as an addendum to the procedure. The database administrator submits the data validation report to the SNL/NM Customer Funded Record Center for archiving. The data validation report shall include the following (as appropriate):

5.1 Sample Findings Summary and Validation EDD Files

A data table or spreadsheet summarizing flagged data resulting from the data review and validation. The sample findings summary is to be used by database personnel to facilitate the data entry of data validation qualifiers to the electronic database. However, when laboratory EDD files are available the SNL/NM Validation EDD Generator is used to produce a sample findings summary and validation EDD file. The validation EDD file is subsequently used for electronic data entry of data validation qualifiers to the database. The sample findings summary and validation EDD file shall include the following:

- The site name
- ARCOC number
- Sample number(s)
- Analysis or individual analytes
- Data validation qualifiers
- Any relevant comments

5.2 Data Validation Narrative (format may vary by project)

A summary of samples and all qualifiers applied to the data as a result of the validation process. The narrative shall include the following:

- The date issued
- The names of those to whom the report is issued
- The validator's name
- The laboratory name and SDG identifier
- ARCOC number
- Type of analysis addressed in the report
- Sample/analyte qualification and a general description of why qualification was applied
- Data validation procedure and revision used
- Any relevant comments

5.3 Data Qualification Summary

A summary of the process used for review and validation. The data qualification summary includes the following sections **(as appropriate)**:

- Sample Shipping/Receiving (refer to Section 4.1.1). Are all shipping/receiving and ARCOC issues that could affect data quality and defensibility discussed, and qualifications properly applied?
- Holding Times and Preservation (refer to Section 4.1.1). Are all holding time and preservation issues that could affect data quality discussed, and qualifications properly applied?
- Calibration. Are all calibration (initial and/or continuing/verification) issues that could affect data quality discussed, and qualifications properly applied?
- Tuning. Are all tuning issues that could affect data quality discussed, and qualifications properly applied?
- IS. Are all IS issues that could affect data quality discussed, and qualifications properly applied?
- Isotope Ratios. Are all isotope abundance issues that could affect data quality discussed, and qualifications properly applied?
- Surrogates. Are all surrogate issues that could affect data quality discussed, and qualifications properly applied?
- TICs. If required, are the identification and qualification of TICs discussed?
- Confirmation. Was second-column analysis discussed, and were qualifications properly applied?
- RLV (CRI/CRA/CRDL). Are all RLV and CRI/CRA/CRDL issues that could affect data quality discussed, and qualifications properly applied?
- ICP ICS. Are all ICS issues that could affect data quality discussed, and qualifications properly applied?
- ICP SD. Are all SD issues that could affect data quality discussed, and qualifications properly applied?
- Tracer/Carrier. Are all tracer and/or carrier issues that could affect data quality discussed, and qualifications properly applied?
- Blanks. Are all detections of target analytes in all applicable blanks discussed, and qualifications properly applied?

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- LCS. Are all LCS issues that could affect data quality discussed, and qualifications properly applied?
- MS. Are all MS issues that could affect data quality discussed, and qualifications properly applied?
- Laboratory Replicates. Are all the laboratory replicate issues that could affect data quality discussed, and qualifications properly applied?
- DLs/Dilutions. Is the appropriateness of the reported DLs discussed? Are sample dilutions discussed?
- Other QC. Are all QC issues that could affect data quality, other than those previously addressed, discussed? Include a brief description of any laboratory nonconformance reports that directly impacted data quality.
- Corrective Action Reports. Discuss or attach laboratory correspondence covering any corrective action, clarification, or modification to the report that was required to complete the validation process.

5.4 Validation Notes/Worksheets (as appropriate)

The validation notes/worksheets document results of the review and data validation by methodology and show QC results that do not meet acceptance criteria (that is, failures). These notes/worksheets identify data for which holding time/preservation requirements and calibration acceptance criteria were not met; laboratory blanks, FBs, EBs, or TBs were contaminated; surrogate recovery criteria were exceeded; MS/MSDs exceeded limits; and LCS %Rs and replicate RPDs or RERs exceeded acceptance limits. In addition, the validation notes/worksheet identify the validator and the laboratory; include the validator's comments and notes; and include ARCOC numbers, SDG number, types and number of samples analyzed, and sample numbers.

5.5 CVR and ARCOC

The CVR and ARCOC records also are pertinent to data review and validation. These records are supplied by the SMO and the laboratory and are copied and attached to the data validation report.

6.0 DEFINITIONS

6.1 Data Qualifier Definitions

Data qualifiers are commonly used during the validation process to classify sample data as to their conformance to QC requirements. For the purposes of this procedure, the following code letters and associated definitions are provided:

BD	(below DL) - Used in radiochemistry to identify results that are not statistically different from zero.
J	The associated value is an estimated quantity.
J+	The associated numerical value is an estimated quantity with a suspected positive bias.
J-	The associated numerical value is an estimated quantity with a suspected negative bias.
N	Presumptive evidence of the presence of the material.

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NJ Presumptive evidence of the presence of the material at an estimated quantity.

NJ+ Presumptive evidence of the presence of the material at an estimated quantity with a suspected positive bias.

NJ- Presumptive evidence of the presence of the material at an estimated quantity with a suspected negative bias.

R The data are unusable (compound may or may not be present). Resampling and reanalysis are necessary for verification.

U The analyte was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.

UJ The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

Datum is unqualified if the quality parameters indicate the method was appropriate and that the reported result reflects the true value within the expected analytical uncertainty.

Datum is qualified as estimated (J) if the reported result can be used to infer an estimate of the true value (with a suspected positive or negative bias, as may be indicated), but the quality parameters indicate an uncertainty in the result that is > the expected analytical uncertainty.

Datum is qualified as presumptive (N) if there is question as to whether the analyte is indigenous to the sample or if there is question regarding the identity of the analyte.

Datum is qualified as presumptive and estimated (NJ) when there is evidence of the presence of the material at an estimated quantity (with a suspected positive or negative bias, as may be indicated).

Datum is qualified as unusable (R) if the quality parameters do not support the reported result as a valid indicator of the true value.

Datum is qualified as estimated non-detects (UJ) for results reported as < the DL and for which some other quality concerns exist.

6.2 Sample Quantification Limits

For purposes of this procedure, the following definitions are provided:

MDA Minimum detectable activity. A radiological DL. A sample with activity concentration at the minimum detectable concentration (MDC) has a 95% probability of being measured above the decision level, which is the lowest threshold used to distinguish a positive result (i.e., a detect). For the purposes of data validation, the MDC equals the minimum detectable activity.

MDL Method detection limit. The minimum concentration of a substance that can be measured (quantified) and reported with 99% confidence that the analyte concentration is > zero. This measure of instrument sensitivity takes into account all solutions that have been subjected to all sample preparation steps for the method. In data packages the MDL may be referred to as the DL. For organic data, the MDL will be one-fifth the PQL, and the

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value associated with the "U" qualifier or the value of the low standard will be used as the PQL.

PQL Practical quantitation limit. The lowest concentration of analytes in a sample that can be reliably determined and quantified within specified limits of precision and accuracy by the indicated methods under routine laboratory operating conditions. For the purposes of this procedure, the PQL is considered to be 5X the value of the MDL if not defined by the laboratory. In data packages the PQL may be referred to as the contract-required DL or RL. For inorganic data, the PQL will be 5X the MDL, and the value associated with the "U" qualifier will be used as the MDL.

6.3 Formulas

The %D for LCSs, standards, and SD is calculated as follows:

$$\%D = \frac{[\,M - T\,]}{T} \times 100$$

where,
- %D = percent difference
- M = measured value
- T = true value or sample value for SD

The RPD for replicate samples is calculated as follows:

$$RPD = \frac{[S - R\,]}{(S + R)/2} \times 100$$

where,
- RPD = relative percent difference
- S = sample value (original)
- R = replicate sample value

The RPD for MS/MSD samples is calculated as follows:

$$RPD = \frac{MS - MSD}{(MS+MSD)/2} \times 100$$

where,
- RPD = relative percent difference
- MS = MS value
- R = MSD value

The %R for spiked samples is calculated as follows:

$$\%R = \frac{SSR-SR}{SA} \times 100$$

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where, SSR = spiked sample result
SR = sample result
SA = spike added

The RER is used to determine replicate precision for radiochemical results. The RER is given by:

$$RER = \frac{[\,S - R\,]}{F_{95S} + F_{95R}}$$

where, RER = replicate error ratio
S = sample value (original)
R = replicate sample value
F_{95S} = sample uncertainty (95% or 2-σ)
F_{95R} = replicate uncertainty (95% or 2-σ)

The linear curve equation is given by:

$$y = mx + b$$

where, y = instrument response (peak area or height)
m = slope of the line (also called the coefficient of x)
x = concentration of the calibration standard
b = the intercept

The %RSD is calculated as follows:

$$\%RSD = \frac{SD}{RF} \times 100\%$$

where, SD = standard deviation
RF = mean RF for each compound from the ICAL

7.0 GLOSSARY OF TERMS

2-σ error: The error reported at the 95% confidence interval.

Acceptance limits: Ranges of acceptable results for each type of QC measurement. They may be defined on a program-specific basis, or they may be derived internally at a laboratory from historic QC performance data. May also be referred to as control limits.

Accuracy: The closeness of agreement between an observed value and the true value. "Precision" is a measure of the reproducibility of a value, without knowledge of the true value. The classic example used to illustrate these terms is a dartboard example: The placement of four darts thrown at a dartboard is considered accurate if the darts are each close to the bull's-eye (regardless of their proximity to one

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another). Hence, to be both accurate and precise the four darts would need to be grouped closely together and be close to the bull's-eye.

Analyte: That which is analyzed for. This can be chemical (chromium, benzene), biological (fecal coliform bacteria), mineral (asbestos fibers), or radiological (alpha and beta emissions).

Analytical run: The interval (i.e., period of time or series of measurements) within which the accuracy and precision of the measuring system is expected to be stable. Within the analytical run, controls are often analyzed to confirm stability.

Batch: A group of samples which behave similarly with respect to the sampling or the testing procedures being employed and which are processed as a unit. For QC purposes, if the number of samples in a group is > 20, then each group of 20 samples or less will all be handled as a separate batch.

Bias: The difference between the reported result and the true result. Bias may be introduced through field or laboratory variability and error or due to substances in the sample that interfere with the analytical system's ability to provide an accurate measurement. Because the true concentration of an analyte in an environmental sample is generally never known, bias is estimated by using surrogates, MSs, LCSs, and other indicators of analytical accuracy.

Calibration: The process of correlating instrument signal response with analyte concentration. An instrument must be properly calibrated in order to produce accurate results.

Chemical carrier: An identical or similar carrier material used to infer the degree to which the separation processes were effective in separating the analyte from the matrix. Measured gravimetrically or chemically.

Congener: A congener refers to any one particular compound of the same chemical family. For example, there are 209 congeners of Chlorinated Biphenyls (CBs).

Contamination: A component of a sample from an extract that is not representative of the environmental source of the sample. Contamination may stem from other samples, sampling equipment, while in transit, from laboratory reagents, laboratory environment, or analytical instruments. Blanks (instrument blanks, MBs, preparation blanks, TBs, EBs, and FBs) may be used to assess contamination.

Control sample: A QC sample introduced into a process to monitor the performance of the system.

Correlation coefficient (r) or coefficient of determination (r^2): A statistical evaluation of the linearity of a calibration curve, i.e. "goodness of fit."

Detect: Sample result ≥the MDL.

Duplicate: A second aliquot of a sample that is treated the same as the original aliquot of sample. (See definitions for field duplicate and replicate.)

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Environmental sample: A sample taken unaltered (as much as possible) from the environment (as opposed to a blank, performance evaluation sample, MS sample, etc.). Environmental sample may be referred to as "field sample."

Equipment blank (EB): A sample of analyte-free media (for example, clean water poured over a bailer) that has been used to rinse the sampling equipment. The EB is collected after completion of decontamination and prior to collection of environmental samples. This blank is useful in documenting adequate decontamination of sampling equipment. An EB also may be referred to as a "rinsate blank."

Field blank (FB): A sample containing an analyte-free matrix that is collected and processed in exactly the same manner as an equivalent environmental sample (for example, clean water is poured into a sample container in the same physical location where the environmental sample is collected and is subsequently handled, processed, and analyzed exactly as an equivalent environmental sample). The FB is used to identify contamination resulting from field sample collection techniques.

Field duplicate: A duplicate sample generated in the field used to determine sampling and analytical precision.

Holding time: The period between collection of samples by the samplers and preparation and/or analysis of samples by the laboratory (see Appendix B for required hold times). If the method specifies a holding time to extraction and a holding time to analysis then two holding times are evaluated. If no holding time to extraction is specified then the listed holding time is the holding time to analysis. That is, the laboratory cannot extract a sample and store the extract in order to meet holding time. However, professional judgment may be applied here. If the sample preparation includes MS and LCS samples and both of these pass it may be inferred that the stability of the extract has been verified.

Instrument blank: A blank designed to determine the level of contamination associated with the analytical instruments.

Internal standard (IS): A chemical compound added to every blank, sample, and standard extract at a known concentration that is used to (1) compensate for analyte concentration changes that might occur during storage of the extract, and (2) compensate for quantification variations that can occur during analysis. ISs are used as the basis for quantifying target analytes.

Isomer: A chemical species with the same number and types of atoms as another chemical species, but possessing different properties. For example, 2,3,7,8-TCDD refers to only one of the 22 possible TCDD isomers; that isomer which is chlorinated in the 2,3,7,8-position of the dibenzo-p-dioxin ring structure.

Isotope dilution: A means of determining a naturally occurring (native) compound by reference to the same compound in which one or more atoms has been isotopically enriched.

Laboratory control sample (LCS): A known matrix that is spiked with compounds representative of the target analytes at known concentrations. The spiking occurs prior to sample preparation and analysis. An LCS is used to document laboratory overall performance.

Matrix: The substrate that contains the analyte of interest (for example, surface water, drinking water, air, soil, tissue, etc.).

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Matrix interference: Bias introduced because something in the sample interferes with the analytical system's ability to provide an accurate measurement. The interference may be physical (turbidity in stormwater runoff may block light transmission in an analysis based on ultraviolet absorbance) or chemical (a chemical similar to the analyte of interest may increase the response of the instrument, resulting in a positive bias).

Matrix spike (MS): A measured amount of sample spiked with a known concentration of target analyte(s). The spiking occurs prior to sample preparation and analysis. An MS is used to assess the bias of a method in a given sample matrix.

Matrix spike duplicate (MSD): Intralaboratory (within the same laboratory) split-samples spiked with identical concentrations of target analyte(s). The spiking occurs prior to sample preparation and analysis. MSDs are used to assess the precision and bias of a method in a given sample matrix.

Method blank (MB): An analyte-free matrix that is prepared and processed at the laboratory in exactly the same manner as an equivalent environmental sample (that is, all reagents are added in the same volumes or proportions as used in sample processing). The MB is used to document contamination resulting from the analytical process.

Non-detect: Sample result < the MDL.

Ongoing Precision and Recovery (OPR): A MB spiked with known quantities of analytes and analyzed as a sample. Its purpose is to assure that results produced by the laboratory remain within the limits specified in EPA Method 1668A for precision and recovery.

Precision: The proximity to one another of the results for multiple measurements on the same sample (i.e., a measure of the repeatability of a measurement process). This does not address proximity to a true value; it is possible for multiple results to show very high precision and yet be completely incorrect by comparison with a true value. Precision is quantified, for example, by calculating the RPD between the result obtained for a sample and that obtained from an associated duplicate or replicate sample. As with accuracy, there is an assumed correlation between quantitative precision as determined via QC analyses and the inferred precision in measurements of unknowns.

Quality control (QC): The system of routine technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users. In other words, QC activities are the tactics used to measure and control quality.

Radioactive tracer: A radioactive isotope of the analyte that is added to the sample to correct for any losses of the analyte during the chemical separations or other processes employed in the analysis.

Relative dilution factor: The dilution factor ratio (value ≥1) of two samples. For example, if one sample has a dilution factor of 2 and another sample has a dilution factor of 10, the relative dilution factor is 5.

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Relative response factor (RRF): A measure of the relative mass spectral response of an analyte compared to its IS. RRFs are determined by analysis of standards and are used in the calculation of concentrations of analytes in samples.

Relative retention time (RRT): The ratio of the RT of a compound to that of a standard (such as an IS).

Replicate (also may be called "sample duplicate"): A duplicate sample generated in the laboratory used to determine analytical precision.

Reporting limit verification (RLV): A low-level verification standard of the same origin as the calibration standard run as a measure of accuracy near the PQL. The RLV is known as the CRI for ICP-AES, ICP-MS, and LC/MS/MS methods, CRA for AA methods, and CRDL for cyanide methods.

Response (also may be called "instrument response"): The signal output of an analytical instrument in which the intensity of the signal is proportionate to the concentration detected. Response is measured by peak area or peak height.

Retention time (RT): The time a target analyte is retained on a chromatography column before elution. The identification of a target analyte is dependent on a target compound's RT falling within the specified RT window established for that compound. RT is dependent on the nature of the column's stationary phase, column diameter, temperature, flow rate, and other parameters.

Sample delivery group (SDG): A group of samples that are processed together by the laboratory. Ideally, all the samples in a batch will be similar enough that matrix QC measurements performed with the batch will be representative of all the samples in the batch.

Spike: A known amount of analyte that is introduced purposely into a sample (either an environmental sample or a blank) for the purpose of determining whether the analytical system can accurately measure the analyte.

Surrogate: A chemical that is similar to the target analyte(s) in chemical composition and behavior in the analytical process but that is not expected to be present in the sample. Surrogates are added to all the environmental samples, blanks, and QC samples in the analytical batch during the preparation stage of the analysis. Surrogates are used to monitor the performance of the analytical process. An example would be the use of fluorinated organic compounds in an analysis that looks for chlorinated and brominated organic compounds. Surrogates also may be called "system monitoring compounds" (SMCs).

Target analyte: A chemical that is being looked for in an analysis.

Tentatively identified compound (TIC): A compound that is outside the standard list of analytes in a GC/MS method but that is reported based on a tentative match between the instrument response and the instrument's computer library. The identification and quantitation of these compounds is tentative.

Trip blank (TB): A sample of analyte-free media (such as distilled/deionized water) taken from the laboratory to the sampling site and returned to the laboratory unopened. A TB is used to document contamination attributable to shipping and field handling procedures. This type of blank is useful in documenting contamination of volatile organic samples.

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8.0 REASON CODES

Programs may require that general validation codes be included in their computer databases or EDDs. The following codes are the default codes used when this is required.

H1 - Holding time exceeded for sample analysis
H2 - Holding time exceeded for sample extraction
H3 - Holding time exceeded by >2X the specified holding time

TP1 - Sample improperly preserved
TP2 - Sample not preserved
TP3 - Sample not maintained at required temperature
TP4 - Required sample or extract clean up not performed
TP5 - Sample received unpreserved and preserved at the laboratory

I1 - Initial calibration not reported
I2 - Initial calibration not independently verified
I3 - Slope r^2 or RF %RSD criteria not met
I4 - Minimum RF / Slope not met
I5 - Intercept too large
I6 - Insufficient number of calibration standards used

C1 - Continuing calibration frequency not met
C2 - Continuing calibration %D failed high
C3 - Continuing calibration %D failed low

B - MB contamination at concentration >MDL
B1 - TB contamination at concentration >MDL
B2 - FB/EB contamination at concentration >MDL
B3 - Calibration blank contamination at concentration >MDL
B4 - Negative value for calibration blank - absolute value >the MDL
B5 - Negative value for MB - absolute value >the MDL
B6 - Negative value for FB/EB/TB - absolute value >the MDL
B7 - MB contamination at activity ≥the MDA
B8 - MB frequency not met
B9 - Instrument or calibration blank frequency not met

IS1 - IS / tracer recovery failed high
IS2 - IS / tracer recovery failed low but ≥10%
IS3 - IS / tracer recovery failed low and <10%

S1 - Surrogate(s) failed high
S2 - Surrogate(s) failed low
S3 - Multiple random surrogate failures

FR1 - Result exceeds calibration range
FR2 - No result reported - sample lost or damaged
FR3 - Result is less than the MDA / MDL or < the 2-σ TPU
FR4 - Negative result - absolute value >2X the MDA/MDL

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FR5 - RT criteria not met
FR6 - Ion mass ratio criteria not met
FR7 – Result is ≥ the MDA and <3X the MDA

MS1 - MS not analyzed or not applicable
MS2 - MS analyte(s) recovery failed high
MS3 - MS analyte(s) recovery failed low
MS4 - MS analytes recovery failed both high and low
MS5 - MS/MSD RPD failed

RP1 - Replicate not analyzed or not applicable
RP2 - Replicate RPD failed

L1 - LCS frequency not met
L2 - LCS analyte(s) recovery failed high
L3 - LCS analyte(s) recovery failed low
L4 - LCS analytes recovery failed both high and low
L5 - LCS/LCSD RPD failed

DL1 - RLV frequency not met[1]
DL2 - RLV percent recovery failed high[1]
DL3 - RLV percent recovery failed low[1]

CK1 - ICS frequency not met
CK2 - ICS analyte(s) failed high
CK3 - ICS analyte(s) failed low

D1 - SD failed %D
D2 - Inappropriate initial dilution

V1 - Conformation analysis not done
V2 - Conformation RPD exceeds criteria
V3 - Confirmation analysis by second method did not confirm original result (LCMSMS)

X1 - Non-specified data quality concern – see validation report
X2 - Analysis failed to meet method requirements - see validation report
X3 - Required QC documentation missing

Z1 - Spectral identification criteria not met[2]
Z2 - Minimum peak criteria not met[3]

1: refers to QC for CRA/CRDL/CRI analyses.
2: used when rejecting results that have been X qualified by the lab for interference or short half-life, and also for failed organic spectral matching (GC/MS, diode array, HPLC, etc.).
3: used when rejecting results that have been X qualified by the lab for low abundance, no valid peak, or peak not meeting identification criteria.

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9.0 REFERENCES

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40 CFR 136, Protection of Environment: Guidelines Establishing Test Procedures for the Analysis of Pollutants

EPA Method 314, *Determination of Perchlorate in Drinking Water by Ion Chromatography*

EPA Method 1613B, *Tetra-thru-Octa (CDDs) Chlorinated Dioxins and Furans (CDFs)*

EPA Method 1668A, *Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)*

EPA Method 1694, *Pharmaceuticals and Personal Care Products in Water, Soil, Sediment, and Biosolids by HPLC/MS/MS*

EPA Method TO-14A (Rev. 1), *Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using Specially Prepared Canisters with Subsequent Analysis by Gas Chromatography*

EPA Method TO-15 (Rev. 1), *Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)*

SW-846 Method 428, *Determination of Polychlorinated Dibenzo-p-dioxin (PCDD), Polychlorinated dibenzofuran (PCDF), and Polychlorinated Biphenyl Emissions from Stationary Sources*

SW-846 Method 8000C, *Determinative Chromatographic Separations*

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SW-846 Method 8015C, *Nonhalogenated Organics Using GC/FID*

SW-846 Method 8015D, *Nonhalogenated Organics Using GC/FID*

SW-846 Method 8081B, *Organochlorine Pesticides by Gas Chromatography*

SW-846 Method 8082A, *Polychlorinated Biphenyls (PCBs) by Gas Chromatography*

SW-846 Method 8151A, *Chlorinated Herbicides by GC Using Methylation or Pentafluorobenzylation Derivatization*

SW-846 Method 8260B, *Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)*

SW-846 Method 8260C, *Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)*

SW-846 Method 8270C, *Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)*

SW-846 Method 8270D, *Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)*

SW-846 Method 8280B, *The Analysis of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans by High Resolution Gas Chromatography/Low Resolution Mass Spectrometry (HRGC/LRMS)*

SW-846 Method 8290A, *Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)*

SW-846 Method 8310, *Polynuclear Aromatic Hydrocarbons*

SW-846 Method 8330B, *Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC)*

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Appendix A

Volatile Organic Holding Times

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Volatile Organic Compounds
Maximum Holding Times
Non-detects in Water

Compound	CAS #*	15 - 60 days	60 - 120 days
1,1-dichloroethene	75-35-4	UJ	R
2-butanone	78-93-3	UJ	R
Acrolein	107-02-8	UJ	R
Allyl chloride	107-05-1	UJ	R
Bromomethane	74-83-9	UJ	R
Carbon tetrachloride	56-23-5	UJ	R
Chloromethane	74-87-3	UJ	R
Dibromochloromethane	124-48-1	UJ	R
Ethyl benzene	100-41-4	UJ	R
m&p xylene	Na	UJ	R
Methyl methacrylate	80-62-6	UJ	R
o xylene	95-47-6	UJ	R
Vinyl chloride	75-01-4	UJ	R
1,1,1 trichloroethane	75-55-6	Not Qualified	UJ
1,1 dichloropropene	563-58-6	Not Qualified	UJ
1,2,4 trichlorobenzene	120-82-1	Not Qualified	UJ
1,2,4 trimethylbenzene	95-63-6	Not Qualified	UJ
1,2 dibromo-3-chloropropane	96-12-8	Not Qualified	UJ
1,2 dichlorobenzene	95-50-1	Not Qualified	UJ
1,3,5 trimethylbenzene	108-67-8	Not Qualified	UJ
1,3 dichlorobenzene	541-73-1	Not Qualified	UJ
1,4 dichlorobenzene	106-46-7	Not Qualified	UJ
4-methyl-2-pentanone	108-10-1	Not Qualified	UJ
Bromodichloromethane	75-27-4	Not Qualified	UJ
Chlorobenzene	108-90-7	Not Qualified	UJ
Chloroethane	75-00-3	Not Qualified	UJ
Ethyl methacrylate	97-63-2	Not Qualified	UJ
Hexachlorobutadiene	87-68-3	Not Qualified	UJ
Isopropylbenzene	98-82-8	Not Qualified	UJ
Naphthalene	91-20-3	Not Qualified	UJ
n-propylbenzene	103-65-1	Not Qualified	UJ
2-chlorotoluene	95-49-8	Not Qualified	UJ
4-chlorotoluene	106-43-4	Not Qualified	UJ
4-isopropyltoluene	99-87-6	Not Qualified	UJ
Tetrachloroethene	127-18-4	Not Qualified	UJ
Trichloroethene	79-01-6	Not Qualified	UJ

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Volatile Organic Compounds
Maximum Holding Times
Non-detects in Water (concluded)

Compound	CAS #*	60-120 days	120 - 240 days
1,1,1,2 tetrachloroethane	630-20-6	Not Qualified	UJ
1,1,2,2 tetrachloroethane	79-34-5	Not Qualified	UJ
1,1,2 trichloroethane	79-00-5	Not Qualified	UJ
1,1 dichloroethane	75-35-4	Not Qualified	UJ
1,2,3 trichlorobenzene	87-61-6	Not Qualified	UJ
1,2 dibromomethane	106-93-4	Not Qualified	UJ
1,2 dichloroethane	107-06-2	Not Qualified	UJ
1,2 dichloropropane	78-87-5	Not Qualified	UJ
1,3 dichloropropane	142-28-9	Not Qualified	UJ
Acetone	67-64-1	Not Qualified	UJ
Acrylonitrile	75-05-8	Not Qualified	UJ
Benzene	71-43-2	Not Qualified	UJ
Bromobenzene	108-86-1	Not Qualified	UJ
Bromochloromethane	74-97-5	Not Qualified	UJ
Bromoform	75-25-2	Not Qualified	UJ
Chloroform	67-66-3	Not Qualified	UJ
cis-1,2 dichloroethene	156-59-2	Not Qualified	UJ
Dibromomethane	106-93-4	Not Qualified	UJ
Dichlorodifluoromethane	75-71-8	Not Qualified	UJ
Methyl acrylonitrile	126-98-7	Not Qualified	UJ
Methylene chloride	75-09-2	Not Qualified	UJ
n-butylbenzene	104-51-8	Not Qualified	UJ
sec-butyl benzene	135-98-8	Not Qualified	UJ
tert-butyl benzene	98-06-6	Not Qualified	UJ
Toluene	108-88-3	Not Qualified	UJ

*chemical abstract service number

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Appendix B

Sample Preservation and Holding Times

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Sample Preservation Techniques and Holding Times

Method	Parameters	Matrix	Volume/Container	Preservation	Holding Times Sample	Holding Times Extract
2310B, 2320B	Acidity, Alkalinity	Water	500 mL Plastic or Glass	≤6 °C	14 Days	NA
300.0, 300.1 375.2	Bromide, Chloride, Fluoride, Sulfate	Water	1 L Plastic	≤6 °C	28 Days	NA
5210B	BOD	Water	1 L Plastic	≤6 °C	48 Hours	NA
9010B, 9013, 9014, 335.4, 4500CN-G	Total Cyanide	Water	1 L Plastic	≤6°C; NaOH; pH > 12	14 Days	NA
	Amenable Cyanide	Solid/Other	125 mL Glass Jar	≤6°C	14 Days	NA
5310B, C or D, 9060	DOC, TOC	Water	250 mL Amber Glass	≤6 °C; H_2SO_4; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	≤6 °C	28 Days	NA
200.7, 200.8, 6010B, 6020A	All metals except Cr(VI) and Hg	Water	500 mL Plastic	HNO_3 ; pH < 2	180 Days	NA
		Solid/Other	250 mL Glass Jar		180 Days	NA
3060A	Cr(VI)	Water	500 mL Plastic	≤6 °C	24 Hours	NA
218.6		Water	500 mL Plastic	≤6°C, pH 9-9.5	28 Days	NA
7197, 7196A		Solid/Other	250 mL Glass Jar	≤6 °C	30 Days	7 Days
245.1, 7470A, 7471A	Hg	Water	500 mL Plastic	HNO_3 ; pH < 2	28 Days	NA
		Solid/Other	250 mL Glass Jar	≤6 °C	28 Days	NA
130.1	Hardness	Water		HNO_3 ; pH < 2 ≤6 °C	180 Days	NA
345.1	Iodide	Water	500 mL Plastic or Glass	≤6 °C	24 Hours	NA

Note: 40 mL vials require caps with Teflon lined septum. All other containers require Teflon lined screw cap lids to minimize container contamination and loss of analyte.
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Method	Parameters	Matrix	Volume/Container	Preservation	Holding Times Sample	Holding Times Extract
353.2, 351.1	Ammonium, Nitrate + Nitrite,	Water	1 L Plastic	≤6 °C; H_2SO_4; pH < 2	28 Days	NA
351.2, 365.4	Total Phosphorus, TKN			≤6°C; not acidified	24 Hours	NA
350.1						
300.0	Nitrate, Nitrite,	Water	500 mL Plastic	≤6 °C	48 Hours	NA
354.1	Ortho Phosphorus					
365.1, 365.3	Ortho Phosphorus	Water	500 mL Plastic	≤6 °C; H_2SO_4; pH < 2	48 Hours	NA
9210, 9211	Nitrate	Water	1 L Plastic	≤6 °C; 1M Boric Acid	48 Hours	NA
		Solid/Other	250 mL Glass Jar	≤6 °C	48 Hours	NA
314.0, 9058	Perchlorate by IC	Water	250 mL Plastic or Glass	≤6 °C	28 Days	NA
6850, 331.0	Perchlorate by HPLC/MS/MS	Water	250 mL Plastic or Glass	≤6 °C	28 Days	60 days
6860, 330.0	Perchlorate by IC/ESI/MS/MS					
		Solid	4 oz. Wide-mouth jar	≤6 °C	28 Days	60 days
410.3, 410.4	Chemical Oxygen Demand (COD)	Water	250 mL Glass	≤6 °C; H_2SO_4; pH < 2	28 Days	NA
1664	Total Recoverable Oil and Grease	Water	1 L Glass	≤6 °C; H_2SO_4 or HCl; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	≤6 °C	28 Days	NA
9070A, 9071B	Total Recoverable Oil and Grease	Water	1 L Glass	≤6 °C; HCl; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	≤6 °C	28 Days	NA
ASTM D-854	Specific Gravity	Water	500 mL Plastic or Glass	None	None	

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Method	Parameters	Matrix	Volume/Container	Preservation	Holding Times Sample	Holding Times Extract
9030B, 9031	Sulfide	Water	1 L Glass	≤6 °C; NaOH; Zinc acetate; pH > 9	7 Days	NA
4500S^{2-}-D, E, F, or G		Solid/Other	125 mL Glass Jar	≤6 °C	7 Days	NA
2540 B, C, D	TDS, TSS, TS	Water	1 L Plastic	≤6 °C	7 Days	NA
160.4	Volatile solids (volatile residue)	Water	Plastic or glass	≤6 °C	7 Day	NA
9020B	TOX	Water	1 L Amber Glass	≤6 °C; H_2SO_4; pH < 2	28 Days	NA
		Solid/Other	125 mL Glass Jar	≤6 °C	28 Days	NA
9060A	TOC	Water	Glass	≤6°C; H_2SO_4 or HCL; pH < 2 if analyzed >2 hours after collection	2 hours, unless acidified	N/A
418.1	Total Petroleum Hydrocarbon (TPH)	Water	1 L Amber Glass	≤6 °C; HCl; pH < 2	28 Days	NA
1664A	TPH	Water	1 L Amber Glass	≤6°C; H_2SO_4 or HCl; pH < 2	28 Days	NA
8440	TPH	Solid/Other	125 mL Glass Jar	≤6 °C	28 Days	NA
9065, 9066	Total Recoverable Phenols	Water	1 L Glass	≤6 °C; H_2SO_4; pH < 4	28 Days	NA
420.1, 410.4		Solid	125 mL Glass Jar	≤6 °C	28 Days	NA
9040C 4500H^{+}-B	pH	Water	125 mL Plastic	≤6 °C	ASAP	NA
2120B, C or E 180.1	Color, Turbidity	Water	500 mL Plastic	≤6 °C	48 Hours	NA
120.1, 9050A	Specific Conductance	Water	125 mL Plastic	≤6 °C	ASAP	NA

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Method	Parameters	Matrix	Volume/Container	Preservation	Holding Times Sample	Holding Times Extract
All radiochemical parameters		Water	1 L Plastic (2 x 2 L Preferred)	HNO_3 ; pH < 2	180 Days	NA
except Rn-222 and tritium		Solid/Other	250 mL Glass Jar		180 Days	NA
913.0	Radon 222	Water	125 mL Glass	None	72 Hours	NA
906.0	Tritium	Water	1 L Glass		180 Days	NA
		Solid/Other	Sample size will vary with moisture content		180 Days	NA
8015C/D	Petroleum Hydrocarbons	Water[3]	2 x 1 L Amber Glass Bottle	≤6 °C	7 Days	40 Days
	(Diesel Range Organics)	Soil/Other	250 mL Glass Jar	≤6 °C	14 Days	40 Days
	Petroleum Hydrocarbons	Water[4]	3 x 40 mL Glass Vial	≤6 °C; HCl; pH < 2	14 Days	NA
	(Gasoline Range Organics)	Soil/Other	125 mL Glass Jar	≤6 °C	14 Days	NA
5035A/	Petroleum Hydrocarbons	Soil	4 x 40 mL Glass Vial	≤6 °C, 2 Vials $NaHSO_4$	*14 days	NA
8015C/D	(Gasoline Range Organics)			1 Vial CH_3OH, 1 Vial No Preservative		
8021B	Halogenated Volatile Organics	Water[4]	3 x 40 mL Glass Vial	≤6 °C; HCl; pH < 2	14 Days	NA
		Soil/Other	125 mL Glass Jar	≤6°C	14 Days	NA
5035A/8021B	Halogenated Volatile Organics	Soil	4 x 40 mL Glass Vial	≤6°C, 2 Vials $NaHSO_4$	*14 days	NA
				1 Vial CH_3OH, 1 Vial No Preservative		
8081B	Organochlorine Pesticides	Water[3]	4 L Amber Glass Bottle	≤6 °C	7 Days	40 Days
		Soil/Other	250 Glass Jar	≤6 °C	14 Days	40 Days
8082A	PCBs	Water[3]	4 L Amber Glass Bottle	≤6 °C	1 Year	1 Year
		Soil/Other	250 Glass Jar	≤6 °C	1 Year	1 Year

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Method	Parameters	Matrix	Volume/Container	Preservation	Holding Times Sample	Holding Times Extract
8141B	Organophosphorous Compounds	Water[3]	4 L Amber Glass Bottle	≤6 °C; NaOH or H_2SO_4; pH 5-8	7 Days	40 Days
		Soil/Other	250 Glass Jar	≤6 °C	14 Days	40 Days
8151A	Chlorinated Herbicides	Water[3]	4 L Amber Glass Bottle	≤6 °C	7 Days	40 Days
		Soil/Other	250 Glass Jar	≤6 °C	14 Days	40 Days
8260B/C	Volatile Organics by GC-MS	Water[1,2,4]	3 x 40 mL Glass Vial	≤6 °C; HCl; pH < 2	14 Days	NA
				≤6 °C; not acidified	7 Days	NA
		Soil/Other	125 mL Glass Jar	≤6 °C	14 Days	NA
5035A/ 8260B/C	Volatile Organics by GC-MS	Soil	4 x 40 mL Glass Vial	≤6 °C, 2 Vials $NaHSO_4$ 1 Vial CH_3OH, 1 Vial No Preservative	*14 days	NA
8270C/D	Semivolatile Organics by GC-MS	Water[3]	4 L Amber Glass Bottle	≤6 °C	7 Days	40 Days
		Soil/Other	250 mL Glass Jar	≤6°C	14 Days	40 Days
8280B	Polychlorinated Dioxins and Furans by HRGC/LRMS	Water[3]	4 L Amber Glass Bottle	≤6 °C	30 Days	45 Days
		Soil/Other	250 mL Glass Jar	≤6 °C	30 Days	45 Days
8290A	Dioxins and Furans By HRGC/HRMS	Water[3]	4 L Amber Glass Bottle	≤6 °C	30 Days	45 Days
		Soil/Other	250 mL Glass Jar	≤6 °C	30 Days	45 Days
1613	Dioxins and Furans by Isotope Dilution HRGC/HRMS	Water[3]	Amber Glass	≤6 °C	1 Year	1 Year
		Solid	Amber Glass Jar	≤6 °C	1 Year	1 Year
1668A	PCB Congeners by HRGC/HRMS	Water[3]	Amber Glass	≤6 °C,	1 Year	1 Year
		Solid	Amber Glass Jar	≤6 °C	1 Year	1 Year

Note: 40 mL vials require caps with Teflon lined septum. All other containers require Teflon lined screw cap lids to minimize container contamination and loss of analyte.
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Sample Preservation Techniques and Holding Times

Method	Parameters	Matrix	Volume/Container	Preservation	Holding Times Sample	Holding Times Extract
1694	PPCP	Water[3]	Amber Glass	≤6 °C	7 Days	40 Days
		Solid	Amber Glass Jar	≤6 °C	7 Days	40 Days
8318A	N-Methylcarbamate Pesticides by HPLC	Water	4 L Amber Glass Bottle	≤6 °C; 0.1 N $ClCH_2CO_2H$, pH 4 - 5	7 Days	40 Days
		Soil/Other	250 mL Glass Jar	≤6 °C	7 Days	40 Days
8330B	Nitroaromatics and Nitramines by HPLC	Water	4 L Amber Glass Bottle	≤6 °C	7 Days	40 Days
		Soil/Other	250 mL Glass Jar	≤6 °C	14 Days	40 Days
610, 8310	PAHs by HPLC	Water[3]	Amber Glass/Teflon lined cap	≤6 °C	7 Days	40 Days
		Soil/Other	250 mL Glass Jar	<6 °C	14 Days	40 Days
TO-13A	PAHs in Filter Cartridges	PUF, Tenax, or XAD-2 Filter Cartridge		≤6 °C	7 Days	40 Days
TO-14A, TO-15		VOC in Air	SUMMA® Canister		30 Days	
8321A (modified)	High Explosives by LC/MS/MS	Water	Amber Glass/Teflon lined cap	≤6 °C	7 Days	40 Days
		Solid	Amber Glass/Teflon lined cap	≤6 °C	14 Days	40 Days

[1] If vinyl chloride, styrene, or 2-chloroethylvinylether are analytes of interest, collect a second set of samples without acid preservative and analyze within 7 days.

[2] If acrolein and acrylonitrile are analytes of interest, adjust to pH 4-5.

[3] If residual chlorine is present, preserve with 80 mg of sodium thiosulfate per liter of water.

[4] If residual chlorine is present, preserve with 10 mg of sodium thiosulfate per 125 mL of water.

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Appendix C

Data Reporting Requirements

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If any quality control (QC) samples are analyzed using a different initial calibration (ICAL) than that of the field samples, the laboratory must include a calibration report for the calibration affecting the QC samples. This calibration data shall only be used to evaluate the QC samples, and only if the QC samples fail to meet recovery or relative percent difference (RPD) acceptance criteria. The laboratory is not required to report calibration data associated with QC samples from another sample delivery group.

If required data is not present contact the laboratory to request an amended report. Documentation may include the following, as appropriate.

Gas Chromatography/Mass Spectrometry (GC/MS)

- Case narrative
- Instrument tuning data
- ICAL data
- Applicable calibration verification data
- Continuing calibration check data
- Instrument and preparation blank data
- Surrogate data
- Internal standard (IS) performance data
- Matrix spike/matrix spike duplicate (MS/MSD) data
- Laboratory control sample (LCS) data
- Sample results and analytical data for the requested target analytes, including results from dilutions, if analyzed
- Identification and data for any sample tentatively identified compounds
- Instrument run logs
- Analysis Request and Chain of Custody (ARCOC) and shipping documents
- Login worksheet
- Laboratory replicate data, if analyzed

Dioxins and Furans by High Resolution Gas Chromatography/High Resolution Mass Spectrometry (HRGC/HRMS)

- Case narrative
- Column performance check data
- ICAL data
- Applicable calibration verification data
- Continuing calibration check data
- Preparation blank data
- Labeled compound data
- Ongoing precision and recovery (OPR) data
- Ion abundance ratio data
- Sample results and analytical data for the requested target analytes, including results from dilutions, if analyzed
- Instrument run logs
- ARCOC and shipping documents
- Login worksheet
- Laboratory replicate data, if analyzed

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Gas Chromatography (GC) and High-Performance Liquid Chromatography (HPLC)

- Case narrative
- ICAL calibration data, including secondary column, if appropriate
- Applicable calibration verification data
- Continuing calibration check data
- Instrument and preparation blank data
- Surrogate data
- MS/MSD data
- LCS data
- Sample results and analytical data for the target analytes, including data from dilutions, if analyzed
- Confirmation data and RPD between the results
- Instrument run logs
- ARCOC and shipping documents
- Login worksheet
- Laboratory replicate data, if analyzed

Polychlorinated Biphenyl (PCB) Congeners, EPA Method 1668A

- Case Narrative
- ICAL data, including relative retention time (RRT) windows
- Calibration verification data including ion abundance ratios and RRTs
- Preparation blank data
- OPR data
- Clean-up standard data
- Labeled compound data
- Sample results and analytical data for the requested target analytes, including results from dilutions, if analyzed
- Ion abundance ratio for all detected sample results, labeled compounds, and clean-up standards
- RRTs for all detected sample results, labeled compounds, and clean-up standards
- Instrument run logs
- Sample preparation data
- Lipid data (tissue samples only)
- ARCOC and shipping documents
- Login worksheet

High Explosives (HE) and Perchlorate by Liquid Chromatography/Mass Spectrometry/Mass Spectrometry (LC/MS/MS)

- Case narrative
- ICAL data
- Applicable calibration verification data
- Initial calibration blank (ICB) data
- Continuing calibration check data

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- Continuing calibration blank (CCB) data
- Low level calibration verification (CRI) [1] data
- Instrument and preparation blank data
- Surrogate data (HE only)
- IS or Method of Standard Addition performance data
- MS/MSD data
- LCS data
- Retention time data
- Isotope Ratio data (perchlorate only)
- Sample results and analytical data for the requested target analytes, including results from dilutions, if analyzed
- Instrument run logs
- ARCOC and shipping documents
- Login worksheet
- Laboratory replicate data, if analyzed

Inorganic

- Case narrative
- ICAL data
- Applicable calibration verification data
- ICB data
- Continuing calibration data
- CCB data
- Instrument tuning data
- Instrument and preparation blank data
- MS data
- LCS data
- Laboratory replicate data
- Inductively coupled plasma-atomic emission spectroscopy (ICP-AES) and inductively coupled plasma-mass spectrometry (ICP-MS) interference check sample data
- ICP SD data
- PQL verification (CRA/CRI/CRDL)[2]
- Sample results and analytical data, including data from dilutions, if analyzed
- Instrument run logs
- ARCOC and shipping documents
- Login worksheet

[1] CRI = reporting limit verification (RLV) for LC/MS/MS, ICP-AES and ICP-MS methods.
[2] CRA = RLV for atomic absorption (AA) methods.
CRI = RLV for LC/MS/MS, ICP-AES, and ICP-MS methods.
CRDL = RLV for cyanide methods.

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Radiochemistry

- Case narrative
- Instrument and preparation blank data
- Applicable calibration verification data
- MS data
- LCS data
- Laboratory replicate data
- Sample results
- Carrier or chemical tracer data
- Instrument run logs
- ARCOC and shipping documents
- Login worksheet
- Control Charts

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Appendix D

Surrogate Recovery Limits

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Guidelines for Surrogate Recovery Limits

Volatile Organics – Water	**Mean**	**Lower Limit**	**Upper Limit**
1,2-Dichloroethane-d4	95	72	119
4-bromofluorobenzene	98	76	119
Dibromofluoromethane	100	85	115
Toluene-d8	102	83	120
Volatile Organics – Solid			
4-bromofluorobenzene	101	84	118
Toluene-d8	100	84	116
Semivolatile Organics – Water			
2-fluorobiphenyl	79	48	112
Terphenyl-d14	92	51	135
2,4,6-Tribromophenol	82	42	124
2-Fluorophenol	63	19	108
Nitrobenzene-d5	76	41	111
Semivolatile Organics – Solid			
2-fluorobiphenyl	72	43	103
Terphenyl-d14	78	32	125
2,4,6-Tribromophenol	80	36	126
2-Fluorophenol	70	37	104
Phenol-d5/d6	71	40	102
Nitrobenzene-d5	69	37	102
Pesticides – Water			
Decachlorobiphenyl	83	32	135
Tetrachlorometaxylene (TCMX)	81	25	138
Pesticides – Solid			
Decachlorobiphenyl	94	56	132
TCMX	97	69	124
Polychlorinated Biphenyl (PCB) – Water			
Decachlorobiphenyl	88	42	133
PCB – Solid			
Decachlorobiphenyl	91	58	125
High Explosives (HE) – Water			
3,4-Dinitrotoluene	86	33	139
2-Methyl-4-nitroaniline	86	33	139
1,4-Dintrobenzene	86	33	139
1,2-Dintrobenzene	86	33	139
HE – Solid			
3,4-Dinitrotoluene	98	56	140
2-Methyl-4-nitroaniline	98	56	140
1,4-Dintrobenzene	98	56	140
1,2-Dintrobenzene	98	56	140

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Appendix E

Gas Chromatography/Mass Spectrometry (GC/MS) Internal Standards

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Laboratories may vary the compounds calculated off of any internal standard (IS) and should identify within the report which compounds were calculated from each IS. If this information is not readily available the following tables may be used as guidelines.

GC/MS Volatile Organic Analysis Internal Standard Tables

Fluorobenzene

Chloromethane	Vinyl Chloride	Bromomethane	Chloroethane
Acetone	1,1-Dichloroethene	Methylene Chloride	Carbon Disulfide
1,1-Dichloroethane	Trans-1,2-Dichloroethene	2-Butanone	2,2-Dichloropropane
Cis-1,2-Dichloroethene	Chloroform	Bromochloromethane	1,1,1-Trichloroethane
1,1-Dichloropropene	Carbon Tetrachloride	1,2-Dichloroethane	Benzene
Trichloroethene	1,2-Dichloropropane	Bromodichloromethane	Dibromomethane
4-Methyl-2-pentanone	Cis-1,3-Dichloropropene	Trichlorofluoromethane	Acetonitrile
Acrolein	Acrylonitrile	n-Butyl alcohol	2-Chloro-1,3-butadiene
Dichlorodifluoromethane	1,4-Dioxane	Ethyl acetate	Iodomethane
Isobutyl alcohol	Methacrylonitrile	Methyl methacryalate	Methyl isobutyl ketone
Propionitrile	Trichlorofluoromethane		

Chlorobenzene-d5

Toluene	Trans-1,3-Dichloropropene	1,1,2-Trichloroethane	2-Hexanone
1,3-Dichloropropane	Tetrachloroethene	Chlorodibromomethane	1,2-Dibromoethane
Chlorobenzene	1,1,1,2-tetrachloroethane	Ethylbenzene	m,p-Xylenes
o-Xylene	Styrene	Bromoform	1,1,2,2-Tetrachloroethane
Ethyl methacrylate			

1,4-Dichlorobenzene-d4

1,2,3-Trichloropropane	Bromobenzene	1,2-Dibromo-3-chloropropane	1,2-Dichlorobenzene
1,3-Dichlorobenzene	1,4-Dichlorobenzene	Hexachlorobutadiene	Napthalene
Pentachloroethane	1,2,4-Trichlorobenzene		

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GC/MS Semivolatile Organic Analysis Internal Standard Tables

1,4-Dichlorobenzene-d4

2-Fluorophenol	Phenol-d5	2-Chlorophenol-d4	1,2-Dichlorobenzene-d4
Phenol	Bis (2-Chloroethyl) ether	2-Chlorophenol	1,3-Dichlorobenzene
1,4-Dichlorobenzene	1,2-Dichlorobenzene	2-Methylphenol	2,2'-oxybis(2-Chloropropane
4-Methylphenol	N-Nitroso-di-n-propylamine	Hexachloroethane	Pyridine
Acetophenone	Aniline	Methyl metanesulfonate	N-Nitrosodiethylamine
N-Nitrosodimethylamine	N-Nitrosomethylethylamine	N-Nitrosomorpholine	N-Nitrosopiperidine
N-Nitrosopyrrolidine			

Naphthalene-d8

Nitrobenzene-d5	Nitrobenzene	Isophorone	2-Nitrophenol
2,4-Dimethylphenol	Bis (2-Chloroethoxy) methane	2,4-Dichlorophenol	1,2,4-Trichlorobenzene
Naphthalene	4-Chloroaniline	Hexachlorobutadiene	4-Chloro-3-methylphenol
2-Methylnaphthalene	Benzoic Acid	2.6-Dichlorophenol	Hexachloropropene
N-Nitrosodi-n-butylamine	Safrole		

Acenaphthene-d10

2,4,6-Tribromophenol	2-Fluorobiphenyl	Hexachlorocyclopentadiene	2,4,6-Trichlorophenol
2,4,5-Trichlorophenol	2-Chloronaphthalene	2-Nitroaniline	Dimethylphthalate
Acenaphthylene	2,6-Dinitrotoluene	3-Nitroaniline	Acenaphthene
2,4-Dinitrophenol	4-Nitrophenol	Dibenzofuran	2,4-Dinitrotoluene
Diethylphthalate	4-Chlorophenyl phenyl ether	Fluorene	4-Nitroaniline
2-sec-Butyl-2,6-dinitrophenol	Isosafrole	N-Nitro-o-toluidine	Pentachlorophenol
1,2,4,5-Tetrachlorobenzene	2,3,4,6-Tetrachlorophenol		

Phenanthrene-d10

2,4-Dinitro-2-methylphenol	N-Nitrosodiphenylamine	4-Bromophenyl phenyl ether	Hexachlorobenzene
Pentachlorophenol	Phenanthrene	Anthracene	Carbazole
Di-n-butylphthalate	Fluoranthene	Methapyrilene	Pentachloronitrobenzene
Phenacetin	Pronamide		

Chrysene-d12

Pyrene	Butylbenzylphthalate	3,3'-Dichlorobenzidine	Benzo(a)anthracene
Chrysene	Bis(2-Ethylhexl)phthalate	2-Acethylaminofluorene	Chlorobenzilate

Perlene-d12

Di-n-octylphthalate	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene	Dibenz(a,h)anthracene	Benzo(g,h,i)perylene	Hexachlorophene
3-Methylcholanthrene			

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Appendix F

Laboratory Control Limits

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Organic Laboratory Control Sample (LCS) Criteria Guidelines (Volatile Compounds)

Volatile Compound	CAS #*	Water			Solid		
		Ave	Low	High	Ave	Low	High
Acetone	67-64-1	91	39	142	88	19	158
Benzene	71-43-2	102	81	122	99	73	126
Bromobenzene	108-86-1	100	76	124	93	66	121
Bromochloromethane	74-97-5	97	65	129	99	71	127
Bromodichloromethane	75-27-4	98	76	121	100	72	128
Bromoform	75-25-2	99	69	128	96	56	137
Bromomethane	74-83-9	88	30	146	95	31	159
2-Butanone	78-93-3	91	32	150	94	29	159
n-Butylbenzene	104-51-8	103	69	137	101	65	138
sec-Butylbenzene	135-98-8	100	72	127	97	63	132
tert-Butylbenzene	98-06-6	99	70	129	99	65	132
Carbon disulfide	75-15-0	100	37	162	103	47	159
Carbon tetrachloride	56-23-5	102	66	138	100	67	133
Chlorobenzene	108-90-7	102	81	122	99	75	123
Chloroethane	75-00-3	99	62	135	98	39	157
Chloroform	67-66-3	100	63	136	98	72	124
Chloromethane	74-87-3	83	39	127	90	51	129
2-Chlorotoluene	95-49-8	100	73	126	98	69	128
4-Chlorotoluene	106-43-4	101	74	128	100	73	126
Dibromochloromethane	124-48-1	96	58	133	98	66	130
1,2-Dibromo-3-chloropropane	96-12-8	91	50	132	87	40	135
1,2-Dibromoethane	106-93-4	100	80	121	97	70	124
Dibromomethane	74-95-3	101	76	125	100	73	128
1,2-Dichlorobenzene	95-50-1	96	71	122	97	74	119
1,3-Dichlorobenzene	541-73-1	100	75	124	98	72	124
1,4-Dichlorobenzene	106-46-7	99	74	123	98	72	125
Dichlorodifluoromethane	75-71-8	93	31	155	85	34	136
1,1-Dichloroethane	75-34-3	101	69	133	99	73	125
1,2-Dichloroethane	107-06-2	100	69	132	104	72	137
1,1-Dichloroethene	75-35-4	99	68	130	100	65	136
cis-1,2-Dichloroethene	156-59-2	99	72	126	96	67	125
trans -1,2-Dichloroethene	156-60-5	99	60	139	100	66	134
1,2-Dichloropropane	78-87-5	100	75	125	95	71	119
1,3-Dichloropropane	142-28-9	100	73	126	100	76	123
2,2-Dichloropropane	594-20-7	103	69	137	101	67	134
1,1-Dichloropropene	563-58-6	102	73	132	102	70	135
cis-1,3-Dichloropropene	10061-01-5	100	69	131	99	72	126
trans-1,3-Dichloropropene	10061-02-6	98	53	142	96	65	127
Ethylbenzene	100-41-4	100	73	127	101	74	127
Hexachlorobutadiene	87-68-3	97	51	142	98	53	142

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Organic LCS Criteria Guidelines (Volatile Compounds) (concluded)

Volatile Compound	CAS #*	Water			Solid		
		Ave	Low	High	Ave	Low	High
2-Hexanone	591-78-6	92	56	128	97	47	146
Isopropylbenzene	98-82-8	101	75	127	103	77	129
4-Isopropyltoluene	99-87-6	102	73	131	104	75	133
Methylene chloride	75-09-2	96	53	140	97	54	141
4-Methyl-2-pentanone	108-10-1	96	58	134	97	47	147
Naphthalene	91-20-3	96	54	138	84	40	127
n-Propylbenzene	103-65-1	101	72	129	99	63	135
Styrene	100-42-5	100	65	134	101	74	128
1,1,1,2-Tetrachloroethane	630-20-6	105	81	129	100	74	125
1,1,2,2-Tetrachloroethane	79-34-5	96	63	128	93	54	131
Tetrachloroethene	127-18-4	96	44	149	103	67	139
Toluene	108-88-3	100	77	122	99	71	127
1,2,3-Trichlorobenzene	87-61-6	99	57	142	97	62	133
1,2,4-Trichlorobenzene	120-82-1	100	66	134	98	65	131
1,1,1-Trichloroethane	71-55-6	100	67	132	101	68	133
1,1,2-Trichloroethane	79-00-5	100	75	125	95	62	127
Trichloroethene	79-01-6	96	44	149	103	67	139
1,2,3-Trichloropropane	96-18-4	98	73	124	97	63	130
1,2,4-Trimethylbenzene	95-63-6	103	74	132	98	65	131
1,3,5-Trimethylbenzene	108-67-8	102	74	131	99	65	133
Vinyl chloride	75-01-4	99	50	147	92	58	126
o-Xylene	95-47-6	100	80	121	101	77	125

*chemical abstract service number

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Organic LCS Criteria Guidelines (Semivolatile Compounds)

Semivolatile Compound	CAS #*	Water			Solid		
		Ave	Low	High	Ave	Low	High
Polynuclear Aromatics							
2-Methynaphthalene	91-57-6	75	46	104	77	47	107
Acenaphthene	83-32-9	78	47	108	77	46	108
Acenaphthylene	208-96-8	79	50	107	76	44	107
Anthracene	120-12-7	83	54	112	80	53	107
Benz(a)anthracene	56-55-3	83	56	109	82	52	111
Benzo(b)fluoranthene	205-99-2	82	45	118	80	45	114
Benzo(k)fluoranthene	207-08-9	85	45	124	84	45	123
Benzo(g,h,i)perylene	191- 24-2	81	38	123	82	38	126
Benzo(a)pyrene	50-32-8	81	53	110	81	50	111
Chrysene	218-01-9	82	55	109	83	53	112
Dibenz(a,h)anthracene	53-70-3	85	42	127	83	41	125
Fluoranthene	206-44-0	85	54	116	84	54	114
Fluorene	86-73-7	81	50	112	78	49	108
Indeno(1,2,3-cd)pyrene	193-39-5	84	43	125	80	38	121
Naphthalene	91-20-3	71	39	102	73	40	107
Phenanthrene	85-01-8	84	51	117	80	50	110
Pyrene	129-00-0	89	49	128	84	46	123
Phenolic/Acidic							
2,4-Dichlorophenol	120-83-2	76	48	105	77	45	110
2, 4-Dimethylphenol	105-67-9	69	28	109	67	32	103
2,4-Dinitrophenol	51-28-5	76	14	138	73	13	132
2-Chlorophenol	95-57-8	71	37	106	75	44	106
2-Methylphenol	95-48-7	73	38	109	72	40	104
3-Methylphenol	108-39-4	71	32	110	74	41	107
4-Methylphenol	106-44-5	71	32	110	74	41	107
2-Nitrophenol	88-75-5	76	39	113	76	42	111
4,6-Dinitro-2-methylphenol	534-52-1	85	40	130	83	29	137
4-Chloro-3-methylphenol	59-50-7	79	47	111	80	46	113
Pentachlorophenol	87-86-5	78	38	117	72	25	119
4-Nitrophenol	100-02-7				77	17	138
Phenol	108-95-2				70	39	100
Basic							
3,3'-Dichlorobenzidine	91-94-1	65	19	111			
4-Chloroaniline	106-47-8	62	15	109			
Phthalate Esters							
Bis(2-ethylhexyl) phthalate	117-81-7	84	42	126	87	47	127
Butyl benzyl phthalate	85-68-7	81	46	116	86	49	123
Di-n-butyl phthalate	84-74-2	85	54	116	83	56	110
Di-n-octyl phthalate	117-84-0	87	37	137	86	41	132

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Organic LCS Criteria Guidelines (Semivolatile Compounds) (concluded)

Semivolatile Compound	CAS #*	Water			Solid		
		Ave	Low	High	Ave	Low	High
Polynuclear Aromatics							
Diethyl phthalate	84-66-2	79	41	118	82	50	114
Dimethyl phthalate	131-11-3	76	25	127	80	49	110
Nitrosoamines							
N-Nitrosodimethylamine	62-75-9	68	26	110	66	18	114
N-Nitrosodiphenylamine	86-30-6	80	48	111	82	49	116
N-Nitroso-di-n-propylamine	621-64-7	81	34	128	77	40	114
Chlorinated Aliphatics							
Bis(2-chloroethoxy) methane	111-91-1	76	46	107	76	43	108
Bis(2-chloroethyl) ether	111-44-4	73	37	110	71	38	105
Bis(2-chloroisopropyl) ether	108-60-1	78	26	131	68	21	115
Hexachlorobutadiene	87-68-3	65	27	103	78	40	117
Hexachloroethane	67-72-1	61	28	94	72	37	110
Halogenated Aromatics							
1,2,4-Trichlorobenzene	120-82-1	72	37	107	77	44	111
1,2-Dichlorobenzene	95-50-1	67	33	102	71	45	97
1,3-Dichlorobenzene	541-73-1	65	32	98	70	39	100
1,4-Dichlorobenzene	106-46-7	65	32	98	69	35	103
2-Chloronaphthalene	91-58-7	77	49	104	75	45	105
4-Bromophenyl phenyl ether	101-55-3	83	52	113	82	46	117
4-Chlorophenyl phenyl ether	7005-72-3	81	50	111	80	47	112
Hexachlorobenzene	118-74-1	82	52	112	83	47	118
Nitroaromatics							
2,4-Dinitrotoluene	121-14-2	84	51	118	82	48	116
2,6-Dinitrotoluene	606-20-2	83	49	117	80	48	112
2-Nitroaniline	88-74-4	82	48	115	81	44	118
3-Nitroaniline	99-09-2	73	19	126	69	27	110
4-Nitroaniline	100-01-6	77	36	118	74	34	113
Nitrobenzene	98-95-3	77	44	109	77	41	113
Neutral Aromatics							
Carbazole	86-74-8	83	48	117	80	44	117
Dibenzofuran	132-64-9	80	54	107	77	51	103
Others							
Benzyl alcohol	100-51-6	71	30	112	71	19	123
Isophorone	78-59-1	81	50	112	77	43	111

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Organic LCS Criteria Guidelines
(Pesticides and Polychlorinated Biphenyl [PCB])

Pesticide	CAS #*	Water			Solid		
		Ave	Low	High	Ave	Low	High
Aldrin	309-00-2	83	27	138	93	47	140
α-benzene hexachloride (BHC)	319-84-6	94	60	128	93	62	125
β-BHC	319-85-7	96	66	126	95	62	127
δ-BHC	319-86-8	91	46	136	94	57	130
γ-BHC (Lindane)	58-89-9	82	27	137	91	59	123
α-Chlordane	5103-71-9	93	63	123	92	63	121
4,4'- Dichlorodiphenyldichloroethane (DDD)	72-54-8	88	27	149	81	28	135
4,4'- Dichlorodiphenyldichloroethylene (DDE)	72-55-9	87	33	140	97	68	126
4,4'- Dichlorodiphenyltrichloroethane (DDT)	50-29-3	92	47	138	92	45	140
Dieldrin	60-57-1	95	62	129	96	67	125
Endosulfan I	959-98-8	80	49	111	74	14	133
Endosulfan II	33213-65-9	79	28	130	89	37	141
Endosulfan sulfate	1031-07-8	96	54	137	99	62	135
Endrin	72-20-8	95	56	134	97	61	133
Endrin aldehyde	7421-93-4	96	56	137	92	37	147
Endrin ketone	53494-70-5	102	77	127	100	66	134
Heptachlor	76-44-8	87	42	131	96	51	140
Heptachlor epoxide	1024-57-3	96	62	131	98	66	130
4,4'-Methoxychlor	72-43-5	103	56	150	100	57	143
PCB							
Aroclor – 1016	12674-11-2	85	25	144	90	41	138
Aroclor – 1260	11096-82-5	87	30	146	96	61	131

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Organic LCS Criteria Guidelines (Nitroaromatics and Nitramines)

Nitroaromatics and Nitramines	CAS #*	Water			Solid		
		Ave	Low	High	Ave	Low	High
2-Amino-4,6-Dinitrotoluene (2-Am-DNT)	355-72-78-2	87	59	115	102	80	124
4-Amino-2,6-Dinitrotoluene (4-Am-DNT)	1946-51-0	96	56	137	101	79	124
1,3-Dinitrobenzene (DNB)	99-65-0				101	79	124
2,4-Dinitrotoluene (24DNT)	121-14-2	83	12	154	98	36	161
2,6-Dinitrotoluene (26DNT)	606-20-2				100	77	122
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	88	40	136	103	72	134
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	85	17	153			
Nitrobenzene (NB)	98-95-3				96	39	154
2-Nitrotoluene (2NT)	88-72-2				97	39	156
3-Nitrotoluene (3NT)	99-08-1	80	15	146	95	32	159
4-Nitrotoluene (4NT)	99-99-0	80	16	144	101	77	124
Pentaerythritol tetranitrate (PETN)							
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	89	47	131	100	74	126
Trinitrobenzene (135TNB)	99-35-4				95	34	156
2,4,6-Trinitrotoluene (TNT)	118-96-7				95	17	173

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Appendix G

Mass Spectra Acceptability

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Mass Spectra Acceptability

Ideal spectral identification of a target analyte by a mass spectrometer data system is performed by comparing three characteristic ions (i.e., a primary or quantitation ion, a secondary ion, and a tertiary ion) from one mass spectrum to the same characteristic ions in the reference mass spectrum. The three characteristic ions from the mass spectrum are defined as the three ions of greatest relative intensity or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum. In most cases, ions with the greatest abundance are used for evaluation; however, if target analytes suffer from coelution, interferences may dictate the use of less abundant ions for evaluation. Some analytes generate a mass spectrum that is of such a simple nature that a tertiary ion is not sufficiently abundant (e.g., low molecular weight analytes and analytes that do not fragment sufficiently upon electron impact ionization). In this case, two ions are used for identification.

For evaluation of analyte spectra, all of the following factors should be considered before an acceptability judgment is made.

Retention Times (RT)

The intensities of the primary, secondary, and, if applicable, tertiary ions at the established RT of the target analyte are shown in the extracted ion current profiles (EICP). The RTs for the secondary and tertiary ion profiles should be the same as the primary ion. Depending on peak shape and chromatographic interferences, the RTs could differ by a few hundredths of a minute; however, the RTs between primary and secondary ions should not vary by more than 0.03 minutes.

Relative Retention Times (RRT)

The RRT of the target analyte in the sample should agree to within 0.06 RRT units of the same analyte in the reference standard (either the midpoint standard of the initial calibration or the daily continuing calibration verification).

Ion Ratios

The most intense ion in a spectrum is assigned a relative abundance of 100 and is known as the base peak. The intensities of all other ions in the spectrum are compared to the intensity of the base peak to obtain an intensity ratio (or ion ratio). The ion ratios for the three characteristic ions from the sample spectrum are compared to the ion ratios for the same ions from the reference spectrum. Relative intensities should agree to within ±30%. For example, an ion that has an abundance of 50% when compared to the base peak in the reference spectrum will have a range of 20-80% as its acceptance criteria for that same ion in the sample spectrum.

Ion ratio evaluation is performed by the laboratory. Gas chromatography/mass spectrometry data systems automatically flag target analytes with a “Q” or a “#” on the quantitation report when ratio comparison criteria are exceeded. Because interferences and varying instrument conditions can affect relative abundances, the presence of a Q flag does not necessarily indicate an invalid identification; however, a Q flag in addition to other guideline failures may result in the need for additional data in order to make an acceptability judgment.

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Visual Comparison of Mass Spectra

The sample spectrum should be visually compared to the reference spectrum for pattern similarity. When a peak elutes in a discrete manner and the reference spectrum was obtained under similar conditions as the sample spectrum, the mass spectral pattern from the sample will be similar to the mass spectral pattern of the reference spectrum. If coelution occurs or a high level of background is present, the partial or total spectral pattern from the reference spectrum should be visible within the spectral pattern of the sample spectrum, with sample ion ratios emulating the reference ion ratios, depending on the inherent complexity of the analyte spectrum.

Identification of Target Analytes Present in Samples at Low Levels

Spectra from target analytes that are detected at levels around the established method detection limit (MDL) should be examined carefully for the presence of secondary and, if applicable, tertiary ions. For a qualitative identification to be made, all ions used by the instrument method should be present. Because background noise, column bleed, and interferences can hamper identification, correct subtraction is important to identification. Supplemental data may be required from the laboratory in order to properly separate chromatographic interferences. These data may include a library search with listed spectral fit (or match) quality (i.e., a "Q report") or additional EICPs displaying interfering ions for RT comparison.

Interferences

Identification of target analytes is hampered when sample components are not resolved chromatographically (i.e., there is co-elution of non-target and/or target analytes) and produce mass spectra containing ions from more than one analyte. When gas chromatography (GC) peaks, EICPs, or spectra show evidence of interference (e.g., GC or EICP peak appears broadened with shoulders, obviously overlapping peaks are present, or extraneous ions are present in the spectrum), supplemental data may be required from the laboratory in order to properly evaluate analyte spectra. These data may include a Q report or additional EICPs displaying interfering ions for RT comparison.

Guidelines for Use of Supplemental Data

Q Report

If a target analyte is detected by the mass spectrometer data system and its identification is questionable, the mass spectrum for that analyte may be subjected to a computer comparison against a library of established mass spectra (i.e., a "library search"). This search generates a Q report that shows the mass spectrum being searched, the compounds in the library whose spectra most closely matches the mass spectrum being searched, and a Chemical Abstract Services (CAS) number and a match quality rating from 1-100 (with 100 being a perfect match fit) for each of those compounds. A Q report obtained for a spectrum at the RT of the analyte in question can sometimes help identify that analyte. Ideally, if a data system identifies a target analyte using the identification parameters discussed (i.e., RT, RRT, and major ion intensity ratios), a library search of the analyte should yield concurrent results with a match rating of >75. The following variables affect match quality ratings:

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The Analyte Concentration

For identification of an analyte of low concentration (i.e., detections at or just above the MDL), ions of >50% relative intensity in library spectrum should be present in sample spectrum. If minor ions in the analyte spectrum are absent due to low concentration, the match quality rating may be low.

The Nature of the Spectrum

If the spectrum of the analyte in question is relatively complex (i.e., the spectrum contains multiple ions of >50% relative intensity), match quality ratings will generally be higher. If the spectrum of the peak in question only yields two or three ions within scanning range, separation from interferences and background is sometimes not possible, making match quality ratings lower. Also, if the spectrum of the analyte in question has one or more ions common to known contaminants, misidentification will be more common (e.g., acetone with its primary ion of 43 is sometimes hard to distinguish from early eluting, low molecular weight hydrocarbons that have the same ion as their primary ions).

The presence of one or more interferences can affect match quality ratings. One dominant interference can yield spectral match quality ratings that are high but whose best match is primarily due to the interfering non-target analyte, not the analyte in question. Multiple interferences will usually yield match quality ratings that are low due to the inability of the software to make a match without a dominant pattern.

The Conditions Under Which the Library Spectrum is Obtained

If spectral quality matches are low, especially for the target analyte in question, the library spectra for the analyte in question should be considered suspect. Mass spectra in established libraries are normally generated under wider scan ranges than are dictated in methods. Low molecular weight analytes in the library may have one or more characteristic ions below the scanning range of the environmental analytical method, rendering the spectra in the low molecular weight range only partially comparable. If it is obvious that the library mass spectrum for an analyte was obtained under different scanning conditions as the sample spectrum, match quality ratings may be reduced.

Additional EICPs

The review of EICPs of all ions of >50% relative abundance, including the primary, secondary, and tertiary ions of the analyte in question as well as ions from interfering analytes, is one way to determine interference separability and abundance contribution. If some or all of the ions from an interfering analyte (i.e., those not contained in the target analyte in question) maximize at the same RT as the target analyte in question, it is possible that interfering ions are contributing abundance to the analyte in question. Also, if peak shape is variable, it is possible that two or more compounds are co-eluting and are contributing a range of ions and overlapping chromatographic peak shapes. If EICPs show that the characteristic ions from the analyte in question elute at the same RT and that RT differs from the EICPs of the ions from interfering compounds, then it is possible that the target analyte in question is present.

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SANDIA NATIONAL LABORATORIES
LONG TERM STEWARDSHIP DEPARTMENT (4142)

SOIL VAPOR MONITORING
FIELD OPERATING PROCEDURE

FOP 08-22
Revision 3

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Approved: _____ **Date:** 6/16/14
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Revision History

Revision	Effective Date	Summary of Changes
0	1/27/2009	Original Issue
1	5/27/09	Section 6.3 – "Quality Control Sample Equipment Setup and Sampling Procedure" added.
2	6/09/2011	The rewrite makes FOP not specific to the CAMU. It now applies to soil vapor sampling at any SNL/NM site. Site-specific information for CAMU, CWL, MWL, and TA-V included in the attachments.
3		Updates include methane gas monitoring and attachment for TA-III Classified Waste Landfill. On-the-Job Training, Authorized User List, and Tailgate Safety Briefing attachments removed. Table B-1 and purge time requirements removed from Attachment B. Updated Attachment C to reflect approval of the LTMMP.

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ACRONYMS

AR/COC	Analysis Request/Chain of Custody
AOP	administrative operation procedure
CAMU	Corrective Action Management Unit
CLWL	TA-III Classified Waste Landfill
CWL	Chemical Waste Landfill
ES&H	Environment Safety & Health
ft	foot/feet
FOP	field operating procedure
GFCI	ground fault circuit interrupter
Hg	mercury
In.	inch/inches
LEL	lower explosive limit
LTMMP	Long-Term Monitoring and Maintenance Plan
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
OJT	on-the-job training
PCC	Post-Closure Care
PHS	primary hazard screening
PID	photoionization detector
psi	pounds per square inch
QA/QC	quality assurance / quality control
SAP	sampling and analysis plan
SIH	standard industrial hazards
SMO	Sample Management Office
SNL/NM	Sandia National Laboratories/New Mexico
TA	Technical Area
TEDS	Training and Employee Development System
THA	task hazard analysis
VOC	volatile organic compound

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1.0 PURPOSE, SCOPE, AND OWNERSHIP

Purpose

The purpose of this field operating procedure (FOP) is to provide guidelines and procedures for soil vapor monitoring at different Sandia National Laboratories/New Mexico (SNL/NM) sites. Soil vapor monitoring can consist of taking *in situ* real-time measurements and/or collecting samples. Different sites are subject to different regulatory requirements and this is reflected in the type of monitoring that is performed. This procedure shall be used, as applicable, based upon the regulatory requirements for each site. Site-specific information, requirements and protocol are summarized in site-specific permits, and in attachments to this FOP.

Scope

This FOP is applicable to all Sandia Corporation (Sandia) employees and contractors who perform soil vapor monitoring activities at SNL/NM. Soil vapor monitoring is routinely performed at the Corrective Action Management Unit (CAMU) containment cell, Chemical Waste Landfill (CWL), Mixed Waste Landfill (MWL), Technical Area (TA)-V, and TA-III Classified Waste Landfill (CLWL). Site-specific information is provided in Attachments A, B, C, D, and E for the CAMU, CWL, MWL, CLWL, and TA-V, respectively. The general guidelines in this FOP may also be applied to non-routine soil vapor monitoring locations/events (*e.g.*, Tijeras Arroyo).

If other SNL/NM sites are subject to routine soil vapor monitoring in the future, additional attachments may be added to this FOP to address site-specific requirements and any variations to the general monitoring procedures covered in this FOP. If requirements change for the sites already addressed in this FOP, revisions will be made to the site-specific attachment.

Ownership

The Long Term Stewardship Department is responsible for development, approval, and revision of this document.

2.0 RESPONSIBLE INDIVIDUALS AND ORGANIZATIONS

The **Department Manager** is responsible for the following:

- Providing programmatic guidance leading to the development of this FOP.
- Review and approval of the procedure.
- Establishing and documenting field technician training in compliance with this FOP, site-specific permits (CAMU and CWL), and the MWL Long-Term Monitoring and Maintenance Plan (LTMMP).

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The **Field Support Operations Project Lead** is responsible for the following:

- Coordinating with the Department Manager, Project Lead and Field Technicians regarding soil vapor sampling activities and the documentation of all required training.
- Assigning qualified Field Technicians to conduct the activities described in this procedure.
- Supervising the Field Technicians.
- Coordinating on-the-job (OJT) training for Field Technicians (trainees) performing the activities described in this procedure for the first time.
- Reviewing, implementing, and verifying the completion of all training required for Field Technicians.
- Providing Field Technicians with necessary equipment and supplies to conduct field work.
- Reviewing, revising, and maintaining technical work documents.

The **Project Lead** or designee is responsible for the following:

- Reviewing and concurring with this procedure and the related site-specific attachment(s).
- Providing overall coordination and management of site-specific soil vapor monitoring events.
- Providing copies of the relevant sections of the site-specific permit and sampling and analysis plan (SAP) (CAMU and CWL) and the MWL LTMMP for Field Technician review and signoff, prior to sampling.
- Reviewing field documentation and analytical results.
- Assisting with the revision of this procedure as necessary or every three years.

The **Field Technician** is responsible for the following:

- Completing all necessary and required training as specified by the Field Support Operations Project Lead. At a minimum, required training shall include the training defined in this FOP, site-specific permits (CAMU and CWL), and the MWL LTMMP.
- Maintaining requisite training status.
- Inspecting and maintaining equipment.
- Completing a tailgate safety briefing prior to each day's soil vapor monitoring activities.
- Collecting and storing samples properly, when applicable.
- Delivering samples to the Sample Management Office (SMO) in a timely manner, relative to analytical holding times, when applicable.
- Completing and reviewing field documentation forms.
- Inspecting soil vapor monitoring locations during each sampling event and documenting the inspections along with any deficiencies and/or repairs, or breach of monitoring location security. Reporting deficiencies and/or breach of security to the Field Support Operations Project Lead and the Project Lead.

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- Providing recommendations for revisions to this procedure (*i.e.*, process improvement feedback as appropriate).

3.0 TRAINING QUALIFICATIONS

Personnel conducting soil vapor monitoring shall complete all training required to perform work under this FOP and in accordance with site-specific permits and the MWL LTMMP:

- Field personnel shall sign an Authorized Users List (EP2009-AUL) to affirm they have read and understand this document, and agree to operate within the stated constraints.
- Read SNL/NM Corporate Policy ESH100 Environment Safety & Health.
- Required department training and training identified in the primary hazard screening (PHS) results.
- Read applicable site-specific training (*i.e.*, PHS, health and safety plan, etc.)
- Read applicable sections of site-specific permits and SAPs (CAMU and CWL), the MWL LTMMP, and comply with the related training program requirements.
- Document site-specific permit training requirements (CAMU, CWL) for a Field Technician (on file at the CAMU Administrative Trailer).
- OJT, as necessary, for new personnel performing field activities. Document training by completing an OJT Form (EP 2009-OJT).
- Complete training courses listed in Table 1.

Table 1 - Training Course List

Course Code	Course Title
CHM100	Chemical Safety
CHM103	Site Specific Chemical Safety
ELC105	Basic Electrical Safety (> 50 volts)
ENV100	OSHA Health & Safety Basic Training – General Worker (40 HR)
ENV103	OSHA Health & Safety Training Refresher (8 HR)
ENV112	Hazardous Waste & Environmental Management Training
ESH100	Environment Safety& Health Awareness
MCH200	Hand and Power Tool Safety
MED102	Standard First Aid
MED104	Heartsaver CPR
OTS101	Occupational Thermal Stress
PPE106	Personal Protective Equipment Training
PRS150	Pressure Safety Orientation
PRS250	Advance Pressure Safety
RAD102	General Employee Radiological Training

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4.0 HEALTH AND SAFETY

A task hazard analysis (THA) has been performed on the activities described in this FOP and is detailed in Section 4.1. The THA classifies the potential hazards and rates them based on the probability of occurrence. The THA lists control measures that will be used to mitigate the potential hazards. A site-specific PHS (see Section 9.0 for list of applicable PHSs) shall be completed prior to soil vapor monitoring activities to help identify potential hazards that can be expected when performing the work. The control measures may include exposure assessment surveys (by a SNL/NM industrial hygienist), courses, and training that are identified as part of the PHS results. This approach to identifying, rating, and controlling hazards is consistent with SNL/NM's Integrated Safety Management System initiative. Hazards classification is standard industrial hazards (SIH) for activities identified in this FOP.

A site-specific Activity Level Work Evaluation Form (EP 2009-ALW) shall be completed and approved by the Department Manager as required by administrative operating procedure (AOP) 09-10, *Work Planning and Controls*.

A site-specific tailgate safety and emergency response briefing shall be conducted by a qualified Field Technician each day before the start of field activities.

In the event that work is stopped due to:

- safety related issue(s),
- an injury incurred while performing the tasks identified in this procedure, or
- as the result of an audit,

the Field Technician shall immediately notify the Field Support Operations Team Lead, the Project Lead, and the Department Manager. The Field Technician shall seek the assistance of the Field Support Operations Team Lead for the mitigation of the hazard and the completion of a Work Resumption Authorization Form (EP 2009-WRA) as required by AOP 09-10, *Work Planning and Controls*. The Department Manager shall sign the completed form prior to the restart of work.

4.1 Task Hazard Analysis

Task Description - Soil Vapor Sampling for Volatile Organic Compounds

Soil vapor samples are collected from various SNL/NM sites (*e.g.*, CAMU, CWL, MWL, TA-V) and are analyzed to determine levels of volatile organic compound (VOC) contaminants in the surrounding soil pore space. VOC screening with a photoionization detector (PID) or equivalent detector is performed prior to sample collection to provide real-time data relative to stabilization of organic soil vapor concentrations during the purging process. (Note: Based upon historic soil

vapor concentrations documented at the sites, VOC screening with a PID or equivalent detector during the purging and sampling process is not necessary for worker health and safety purposes). The samples are collected by connecting tubing from a sampling pump to a sampling port on the soil vapor monitoring system. A SUMMA® canister is connected in line with the tubing system. The SUMMA® canister is under a vacuum and has a valve that when opened, draws in the vapor sample. The pump is run to purge the air from the sampling tube and draw representative soil vapor from the soil pore space surrounding the sampling port in the subsurface prior to collecting the soil vapor sample. After the air has been purged from the sampling tube and area immediately surrounding the sample port, the pump is turned off and a valve is opened on the SUMMA® canister which draws in the vapor sample. A THA is provided in Table 2.

Task Description – Soil Vapor Monitoring for Methane Gas

An instrument which is capable of measuring methane gas as a percentage of the lower explosive limit is used to monitor and report methane. An extension tube (rigid acrylic) with stopper is attached to the instrument and is lowered into monitoring ports. The stopper creates a seal that allows for *in situ* monitoring of methane gas that may have collected inside the port.

A THA for the activities soil monitoring for VOCs and methane gas is provided in Table 2.

Table 2 – Task Hazard Analysis
Soil Monitoring for VOCs and Methane Gas

Level of Protection—Level D Personal Protective Equipment (safety shoes/boots, safety glasses)

Potential Hazard	Hazard Rating	Control
Chemical (various VOCs)	SIH	• There will be no contact with contaminated soils during soil vapor monitoring activities. Soil vapors will be monitored using a PID as part of the purging process for VOC sampling. Historically VOC levels have been low (parts per million). Eating, drinking and smoking will not be permitted while performing soil monitoring activities.
Physical • Heat stress • Cold stress • Sunburn • Mechanical hazards • Pinch points • Strains, and lifting hazards • Slips, trips, falls • Motor vehicle accident • Electrical • Vacuum (negative pressure)	SIH	• Soil vapor monitoring activities are not physically demanding. Workers will be trained on heat stress, cold stress, and sunburn hazards. Sunscreen will be provided. • Appropriate inspections of equipment will be performed prior to use. • Leather work gloves will be worn when handling steel cable and removing vault covers. • Proper lifting techniques will be reinforced. • Proper housekeeping will be maintained. • Holes around monitoring area will be filled or covered to eliminate slip, trip hazards. • Seat belts will be worn anytime drivers and passengers are in a moving motor vehicle. • Proper ground fault circuit interrupter (GFCI) devices will be used for the electric equipment and tested before each use.

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Table 2 – Task Hazard Analysis
Soil Monitoring for VOCs and Methane Gas (concluded)
Level of Protection—Level D Personal Protective Equipment (safety shoes/boots, safety glasses)

Potential Hazard	Hazard Rating	Control
Physical (concluded)	SIH	• A management approved pressure safety data package is in place for equipment used for soil vapor sampling.
Radiological	SIH	• There are no radiological hazards specifically related to soil vapor monitoring at the CAMU, CWL, MWL, CLWL, and TA-V.
Fire	SIH	• Fire extinguishers will be located in mobile equipment.

5.0 EQUIPMENT AND MATERIALS

5.1 Equipment and Materials for VOC Soil Vapor Sampling

The equipment and materials required for performing VOC soil vapor sampling are as follows:

- Analysis Request/Chain-of-Custody (AR/COC) forms and sample labels.*
- Logbook (if applicable).
- Field forms:
  - SUMMA® Canister Log (Attachment F).
  - Soil Vapor Sampling Log (Attachment G).
- AC power provided by ground fault circuit interrupter (GFCI) outlets.
- Vacuum pump and sampling manifold assembly.
- Flow rate meter.
- Vacuum gauge.
- VOC monitoring equipment (PID or equivalent).
- SUMMA® canister(s).
- Ultra-pure nitrogen gas cylinder for collecting quality control samples.
- Regulator manifold assembly specific to ultra-pure nitrogen quality control sample collection.
- Key(s) to unlock padlocks.

Additional equipment requirements may exist at the different sites. See Attachments A (CAMU), B (CWL), C (MWL), and D (TA-V) for site-specific requirements and protocol.

5.2 Equipment and Materials for Methane Gas Monitoring

The equipment and materials required for performing *in situ* soil vapor monitoring for methane gas are as follows:

- Logbook.

- A field form that meets program requirements.
- Calibrated instrument that measures percent of the lower explosive limit (LEL) for methane gas (obtain from the SNL/NM Instrumentation and Dosimetry Department).
- 48-inch extension sample tube with stopper for sealing sampling port.
- Watch.

Additional equipment requirements may exist at the different sites. See Attachment D (CLWL) for site-specific requirements and protocol.

6.0 PROCEDURES

6.1 SOIL VAPOR SAMPLING FOR VOCS

Note: Prior to conducting sampling refer to site-specific Attachments in this FOP for additional information.

Soil vapor sampling for VOCs involves pre-sampling preparation, monitoring system and equipment inspection, equipment set up and purging/sample collection, quality control sample collection (if required for site), and shipment of samples to the analytical laboratory. The following sections detail the overall soil vapor sampling procedure in the sequence the activities will be performed.

6.1.1 Pre-Sampling Preparations

The following must be completed before soil vapor sampling can begin:

1) Obtain the SUMMA® canisters from the SMO and check their vacuums by:
   - Connecting the vacuum gauge provided by the laboratory to the valve on top of the SUMMA® canister.
   - Open dial on needle valve.
   - Record vacuum for each canister on the SUMMA® Canister Log (Attachment F).
   - Close valve before removing vacuum gauge.

   The nominal vacuum at SNL/NM (approximate elevation 5,400 feet [ft]) is 23 to 25 inches (in.) mercury (Hg). A copy of the SUMMA® canister vacuum readings shall be sent to the laboratory with the canisters after soil vapor sampling is completed.
2) Obtain AR/COC and sample control numbers from the SMO Home Page, http://info.sandia.gov/esh/smo/index.html. Prepare and print out AR/COC and sample labels.
3) Calibrate the VOC monitoring instrument according to manufacturer's manual prior to use during sampling, or obtain monitoring instruments from the SNL/NM Safety and Health Instrumentation Program.

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6.1.2 Equipment Setup and Sample Collection

1) Load equipment detailed in Section 5.0 into sampling vehicle.
2) Position sampling vehicle adjacent to sampling location. The vehicle engine shall be turned off during purging and soil vapor sample collection.
3) Connect vacuum pump to AC power.

See Figure 6-3 for a general schematic of the vacuum pump and SUMMA® canister setup.

4) Connect stainless steel line from soil vapor sampling manifold to SUMMA® canister port.
5) Connect intake tube of vacuum pump to sampling port.
6) Open both in-line valves. Make sure SUMMA® canister valve and pump relief valve are closed.
7) Turn on pump to purge sampling tube and/or borehole. Use the sampling tube and/or borehole volume (see information below and Attachments A [CAMU], B [CWL], C [MWL], and D [TA-V] for site-specific purging information) and flow rate meter value to calculate the purge time (see purging information below).
8) Purge for length of time that allows a minimum of three volumes of the sampling tube and/or borehole to be purged (see purging information below).
9) After three volumes have been purged, monitor the VOC levels by attaching the VOC monitoring instrument to the exhaust port of the vacuum pump. Continue the purging process until the VOC levels stabilize. Record stabilized VOC reading on the Soil Vapor Sampling Log (Attachment G).
10) Upon completing purging of three sampling tube volumes and stable final VOC measurements, close in-line valve closest to the pump.
11) Open pump relief valve.
12) Open SUMMA® canister valve.
13) When the vacuum gauge on the manifold reaches approximately minus 10 in. Hg, close the SUMMA® canister valve. This will prevent the canister from going to ambient pressure (0 in. Hg).
    (Note: The analytical laboratory, Test America, requests that approximately minus 10 in. Hg of vacuum remain in the SUMMA® canister at completion of sampling.)
14) Remove manifold from the SUMMA® canister.
15) Verify end vacuum of approximately minus 10 in. Hg by connecting the vacuum gauge provided by the laboratory to the valve on top of the SUMMA® canister.
16) Open SUMMA® canister valve.
17) Record the ending vacuum for the canister on the SUMMA® Canister Log (Attachment F).
18) Close the SUMMA® canister valve, remove vacuum gauge and replace Swagelok® dust cap.

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19) Disconnect intake tube of vacuum pump from sampling port and replace Swagelok® dust cap.
20) Fill out date and time on sample label and attach it to SUMMA® canister tag. Do not attach sample label to canister itself.
21) Complete appropriate Soil Vapor Sampling Log. Complete AR/COC.

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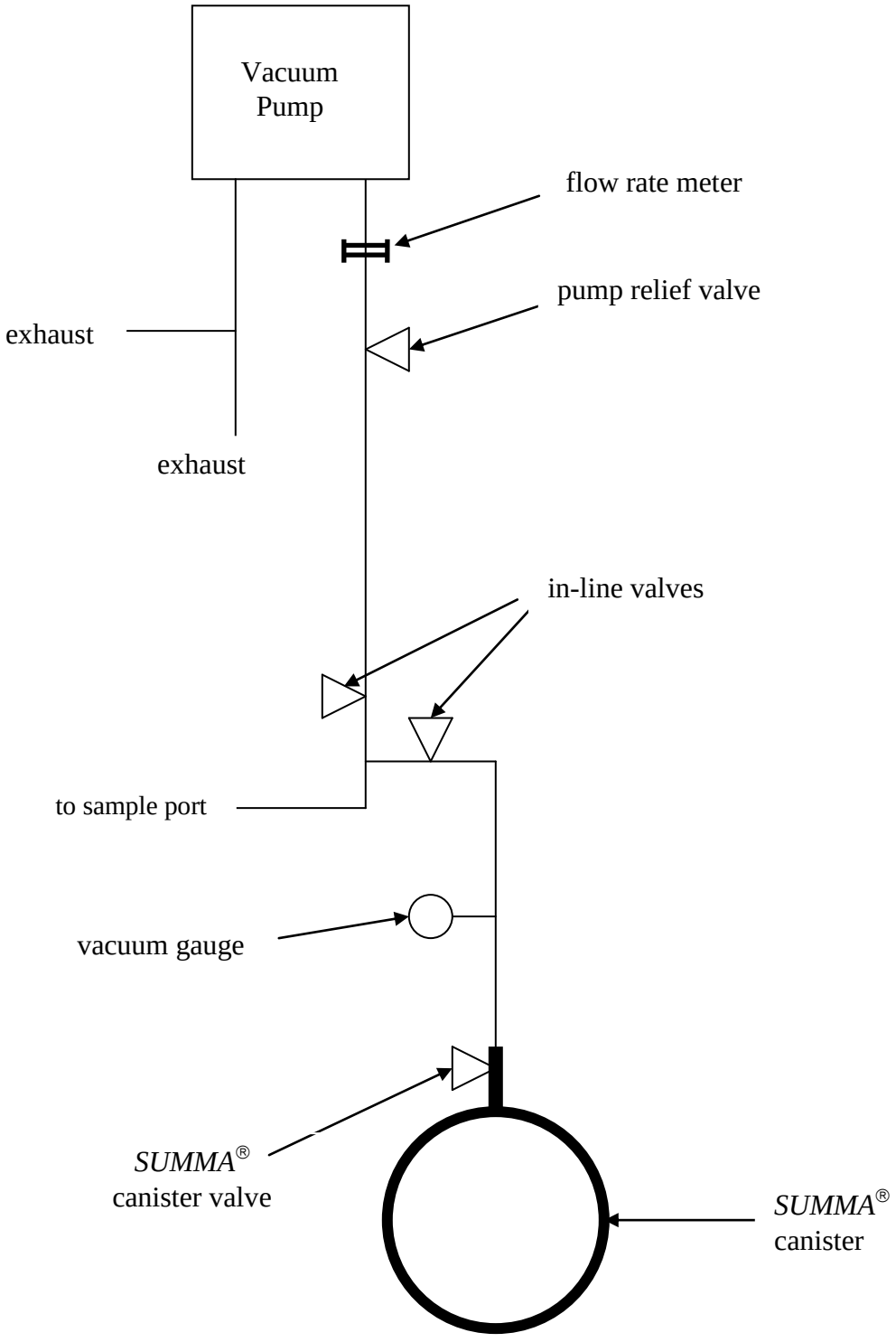
Figure 6-3
Vacuum Pump and SUMMA® Setup



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Purging Information

The purge time is a function of the volume of the sampling tube and/or borehole that needs to be purged and the flow rate through the sampling tube. A minimum of three sampling tube and/or borehole volumes are purged at each location before a sample is collected.

Volume calculations for cylindrical pipes and sampling tubes are as follows:

$V = \pi(D^2/4)L$ where: V = volume
D = diameter
L = length

Minimum pump running time to evacuate three sampling tube/well volumes from each sampling port is calculated as follows:

$t = (V/Q)*3$ where: t = time
V = volume
Q = flow rate

See Attachments A (CAMU), B (CWL), C (MWL), and D (TA-V) for site-specific purge volumes based upon individual soil vapor monitoring location construction details.

6.1.3 Quality Control Sample Equipment Setup and Sampling

The site-specific SAP may require that a quality control sample of ultra-pure nitrogen gas be collected in a SUMMA® canister. The quality control sample shall be kept in the presence of the other SUMMA® canisters during routine sample collection and will accompany the routine samples to the laboratory for analysis.

Use the following procedure for collecting the ultra-pure nitrogen gas sample. See Figure 6-4 for diagram of equipment set up.

1) Close needle valve, purge valve, and regulator.
2) Connect regulator manifold assembly to SUMMA® canister and cylinder containing nitrogen gas.
3) Open nitrogen gas cylinder valve.
4) Adjust regulator to 8 pounds per square in. (psi) line pressure.
5) Adjust needle valve until compound gauge measures positive 8 psi.
6) Close nitrogen gas cylinder valve.
7) Open purge valve to purge line.
8) Close purge valve when compound gauge measures zero.
9) Repeat steps 3 through 8 a total of two times.
10) Open nitrogen gas cylinder valve.

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11) Open SUMMA® canister valve.
12) Close SUMMA® canister valve when compound gauge measures negative 10 in. of Hg.
13) Close nitrogen gas cylinder valve.
14) Open purge valve.
15) Disconnect regulator manifold assembly from SUMMA® canister and nitrogen gas cylinder.
16) Close needle valve, purge valve, and regulator.

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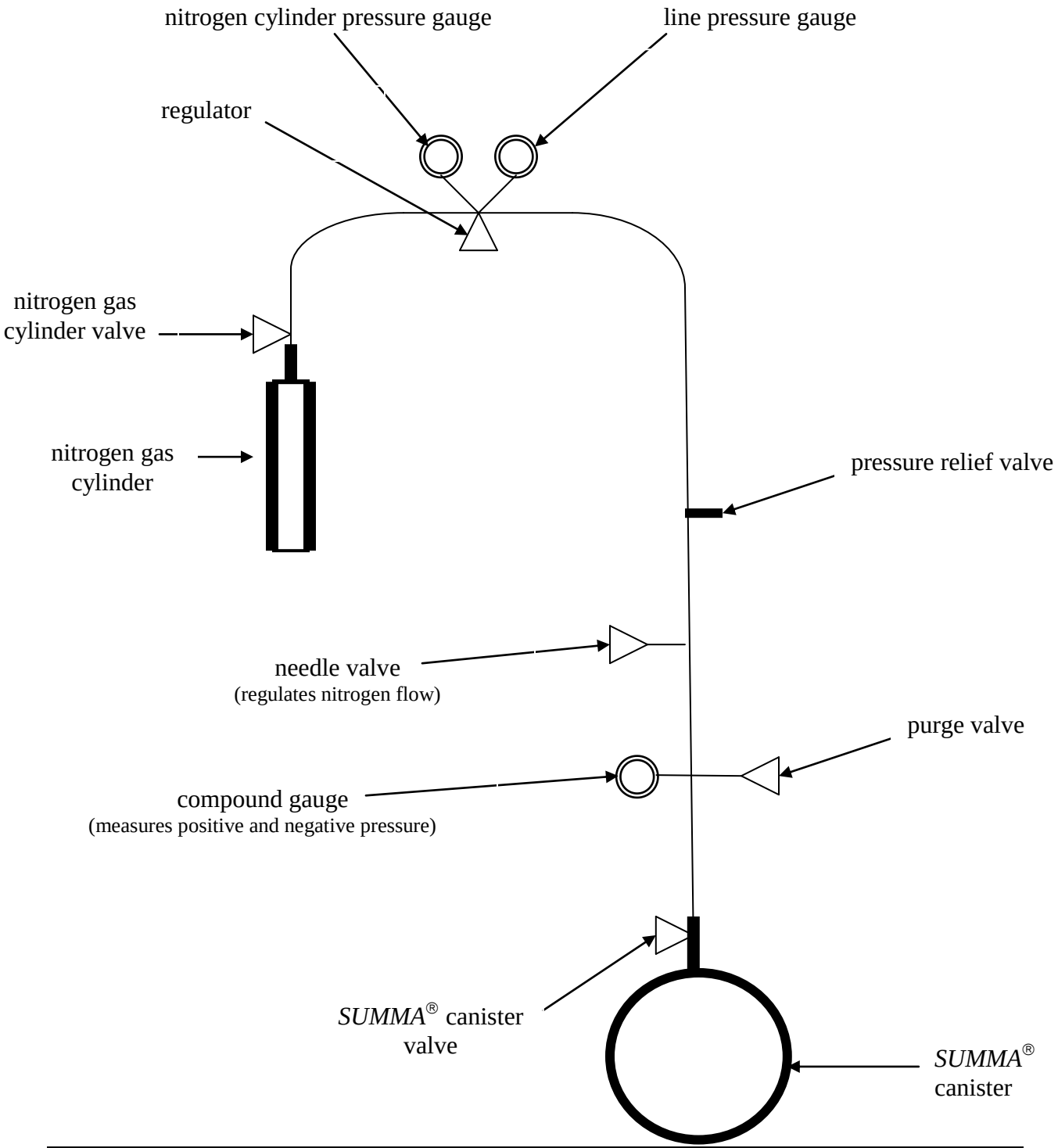
Figure 6-4
Quality Control Sample Regulator Manifold and SUMMA® Setup



6.1.4 Shipping Samples to Laboratory

The SUMMA® canisters, AR/COC, and SUMMA® Canister Log will be taken to the SMO for shipment to the laboratory.

6.2 METHANE GAS MONITORING

1) Attach 48-inch extension tube with stopper to the methane gas monitoring instrument. The stopper that seals the sampling port should be located 30 inches from the open end of the extension tube.
2) Turn on methane gas monitoring instrument.
3) Remove end cap from monitoring port.
4) Immediately lower extension tube into monitoring port with the stopper creating a seal at the top of the sampling port.
5) After 2 minutes, record methane gas measurement and any other applicable gas values.
6) Remove extension tube.
7) Reseal monitoring port with end cap.

6.3 INSPECTIONS

Inspections of soil vapor monitoring locations and equipment shall be performed in accordance with site requirements (*i.e.*, permits, MWL LTMMP). An example of an inspection form is provided in Attachment H. (Note: Inspection frequency and the format of inspection forms will vary based on site-specific requirements detailed in applicable Permits or regulatory documents.) Deficiencies and repairs shall be documented per site requirements.

7.0 QUALITY ASSURANCE / QUALITY CONTROL

See site-specific quality assurance/quality control (QA/QC) guidelines and requirements as detailed in Attachments A through E and associated site-specific permits (CAMU and CWL) and the MWL LTMMP.

8.0 RECORDS

Analytical reports will be provided with acceptable QA/QC. The following records will be maintained at the Customer Funded Record Center:

- authorized user list
- sampling and analytical results
- field forms
- inspection forms
- logbooks (if applicable).

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Sampling results shall be kept electronically in the Environmental Data Management System database. Copies of logbooks (if applicable), authorized user list, field and inspection forms shall be maintained at the CAMU Administrative Trailer for the CAMU, CWL, and MWL per site-specific permits (CAMU and CWL) and the MWL LTMMP. Training records shall be kept electronically in the Training and Employee Development System (TEDS) database. TEDS shall be accessible from the CAMU Administrative Trailer. Copies of inspection forms for the CAMU, CWL, and MWL shall be included in annual reports.

9.0 REFERENCES

Appendix E of the Class III Permit Modification for the Management of Hazardous Remediation Waste in the CAMU, Technical Area III, SNL/NM, ER Project, September 1997, Final, as amended.

ASSOP 01-04, "ASSOP Active Soil-Gas Sampling Using Method TO-14 at the CAMU", SNL/NM, November 2001.

Environment Safety & Health Manual, SNL/NM, (latest edition).

New Mexico Environment Department (NMED), October 2009. "Final Permit Decision and Response to Comments, Post-Closure Care Permit for the Chemical Waste Landfill, Sandia National Laboratories, EPA ID# NM5890110518, SNL-06-002." New Mexico Environment Department Hazardous Waste Bureau, Santa Fe, New Mexico.

New Mexico Environment Department (NMED), March 2012. "New Mexico Solid Waste Rules, Solid Waste Management Act, Article 8 and Article 9, Solid Waste Rules 20.9.2 – 20.9.10 NMAC". New Mexico Environment Department Solid Waste Bureau, Santa Fe, New Mexico.

PLA 04-01, "Health and Safety Plan for the CAMU Containment Cell", SNL/NM, Environmental Programs and Assurance, (latest edition).

SNL PHS # SNL05A01119 "CAMU Containment Cell Monitoring", SNL/NM, (latest edition).

SNL PHS # SNL06A00497 "Vadose Zone Monitoring at the Mixed Waste Landfill", SNL/NM, (latest edition).

SNL PHS # SNL11A00081 "Environmental Programs Soil Vapor Well Sampling", SNL/NM (latest edition).

SNL PHS # SNL13A00003 "TAIII Classified Waste Landfill Quarterly Methane Monitoring", SNL/NM (latest edition).

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Attachment A

Corrective Action Management Unit

Site-Specific Information

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Corrective Action Management Unit (CAMU) Introduction and Background

Soil vapor monitoring requirements are defined in Appendix E (Proposed Alternative to Groundwater Monitoring for the Corrective Action Management Unit) of the CAMU Permit Application (SNL/NM September 1997), incorporated by reference as part of the Hazardous and Solid Waste Amendments Module of the Resource Conservation and Recovery Act (RCRA) Permit issued by U.S. Environmental Protection Agency (EPA) Region 6 (EPA 1993) and administered by the New Mexico Environment Department (NMED).

Prior to performing work field technicians shall complete/document all required training as indicated in Table 1 of FOP 08-22, *Soil Vapor Sampling* and pertinent training as listed in PLA 04-01, *Health & Safety Plan for the Corrective Action Management Unit*.

CAMU Soil Vapor Sampling Network

The CAMU uses the following three monitoring subsystems to monitor for volatile organic compounds (VOCs) as supplemental data for the CAMU Vadose Zone Monitoring System (VZMS) leak detection program:

VSA - The Vertical Sensor Array (VSA) consists of eleven pairs of vertically oriented monitoring locations. Five are located on both the eastern and western margins of the containment cell. The eleventh monitoring location is situated at the northern end of the cell. Each VSA location contains a soil vapor sampling port at 5 ft and 15 ft beneath the containment cell sub-liner. Tubing extends from the two soil vapor sampling ports and terminates in the above ground enclosure (AGE) where there are connections for the sampling tube to connect to the vacuum pump.

CSS - The six Chemical Waste Landfill Sanitary Sewer (CSS) boreholes are located between the CAMU containment cell and the sanitary sewer line. Each monitoring location consists of a 2 in. diameter steel pipe driven to approximately 20 feet (ft) below grade. Each pipe has a screened section at the bottom to allow for soil vapor sampling. 2 ft of the pipe protrudes above ground and is protected by a steel casing with a locking cap.

PSL - The Primary Sub-Liner (PSL) consists of five, 6-inch (in.) inside diameter vitrified clay pipe (VCP) runs that are oriented horizontally under the CAMU containment cell. The end of each VCP run is connected to 6 in. poly vinyl chloride (PVC) pipe risers that are located on the north and south ends of the CAMU containment cell. The PVC risers are protected above ground by locked steel casings. The PVC risers are used to access the PSL system.

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CAMU Equipment Setup and Sampling Process

Follow the procedure detailed in Section 6.3 of FOP 08-22 and the specific instructions provided below for the VSA, CSS, and PSL subsystems respectively.

VSA Subsystem

1) Position sampling vehicle adjacent to VSA location's AGE.
2) Unlock and remove padlock from AGE.
3) Release the two door clamps and open the door.
4) The 5-ft and 15-ft soil vapor sample ports are clearly labeled inside AGE. Remove Swagelok® dust cap and connect intake tube from vacuum pump to the appropriate soil vapor sampling port (5-ft or 15-ft).
5) Collect soil vapor sample as described in Section 6.3 of FOP 08-22.
6) After samples have been collected, replace Swagelok® dust cap, close door and secure door clamps. Lock padlock on AGE hasp.
7) Repeat steps 2 through 6 for remaining VSA locations.

CSS Subsystem

1) Position sampling vehicle adjacent to CSS well to be sampled.
2) Unlock and open wellhead lid.
3) Remove Swagelok® dust cap from the soil vapor sample port on top of the well standpipe.
4) Collect soil vapor sample as described in Section 6.3 of FOP 08-22.
5) After soil vapor sample has been collected, replace Swagelok® dust cap and close and lock wellhead lid.
6) Repeat steps 2 through 5 for remaining CSS boreholes.

PSL Subsystem

Equipment items required in addition to those listed in Section 5.0 of FOP 08-22 include:

1) Aluminum centralizer.
2) Pulley assembly with locking pin.
3) Cable guide.
4) Cable winch (mounted to floor of sampling vehicle).
5) 500 ft polyethylene tube on a reel. The tube has a 0.25 in. outside diameter and 0.17 in. inside diameter.
6) Two-way radios.

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At the south end of the CAMU containment cell:

1) Position vehicle so cable winch is aligned with south opening of PSL to be sampled.
2) Thread winch cable and polyethylene tube through pulley assembly.
3) Loosen allen screws on slotted end of aluminum capsule/centralizer.
4) Remove slotted end cap and feed winch cable through slot.
5) Reattach slotted end cap and secure allen screws.
6) Attach polyethylene tube from reel to aluminum capsule/centralizer using duct tape.
7) Unlock and open protective steel casing cap.
8) Unhook resident steel cable from 6 in. PVC cap and attach resident steel cable to swivel/carabiner assembly on aluminum capsule/centralizer.
9) Place aluminum capsule/centralizer into opening of PVC pipe.
10) Slide pulley assembly into unistrut fixture mounted on top inside of protective steel casing. Use locking pin to hold pulley assembly in place.
11) Take up slack in winch cable and zero cable winch footage counter.
12) Release winch drive lock to allow winch drum to turn freely.
13) Remain with vehicle to monitor cable winch while coworker goes to north end of PSL.

At the PSL north end:

14) Unlock protective steel casing cap and remove 6 in. PVC cap.
15) Unhook resident steel cable end from 6 in. PVC cap and thread resident steel cable through cable guide. Immediately hook resident steel cable end back to 6 in. PVC cap to prevent cable end from sliding into PSL.
16) Insert cable guide into unistrut fixture mounted on inside bottom of protective steel casing.
17) Notify coworker on south end by two-way radio and begin pulling resident steel cable. Pull resident steel cable 170 ft to position gas sampling tube in midway point of PSL.

At the PSL south end:

18) Polyethylene tube from reel and winch cable are played out simultaneously while resident steel cable is pulled through PSL.
19) South end worker will use 2-way radio to notify north end worker when footage counter indicates polyethylene tube is positioned 170 ft inside PSL.
20) Connect intake tube of vacuum pump to the Swagelok® connector on polyethylene tube at reel hub.
21) Collect sample as described in Section 6.3 of FOP 08-22.
22) After soil vapor sample has been collected, disconnect intake tube of vacuum pump from polyethylene tube at reel hub. Retrieve winch cable and 170 ft polyethylene tube simultaneously.
23) Disconnect resident steel cable from aluminum capsule/centralizer and reattach it to 6 in. PVC cap.

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24) Replace 6 in. PVC end cap and lock protective steel casing cap.

At the PSL north end:

25) Unhook resident steel cable from 6 in. PVC cap and remove cable guide.
26) Reattach resident steel cable to 6 in. PVC cap.
27) Replace 6 in. PVC end cap and lock protective steel casing cap.

Repeat steps 7 through 27 for the remaining PSL locations.

CAMU Tube Volumes and Purge Time Calculations

Standard practice calls for purging soil vapor until a minimum of three tube volumes are evacuated. Volume calculations and purge time are calculated below. Because minimum purge times are so small, they have been increased to a required purge time. Table A-1 presents the purge volumes, minimum purge times, and the required purge times for the VSA, CSS, and PSL soil vapor monitoring locations.

Volume calculations for tubes are as follows:

$V = \pi(D^2/4)L$ where: V = volume
D = diameter
L = length

Minimum pump run time to evacuate three tube volumes is calculated as follows:

$t = (V/Q)*3$ where: t = time
V = volume
Q = flow rate (has been predetermined for the VSA, CSS, and PSL)

VSA Subsystem

Volume of the VSA soil vapor screen and ¼-inch polyethylene sampling tube is calculated as follows:

V of soil vapor screen $= \pi * [(2 \text{ in.})^2 / 4] * 12 \text{ in.} * [1\text{ft}^3 / (12 \text{ in.})^3] = 0.022 \text{ ft}^3$
V of sampling tube $= \pi * [(0.25 \text{ in.})^2 / 4] * 50 \text{ ft} * (12 \text{ in./ft}) * [1\text{ft}^3 / (12 \text{ in.})^3] = 0.017 \text{ ft}^3$

Minimum pump running time to evacuate three volumes from each VSA sampling port is calculated as follows:

$t = [(0.022 \text{ ft}^3 + 0.017 \text{ ft}^3) / (1.3 \text{ ft}^3/\text{minute})] * 3 = 0.09$ minute or 5 seconds

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CSS Subsystem

Volume of the CSS tube (galvanized well pipe) are calculated as follows:

V of galvanized pipe = π * [(2.07 in.)^2 / 4] * 21 ft * (12 in./ft) * [1ft^3 / (12 in.)^3] = 0.49 ft^3

Minimum pump running time to evacuate three volumes from each CSS well is calculated as follows:

t = [(0.49 ft^3) / (1.3 ft^3/minute)] * 3 = 1.13 minutes or 68 seconds

PSL Subsystem

Based on the construction of the PSL monitoring subsystem, it is not practical to purge the large tube volumes (VCP + PVC) associated with each of the five monitoring locations. Instead, the purge volume and purge time is based on the length of sampling tube inserted into each of the PSL tubes.

The soil vapor samples drawn from the VCPs in the PSL are taken from midway down the length of each pipe. 500 ft of polyethylene tube, with a 0.17 in. nominal inside diameter, is unrolled from a reel and pulled down the VCPs with a winch and wire cable to the midpoint of the VCPs. The other end of the tube is connected to the soil vapor sampling system. The vacuum pump is used to draw soil gas from the VCPs and evacuate the 500 ft of polyethylene tube.

V of sampling tube = π * [(0.17 in.)^2 / 4] * 500 ft * (12 in./ft) * [1ft^3 / (12 in.)^3] = 0.079 ft^3

Minimum pump running time to evacuate three volumes from the 500 ft. reel of tube is calculated as follows:

t = [(0.079 ft^3) / (1.3 ft^3/minutes)] * 3 = 0.18 minute or 11 seconds

Table A-1 CAMU VZMS Soil Vapor Sampling Purge Volumes and Purge Time

System	VSA	CSS	PSL
Purge Volume (ft^3)	0.039	0.49	0.079
Minimum Purge Time (seconds)	5	68	11
Required Purge Time (minutes)	2	3	5

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Attachment B

Chemical Waste Landfill

Site-Specific Information

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Chemical Waste Landfill (CWL) Introduction and Background

Soil vapor sampling at the CWL shall be performed under the New Mexico Environment Department (NMED) approved Post-Closure Care Permit (PCCP) (NMED October 2009 and subsequent revisions). The PCCP includes a description of the soil gas monitoring process and network, as well as a Soil Gas Sampling and Analysis Plan (SAP). The SAP also references Sandia National Laboratories/New Mexico (SNL/NM) operating procedures and the *Sample Management Office Statement of Work for Analytical Laboratories and Quality Assurance Project Plan*. In all cases, the requirements of the PCCP SAP take precedence over those of any other referenced or listed document and/or procedure, including FOP 08-22, *Soil Vapor Sampling*.

Prior to performing CWL soil vapor sampling, field technician must meet all training requirements as specified in the PCCP.

CWL Soil Vapor Sampling Network

The CWL soil vapor sampling network consists of the following five soil vapor monitoring wells: UI-1, UI-2, D-1, D-2, and D-3. The UI designation refers to "Upper Intermediate" indicating the general depth horizon that these wells are designed to sample. The D designation refers to "Deep" and is similarly indicative of the sampling depth interval. There are three soil vapor sampling ports associated with each of the UI series wells and five soil vapor sampling ports associated with each of the D series wells. One soil vapor screen at each sampling depth consists of a 2 ft long by 0.31 in. inner diameter stainless steel screen that is attached to a 0.215 in. stainless steel tube that extends to the surface.

CWL Equipment Setup and Sampling Process

Follow the applicable sections of FOP 08-22, *Soil Vapor Monitoring*, and Attachment 3 of the CWL PCCP.

CWL Sampling Tube Volume and Purge Time Calculations

V of soil vapor screen = π * [(0.31 in.)^2 / 4] * 2 ft * (12 in./ft) * [1ft^3 / (12 in.)^3]= 0.0010 ft^3
V of sampling tube = π * [(0.215 in.)^2 / 4] * tube length (ft) * (12 in./ft) * [1ft^3 / (12 in.)^3]
Vapor Well Volume = (V soil vapor screen + V of sampling tube)
V to purge = 3 * (Vapor Well Volume)

The sampling locations, associated ports, corresponding sampling depths, and sampling tube volumes are presented in Table B-2.

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Table B-2 CWL Purge Volume Calculations

Sampling Location	Port #	Soil Vapor Screen Volume (ft^3)	Sampling Tube Length = sample depth (ft. bgs) + riser (ft)	Sampling Tube Volume (ft^3)	Vapor Well Volume (ft^3)	Volume to purge (ft^3)
UI-1	1	0.0010	120+4.8 = 124.8	0.0315	0.033	0.098
	2	0.0010	80+4.8 = 84.8	0.0214	0.022	0.067
	3	0.0010	40+4.8 = 44.8	0.0113	0.012	0.037
UI-2	1	0.0010	136+3.1 = 139.1	0.0351	0.036	0.108
	2	0.0010	76+3.1 = 79.1	0.0199	0.021	0.063
	3	0.0010	36+3.1 = 39.1	0.0099	0.011	0.033
D-1	1	0.0010	470+4=474	0.1194	0.120	0.362
	2	0.0010	350+4=354	0.0892	0.090	0.271
	3	0.0010	240+4=244	0.0615	0.063	0.188
	4	0.0010	160+4=164	0.0413	0.042	0.127
	5	0.0010	100+4=104	0.0262	0.027	0.082
D-2	1	0.0010	470+1.7 = 471.7	0.1189	0.120	0.360
	2	0.0010	440+1.7 = 441.7	0.1113	0.112	0.337
	3	0.0010	350+1.7 = 351.7	0.0886	0.090	0.269
	4	0.0010	240+1.7 = 241.7	0.0609	0.062	0.186
	5	0.0010	120+1.7 = 121.7	0.0307	0.032	0.095
D-3	1	0.0010	480+3 = 483	0.1217	0.123	0.368
	2	0.0010	440+3 = 443	0.1116	0.113	0.338
	3	0.0010	350+3 = 353	0.0890	0.090	0.270
	4	0.0010	170+3 = 173	0.0436	0.046	0.134
	5	0.0010	120+3 = 123	0.0310	0.032	0.096

Minimum pump run time to evacuate three volumes from each sampling port is calculated as follows:

t = V to purge / Q where: t = time
V = volume
Q = flow rate (to be determined in the field based on equipment limitations)

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Attachment C

Mixed Waste Landfill

Site-Specific Information

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Mixed Waste Landfill Introduction and Status

Soil vapor sampling at the MWL shall be performed under the New Mexico Environment Department (NMED) approved LTMMP (NMED January 2014). The LTMMP includes a description of the soil vapor monitoring process and network, as well as a Soil-Vapor Sampling and Analysis Plan (SAP). The SAP also references Sandia National Laboratories/New Mexico (SNL/NM) operating procedures and the *Sample Management Office Statement of Work for Analytical Laboratories and Quality Assurance Project Plan*. In all cases, the requirements of the LTMMP SAP take precedence over those of any other referenced or listed document and/or procedure, including FOP 08-22, *Soil Vapor Sampling*.

Prior to performing soil vapor sampling at the MWL, field technicians shall read the pertinent sections of the LTMMP.

MWL Soil Vapor Sampling Network

The MWL soil vapor sampling network consists of the following five soil vapor monitoring wells:

- MWL-SV-01
- MWL-SV-02
- MWL-SV-03
- MWL-SV-04
- MWL-SV-05

The soil vapor implant at MWL-SV-01 and MWL-SV-02 consists of a 0.5 ft long by 0.5 in. diameter stainless steel screen. It is attached to a nominal 0.25 in. diameter polyethylene tube that extends 41 ft to the ground surface and a sampling port.

The soil vapor sampling systems at MWL-SV-03, MWL-SV-04, and MWL-SV-05 consists of three Flexible Liner Underground Technologies (FLUTe^{TM}) multi-port soil-vapor monitoring wells with five sampling ports per location. Sampling ports are set at 50, 100, 200, 300, and 400 foot depths and attach to nominal 0.25 in. diameter polyethylene tubing. Each sampling interval spans a 5 ft depth interval. [Note: Installation of these three soil vapor monitoring wells is scheduled for May-June 2014. The NMED-approved Installation Plan requires sampling ports to be installed within "….plus or minus 10 vertical feet of the planned depth." Minor adjustments to the sampling and purging process based on actual as-built specifications will be incorporated as appropriate and documented in required MWL LTMMP annual reports.]

MWL Equipment Setup and Sampling Process

Follow the applicable sections FOP 08-22, *Soil Vapor Monitoring*, and any applicable information in the approved version of the LTMMP.

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MWL Sampling Tube Volume and Purge Time Calculations

Calculations for MWL-SV-01 & MWL-SV-02:

V of soil vapor implant = π * [(0.5 in.)^2 / 4] * 0.5 ft * (12 in./ft) * [1ft^3 / (12 in.)^3]= 0.0007 ft^3
V of sampling tube = π * [(0.25 in.)^2 / 4] * 41 ft * (12 in./ft) * [1ft^3 / (12 in.)^3] = 0.0140 ft^3
Vapor Well Volume = (V soil vapor screen + V of tubing)
V to purge = 3 * (Vapor Well Volume)

Calculations for MWL-SV-03, MWL-SV-04, MWL-SV-05:

V of soil vapor implant = π * [(0.25 in.)^2 / 4] * 5 ft * (12 in./ft) * [1ft^3 / (12 in.)^3] = 0.0017 ft^3
V of sampling tube = π * [(0.25 in.)^2 / 4] * 50 ft * (12 in./ft) * [1ft^3 / (12 in.)^3] = 0.0170 ft^3
V of sampling tube = π * [(0.25 in.)^2 / 4] * 100 ft * (12 in./ft) * [1ft^3 / (12 in.)^3] = 0.0341 ft^3
V of sampling tube = π * [(0.25 in.)^2 / 4] * 200 ft * (12 in./ft) * [1ft^3 / (12 in.)^3] = 0.0681 ft^3
V of sampling tube = π * [(0.25 in.)^2 / 4] * 300 ft * (12 in./ft) * [1ft^3 / (12 in.)^3] = 0.1022 ft^3
V of sampling tube = π * [(0.25 in.)^2 / 4] * 400 ft * (12 in./ft) * [1ft^3 / (12 in.)^3] = 0.1363 ft^3
Vapor Well Volume = (V soil vapor screen + V of tubing)
V to purge = 3 * (Vapor Well Volume)

The sampling locations, associated ports, corresponding sampling depths, and purge volumes are presented in Table C-1.

Table C-2 MWL Purge Volume Calculations

Sampling Locations	Port #	Soil Vapor Implant Volume (ft^3)	Sample Depth (bgs) tubing length (ft)	Sampling Tube Volume (ft^3)	Vapor Well Volume (ft^3)	Volume to purge (ft^3)
MWL-SV-01 MWL-SV-02	1	0.0007	41	0.0140	0.015	0.044
MWL-SV-03 MWL-SV-04 MWL-SV-05	1	0.0017	50	0.0170	0.019	0.057
	2		100	0.0341	0.036	0.090
	3		200	0.0681	0.070	0.210
	4		300	0.1022	0.104	0.312
	5		400	0.1363	0.138	0.414

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Minimum pump running time to evacuate three volumes from each sampling port is calculated as follows:

t = V to purge / Q where: t = time
V = volume
Q = flow rate (to be determined in the field based on equipment limitations)

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Attachment D

Technical Area III Classified Waste Landfill

Site-Specific Information

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Technical Area III (TA-III) Classified Waste Landfill Introduction and Background

In situ monitoring for methane gas is performed quarterly at the TA-III Classified Waste Landfill (CLWL) in accordance with New Mexico Administrative Code (NMAC), Title 20 (Environmental Protection), Chapter 9 (Solid Waste), Part 5 (Solid Waste Facility and Registered Facility Operating Requirements), Section C. An instrument which is capable of measuring methane gas as a percentage of the lower explosive limit is used to monitor and report methane gas concentrations. Other compounds that are measured include percent oxygen, carbon monoxide (parts per million [ppm]), and hydrogen sulfide (ppm).

CLWL Methane Gas Monitoring Network

The CLWL methane gas monitoring network (Figure 1) consists of five methane monitoring port (MMP) locations. MMP-1 is located on the east side of the site approximately 3 feet from the site perimeter fence. MMP-2, 3, and 4 are located near the only trench containing waste and within 3 feet of the site perimeter fence. MMP-5 is located immediately east of the waste containing trench.

Each port consists of a 48-inch long, ¾-inch outer diameter, open ended, galvanized steel pipe, installed in a slightly larger diameter pilot hole approximately 36 inches deep, leaving 12-inches of the pipe exposed above ground surface. Loose soil was used to backfill the open space around each pipe. Each pipe has three columns of 1/8-inch diameter holes, four per column. The columns are spaced approximately 120 degrees apart radially. The holes start 3-inches from the bottom of the open ended pipe and are spaced vertically 1-inch apart. A threaded end cap is used to seal the section of pipe exposed at the surface. The end cap is removed when monitoring is performed. The attached methane monitoring field form is used when performing methane gas monitoring at the CLWL.

CLWL Equipment Setup and Monitoring Process

Follow the applicable sections of FOP 08-22, *Soil Vapor Monitoring*. Use the attached monitoring form and record values for all specified compounds.

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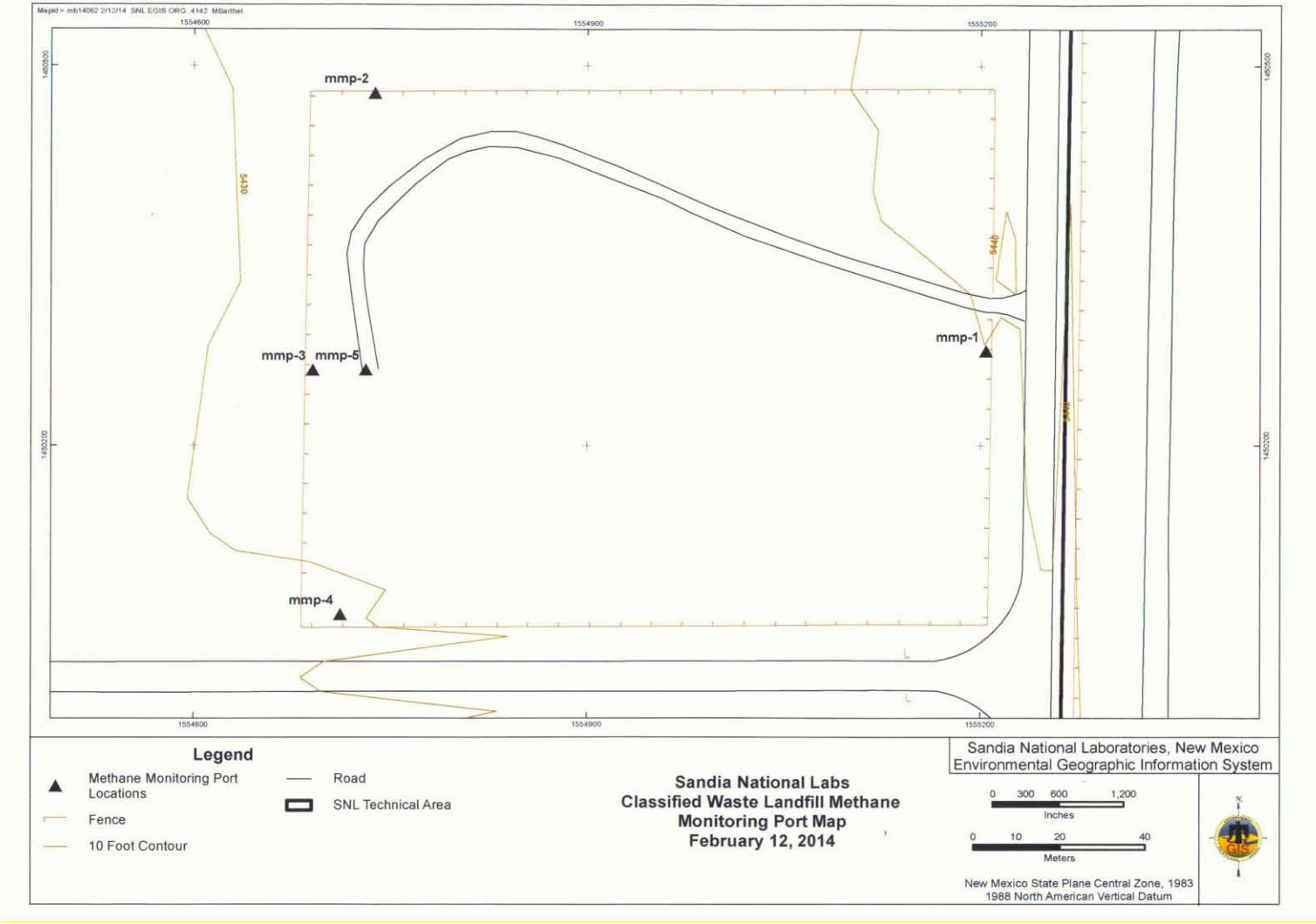
Figure 1. TA-III Classified Waste Landfill Monitoring Locations Map



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SANDIA NATIONAL LABORATORIES/NM
TECH AREA III CLASSIFIED WASTE LANDFILL
METHANE MONITORING FORM

Date:_____ Start time: _____ End time: _____

Barometric Pressure: _____ millibars Temperature: _____° C

Weather conditions:_____ Wind speed: _____ Wind direction: _____

Date and amount of last precipitation (within last 48 hours): _____

Instrument: Industrial Scientific ITX Multi-Gas Monitor (O_2/LEL/CO/H_2S)

Calibration expiration date: _____

Methane monitoring type: Dedicated probe port Probe depth: ~30 inches

Table of Results

Port Location, see attached map	Methane, % LEL	Oxygen, %	Carbon Monoxide, parts per million	Hydrogen Sulfide, parts per million
Port 1				
Port 2				
Port 3				
Port 4				
Port 5				

Sampler: _____

Signature: _____

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Attachment E

Technical Area V

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Technical Area V (TA-V) Introduction and Background

In April 2004, the New Mexico Environment Department (NMED) issued a Compliance Order on Consent (NMED April 2004) to the U.S. Department of Energy (DOE) and Sandia Corporation, that identified TA-V as an area of groundwater contamination at Sandia National Laboratories/New Mexico (SNL/NM) requiring completion of a Corrective Measures Evaluation (CME). A CME Work Plan was prepared and implemented and a CME Report was submitted by SNL/NM in July 2005. In July 2008, the NMED issued the first Notice of Disapproval (NOD) to the DOE and Sandia regarding the CME Report for the TA-V study area at SNL/NM, which required further characterization of groundwater and soil vapor at TA-V. SNL/NM prepared the *Technical Area V Groundwater Investigation Work Plan* and submitted the plan to the NMED in April 2009. SNL/NM received NODs from NMED in August 2009 and December 2009, and submitted revised work plans in November 2009 and February 2010. The NMED conditionally approved the SNL/NM February 2010 *Technical Area V Groundwater Investigation Work Plan* in May 2010.

The approved work plan included the design of the soil vapor monitoring system required to provide data regarding vadose-zone volatile organic compound (VOC) profiles with depth. The work plan also discussed soil vapor sampling field activities such as preparation, purging, VOC monitoring, sample collection, and sample shipping. As established in the regulatory-approved work plan, requirements for soil sampling are addressed by the procedures documented in FOP 08-22, *Soil Vapor Sampling*. Information on the monitoring network and soil vapor sampling specific to TA-V (necessary to fulfill the requirements of the work plan) are provided below.

TA-V Soil Vapor Sampling Network

The TA-V soil vapor sampling network consists of three soil vapor monitoring wells (TAV-SV01, TAV-SV02, and TAV-SV03), with soil vapor sampling ports at depths of approximately 50 feet (ft), 100 ft, 150 ft, 200 ft, 250 ft, 300 ft, 350 ft, 400 ft, 450 ft, and 500 ft below ground surface (bgs). The soil vapor screen at each location consists of a 1-ft long by 0.5-in. diameter stainless steel screen. It is attached to 0.25 in. outside diameter stainless steel tube that extends to the ground surface and a sampling port.

TA-V Equipment Setup and Sampling Process

The TA-V soil vapor sampling equipment includes a sampling manifold assembly and a multiport purging chamber (Figure D-1). The multiport purging chamber is equipped with individual valves, fittings, and tubing which can be connected up to ten individual sample ports. The multiport purging chamber allows up to ten sampling locations to be purged at the same time. To setup the equipment and collect samples:

1) The ten valves on the multiport purging chamber are numbered 1 through 10. Connect the valve labeled #1 to the deepest sampling port. Connect the valve labeled #2 to the

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second deepest sampling port. Continue connecting in this order with the valve labeled #10 connected to the shallowest sampling port.

2) Open valve on the multiport purging chamber associated with the shallowest sampling port and begin the purging process. Purging and sample from shallow to deep, as deep sampling ports may contain groundwater.
3) Turn on pump to purge soil vapor from sample depth.
4) Use the sampling tube volume and flow rate meter value to calculate the purge time for the sampling port. Purge for length of time that allows a minimum of three volumes of the sample tube to be evacuated.
5) Monitor the VOC levels of current sampling depth by attaching the VOC monitoring instrument of the exhaust port of the vacuum pump. Continue the purging process until the VOC levels stabilize. Record stabilized VOC reading on the Soil Vapor Sampling Log (FOP 08-22, Attachment F).
6) Close valve and turn off the vacuum pump.
7) Disconnect the multiport purging chamber valve from the sampling port.
8) Attach the sampling manifold assembly to the sampling port and to a SUMMA® canister.
9) Open SUMMA® canister valve.
10) Open flow valve on sampling manifold assembly by squeezing flow valve lever.
11) When the vacuum gauge on the sampling manifold assembly reaches approximately minus 10 in. Hg, release flow valve lever and close the SUMMA® canister valve. This will prevent the canister from going to ambient pressure (0 in. Hg). (Note: The analytical laboratory, Test America, requests that approximately minus 10 in. Hg of vacuum remains in the SUMMA® canister at completion of sampling).
12) Remove sampling manifold assembly from the SUMMA® canister.
13) Fill out date and time on sample label and attach it to SUMMA® canister tag. Do not attach sample label to canister itself.
14) Verify the final vacuum reading of approximately minus 10 in. Hg on all SUMMA® canisters by connecting the vacuum gauge provided by the laboratory to the valve on top of the SUMMA® canister.
15) Record the final vacuum reading for each canister on the SUMMA® Canister Log (FOP 08-22, Attachment E).
16) Close the SUMMA® canister valve, remove vacuum gauge and replace Swagelok® dust cap.
17) Proceed to the next sampling depth by opening the corresponding valve on the multiport purging chamber.
18) Continue with steps 4) through 16) until all sampling ports have been purged and samples have been collected.
19) If more than one sampling location or sampling port are purged at the same time, then modify purge length in step 4) as the length of time that allows a minimum of three volumes from each sampling tube to be purged based upon calculated purge time for the sampling port with the greatest volume.

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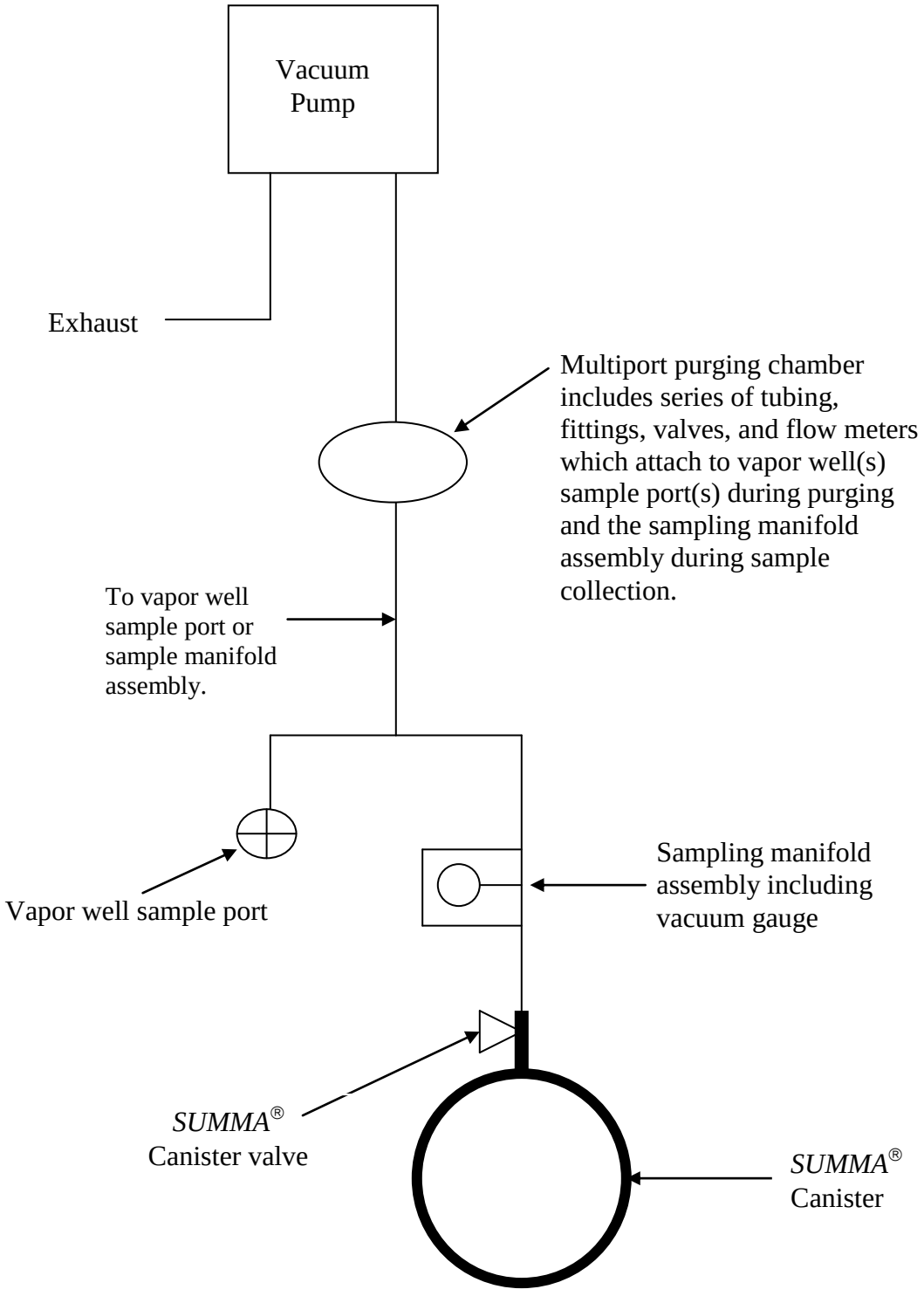
Figure D-1
TA-V Vacuum Pump and SUMMA® Setup



TA-V Sampling Tube Volume and Purge Time Calculations

V of soil vapor screen = π * [(0.5 in.)^2 / 4] * 1 ft. * (12 in./ft.) * 1ft.^{3} / (12 in.)^3 = 0.0014 ft.^{3}
V of sampling tubing = π * [(0.25 in.)^2 / 4] * tubing length (ft.) * (12 in./ft.) * [1ft^3 / (12 in.)^3]
Vapor Well Volume = (V soil vapor screen + V of tubing)
V to purge = 3 * (Vapor Well Volume)
The sampling locations, associated ports, corresponding sampling depths, and purge volumes are presented in the table below.

Table D-1 TA-V Purge Volume Calculations

Sampling Locations	Sample Depth (bgs) tubing length (ft)	Soil Vapor Screen Volume (ft^3)	Sampling Tube Volume (ft^3)	Vapor Well Volume (ft^3)	Volume to purge (ft^3)
TAV-SV01 TAV-SV02 TAV-SV03	50	0.0014	0.0170	0.018	0.055
	100	0.0014	0.0341	0.035	0.106
	150	0.0014	0.0511	0.052	0.157
	200	0.0014	0.0682	0.070	0.209
	250	0.0014	0.0852	0.087	0.260
	300	0.0014	0.1023	0.104	0.311
	350	0.0014	0.1193	0.121	0.362
	400	0.0014	0.1364	0.138	0.413
	450	0.0014	0.1534	0.155	0.464
	500	0.0014	0.1704	0.172	0.515

Minimum pump running time to evacuate three volumes from each sampling port is calculated as follows:

t = V to purge / Q where: t = time
V = volume
Q = flow rate (to be determined in the field based on equipment limitations)

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Attachment F

SUMMA® Canister Log

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SUMMA® Canister Log

Serial #	Date Received	Date Tested for Initial VAC	Initial VAC at 5400 ft (in. Hg)	Date Used	End VAC at 5400 ft (in. Hg)	Date Returned to SMO

SUMMA® Canister Log completed by:

Printed Name

Signature

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Attachment G

Soil Vapor Sampling Log

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Soil Vapor Sampling Log

Location	Date	Time	Canister #	PID (ppm)	Starting Vacuum (in. Hg)	Ending Vacuum (in. Hg)	Location Comments

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Attachment H

Soil Vapor Monitoring Inspection Form

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Soil Vapor Monitoring Inspection Form

1. Soil vapor monitoring site (CAMU, CWL, MWL, TA-V) _____
2. Date of Inspection _____
3. Time of Inspection _____
4. Name of Inspector _____

Mandatory requirement:

The inspector has read applicable site-specific Permits (CAMU and CWL), LTMMP (MWL) and activity related procedures in the last 12 months for the location indicated on line 1 above: (*Inspector must initial box before proceeding with the inspection.)*

Date read _____

Provide explanatory notes for each parameter not inspected or each action required. Include any remedial steps required.

SOIL VAPOR MONITORING LOCATIONS				
Inspection Parameter	***Indicate if Applicable (Yes or No)***	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Concrete pads, bollards, and protective casings in need of repair/maintenance.				
B. Above-ground enclosure in need of repair/maintenance.				
C. Well cover caps and Swagelok® dust caps in need of repair/maintenance.				
D. Sampling ports in need of repair/maintenance.				
E. Passive venting Baroballs™ in need of repair/maintenance.				
F. Monitoring wells and soil-gas sample port locations properly labeled.				
G. Locks in need of cleaning or replacement.				

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Soil Vapor Monitoring Inspection Form (continued)

SAMPLING EQUIPMENT				
Inspection Parameter	***Indicate if Applicable (Yes or No)***	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
A. Sampling pump in need of repair/maintenance				
B. Sampling manifold (tubing, gauges, and valves) in need of repair/maintenance.				

PREVIOUS DEFICIENCIES			
Inspection Parameter	***Parameter Inspected (Yes or No)***	***Action Required (Yes or No)***	***Note Number***
Uncorrected/undocumented previous deficiencies.			

NOTES

Note Number	Description

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Soil Vapor Monitoring Inspection Form (concluded)

Action (Note Number) _____ assigned to _____Date action completed_____

Action (Note Number) _____ assigned to _____Date action completed_____

Action (Note Number) _____ assigned to _____Date action completed_____

Action (Note Number) _____ assigned to _____Date action completed_____

Action (Note Number) _____ assigned to _____Date action completed_____

Additional Comments:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

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_____

_____

Inspector's Signature _____
Original to: Site's Operating Record
Copy to: Environmental Operations Records Center, MS-1309

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SANDIA NATIONAL LABORATORIES
LONG TERM STEWARDSHIP DEPARTMENT (4142)

GROUNDWATER MONITORING HEALTH AND SAFETY PLAN

PLA 05-09
Revision 05

Author: _____ **Date:** 04/21/2014
Tim Jackson, Subject Matter Expert

Approved: _____ **Date:** 21 APR 14
Michael Skelly, Project Leader

Approved: _____ **Date:** 04/22/14
Don Schofield, Field Support Operations Project Leader

Approved: _____ **Date:** 06/16/14
Pamela Puissant, Department Manager

Author: How frequently does this document need to be reviewed and/or revised?	Every **three** years, or when activities change.
Manager: Does this document need to be tracked?	**Yes**

EFFECTIVE DATE: _____

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LIST OF FORMS

EP 2009-ALW – Environmental Planning – Activity Level Work Evaluation Form
EP 2009-AUL – Environmental Planning – Authorized Users List
EP 2009-OJT – Environmental Planning – On-the-Job Training
EP 2009-WRA – Environmental Planning – Work Resumption Authorization Form

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Revision History

Revision	Effective Date	Summary of Changes
1	10/10/2005	New document
2	8/16/2007	Formatting changes. Updated section 2, Roles and Responsibilities; section 3, Training Qualifications; section 11, References.
3	3/4/2010	Formatting changes. Added work planning and control information to section 6, Task Hazard Analysis. Updated section 3, Training Qualifications; section 11, References.
4	1/24/2012	Formatting changes. Revision history changed from 2 years to 3 years. Removal of some forms (attachments) and replaced with hyperlinks to where the forms can be found. Updated section 3, Training Qualifications; section 11, References.
5		Revised Work Planning and Controls requirements per Engineered Safety Implementation and included Mixed Waste Landfill Long Term Monitoring and Maintenance Plan HASP reference.

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ACRONYMS AND ABBREVIATIONS

AOP	administrative operating plan
EOC	Emergency Operations Center
ES&H	Environment, Safety and Health
FOP	field operating procedure
GMP	Groundwater Monitoring Program
HASP	health and safety plan
HNO_3	nitric acid
KAFB	Kirtland Air Force Base
LOP	laboratory operating procedure
LTS	Long Term Stewardship
OJT	on-the-job training
OSHA	Occupational Safety and Health Administration
PHS	primary hazard screening
PLA	plan
PPE	personal protective equipment
RCRA	Resource Conservation and Recovery Act
SAP	sampling and analysis plan
SNL/NM	Sandia National Laboratories, New Mexico
THA	task hazard analysis
TWD	technical work document

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1.0 PURPOSE, GOALS AND OBJECTIVES

Sandia Corporation conducts general groundwater surveillance monitoring for the U.S. Department of Energy (DOE), National Nuclear Security Administration (NNSA) at Sandia National Laboratories, New Mexico (SNL/NM). Monitoring is performed on a site-wide basis as part of the Long-Term Stewardship (LTS) Program's Groundwater Monitoring Program (GMP). The GMP includes groundwater surveillance and site-specific groundwater monitoring at LTS/Environmental Restoration (ER) Operations (formerly ER Project) sites with ongoing groundwater investigations.

This health and safety plan (HASP) covers groundwater monitoring operations that are detailed in associated regulations, requirements, and technical work documents (TWD) (i.e., administrative operating procedures [AOP], field operating procedures [FOPs], laboratory operating procedures [LOP], sampling analysis plans [SAP], and mini-SAPs).

Purpose The purpose is to recognize and anticipate all potential hazards associated with performing groundwater monitoring activities at SNL/NM.

Goals The goal is to perform groundwater sampling and surveillance activities with zero occupational injuries and reportable occurrences. The activities are described in detail in the associated TWDs.

Objectives The objectives are to perform work identified in the TWDs for groundwater monitoring activities by:

- Planning work so that potential hazards are recognized and controlled.
- Following health and safety protocols to prevent hazards to workers and protection of the environment.
- Executing work **only** as it is identified and described in the TWDs for groundwater monitoring activities listed in section 3.0. The work shall be performed in a manner that protects personnel from hazards, thus preventing injury.
- Limiting work activities to authorized and trained personnel.
- Improving this document and work processes (if necessary) based on feedback from personnel, safety case discussions, and lessons learned.

2.0 ROLES AND RESPONSIBILITIES

The Long-Term Stewardship Program is responsible for development, approval, distribution, revision, and control of this document.

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The **Department Manager** is responsible for the following:

- Providing programmatic guidance leading to the development of this HASP.
- Reviewing and approving of this HASP.

The **Project Lead** or designee is responsible for the following:

- Reviewing and recommending approval of the HASP.
- Providing overall coordination and management of the GMP.
- Providing regulatory or programmatic requirements.
- Reviewing completed field forms and data pertaining to waste management and groundwater sampling activities.
- Reporting all information as required by regulations or directives.

The **Sampling Coordinator** is responsible for the following:

- Generating a mini-SAP from the SAP. The mini-SAP is a field friendly version of the SAP that:1) details sampling activities for the field support operations project leader and field technicians: 2) summarizes sampling procedures, analytical parameters, field measured parameters, purge requirements, and waste management tasks: and 3) identifies monitoring well characteristics that may extend the sampling period (e.g., low yield wells, well construction issues, etc.).
- Preparing a waste management plan for each sampling event.
- Providing the field support operations project leader with a copy of the mini-SAP.
- Coordinating waste management activities with the project leader and the field support operations project leader.
- Reviewing completed field forms and data pertaining to sampling activities.
- Ensuring that all data quality requirements are performed.
- Reviewing all analytical data used for waste characterization.
- Obtaining waste determination from the environment protection representative (non-regulated, hazardous, and radioactive).
- Managing, coordinating, and disposing of purge water and other waste generated from field operations.
- Obtaining discharge permits for purge and decontamination water from the Environmental Programs Water Quality Group.
- Submitting disposal requests to SNL Waste Management (Hazardous Waste Management Facility Radioactive and Mixed Waste Management Facility, and Solid Waste).
- Coordinating with the field support operations project leader for disposal and discharges.
- Tracking and documenting each waste activity.
- Performing and documenting weekly inspections of Building 9925 Resource Conservation and Recovery Act (RCRA) Less Than 90-Day Waste Accumulation Area.

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- Performing and documenting weekly inventory of all waste stored at Building 9925 waste accumulation areas.
- Performing monthly inspection of emergency equipment.
- Maintaining documentation for waste disposal activities.
- Submitting completed field forms to the Customer Funded Record Center and entry of relevant data to the Environmental Data Management System (EDMS) database.
- Reviewing and providing recommendations for revisions to this plan (if necessary).

The **Field Support Operations Team Leader** is responsible for the following:

- Communicating with the sampling coordinator regarding sampling activities.
- Supervising the field technicians.
- Reviewing training requirements for field technicians.
- Providing on-the-job training (OJT) of new field technicians.
- Assigning field technicians (qualified by training and experience) to conduct the activities described in this HASP.
- Coordinating sampling activities with the sampling coordinator, Sample Management Office and field technicians.
- Providing field technicians with necessary equipment and supplies to conduct field work.
- Maintaining, reviewing, and revising all TWDs.
- Owner/manager/emergency coordinator of Building 9925 RCRA Less Than 90-Day Waste Accumulation Area.
- Reviewing and providing recommendations for revisions to this plan (if necessary).

The **Field Technicians** are responsible for:

- Stopping work if any operation threatens worker or public health and safety.
- Conducting tasks as described in the TWDs.
- Completing all necessary and required training as specified by the field support operations project leader.
- Conducting a tailgate safety meeting prior to the start of all field activities.
- Participate in the work Planning and Controls process, including the safety case discussions.
- Inspecting and maintaining equipment.
- Collecting, storing, and delivering samples to the Sample Management Office (SMO) in accordance with the SMO TWDs.
- Managing and disposing of waste as directed by completed Work Request Forms, (FOP 05-04, Attachment A) and the field support operations project leader.
- Performing project inspections in accordance with associated TWDs.
- Completing and reviewing field documentation forms.
- Providing recommendations for revisions to this plan (if necessary).

The **Training Director** is responsible for:

- Reviewing, verifying, and documenting the completion of all training required for groundwater monitoring activities.

3.0 TRAINING QUALIFICATIONS

Personnel conducting field activities shall complete the following:

- Read applicable sections of SNL/NM Corporate Policy ESH100 Environment Safety & Health
- Read primary hazard screening (PHS) SNL05A01241, *Long Term Stewardship (LTS) Groundwater Monitoring Activities*.
- Read and sign ALW 13-01, Activity Level Work Evaluation Form for the Groundwater Program.
- Read and sign AOP 95-16, *Sample Management and Custody*.
- Read and sign LOP 94-03, *Sample Handling, Packaging and Shipping*.
- Read and sign FOP 05-01, *Groundwater Monitoring Well Sampling and Field Analytical Measurements*.
- OJT for new field personnel performing groundwater monitoring activities if it pertains to any of the FOPs listed below. Document training by completing On-the-Job Training form (EP 2009-OJT).
- Read and sign FOP 03-02, *LTS Groundwater Level Data Acquisition and Management*. (Note: The training requirements denoted with an "*" in Table 1 below are all that are required for FOP 03-02.)
- Read and sign FOP 05-02, *Groundwater Monitoring Equipment Field Check*.
- Read and sign FOP 05-03, *Groundwater Sampling Equipment Decontamination*.
- Read and sign FOP 05-04, *Groundwater Waste Management Plan.*
- Read and sign FOP 09-05, *Conducting Slug Test Using Data Logger & Pressure Transducer* (only necessary if conducting slug test).
- Read and sign FOP 10-01, *Borehole and Downhole Well Video Inspection*. (Note: The training requirements denoted with an "*" in Table 1 below are all that are required for FOP 10-01).
- Read and sign plan (PLA) PLA 13-02, *Mixed Waste Landfill Long-Term Monitoring and Maintenance Health & Safety Plan*.
- Complete training courses listed in Table 1.
- Field personnel shall sign the Authorized Users List (EP 2009-AUL) to affirm they have read and understand this document, and agree to operate within the stated constraints.

Table 1. Training Course List

Course Code	Course Title
*CHM100/103	Chemical Safety Training/Site-Specific Chemical Training
*ELC105	Basic Electrical Safety (> 50 volts)
ELC901	Safe Switching Briefing
ENV100	OSHA Health & Safety Basic Training - General Worker (40 HR)
*ENV103	OSHA Health & Safety Training Refresher (8 HR)
*ENV112	Hazardous Waste & Environmental Management Training
ENV216	RCRA - Less Than 90-Day Area Accumulation Area for Owners & Emergency Coordinators
ENV316	RCRA - Less Than 90-Day Area Accumulation Area for Waste Workers
ENV416	RCRA - Less Than 90-Day Area Accumulation Area for Waste Workers - Site-Specific
*ESH100	ES&H Awareness
FKL153	Forklift Operator and Hands-On Training
*MCH200	Hand and Power Tool Safety
*MED102	Standard First Aid
*MED104	Heartsaver CPR
*OTS101	Occupational Thermal Stress
PKX100	Basic Hazardous Material Transportation Training
*PPE106	Personal Protective Equipment Training
PRS150	Pressure Safety Orientation
PRS250	Advanced Pressure Safety
*RAD102	General Employee Radiological Training
RAD230	Radiological Worker II Training

NOTES: *Training requirements are all that are required for FOP 10-01
CPR = Cardiopulmonary Resuscitation
ES&H = Environment, Safety and Health
HR = hour
OSHA = Occupational Safety and Health Administration
RCRA = Resource Conservation and Recovery Act

4.0 SCOPE OF WORK

The scope of work covered by this HASP **only** includes the activities as they are identified and described in the TWDs listed in Section 3.0. This HASP **can not** be utilized for any other work without the explicit authorization from the field support operations project leader or higher authority.

5.0 PERSONAL PROTECTIVE EQUIPMENT

Personnel are required to wear the personal protective equipment (PPE) identified by the task hazard analysis described in Section 6.0. Level D PPE will be the minimum level of protection for all activities (Table 2).

6.0 TASK HAZARD ANALYSIS

All activities associated with this HASP shall be covered by the PHS. Activity Level Work Evaluation Form, ALW 13-01, was completed and approved according to AOP 09-10, *Work Planning and Controls*.

Task hazard analyses (THA) have been performed on all groundwater activities in conjunction with PHS SNL05A01241, *LTS Groundwater Monitoring Activities*. The PHS helps identify potential hazards that can be expected when performing the work. The THA classifies the potential hazards and rates them based on the probability of occurrence (Table 2). The THA identifies control measures that will be used to mitigate the potential hazards (Table 2). The control measures may include courses and training that are identified as part of the PHS results. This approach to identifying, rating, and controlling hazards is consistent with SNL/NM's Integrated Safety Management System. The hazards rating are low for all activities identified in groundwater monitoring activities. Field technicians shall comply with PLA 13-02 during groundwater activities at the Mixed Waste Landfill, applicable FOPs when performing groundwater monitoring, in addition to requirements listed in this HASP.

Hazard assessment surveys were performed for groundwater sampling activities by an SNL/NM industrial hygienist. The following hazard assessment survey reports concluded that the potential for exposure to health hazards has been categorized as well-controlled; therefore acceptable:

- SNLNM00825, *9925/1 (High-Bay)* (equipment decontamination)
- SNLNM00827, *Groundwater Monitoring: Roving* (groundwater sampling)
- SNLNM01481, *Groundwater Surveillance: Roving* (measuring groundwater levels)
- SNLNM01520, *Chemwaste Landfill Groundwater Surveillance: Roving* (measuring groundwater levels at the Chemical Waste Landfill)

Groundwater monitoring consists of taking water samples from wells located on Kirtland Air Force Base (KAFB) and SNL. The following is the general order in which theses activities are performed:

- Equipment decontamination
- Calibration of monitoring equipment
- Collecting a depth-to-water measurement
- Lowering of pumps and or monitoring equipment
- Operating pumping equipment to purge the well (or sample line)
- Monitoring (measuring) chemical properties of water
- Operating pumping equipment to fill sample bottles
- Raising pumping equipment after samples have been collected
- Managing samples
- Managing waste water
- Documenting all activities

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Table 2. Task Hazard Analysis - *Level of Protection* – Level D PPE (safety shoes/boots, chemical safety goggles)

Potential Hazard	Hazard Rating	Control
Chemical 1) Decontamination of pump tubing using a diluted nitric acid (HNO_3) rinse and a detergent rinse. 2) Groundwater containing volatile organic compounds (VOCs), nitrates & nitrites (20 parts per million (ppm). 3) Sample preservatives include sodium hydroxide (NaOH), hydrochloric acid (HCl), HNO_3, and sulfuric acid (H_2SO_4). Standardized solutions include Zobell solution, potential of hydrogen (pH) buffers, electrical conductivity solution. Other chemicals include various Hach ACCU-VAC ampules. 4) Spill of liquids (water) during operation of drum handler	Low	Wear chemical safety goggles and latex or nitrile gloves when handling potential chemical hazards. Portable eyewash is located in sampling vehicle. No eating, drinking, and smoking will be permitted around sampling operations. All purge water is treated as a non-regulated waste (based on process knowledge of prior sampling) until analytical results show otherwise. Material Safety Data Sheets (MSDSs) kept in sampling vehicle or obtained through the SNL/NM Chemical Information System. When discharging (dumping) drums requires mandatory 2-person team and follow guidance in the equipment manual provided by the manufacturer.
Mechanical 1) Motorized reel for raising and lowering pump. 2) Hydraulic lift on back of sampling vehicle.	Low	Be aware of potential pinch points. Do not wear loose fitting clothing, dangling badges or jewelry when operating this equipment.

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Table 2. Task Hazard Analysis - *Level of Protection* – Level D PPE (safety shoes/boots, chemical safety goggles) (concluded)

Potential Hazard	Hazard Rating	Control
Mechanical (continued) 3) Operation of forklift. 4) Operation of drum handler	Low	Keep equipment within maintenance schedule and compliance. Keep current with training requirements. Requires use of "spotter" personnel when deemed necessary for safe operations.
Physical 1) Heat exhaustion & hypothermia. 2) Sunburn. 3) Lifting injury from equipment, pumps, and 55-gallon drums containing purge water. 4) Operation of water level meter (shoulder strain). 5) Lowering and raising pump (back strain). 6) Slips, trips, and falls. 7) Tools.	Low	1) Weather conditions are addressed in Tailgate Safety Meeting. Workers trained on heat exhaustion & hypothermia. Wear appropriate clothing and hydrate as necessary. 2) Provide workers with sunscreen. 3) Use proper lifting techniques. Utilize hydraulic lift on back of sampling vehicle and a forklift with a SNL/NM approved drum handler. 4) Use water level meter support device. 5) A motorized reel is used to lower and raise the pump. 6) Maintain proper housekeeping of work area. Use step stools. 7) Use correct tools and inspect them prior to use.
Radiological	Low	None are expected although a minimum of (Radiological Awareness or Radworker I) training is required.
Fire	Low	Fire extinguishers are located in mobile equipment.
Biological • Snakes, rodents, insects	Low	Care will be taken to observe that the well casings pose a potential for insects and other animals. Immediate area around wells will be kept clean and places of refuge for biological hazards minimized.

7.0 WORK PRACTICES

The following work practices will be enforced:

- All personnel must comply with OSHA, U.S. Department of Energy, and SNL/NM requirements regarding health and safety.
- No task will be performed until a PHS and THA has been prepared and reviewed with the personnel performing the task.
- All personnel must conduct their activities in a manner pursuant to the contents of this HASP.
- A tailgate meeting will be held prior to starting the day's sampling activities.
- Any unnecessary contact with potentially contaminated substances must be avoided. This includes contact with potentially contaminated surfaces and/or equipment.

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- Eating, drinking, smoking, chewing gum or tobacco, or any other hand-to-mouth activities are prohibited in the sampling vehicle lab.
- A "buddy system" is implemented for all groundwater sampling activities. A "buddy system" is defined as a system of organizing personnel into work groups in such a manner that each member of the work group is designated to be observed by at least one other member in the group. The purpose of the "buddy system" is to provide rapid assistance to sampling personnel in the event of an emergency. In addition, a person is required to report his/her destination when leaving the other team member(s).
- All members of the sampling crew will carry a cell phone or portable radio capable of contacting the Emergency Operations Center (EOC).
- All members of the sampling crew will carry an EOC pager so they can be notified of any KAFB emergencies or weather alerts.
- An ABC fire extinguisher will be located in each of the field sampling vehicles.
- An eyewash device will be located in each of the sampling vehicles.
- A First Aid kit will be located in each of the sampling vehicles.

8.0 TAILGATE SAFETY MEETING

A field technician or field support operations project leader must conduct a tailgate safety meeting and fill out a Tailgate Safety Meeting Form (Attachment A) prior to the start of groundwater sampling activities. The person conducting the meeting must possess knowledge of groundwater sampling activities and the topics discussed in this HASP. All personnel/visitors who attend the meeting must document that they have attended and understood the meeting by signing the Tailgate Safety Meeting Form.

9.0 SHUTDOWN OF WORK ACTIVITIES

All individuals have the authority to shutdown groundwater monitoring activities if they feel that safety is being compromised. A shutdown could be the result of the following:

- Personnel not following health and safety protocols.
- Not having the appropriate safety gear on site (eyewash, first aid kit, fire extinguisher, appropriate PPE).
- Inadequate equipment or equipment failure.
- Weather
  - If lightning is observed within 5 miles (25 seconds from time of flash to thunder) or the EOC issues a lightning warning (via EOC pager).
  - High winds (greater than 40 miles per hour).
  - Severe snow storms (discretion of sampling crew).
  - Severe rain storms (discretion of sampling crew).
  - Severe heat or cold (discretion of sampling crew).
  - Tornado warnings.
- Unsafe conditions around sampling location (discretion of sampling crew).

- Any unsafe condition(s) noted during performance of groundwater monitoring activities or off-normal events.

In the event that work is stopped due to:

- Safety-related issues,
- an injury incurred while performing the tasks identified in this procedure, or
- as the result of an audit,

the field technicians shall immediately notify the sampling coordinator, field support operations project leader, the project leader, and the department manager. The field technicians shall seek the assistance of the field support operations project leader for the mitigation of the hazard and the completion of a Work Resumption Authorization Form (EP 2009-WRA) as required by AOP 09-10, *Work Planning and Control*. The department manager shall sign the completed form prior to the restart of work.

10.0 EMERGENCY RESPONSE PLAN

During groundwater monitoring activities, the potential for fire, explosion, or unplanned release of radionuclides or RCRA regulated hazardous waste or waste constituents that would significantly threaten human health or the environment is very low. In the unlikely event of an emergency, the SNL/NM EOC will provide coordination, resources, and appropriate emergency equipment on an as-needed basis. In case of an emergency:

- Stop work.
- Alert other personnel in the affected area.
- Evacuate the immediate area.
- Notify the appropriate resources or points of contact listed in Table 3.

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Table 3. Points of Contact and Emergency Telephone Numbers

Resources and Contact	Telephone Number
SNL/NM Incident Command System (Fire, Ambulance, etc.)	911 (505-844-0911 from cell phone)
SNL/NM Medical Clinic	845-8159
SNL/NM Non-Emergency Number	311 or 844-6515
Poison Control Center	272-1222
Sandia Security / Key Service	North: 844-4657 South: 845-3114
ES&H concerns	844-6515
National Response Center (Environmental Emergencies)	800 822-9761
Personnel to Notify if an Incident Occurs	
SNL/NM Project Leader Michael Skelly	office: 845-7697 mobile: 270-5170
SNL/NM Department Manager Pamela Puissant	office: 844-3185 mobile: 239-9144
Center 4100 ES&H Coordinator Noel Duran	office: 284-9707 mobile: 270-8822

10.1 Directions to Medical Facilities

Directions to SNL/NM Medical Facility: From Technical Area I (**TA-I**) proceed to Harding Boulevard and/or Wyoming Boulevard. On Hardin Boulevard proceed west to Wyoming Boulevard. Turn right (north) on Wyoming Boulevard and travel north to F Street. Turn right (east) on F Street and proceed to 7th Street. The medical facility is located at the west end of Building 831 at the intersection of F and 7th Streets.

From Technical Area II (**TA-II**) proceed to East Ordnance Road. Proceed west on East Ordnance Road to Wyoming Boulevard. Turn right (north) to F Street. Turn right (east) on F Street and proceed to 7th Street. The medical facility is located at the west end of Building 831 at the intersection of F and 7th Streets.

From **Tijeras Arroyo** proceed to the Landfill Road. Proceed southwest on Landfill Road to Pennsylvania Street. Turn right on Pennsylvania Street and travel northwest to Wyoming Boulevard. Turn right (north) on Wyoming Boulevard and travel north to F Street. Turn right (east) on F Street and proceed to 7th Street. The medical facility is located at the west end of Building 831 at the intersection of F and 7th Streets.

See Attachment B for SNL Medical Clinic location map.

11.0 REFERENCES

Sandia National Laboratories, Corporate Policy ESH100 Environment Safety & Health, SNL/NM.

Sandia National Laboratories, Sample Management Office, AOP 95-16, *Sample Management and Custody* (latest edition), SNL/NM.

Sandia National Laboratories, Sample Management Office, LOP 94-03, *Sample Handling, Packaging and Shipping* (latest edition), SNL/NM.

Sandia National Laboratories, Environmental Programs and Assurance Department, FOP 03-02, *Long Term Environmental Stewardship Water Level Data Acquisition and Management* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 05-01, *Groundwater Monitoring Well Sampling and Field Analytical Measurements* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 05-02, *Groundwater Monitoring Equipment Field Check for Water Quality Measurements* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 05-03, *Groundwater Monitoring Equipment Decontamination* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 05-04, *Groundwater Monitoring Waste Management* (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, FOP 09-05, *Conducting Slug Test Using Pressure Transducer and Data Logger* (latest edition), SNL/NM.

Sandia National Laboratories, Environmental Programs and Long-Term Stewardship, FOP 10-01, *Borehole and Downhole Well Video Inspection*, (latest edition), SNL/NM.

Sandia National Laboratories, Long-Term Stewardship, PLA 13-02, *Mixed Waste Landfill Long-Term Monitoring and Maintenance Health & Safety Plan* (latest edition), SNL/NM.

Sandia National Laboratories, Environmental Programs and Assurance Department, PHS SNL05A01241, *Long Term Environmental Stewardship Groundwater Monitoring Activities* (latest edition), SNL/NM.

SNLNM00825, *9925/1 (High-Bay)*, SNL/NM, September 2009.

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SNLNM00827, *Groundwater Monitoring: Roving*, SNL/NM, September 2009.

SNLNM01481, *Groundwater Surveillance: Roving*, SNL/NM, February 2010.

SNLNM01520, *Chemwaste Landfill Groundwater Surveillance: Roving*, SNL/NM, February 2010.

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Attachment A

Tailgate Safety Meeting Form

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TAILGATE SAFETY MEETING FORM

Dept: _____Well Location: _____Date: _____ Time: _____

Activities: _____
(Anyone has the right to cease field activities for safety concerns. The buddy system will be used when needed.)

Weather Conditions:
Temp: _____ °F Wind Speed: _____ MPH Humidity: _____ % Wind Chill ____ °F

Chemicals Used: Acids in sample containers, standard solutions, Hach ACCU-VAC ampules_____
Other: _____

Safety Topics Presented

☐ Be aware of slips, trips, and falls. Keep work area clean and use a stepping stool when necessary.	☐ Be aware of environmental conditions (heat / cold stress). Dress accordingly. Wear sunscreen if necessary. Stay hydrated.
☐ Wear safety boots.	☐ Be aware of electrical hazards
☐ Use safe lifting practices. Wear leather gloves if necessary.	☐ Be aware of pressure hazards.
☐ Be aware of pinch points on pump cable reel and hydraulic tailgate lift.	☐ No eating or drinking at sampling counter.
☐ Be aware of chemical hazards.	☐ Be aware of biohazards (snakes, spiders, etc.)
☐ Wear nitrile or latex gloves when sampling.	☐ Wear communication device (cell phone, EOC pager).
☐ Wear chemical safety goggles.	☐ Avoid spilling purge / decon water.

Hospital/Clinic: Sandia Medical Clinic Phone: 844-0911/911

Attendees

Printed Name	Signature
Printed Name	Signature
Printed Name	Signature
Printed Name	Signature
Printed Name	Signature

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Attachment B

SNL Medical Facilities Location Map

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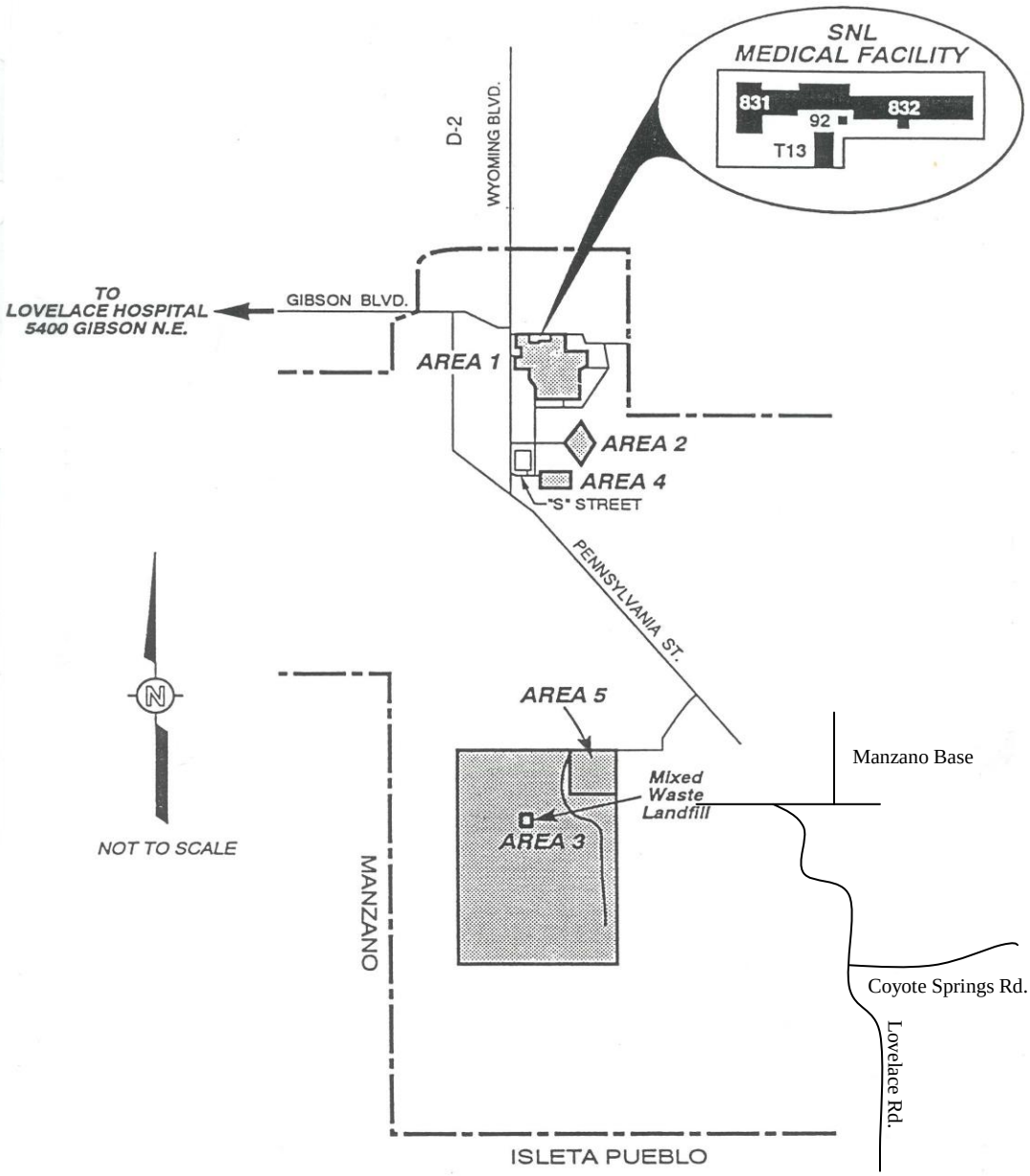

Figure 2
Medical Facilities Location Map, Sandia National Laboratories

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Volume VI

TAB 3

NMED Receipt of Submittal of Updated Reference Documents Cited in the Mixed Waste Landfill Long-Term Monitoring & Maintenance Plan

From: NMED/Kieling
To: SNL/Beausoleil

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NEW MEXICO
ENVIRONMENT DEPARTMENT

SUSANA MARTINEZ
Governor
JOHN A. SANCHEZ
Lieutenant Governor

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

RYAN FLYNN
Cabinet Secretary
BUTCH TONGATE
Deputy Secretary

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

August 4, 2014

Geoffrey L. Beausoleil
Manager
U.S. Department of Energy
P.O. Box 5400, MS-0184
Albuquerque, NM 87185-5400

Peter B. Davies
Director,
Nuclear Energy & Fuel Cycle Programs
P.O. Box 6200, MS-0721
Albuquerque, NM 87185

RE: SUBMITTAL OF UPDATED REFERENCED DOCUMENTS CITED IN THE MIXED WASTE LANDFILL LONG-TERM MONITORING AND MAINTENANCE PLAN, JUNE 2014
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-14-MISC

Dear Mr. Beausoleil and Mr. Davies:

The New Mexico Environment Department (NMED) has received the subject documents that were submitted by the U.S. Department of Energy (DOE) on behalf of itself and Sandia Corporation (collectively, the Permittees). The submittal, dated June 2014, and accompanying cover letter dated July 9, 2014, consists of three updated administrative and field operating procedures, including a health and safety plan for groundwater monitoring, that are cited in the Mixed Waste Landfill Long-Term Monitoring and Maintenance Plan (LTMMP). The documents were required to be submitted to the NMED within 30 days of their effective date, which was June 16, 2014.

If you have any questions regarding this matter, please contact Mr. William Moats of my staff at (505) 222-9551.

Sincerely,

John E. Kieling
Chief
Hazardous Waste Bureau

cc: D. Cobrain, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE OB
L. King, EPA-6
J. Cochran, SNL/NM, MS-0719
J. Weckerle, SFO/ENG MS-0184

File: SNL 2014 and Reading

Sandia National Laboratories

Justification for Class 3 Permit Modification
Corrective Action Complete with Controls
Solid Waste Management Unit 76
Mixed Waste Landfill

October 2014

Volume VII of VIII
Annual Groundwater Monitoring Reports

Environmental Restoration Operations

U.S. DEPARTMENT OF ENERGY

United States Department of Energy
Sandia Field Office

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3	Mixed Waste Landfill Annual Groundwater Monitoring Report, Spring 2007 Sampling Event	SNL/ Wagner	NMED/ Bearzi	02/21/2008	80
4	Mixed Waste Landfill Annual Groundwater Monitoring Report, Calendar Year 2008	SNL/ Davis	NMED/ Bearzi	05/27/2009	112
5	NOD: Mixed Waste Landfill Groundwater Monitoring Report, Calendar Year 2008	NMED/ Bearzi	SNL/ Davis	10/29/2009	4
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April 2005

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SAND REPORT

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Mixed Waste Landfill
Annual Groundwater Monitoring Report
April 2005

Mark L. Lyon and Timothy J. Goering

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550

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Mixed Waste Landfill Annual Groundwater Monitoring Report April 2005 Sandia National Laboratories, Albuquerque, New Mexico

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Abstract

Annual groundwater sampling was conducted at the Sandia National Laboratories' Mixed Waste Landfill (MWL) in April 2005. Seven monitoring wells were sampled using a Bennett™ pump in accordance with the April 2005 Mini-Sampling and Analysis Plan for the MWL (SNL/NM 2005). The samples were analyzed off site at General Engineering Laboratories, Inc. for a broad suite of radiochemical and chemical parameters, and the results are presented in this report. Sample splits were also collected from several of the wells by the New Mexico Environment Department U.S. Department of Energy Oversight Bureau; however, the split sample results are not included in this report.

The results of the April 2005 annual groundwater monitoring conducted at the MWL showed constituent concentrations within the historical ranges for the site and indicated no evidence of groundwater contamination from the landfill.

Acknowledgments

The authors would like to thank Dick Fate, Fran Nimick, MJ Davis, Amy Blumberg, and John Gould for their review of this report. We also thank Tim Jackson for all the work he does behind the scenes for Sandia's Environmental Restoration (ER) groundwater monitoring program, and the ER groundwater sampling team for their diligent efforts in the field, collecting the samples. Finally, we wish to acknowledge Jerry Peace for his management and oversight of the Mixed Waste Landfill project. Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.

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Acronyms and Abbreviations

DOE	U.S. Department of Energy
E_h	oxidation/reduction potential
EPA	U.S. Environmental Protection Agency
FOP	Field Operating Procedure
GEL	General Engineering Laboratories, Inc.
HWB	Hazardous Waste Bureau
L	liter(s)
MCL	Maximum Contaminant Level
MDL	method detection limit
µg	microgram(s)
µm	micron(s)
mg	milligram(s)
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
pCi	picocurie(s)
PQL	practical quantitation limit
QC	quality control
RPD	relative percent difference
SNL/NM	Sandia National Laboratories/New Mexico
SVOC	semivolatile organic compound
TAL	target analyte list
VOC	volatile organic compound

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1. Introduction

Annual groundwater sampling was conducted at the Mixed Waste Landfill (MWL) located in Technical Area 3 at Sandia National Laboratories/New Mexico (SNL/NM). Sampling was conducted by SNL/NM Department 6147 from April 4 through April 19, 2005. All seven monitoring wells at the MWL were sampled, including background monitoring well MWL-BW1, on-site monitoring well MWL-MW4, and downgradient monitoring wells MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW5, and MWL-MW6. Figure 1 shows the location of the MWL, and Figure 2 shows the locations of monitoring wells at the MWL.

Additionally, quarterly groundwater sampling activities and results for perchlorate analysis are reported here for MWL-BW1 and MWL-MW1. These wells were sampled in April, August, and November 2004, and again in February 2005, for perchlorate analysis.

Monitoring well MWL-MW4 is screened at two discrete intervals 20 feet apart, and an inflatable packer separates the screened intervals. During the 2005 sampling event, only the upper interval of MWL-MW4 was sampled, using a dedicated pump, as this is the uppermost water-bearing interval beneath the MWL. References in this report to groundwater samples from MWL-MW4 refer to groundwater withdrawn from the upper interval.

Sampling was conducted in accordance with the MWL April 2005 Mini-Sampling and Analysis Plan (SNL/NM 2005). Sample splits were collected by the New Mexico Environment Department (NMED) U.S. Department of Energy (DOE) Oversight Bureau from several wells. For comparison purposes, the list of analytical parameters was modified to include those parameters analyzed by the NMED DOE Oversight Bureau. The chemical analytical parameters selected for monitoring included volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), target analyte list (TAL) metals, total uranium, nitrate plus nitrite, perchlorate, bromide, fluoride, chloride, and sulfate. Alkalinity titrations were performed in the field on groundwater collected at each well. Radiochemical analysis performed included gross alpha/beta radioactivity, tritium, isotopic plutonium, isotopic uranium, strontium-90, and gamma-emitting radionuclides.

The MWL groundwater samples were submitted to General Engineering Laboratories, Inc. (GEL) located in Charleston, South Carolina, for chemical and radiochemical analysis. All groundwater samples were collected using a Bennett pump.

Field quality control (QC) samples submitted to GEL included three equipment blank samples for VOCs, TAL metals, total uranium, and uranium-235 and -238 analyses only, three performance evaluation samples containing a range of known cadmium concentrations, and ten trip blank samples for VOC analysis.

The remainder of this report is organized as follows: Chapter 2 provides a discussion of field methods and measurements used during this sampling activity; Chapter 3 discusses analytical methods; Chapter 4 provides a summary of the analytical results; Chapter 5 provides QC results; Chapter 6 addresses quarterly sampling for perchlorates; and Chapter 7 presents variances from requirements in the MWL April 2005 Mini-Sampling and Analysis Plan (SNL/NM 2005).

Summaries of findings for the April 2005 sampling event, as well as for five quarters of sampling for perchlorate at MWL-MW1 and MWL-BW1, are presented in Chapter 8. References are included in Chapter 9.

Tables summarizing field measurements and analytical results are included at the end of this report. Tables 1 and 2 present groundwater elevations and associated information and monitoring well purge indicator parameter measurements, respectively. Table 3 lists analytical parameters, test methods, and quantitation limits. Table 4 presents metals analysis results. Table 5 presents the general chemistry analysis results. Table 6 summarizes detected organic compounds. Table 7 summarizes the radiochemical analysis results, and Table 8 compares the duplicate sample analysis results to the sample results. Tables 9 through 11 present field measurements, well purging data, and analytical results for the four quarters of sampling for perchlorate at MWL-MW1 and MWL-BW1. Complete field and laboratory documentation are on file at the SNL/NM Customer Funded Records Center.

2. Field Methods and Measurements

Field measurements performed during annual groundwater sampling activities included groundwater elevation measurements and water quality measurements. The following sections present a more detailed discussion of field activities and methods.

2.1 Groundwater Elevation

Depth-to-groundwater measurements were obtained using a Solinst™ depth-to-water well sounder prior to purging activities. Depth-to-groundwater measurements were performed in accordance with "Measurement of Ground-Water Level," Field Operating Procedure (FOP) 95-02 (SNL/NM 1995). Measurements were obtained from all monitoring wells. Tables 1 and 9 report groundwater elevations, static water heights, and monitoring well completion information.

2.2 Well Purging and Water Quality Measurements

Prior to sample collection, each monitoring well was purged to remove stagnant well casing water. Most MWL monitoring wells recharge slowly, and multiple days were required to purge and sample these wells. The monitoring wells were purged to dryness, allowed to recover, and then sampled to collect the most representative groundwater sample possible, given the low yields of these wells. The recovery period was based on the recharge rate of the well and volume needed for each sample. Total purge volumes presented in Tables 2 and 10 are based on measured volumes evacuated from each monitoring well prior to sample collection.

Field analytical measurements were collected in accordance with FOP 94-46, "Field Analytical Measurement of Groundwater" (SNL/NM 1994a). Groundwater temperature, specific conductance, pH, oxidation/reduction potential (E_h), and dissolved oxygen were measured using a YSI™ Model 6820 flow cell and multi-parameter water quality meter. Turbidity was measured with a Hach™ Model 2100P portable turbidity meter. In addition, a Hach™ field kit was used to perform the alkalinity titration. Water quality measurements were recorded on Field Measurement Log forms. Groundwater pH, temperature, specific conductance, turbidity, dissolved oxygen, and E_h were measured during purging, before sample collection. Tables 2 and 10 show the final three measurements taken before the samples were collected. Water quality parameter field measurements were not taken after sample collection.

2.3 Pump Decontamination

The Bennett™ pump and tubing bundle used to collect groundwater samples were decontaminated prior to installation in MWL monitoring wells according to FOP 94-26, "General Equipment Decontamination" (SNL/NM 1994b). Equipment blank samples were collected after decontamination to verify the effectiveness of the procedure. Three equipment blank samples were collected during the April 2005 annual groundwater sampling event. Equipment blank samples are discussed in Section 5.1.2.

2.4 Sample Collection

All groundwater samples were collected directly from the pump discharge tube into prepared laboratory-provided sample containers. Where appropriate for the requested analysis, chemical preservatives were added to the sample containers at the laboratory prior to shipment. Sample fractions for dissolved TAL metals were collected at MWL-MW1, MWL-MW2, and MWL-MW3, and for major cation analyses at all wells in addition to the routine metals analysis containers. Samples for major dissolved TAL metals and major cation analyses were passed through an in-line filter (0.45-micron [μm] pore size) prior to being placed into the sample container.

2.5 Sample Handling and Shipment

Immediately after collection, all sample containers were custody-taped, sealed in plastic bags, and placed on ice in shipping containers. Analytical Request/Chain-of-Custody forms were completed at the time of collection. The samples for chemical and radiochemical analyses were shipped via the SNL/NM Sample Management Office to the contracted analytical laboratory. Sample management activities followed SNL/NM FOP 94-34, "Field Sample Management and Custody" (SNL/NM 1994c).

2.6 Waste Management

All purge and decontamination water was containerized on site pending results of the analyses. Waste labels were placed on all drums, and the corresponding sample numbers were marked on the outside of the drum with a permanent marker. The wastes were recorded on a Daily Log of Wastes Generated form and submitted to the SNL/NM Environmental Restoration Project Waste Disposal Coordinator.

3. Analytical Methods

Table 3 specifies parameters, appropriate test methods, and target analyte quantitation limits for analytical parameters. A discussion of analytical methods follows.

3.1 Chemical Analytical Methods

All chemical analyses were performed in accordance with the U.S. Environmental Protection Agency (EPA) test methods (EPA 1979, EPA 1986, and EPA 1988). Environmental samples were submitted to GEL and analyzed for VOCs by EPA Test Method 8260B, SVOCs by EPA Test Method 8270C, TAL metals by EPA Test Methods 6020 and 7470A, and total and isotopic uranium by EPA Test Method 6020. General chemistry parameters and methods included nitrate plus nitrite by EPA Method 353.1 and bromide, fluoride, chloride, and sulfate by EPA Method 9056. Perchlorate was analyzed in selected samples by EPA Method 314.0. EPA test methods for chemical analyses are summarized in Table 3.

3.2 Radiochemical Analytical Methods

Radiochemical parameters and methods included gross alpha and beta radioactivity by EPA Method 900.0, gamma-emitting radionuclides by EPA 901.1, strontium-90 by EPA 905.0, and tritium by EPA 906.0. Isotopic plutonium was determined using Method Pu-11-RC referenced to the "Procedures Manual of the Environmental Measurements Laboratory," HASL-300 (U.S. Department of Homeland Security 1997). Radiochemical analytical methods are also summarized in Table 3.

4. Summary of Analytical Results

Tables summarizing the groundwater monitoring results are included at the end of this report. Table 4 summarizes the total metals and filtered major cation results. Table 5 summarizes the general chemistry results. Table 6 summarizes the detected organic constituents, and Table 7 summarizes the radiochemical results. Table 11 presents quarterly sampling results for perchlorate at MWL-MW1 and MWL-BK1. Results for chemical and radiological constituents are compared to established EPA Safe Drinking Water Act Regulations Maximum Contaminant Levels (MCL) (EPA 2001), where applicable. Metals and radiochemical results are also compared to the NMED Hazardous Waste Bureau (HWB) maximum background levels (Dinwiddie 1997).

4.1 Metals

Samples were analyzed for total TAL metals on unfiltered samples. Samples split with the NMED DOE Oversight Bureau were also analyzed for dissolved TAL metals. Dissolved sample fractions were collected by passing the groundwater through 0.45-μm, glass-fiber filters in the field. No reported metals concentrations exceeded EPA MCLs in groundwater samples collected during April 2005. Metals concentrations reported above NMED-HWB maximum background values include barium, nickel, and uranium. The MWL-MW5 barium result of 0.127 milligrams (mg)/liter (L) was slightly above the NMED-HWB background value of 0.120 mg/L. Nickel concentrations from MWL-MW1 and MWL-BW1 samples were detected above the NMED-HWB maximum background value of 0.028 mg/L at 0.424 and 0.0355 mg/L, respectively. Nickel was also detected in the dissolved (field-filtered) sample fraction from MWL-MW1 above the NMED-HWB maximum background value at 0.405 mg/L. Barium and nickel concentrations reported during this annual sampling event are consistent with previously reported data. Nickel concentrations exceeding NMED-HWB maximum background values are attributed to corrosion of the stainless steel screens in the monitoring wells.

Total uranium results exceeded the NMED-HWB maximum background value of 0.0052 mg/L at all wells, except MWL-MW3. Total uranium concentrations exceeding the NMED-HWB maximum background value ranged from 0.00553 mg/L in the MWL-MW1 field-filtered, dissolved sample fraction to 0.00946 mg/L in MWL-MW6. Total uranium results from the April 2005 samples were consistent with data from previous sampling events.

Table 4 summarizes the metals parameters from all groundwater samples collected during the annual groundwater sampling at the MWL. Samples for major cation analyses were filtered through a 0.45-μm, glass-fiber filter to allow mass-balance calculations and to facilitate geochemical analyses of the data. Major cation analysis results on filtered samples are also shown in Table 4.

4.2 General Chemistry Parameters

No general chemistry parameters exceeded established MCLs in the groundwater samples. Nitrate plus nitrite (as nitrogen) was detected below the MCL of 10 mg/L at concentrations ranging from 0.787 mg/L at MWL-MW5 to 3.25 mg/L at MWL-MW3. Fluoride was detected

below the MCL of 4.0 mg/L at concentrations ranging from 0.688 mg/L at MWL-BW1 to 0.896 mg/L at MWL-MW3. The general chemistry analysis results are presented in Table 5.

4.3 Organic Compounds

Groundwater samples from the MWL monitoring wells showed no detections for VOCs greater than the practical quantitation limits (PQL). Acetone was detected in samples from MWL-MW2 (1.95 micrograms [μg]/L) and MWL-MW4 (1.44 and 2.24 μg/L) at estimated concentrations less than the PQL but greater than the method detection limit (MDL). The levels of acetone detected are likely laboratory-introduced contamination. Acetone was also detected at estimated concentrations in samples from MWL-MW1 and MWL-MW3. However, the results were qualified as not detected during data validation due to similar acetone concentrations in one or more QC blank samples. Acetone is a common laboratory contaminant and was also detected in several method blank and trip blank samples.

Analysis results for SVOCs (Table 6) showed an estimated concentration, less than the PQL but greater than the MDL, for the common laboratory contaminant bis(2-ethylhexyl) phthalate in the sample from MWL-MW3 (4.26 μg/L). Because bis(2-ethylhexyl) phthalate, a plasticizer, is a common laboratory contaminant, the likely source is laboratory-introduced contamination. SVOCs were analyzed only in samples from MWL-MW2 and MWL-MW3. A sample fraction for SVOC analysis was collected at MWL-MW1 and shipped to the laboratory; however, the analysis request was cancelled due to laboratory error.

4.4 Radiochemistry

Groundwater samples from the MWL monitoring wells were analyzed for gamma-emitting radionuclides, gross alpha/beta activity, isotopic plutonium, isotopic uranium, strontium-90, and tritium. The results, presented in Table 7, were compared to the established EPA MCLs and NMED-HWB maximum background concentration levels (SNL/NM 1996). Radiological parameters were not detected above established MCLs, with one exception. Gross alpha activity was measured in the parent sample (of the field duplicate pair) from MWL-MW4 at 24.5 picocuries (pCi)/L (or 22.3 pCi/L excluding contribution from uranium), exceeding the MCL of 15 pCi/L. A confirmatory reanalysis of the MWL-MW4 sample for gross alpha activity was performed on August 10, 2005. Results for the reanalysis showed gross alpha activity at 11.1 pCi/L (or 8.9 pCi/L excluding contribution from uranium), less than the EPA MCL. Gross alpha activity in the field duplicate sample from MWL-MW4 was well below the MCL at 4.00 pCi/L (1.81 pCi/L excluding contribution from uranium).

Gross alpha and beta activity levels were detected above laboratory reporting limits in all environmental samples. Gross alpha activity levels ranged from 6.59 ± 3.44 pCi/L in the MWL-MW1 sample to 24.5 ± 3.43 pCi/L in MWL-MW4. Gross beta activity levels ranged from 4.23 ± 1.12 pCi/L in the MWL-MW4 field duplicate sample to 9.29 ± 3.50 pCi/L in the MWL-MW5 sample.

Tritium, analyzed by EPA Method 906.0, and gamma-emitting isotopes, analyzed by EPA Method 901.1,were not detected above laboratory reporting limits in any of the groundwater samples.

Isotopic plutonium and strontium-90 were measured only in samples from MWL-MW1, MWL-MW2, and MWL-MW3. Plutonium isotopes and strontium-90 were not detected above laboratory reporting limits in any of those samples.

4.5 Perchlorate

Analyses for perchlorate were performed on samples from MWL-MW1, MWL-MW2, MWL-MW6, and MWL-BW1 only. Results for perchlorate were nondetect above the MDL of 0.004 mg/L in all samples. The perchlorate results for the April 2005 samples are presented in Table 11 along with perchlorate results for samples collected from MWL-MW1 and MWL-BW1 during the four previous calendar quarters.

5. QC Results

QC samples were purchased from vendors and prepared in the field and in the laboratory in order to assess the quality of the data generated during the annual sampling activities. All data were qualified in accordance with AOP [Administrative Operating Procedure] 00-03, "Data Validation Procedure for Chemical and Radiochemical Data" (SNL/NM 2000). Results for each QC analysis and the impact on data quality are discussed in the following sections.

5.1 Field QC Samples

The field QC samples included blind-spike samples, collection of equipment rinse blank samples, laboratory-prepared trip blank samples, and field duplicate samples. The following sections discuss each QC sample type.

5.1.1 Blind-Spike Samples

Three blind-spike samples were procured and submitted to the laboratory for TAL metals analysis, total uranium, and uranium-235 and -238. The blind-spike samples were submitted as coming from fictitious locations MWL-MW7, MWL-MW8, and MWL-MW9 in a manner identical to the environmental samples. The samples contained known concentrations of cadmium at 0.0001 mg/L (MWL-MW7), 0.0005 mg/L (MWL-MW8), and 0.001 mg/L (MWL-MW9). Percent recoveries for MWL-MW8 and MWL-MW9 were 103 and 95 percent, respectively. The known concentration of 0.0001 mg/L of cadmium for MWL-MW7 is at the MDL, and the laboratory result was nondetect, which is not an unexpected result. If analytical errors follow the normal distribution, then replicate analyses of spiked samples at the MDL should yield nondetect results 50 percent of the time.

5.1.2 Equipment Blank Samples

Three equipment blank samples were collected during the annual sampling activities. The first equipment blank sample, MWL-EB1, was collected on April 1, 2005, prior to purging MWL-MW1 to dryness on April 4, 2005. The second equipment blank sample, MWL-EB2, was collected on April 4, 2005, after purging MWL-MW1 to dryness and prior to purging MWL-MW2 on April 5, 2005. MWL-MW2 was purged to dryness on April 5, 2005. The third equipment blank sample, MWL-EB3, was collected after sampling MWL-MW2 on April 12, 2005, and prior to purging and sampling MWL-MW6 on April 14, 2005. Equipment blank samples were analyzed for VOCs, metals, total uranium, and uranium-235 and -238.

The VOCs acetone and dibromochloromethane were detected in equipment blank sample MWL-EB3 at estimated concentrations less than the relevant PQLs. No other VOCs were detected in any equipment blank sample.

Estimated concentrations, less than the relevant PQLs, of several metals were detected in all three equipment blank samples. Metals detected at these low levels included arsenic, barium, calcium, copper, iron, selenium, thallium, vanadium, and zinc. The low levels of VOCs and metals detected in the equipment blank samples indicate the effectiveness of the decontamination procedures. Associated environmental samples with results less than five times equipment blank

concentrations were qualified as estimated values in accordance with AOP 00-03, "Data Validation Procedure for Chemical and Radiochemical Data" (SNL/NM 2000).

5.1.3 Trip Blank Samples

A laboratory-prepared trip blank sample was returned to the laboratory with each shipment containing samples for VOC analysis. Ten trip blank samples were submitted during annual groundwater sampling and were used to assess VOC contamination that might have occurred during sample shipping and storage. Low levels of VOCs were detected in trip blank samples MWL-TB3, MWL-TB6, and MWL-TB7 associated with the environmental or equipment blank samples MWL-MW1, MWL-MW3, and MWL-EB3, respectively. Estimated concentrations of acetone, a common laboratory contaminant, were detected in MWL-TB3 (1.94 μg/L) and MWL-TB6 (1.97 μg/L). Carbon disulfide was detected in MWL-TB7 at an estimated concentration of 2.05 μg/L. Similar levels of acetone in the environmental samples MWL-MW1 and MWL-MW3 were qualified as not detected during data validation.

5.1.4 Field Duplicate Samples

Duplicate groundwater samples were collected at MWL-MW4. Relative percent differences (RPD) precision measurements for constituents detected above the PQL in both the parent and duplicate samples are presented in Table 8. All RPD measurements for chemical analyses were calculated less than 10 RPD, indicating acceptable precision.

5.2 Laboratory QC Samples

Internal laboratory QC samples, including method blank samples and duplicate laboratory control samples, were analyzed concurrently with all groundwater samples. Additionally, batch matrix spike and matrix spike duplicate samples were analyzed by GEL. All laboratory data were reviewed and qualified in accordance with AOP 00-03, "Data Validation Procedure for Chemical and Radiochemical Data" (SNL/NM 2000). Data review findings and assigned qualifiers are contained in the data validation memoranda and spreadsheets on file at the SNL/NM Customer Funded Records Center. Data validation qualifiers accompany analytical results in the report tables. While some data qualifiers were assigned based on blank sample results or outlying QC sample results, no data were rejected and all data reported are acceptable for use.

6. Quarterly Sampling for Perchlorate

Field and laboratory results for samples collected at MWL-MW1 and MWL-BW1 and analyzed for perchlorate over the previous four calendar quarters, April, August, and November 2004 and February 2005 are detailed in Tables 9 through 11. Table 9 shows groundwater elevations, pump setting depths, and monitoring well completion information. Table 10 summarizes purge volumes and purge indicator measurements for each sampling event. Table 11 presents the analytical results for the perchlorate analyses. Perchlorate samples were also collected in April 2005 from wells MWL-MW1, MWL-MW2, MWL-MW6, and MWL-BW1. These data are also included in Table 11. All samples showed no perchlorate detected above the MDL of 0.004 mg/L.

7. Variances and Nonconformances

All analytical and field methods were in conformance with the MWL Mini-Sampling and Analysis Plan (SNL/NM 2005). Additional sample fractions were collected for field-filtered, dissolved metals and SVOC analyses at MWL-MW1, MWL-MW2, and MWL-MW3. However, the analysis of the SVOC sample fraction from MWL-MW1 was inadvertently cancelled due to laboratory error.

8. Summary and Conclusions

Annual groundwater sampling was conducted at the MWL in April 2005. No inorganic or organic parameters were detected above the corresponding MCLs in any samples. The gross alpha radioactivity measurement at MWL-MW4 of 24.5 ± 3.43 pCi/L (or 22.3 ± 3.43 pCi/L, excluding uranium) exceeded the EPA MCL of 15 pCi/L. Reanalysis of the MWL-MW4 sample showed gross alpha activity at 11.1 ± 3.89 pCi/L (or 8.9 ± 3.89 pCi/L, excluding uranium), which is less than the EPA MCL. The duplicate field sample from MWL-MW4 was well below the MCL at 4.00 ± 1.44 pCi/L (or 1.8 ± 1.44 pCi/L, excluding uranium).

Groundwater samples collected in April 2005 from the MWL monitoring wells showed no organic compound detection greater than the PQL. Estimated concentrations for acetone, less than the PQL but greater than the MDL, are likely inadvertent laboratory-introduced contamination. Analysis results for SVOCs showed an estimated concentration for the common laboratory contaminant bis(2-ethylhexyl) phthalate in the sample from MWL-MW3.

No metals analysis results were reported greater than the established MCLs in any groundwater sample from the MWL in April 2005. Metals concentrations reported above the NMED-HWB maximum background values include barium, nickel, and uranium. The MWL-MW5 barium result of 0.127 mg/L was slightly above the NMED-HWB background value of 0.120 mg/L. Nickel concentrations from MWL-MW1 and MWL-BW1 samples were detected above the NMED-HWB maximum background value of 0.028 mg/L at 0.424 and 0.0355 mg/L, respectively. Nickel was also detected in the dissolved (field-filtered) sample fraction from MWL-MW1 above the NMED-HWB maximum background value at 0.405 mg/L. Barium and nickel concentrations reported during this annual sampling event are consistent with previously reported data. Nickel concentrations exceeding the NMED-HWB maximum background value are attributed to corrosion of the stainless steel screens in the monitoring wells. Total uranium results exceeded the NMED-HWB maximum background value of 0.0052 mg/L at all wells, except MWL-MW3. Total uranium concentrations exceeding the NMED-HWB maximum background value ranged from 0.00553 mg/L in the MWL-MW1 field-filtered, dissolved sample fraction to 0.00946 mg/L in MWL-MW6. Total uranium results from the April 2005 samples were consistent with data from previous sampling events, and are well within the range of total uranium concentrations established by the U.S. Geological Survey for the Middle Rio Grande Basin (USGS 2002).

No general chemistry parameters exceeded established MCLs in the groundwater samples. Nitrate plus nitrite (as nitrogen) was detected below the MCL of 10 mg/L at concentrations ranging from 0.787 mg/L at MWL-MW5 to 3.25 mg/L at MWL-MW3. Fluoride was detected below the MCL of 4.0 mg/L at concentrations ranging from 0.688 mg/L at MWL-BW1 to 0.896 mg/L at MWL-MW3.

Radioactivity and radionuclides were not detected at levels greater than the corresponding MCL or NMED-HWB background concentration levels except for the original analysis of the parent sample for gross alpha activity at MWL-MW4. Reanalysis of the MWL-MW4 sample showed gross alpha activity less than the EPA MCL.

9. References

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FIGURES

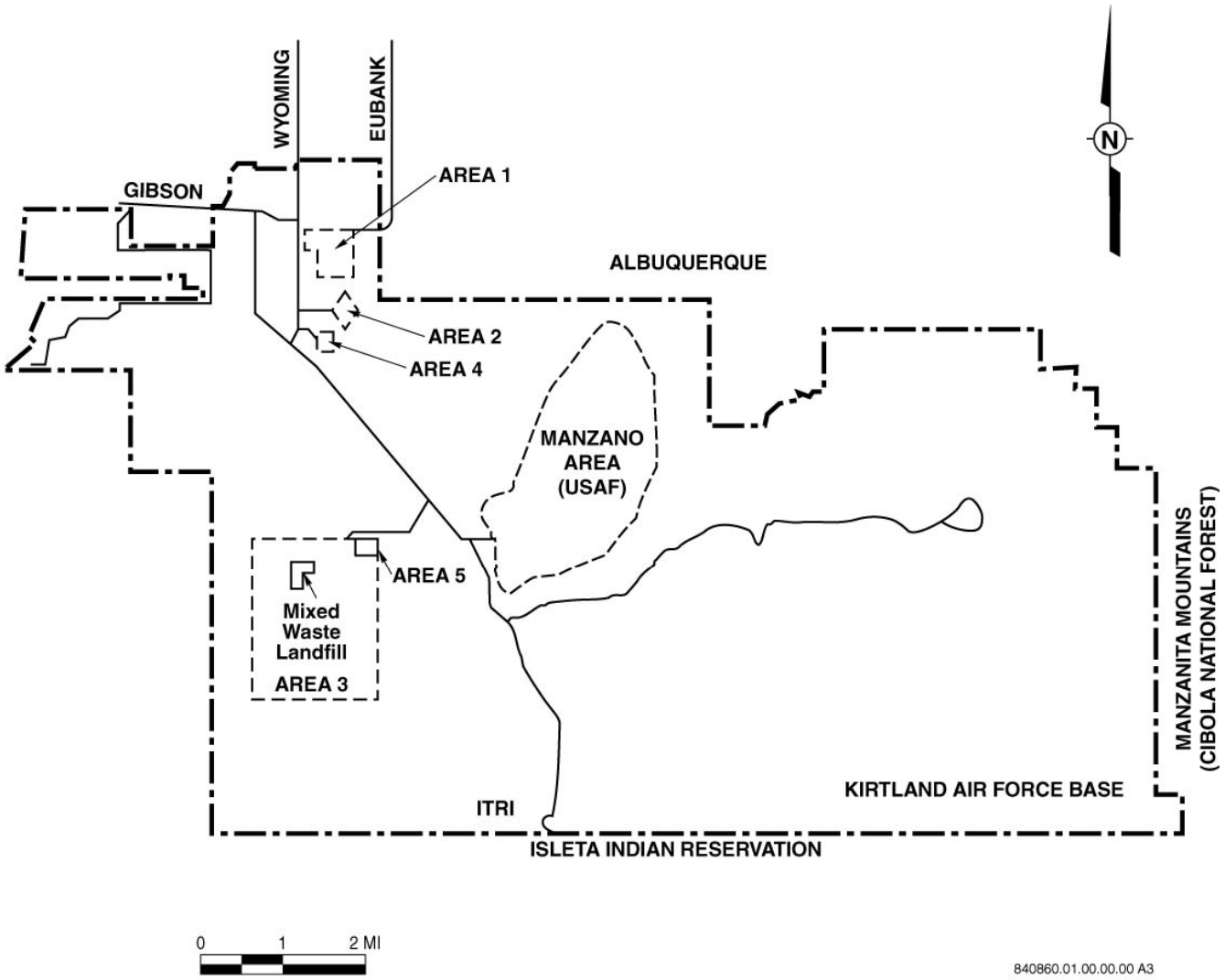

Figure 1 Location of the Mixed Waste Landfill

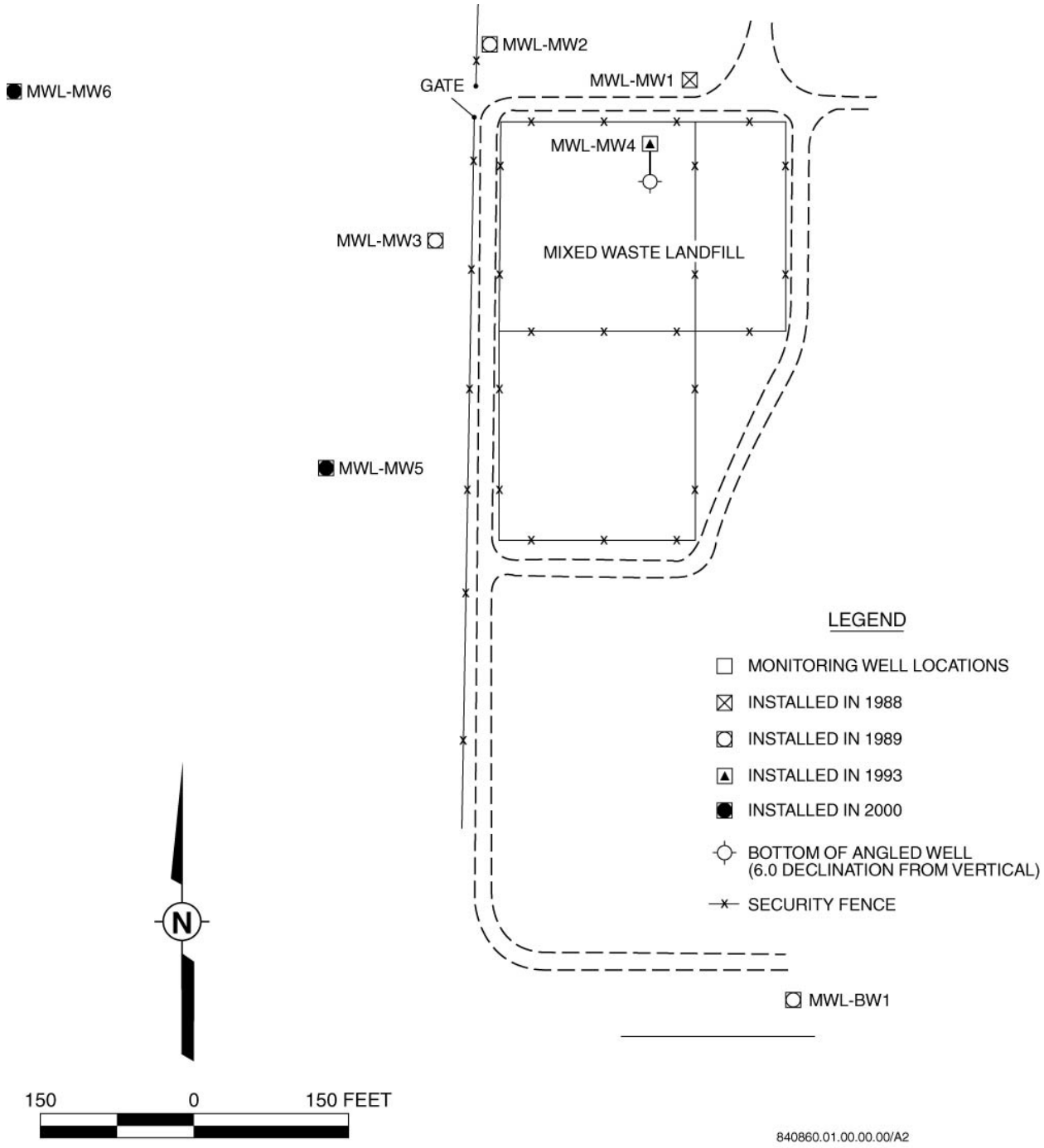

Figure 2 Mixed Waste Landfill Monitoring Well Locations

TABLES

Table 1
Groundwater Elevations, Pump Setting Depths, and Monitoring Well Completion Information
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

Well Number	Date of Measurement	Measurement Point Elevation (FAMSL[a])	Depth to Water (FBTOC)	Groundwater Elevation (FAMSL[a])	Total Well Depth[b] (FBTOC)	Static Water Height (feet)	Pump Setting Depth (FBTOC)
MWL-MW1	04-04-05	5381.54	466.97	4914.57	478	11	478
MWL-MW2	04-05-05	5377.26	463.46	4913.80	477	14	471
MWL-MW3	04-07-05	5381.32	468.68	4912.64	479	10	474
MWL-MW4	04-18-05	5383.46	497.63	4888.56[c]	548	12[d]	509
MWL-MW5	04-06-05	5379.89	491.75	4888.14	521.5	30	509
MWL-MW6	04-14-05	5372.64	485.58	4887.06	530.5	45	518
MWL-BW1	04-08-05	5384.51	470.52	4913.99	477	6	474

[a]Measurement point is the top of well casing.
[b]Total well depth to bottom of sump.
[c]Elevation shown reflects well MWL-MW4 orientation of 6 degrees from vertical.
[d]Depth to the top of the packer is 509.67 FBTOC.
FAMSL Feet above mean sea level.
FBTOC Feet below top of casing.

Table 2
Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	pH (at 25°C)	Temp (°C)	Specific Conductivity (μmhos/cm)	Turbidity (NTU)	E_h (mV)	DO (% Sat)
MWL-MW1[a]	Before sampling:	29	7.62	16.11	511	5.64	273.0	76.7
Date purge began:		31	7.74	17.45	512	6.59	266.0	70.3
04-04-05		33	7.75	17.65	512	6.42	263.3	70.0
Date sampled:	After sampling:	NM	NM	NM	NM	NM	NM	NM
04-11-05								
MWL-MW2[a]	Before sampling:	21	7.74	10.40	522	0.54	96.0	58.7
Date purge began:		22	7.83	12.68	523	0.78	77.8	48.7
04-05-05		23	7.85	15.42	525	1.27	75.6	38.0
Date sampled:	After sampling:	NM	NM	NM	NM	NM	NM	NM
04-12-05								
MWL-MW3[a]	Before sampling:	7	7.67	15.80	476	18.2	262.1	42.8
Date purge began:		9	7.68	17.15	477	15.9	256.2	41.7
04-07-05		14	7.10	14.85	408	14.3	56.0	94.6
Date sampled:	After sampling:	NM	NM	NM	NM	NM	NM	NM
04-13-05								
MWL-MW4[a]	Before sampling:	37	6.94	19.23	532	4.46	-83.9	83.6
Date purge began:		39	7.05	19.73	551	3.39	-121.3	24.4
04-18-05		41	7.07	19.63	551	3.29	-127.9	29.1
Date sampled:	After sampling:	NM	NM	NM	NM	NM	NM	NM
04-19-05								
MWL-MW5	Before sampling:	55	7.17	19.92	795	4.80	123.2	28.8
Date purged:		60	7.17	20.08	796	4.76	123.6	29.0
04-06-05		65	7.17	20.11	797	4.79	123.4	29.0
Date sampled:	After sampling:	NM	NM	NM	NM	NM	NM	NM
04-06-05								

Refer to footnotes at end of table.

Table 2 (Continued)
Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	pH (at 25°C)	Temp (°C)	Specific Conductivity (μmhos/cm)	Turbidity (NTU)	E_h (mV)	DO (% Sat)
MWL-MW6	Before sampling:	100	7.36	21.47	745	0.17	-59.9	30.7
Date purged:		105	7.36	21.47	747	0.25	-60.1	30.9
04-14-05		109	7.36	21.55	747	0.23	-60.2	31.0
Date sampled:	After sampling:	NM	NM	NM	NM	NM	NM	NM
04-14-05								
MWL-BW1[a]	Before sampling:	7	7.90	15.78	498	2.79	278.2	65.4
Date purge began:		7.5	7.90	16.01	498	2.76	277.8	64.5
04-08-05		12.5	7.51	17.68	476	1.32	NM	79.6
Date sampled:	After sampling:	NM	NM	NM	NM	NM	NM	NM
04-15-05								

[a]Wells were purged to dryness. Purge volumes show total gallons removed prior to sampling.

°C	Degrees Celsius.
DO	Dissolved oxygen.
E_h	Oxidation/reduction potential.
μmhos/cm	Micro-mhos per centimeter.
mV	Millivolts.
NM	Not measured.
NTU	Nephelometric turbidity units.
% Sat	Percent saturation.
pH	Potential of hydrogen.
Temp	Temperature.

Table 3
Analytical Parameters, Test Methods, and Target Quantitation Limits
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

Analytical Parameter	Test Method[a]	Target Quantitation Limit[b]
Total metals TAL, major cations, and uranium	EPA 6020 EPA 7470A	0.0002–0.250 mg/L
Dissolved (field filtered) metals TAL and uranium	EPA 6020 EPA 7470A	0.0002–0.250 mg/L
Volatile organic compounds	EPA 8260B	1–5 μg/L
Semivolatile organic compounds	EPA 8270C	1–20 μg/L
Nitrate plus nitrite (as nitrogen)	EPA 353.1	0.250 mg/L
Major anions Bromide, fluoride, chloride, and sulfate	EPA 9056	0.100-0.800 mg/L
Perchlorate	EPA 314.0	0.012 mg/L
Radionuclides		
Gamma-emitting radionuclides	EPA 901.1	MDA is isotope-specific
Gross alpha	EPA 900.0	2.5 pCi/L
Gross beta	EPA 900.0	3.5 pCi/L
Isotopic plutonium	Pu-11-RC	MDA is isotope-specific
Strontium 90	EPA 905.0	0.65 pCi/L
Tritium	EPA 906.0	200 pCi/L

[a]Analytical methods used are referenced to either U.S. Environmental Protection Agency, 1979, "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, U.S. Environmental Protection Agency, Cincinnati, Ohio, or U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C. Radiochemistry method for isotopic plutonium is referenced to the U.S. Department of Homeland Security, 1997, "Procedures Manual of the Environmental Measurements Laboratory," *HASL-300*, Volume 1, 28th Ed., U.S. Department of Homeland Security, New York.
[b]For target compounds only. Reporting limits may be elevated if an interfering component is present or if sample dilution is required.

EPA U.S. Environmental Protection Agency.
MDA Minimum detectable activity.
μg/L Microgram(s) per liter.
mg/L Milligram(s) per liter.
pCi/L Picocurie(s) per liter.
TAL Target Analyte List.

Table 4
Metals Analysis Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

					Sample No.:	068139	068143	068145	068149
					Well ID:	MWL-MW1	MWL-MW2	MWL-MW3	MWL-MW4
					Sampling Date:	04-11-05	04-12-05	04-13-05	04-19-05
					Sample Type:	Environmental	Environmental	Environmental	Environmental
Parameter	**Analytical Method[a]**	**Practical Quantitation Limit (mg/L)**	**MCL (mg/L)**	**NMED-HWB[b] Approved Background (mg/L)**	**All Results in mg/L**			
Aluminum (T)	6020	0.015	NE	NE	0.0312	0.0297	0.118 J, P1	ND (0.005)
Aluminum (D)	6020	0.015	NE	NE	ND (0.005)	ND (0.005)	ND (0.005)	NA
Antimony (T)	6020	0.002	0.006	0.0060	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
Antimony (D)	6020	0.002	0.006	0.0060	ND (0.0005)	ND (0.0005)	ND (0.0005)	NA
Arsenic (T)	6020	0.005	0.010	0.014	ND (0.0015 B)	0.00162 J, B	0.00321 J, B	0.00565 J, B
Arsenic (D)	6020	0.005	0.010	0.014	0.0017 J, B	0.00229 J, B	0.00456 J, B	NA
Barium (T)	6020	0.002	2.0	0.120	0.0685	0.0971	0.0911	0.103 B
Barium (D)	6020	0.002	2.0	0.120	0.0658	0.0959	0.0811	NA
Beryllium (T)	6020	0.0005	0.004	0.004	ND (0.0001)	ND (0.0001)	ND (0.0001)	ND (0.0001)
Beryllium (D)	6020	0.0005	0.004	0.004	ND (0.0001)	ND (0.0001)	ND (0.0001)	NA
Cadmium (T)	6020	0.001	0.005	0.00047	ND (0.0001)	ND (0.0001)	0.000135 J	0.000263 J
Cadmium (D)	6020	0.001	0.005	0.00047	ND (0.0001)	ND (0.0001)	ND (0.0001)	NA
Calcium (T)	6020	0.100	NE	NE	53.2 B	49.5 B	47.3 B	57.2
Calcium (D)	6020	0.100	NE	NE	52.5 B	49.3 J, B	44.2 B	NA
Calcium (D)[c]	6020	0.100	NE	NE	52.6 B	50.1	45.2 B	57.1
Chromium (T)	6020	0.003	0.1	0.043	0.0368 J, A2	0.00217 J	0.00787	0.00105 J
Chromium (D)	6020	0.003	0.1	0.043	0.001	ND (0.001)	0.00392	NA
Cobalt (T)	6020	0.001	NE	0.0025	0.00131	0.000412 J	0.00118	0.000177 J
Cobalt (D)	6020	0.001	NE	0.0025	0.000482 J	0.000144 J	ND (0.0001)	NA
Copper (T)	6020	0.001	1.3[d]	<0.050	0.00357	0.00153	0.0042	0.000925 J
Copper (D)	6020	0.001	1.3[d]	<0.050	0.000985 J	0.00101	0.000852 J	NA

Refer to footnotes at end of table.

Table 4 (Continued)
Metals Analysis Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

				Sample No.:	**068139**	**068143**	**068145**	**068149**
				Well ID:	**MWL-MW1**	**MWL-MW2**	**MWL-MW3**	**MWL-MW4**
				Sampling Date:	**04-11-05**	**04-12-05**	**04-13-05**	**04-19-05**
				Sample Type:	**Environmental**	**Environmental**	**Environmental**	**Environmental**
Parameter	**Analytical Method[a]**	**Practical Quantitation Limit (mg/L)**	**MCL (mg/L)**	**NMED-HWB[b] Approved Background (mg/L)**	**All Results in mg/L**			
Iron (T)	6020	0.025	NE	NE	0.697	0.235 B	0.473 B	0.303
Iron (D)	6020	0.025	NE	NE	0.135	0.175 B	0.121 B	NA
Lead (T)	6020	0.002	0.015[d]	0.010	ND (0.0005)	ND (0.0005)	0.002 J	ND (0.0005)
Lead (D)	6020	0.002	0.015[d]	0.010	ND (0.0005)	ND (0.0005)	ND (0.0005)	NA
Magnesium (T)	6020	0.015	NE	NE	19.7	19.0	15.8 B	21.2
Magnesium (D)	6020	0.015	NE	NE	19.5	19.1 J	14.8 B	NA
Magnesium (D)[c]	6020	0.015	NE	NE	18.5	19.9	15.9 B	21.0
Manganese (T)	6020	0.005	NE	NE	0.019	0.00415 J	0.0259	0.00457 J
Manganese (D)	6020	0.005	NE	NE	0.00563	ND (0.001)	0.00158 J	NA
Mercury (T)	7470A	0.0002	0.002	0.002	ND (0.00005)	ND (0.00005)	ND (0.00005)	ND (0.00005 UJ, B3)
Mercury (D)	7470A	0.0002	0.002	0.002	ND (0.00005)	ND (0.00005)	ND (0.00005)	NA
Nickel (T)	6020	0.002	NE	0.028	**0.424**	0.00802	0.0173	0.00452
Nickel (D)	6020	0.002	NE	0.028	**0.405**	0.00711	0.0115	NA
Potassium (T)	6020	0.300	NE	NE	3.40	4.57	3.95	4.81
Potassium (D)	6020	0.300	NE	NE	3.55	4.56	3.80	NA

Refer to footnotes at end of table.

Table 4 (Continued)
Metals Analysis Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

					Sample No.: 068139 Well ID: MWL-MW1 Sampling Date: 04-11-05 Sample Type: Environmental	068143 MWL-MW2 04-12-05 Environmental	068145 MWL-MW3 04-13-05 Environmental	068149 MWL-MW4 04-19-05 Environmental
Parameter	**Analytical Method[a]**	**Practical Quantitation Limit (mg/L)**	**MCL (mg/L)**	**NMED-HWB[b] Approved Background (mg/L)**	**All Results in mg/L**			
Potassium (D)[c]	6020	0.300	NE	NE	3.42	4.57	3.84	4.96
Selenium (T)	6020	0.005	0.05	0.005	0.0043 J, B	0.00316 J, B	0.00351 J, B	0.00434 J, B
Selenium (D)	6020	0.005	0.05	0.005	**0.00518 J, B**	0.00496 J, B	**0.00501 J, B**	NA
Silver (T)	6020	0.001	NE	<0.010	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)
Silver (D)	6020	0.001	NE	<0.010	ND (0.0002)	ND (0.0002)	ND (0.0002)	NA
Sodium (T)	6020	0.250	NE	NE	49.4	47.9	47.2	47.2
Sodium (D)	6020	0.250	NE	NE	49.9 J	48.0 J	44.8	NA
Sodium (D)[c]	6020	0.250	NE	NE	52.6	52.5	50.2	46.7
Thallium (T)	6020	0.001	0.002	0.002	ND (0.0004)	ND (0.0004)	0.000402 J	ND (0.0004)
Thallium (D)	6020	0.001	0.002	0.002	ND (0.0004)	ND (0.0004)	ND (0.0004)	NA
Uranium, Total (T)	6020	0.0002	0.030	0.0052	**0.00559**	**0.00654**	0.00514	**0.00628**
Uranium, Total (D)	6020	0.0002	0.030	0.0052	**0.00553**	**0.00678**	0.00513	NA
Vanadium (T)	6020	0.030	NE	0.013	ND (0.002) UJ, B3	ND (0.002)	0.00258 J	0.0098 J
Vanadium (D)	6020	0.030	NE	0.013	ND (0.002) UJ, B3	ND (0.002)	ND (0.002)	NA
Zinc (T)	6020	0.010	NE	0.260	0.0127	0.0245	0.0484	0.023
Zinc (D)	6020	0.010	NE	0.260	0.00513 J	0.00886 J	0.00658 J	NA

Refer to footnotes at end of table.

Table 4 (Continued)
Metals Analysis Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

					Sample No.: 068150 Well ID: MWL-MW4 Sampling Date: 04-19-05 Sample Type: Duplicate	Sample No.: 068152 Well ID: MWL-MW5 Sampling Date: 04-06-05 Sample Type: Environmental	Sample No.: 068154 Well ID: MWL-MW6 Sampling Date: 04-14-05 Sample Type: Environmental	Sample No.: 068135 Well ID: MWL-BW1 Sampling Date: 04-15-05 Sample Type: Environmental
Parameter	**Analytical Method[a]**	**Practical Quantitation Limit (mg/L)**	**MCL (mg/L)**	**NMED-HWB[b] Approved Background (mg/L)**	**All Results in mg/L**			
Aluminum (T)	6020	0.015	NE	NE	ND (0.005)	0.0413	ND (0.005)	0.0239
Aluminum (D)	6020	0.015	NE	NE	NA	NA	NA	NA
Antimony (T)	6020	0.002	0.006	0.0060	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
Antimony (D)	6020	0.002	0.006	0.0060	NA	NA	NA	NA
Arsenic (T)	6020	0.005	0.010	0.014	0.00623 J, B	0.00165 J, B	0.00262 J, B, B2	ND (0.0015)
Arsenic (D)	6020	0.005	0.010	0.014	NA	NA	NA	NA
Barium (T)	6020	0.002	2.0	0.120	0.104 B	0.127	0.105 J	0.0748
Barium (D)	6020	0.002	2.0	0.120	NA	NA	NA	NA
Beryllium (T)	6020	0.0005	0.004	0.004	ND (0.0001)	ND (0.0001)	ND (0.0001)	ND (0.0001)
Beryllium (D)	6020	0.0005	0.004	0.004	NA	NA	NA	NA
Cadmium (T)	6020	0.001	0.005	0.00047	0.000263 J	ND (0.0001)	ND (0.0001)	ND (0.0001)
Cadmium (D)	6020	0.001	0.005	0.00047	NA	NA	NA	NA
Calcium (T)	6020	0.100	NE	NE	58.0	78.4 B	76.0 J	44.2 B
Calcium (D)	6020	0.100	NE	NE	NA	NA	NA	NA
Calcium (D)[c]	6020	0.100	NE	NE	57.9	79.7 B	74.8 J	43.8 B
Chromium (T)	6020	0.003	0.1	0.043	0.00125 J	0.00104 J	ND (0.001)	0.00606
Chromium (D)	6020	0.003	0.1	0.043	NA	NA	NA	NA
Cobalt (T)	6020	0.001	NE	0.0025	0.000182 J	0.000249 J	0.000139 J	0.000211 J
Cobalt (D)	6020	0.001	NE	0.0025	NA	NA	NA	NA
Copper (T)	6020	0.001	1.3[d]	<0.050	0.000993 J	0.00128	0.000751 J, B2	0.000752 J
Copper (D)	6020	0.001	1.3[d]	<0.050	NA	NA	NA	NA
Iron (T)	6020	0.025	NE	NE	0.318	0.517	0.282 J, P1	0.200 B
Iron (D)	6020	0.025	NE	NE	NA	NA	NA	NA

Refer to footnotes at end of table.

Table 4 (Continued)
Metals Analysis Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

					Sample No.: 068150 Well ID: MWL-MW4 Sampling Date: 04-19-05 Sample Type: Duplicate	Sample No.: 068152 Well ID: MWL-MW5 Sampling Date: 04-06-05 Sample Type: Environmental	Sample No.: 068154 Well ID: MWL-MW6 Sampling Date: 04-14-05 Sample Type: Environmental	Sample No.: 068135 Well ID: MWL-BW1 Sampling Date: 04-15-05 Sample Type: Environmental
Parameter	**Analytical Method[a]**	**Practical Quantitation Limit (mg/L)**	**MCL (mg/L)**	**NMED-HWB[b] Approved Background (mg/L)**	**All Results in mg/L**			
Lead (T)	6020	0.002	0.015[d]	0.010	ND (0.0005)	0.00113 J	ND (0.0005)	ND (0.0005)
Lead (D)	6020	0.002	0.015[d]	0.010	NA	NA	NA	NA
Magnesium (T)	6020	0.015	NE	NE	20.3	28.9	26.0 J	20.3
Magnesium (D)	6020	0.015	NE	NE	NA	NA	NA	NA
Magnesium (D)[c]	6020	0.015	NE	NE	21.9	29.0	26.4 J	20.8
Manganese (T)	6020	0.005	NE	NE	0.00483 J	0.0377	ND (0.001)	0.00282 J
Manganese (D)	6020	0.005	NE	NE	NA	NA	NA	NA
Mercury (T)	7470A	0.0002	0.002	0.002	ND (0.00005 UJ, B3)	ND (0.00005 UJ, B3)	ND (0.00005 UJ, B3)	ND (0.00005)
Mercury (D)	7470A	0.0002	0.002	0.002	NA	NA	NA	NA
Nickel (T)	6020	0.002	NE	0.028	0.00489	0.0017 J	0.00133 J	**0.0355**
Nickel (D)	6020	0.002	NE	0.028	NA	NA	NA	NA
Potassium (T)	6020	0.300	NE	NE	4.94	5.88	4.72	3.49
Potassium (D)	6020	0.300	NE	NE	NA	NA	NA	NA
Potassium (D)[c]	6020	0.300	NE	NE	4.91	5.89	4.68	3.35
Selenium (T)	6020	0.005	0.05	0.005	0.00481 J, B	0.00279 J, B	0.00384 J, B, B2	0.00405 J, B
Selenium (D)	6020	0.005	0.05	0.005	NA	NA	NA	NA
Silver (T)	6020	0.001	NE	<0.010	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)

Refer to footnotes at end of table.

Table 4 (Continued)
Metals Analysis Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

				Sample No.:	**068150**	**068152**	**068154**	**068135**
				Well ID:	**MWL-MW4**	**MWL-MW5**	**MWL-MW6**	**MWL-BW1**
				Sampling Date:	**04-19-05**	**04-06-05**	**04-14-05**	**04-15-05**
				Sample Type:	**Duplicate**	**Environmental**	**Environmental**	**Environmental**
Parameter	**Analytical Method[a]**	**Practical Quantitation Limit (mg/L)**	**MCL (mg/L)**	**NMED-HWB[b] Approved Background (mg/L)**	**All Results in mg/L**			
Silver (D)	6020	0.001	NE	<0.010	NA	NA	NA	NA
Sodium (T)	6020	0.250	NE	NE	47.4	64.1	55.5 J	53.7
Sodium (D)	6020	0.250	NE	NE	NA	NA	NA	NA
Sodium (D)[c]	6020	0.250	NE	NE	49.1	70.7 J	55.2	51.6
Thallium (T)	6020	0.001	0.002	0.002	ND (0.0004)	ND (0.0004)	ND (0.0004)	ND (0.0004)
Thallium (D)	6020	0.001	0.002	0.002	NA	NA	NA	NA
Uranium, Total (T)	6020	0.0002	0.030	0.0052	**0.00624**	**0.00901**	**0.00946**	**0.00687**
Uranium, Total (D)	6020	0.0002	0.030	0.0052	NA	NA	NA	NA
Vanadium (T)	6020	0.030	NE	0.013	0.0101 J	ND (0.002)	0.00424 J, B2	0.00364 J
Vanadium (D)	6020	0.030	NE	0.013	NA	NA	NA	NA
Zinc (T)	6020	0.010	NE	0.260	0.0225	0.0173	0.00268 J, B2	0.0222
Zinc (D)	6020	0.010	NE	0.260	NA	NA	NA	NA

Note: Values in **bold** exceed EPA MCL or NMED-HWB maximum background values.

[a]Analytical methods from "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.

[b]Dinwiddie, R.S. (New Mexico Environment Department), 1997, Letter to M.J. Zamorski, U.S. Department of Energy, "Request for Supplemental Information: Background Concentrations Report, SNL/KAFB," September 24, 1997.

[c]Results from major cation analyses on samples filtered through 0.45-μm, glass-fiber filter. Duplicate analyses of dissolved calcium, magnesium, and sodium were inadvertently requested for samples that were split with the DOE Oversight Bureau.

[d]Values shown are EPA Action Levels.

Table 4 (Continued)
Metals Analysis Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

A2	Matrix spike percent recovery exceeded acceptance criteria.
B	Analyte detected in the associated laboratory method blank.
B2	Analyte detected in associated equipment blank sample.
B3	Analyte detected in associated initial calibration blank or continuing calibration blank.
CFR	Code of Federal Regulations.
D	Analysis result is on a dissolved basis. The sample was filtered in the field through a 0.45-μm, glass-fiber filter.
DOE	U.S. Department of Energy.
EPA	U.S. Environmental Protection Agency.
HWB	Hazardous Waste Bureau.
ID	Identification.
J	Analyte detected below practical quantitation limit or reported as an estimated concentration.
MCL	Maximum Contaminant Level, U.S. EPA Primary Drinking Water Standards, 40 CFR Part 141, Subpart B and as revised in Subpart G.
μm	Micron.
mg/L	Milligram(s) per liter.
NA	Not analyzed.
ND	The analyte was not detected above the method detection limit indicated in parentheses.
NE	Not established.
NMED	New Mexico Environment Department.
P1	Replicate sample precision exceeds 20 relative percent difference.
T	Analysis result is on a total, unfiltered basis.
UJ	The material was analyzed for but was not detected. The sample quantitation limit is an estimated quantity.

Table 5
General Chemistry Analysis Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

				Sample No.:	068139	068143	068145	068149
				Well ID:	MWL-MW1	MWL-MW2	MWL-MW3	MWL-MW4
				Sampling Date:	04-11-05	04-12-05	04-13-05	04-19-05
				Sample Type	Environmental	Environmental	Environmental	Environmental
Parameter	**Analytical Method[a]**	**Practical Quantitation Limit[b] (mg/L)**	**MCL (mg/L)**	**All Results in mg/L**				
Bromide	9056	0.200	NE	0.174 J	0.203	0.226	0.249	
Chloride	9056	0.400	NE	32.3	39.8	30.3	49.0 B	
Fluoride	9056	0.100	4.0	0.754	0.772	0.896	0.852 B	
Sulfate	9056	0.800	NE	41.9	33.7	37.4	36.7 B	
Nitrate plus Nitrite, as N	353.1	0.200	10	3.17	1.83	3.25	1.94	
Alkalinity, field measurement[c]	HACH	1	NE	192	199	175	185	
				Sample No.:	068150	068152	068154	068135
				Well ID:	MWL-MW4	MWL-MW5	MWL-MW6	MWL-BW1
				Sampling Date:	04-19-05	04-06-05	04-14-05	04-15-05
				Sample Type	Duplicate	Environmental	Environmental	Environmental
Bromide	9056	0.200	NE	0.251	0.378	0.394	0.230	
Chloride	9056	0.400	NE	44.9 B	79.2	69.6	26.0	
Fluoride	9056	0.100	4.0	0.867 B	0.703	0.776	0.688	
Sulfate	9056	0.800	NE	36.6 B	46.7	44.4	42.2	
Nitrate plus Nitrite, as N	353.1	0.200	10	1.94	0.787	1.08	2.82	
Alkalinity, field measurement[c]	HACH	1	NE	NA	295	275	192	

Refer to footnotes at end of table.

Table 5 (Continued)
General Chemistry Analysis Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

[a]Analytical methods used are referenced to either U.S. Environmental Protection Agency, 1979, "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, U.S. Environmental Protection Agency, Cincinnati, Ohio or U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.
[b]Reporting limits may be elevated in the event an interfering component is present or if sample dilution is required.
[c]Alkalinity titration performed in the field using HACH field titrator. Alkalinity results units are mg/L as calcium carbonate.
B Analyte detected in the associated laboratory method blank.
ID Identification.
J Analyte detected below practical quantitation limit or reported as an estimated concentration.
MCL Maximum Contaminant Level, U.S. EPA Primary Drinking Water Standards, 40 CFR Part 141, Subpart B and as revised in Subpart G.
mg/L Milligram(s) per liter.
N Nitrogen.
NA Not analyzed.
NE Not established.

Table 6
Detected Volatile and Extractable Organic Compounds
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

		Analyte	Acetone	bis(2-Ethylhexyl) phthalate
		Practical Quantitation Limit (μg/L)	5.00	10.00
		MCL (μg/L)	NE	NE
Sample Location	Sample Date	Sample No.	All Results in μg/L	All Results in μg/L
MWL-MW1	04-11-05	068139	5.00 U, B1	NA
MWL-MW2	04-12-05	068143	1.95 J	ND (1.90)
MWL-MW3	04-13-05	068145	5 UJ, B1, A	4.26 J
MWL-MW4	04-19-05	068149	1.44 J	NA
MWL-MW4 (Duplicate)	04-19-05	068150	2.24 J	NA
MWL-MW5	04-06-05	68152	ND (1.25)	NA
MWL-MW6	04-14-05	068154	ND (1.25)	NA
MWL-BW1	04-15-05	068135	ND (1.25)	NA

A Laboratory control sample percent recovery exceeds acceptance criteria.
B1 Compound also detected in the trip blank.
CFR Code of Federal Regulations.
EPA U.S. Environmental Protection Agency.
J Analyte detected below practical quantitation limit or reported as an estimated concentration.
MCL Maximum Contaminant Level, U.S. Environmental Protection Agency Drinking Water Standards, 40 CFR 141, Subparts B and as revised in Subpart G.
μg/L Microgram(s) per liter.
NA No analysis results reported.
ND Not detected above the method detection limit shown in parentheses.
NE Not established.
U Qualified undetected in data validation above the detection limit shown.

Table 7
Radiochemical Analysis Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

		Sample No.:	**068139**	
		Well ID:	**MWL-MW1**	
		Sampling Date:	**04-11-05**	
All results in pCi/L				
Analyte	**MCL[a]**	**NMED-HWB[b] Approved Background**	**Results[c] ± TPU**	**MDA[d]**
Gross Alpha	15[e]	NE	6.59 ± 3.44	4.40
Gross Beta	4 (mrem/year dose)	NE	5.61 ± 1.48	2.54
Tritium	NE	NE	0.00 ± 120 U	210
Plutonium-238	NE	NE	-0.0165 ± 0.0253 U	0.042
Plutonium-239/240	NE	NE	0.00549 ± 0.0152 U	0.045
Strontium-90	NE	NE	0.236 ± 0.296 U	0.647
Uranium-235	NE	0.41	0.078[f]	0.022[f]
Uranium-238	NE	3.0	1.865[f]	0.017[f]
		Sample No.:	**068143**	
		Well ID:	**MWL-MW2**	
		Sampling Date:	**04-12-05**	
Gross Alpha	15[e]	NE	8.03 ± 1.45	1.21
Gross Beta	4 (mrem/year dose)	NE	7.90 ± 1.42	2.19
Tritium	NE	NE	0.00 ± 120 U	210
Plutonium-238	NE	NE	-0.0145 ± 0.0219 U	0.028
Plutonium-239/240	NE	NE	-0.00181 ± 0.0118 U	0.030
Strontium-90	NE	NE	0.0509 ± 0.232 U	0.545
Uranium-235	NE	0.41	0.091[f]	0.022[f]
Uranium-238	NE	3.0	2.184[f]	0.017[f]
		Sample No.:	**068145**	
		Well ID:	**MWL-MW3**	
		Sampling Date:	**04-13-05**	
Gross Alpha	15[e]	NE	7.64 ± 1.68	1.83
Gross Beta	4 (mrem/year dose)	NE	7.88 ± 2.84	4.22
Tritium	NE	NE	-76.4 ± 114 U	207
Plutonium-238	NE	NE	-0.0158 ± 0.023 U	0.034
Plutonium-239/240	NE	NE	0.00225 ± 0.0182 U	0.037
Strontium-90	NE	NE	0.142 ± 0.375 U	0.782
Uranium-235	NE	0.41	0.076[f]	0.022[f]
Uranium-238	NE	3.0	1.717[f]	0.017[f]
		Sample No.:	**068149**	
		Well ID:	**MWL-MW4**	
		Sampling Date:	**04-19-05**	
Gross Alpha	15[e]	NE	**24.5 ± 3.43**	1.34
Gross Alpha[g]	15[e]	NE	11.1 ± 3.89	4.42
Gross Beta	4 (mrem/year dose)	NE	7.43 ± 1.62	2.33
Gross Beta[g]	4 (mrem/year dose)	NE	30.7 ± 4.51	5.56
Tritium	NE	NE	-38.5 ± 113 U	202
Uranium-235	NE	0.41	0.089[f]	0.022[f]
Uranium-238	NE	3.0	2.097[f]	0.017[f]

Refer to footnotes at end of table.

Table 7 (Continued)
Radiochemical Analysis Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

		Sample No.:	**068150**	
		Well ID:	**MWL-MW4 (Duplicate)**	
		Sampling Date:	**04-19-05**	
All results in pCi/L				
Analyte	**MCL[a]**	**NMED-HWB[b] Approved Background**	**Results[c] ± TPU**	**MDA[d]**
Gross Alpha	15[e]	NE	4.00 ± 1.44	1.88
Gross Beta	4 (mrem/year dose)	NE	4.23 ± 1.12	1.65
Tritium	NE	NE	0.00 ± 116 U	203
Uranium-235	NE	0.41	0.089[f]	0.022[f]
Uranium-238	NE	3.0	2.083[f]	0.017[f]
		Sample No.:	**068152**	
		Well ID:	**MWL-MW5**	
		Sampling Date:	**04-06-05**	
Gross Alpha	15[e]	NE	11.8 ± 2.48	3.04
Gross Beta	4 (mrem/year dose)	NE	9.29 ± 3.50	6.63
Tritium	NE	NE	-38.5 ± 117 U	209
Uranium-235	NE	0.41	0.128[f]	0.022[f]
Uranium-238	NE	3.0	**3.007**[f]	0.017[f]
		Sample No.:	**068154**	
		Well ID:	**MWL-MW6**	
		Sampling Date:	**04-14-05**	
Gross Alpha	15[e]	NE	11.8 ± 2.08	1.57
Gross Beta	4 (mrem/year dose)	NE	7.29 ± 1.30	1.91
Tritium	NE	NE	-38.8 ± 114 U	204
Uranium-235	NE	0.41	0.141[f]	0.022[f]
Uranium-238	NE	3.0	**3.155**[f]	0.017[f]

Refer to footnotes at end of table.

Table 7 (Continued)
Radiochemical Analysis Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

	Sample No.:	068135
	Well ID:	MWL-BW1
	Sampling Date:	04-15-05
All results in pCi/L		

Analyte	MCL[a]	NMED-HWB[b] Approved Background	Results[c] ± TPU	MDA[d]
Gross Alpha	15[e]	NE	9.99 ± 1.87	1.45
Gross Beta	4 (mrem/year dose)	NE	6.12 ± 1.00	1.23
Tritium	NE	NE	-116 ± 141 U	250
Uranium-235	NE	0.41	0.093[f]	0.022[f]
Uranium-238	NE	3.0	2.295[f]	0.017[f]

Note: Values in **bold** exceed EPA MCL or NMED-HWB maximum background values.

[a]U.S. Environmental Protection Agency Primary Drinking Water Standards, 40 CFR Part 141, Subpart B and as revised in Subpart G.

[b]Dinwiddie, R.S. (New Mexico Environment Department), 1997, Letter to M.J. Zamorski, U.S. Department of Energy, "Request for Supplemental Information: Background Concentrations Report, SNL/KAFB," September 24, 1997.

[c]Laboratory results have a total propagated uncertainty; if the total propagated uncertainty value equals or exceeds the count value, the isotope is considered not to be present.

[d]MDA in pCi/L.

[e]Excluding uranium and radon, but including radium-226.

[f]Sample analysis results and MDA values for uranium isotopes are calculated from concentrations determined by inductively-coupled plasma mass spectrometry, EPA Method 6020. TPU was not reported.

[g]Results from sample reanalysis on August 10, 2005.

CFR Code of Federal Regulations.
EPA U.S. Environmental Protection Agency.
HWB Hazardous Waste Bureau.
ID Identification.
MCL Maximum contaminant level.
MDA Minimum detectable activity.
mrem Millirem.
NE Not established.
NMED New Mexico Environment Department.
pCi/L Picocurie(s) per liter.
TPU Total propagated uncertainty.
U Laboratory qualifier indicating result is less than the MDA.

Table 8
Duplicate Sample Analysis Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2005

Sample No. Sample Location	068149 MWL-MW4	068150 MWL-MW4 (Duplicate)	RPD
	Results (R_1)	Results (R_2)	
Parameter[a]	All results in mg/L, except as noted		
Arsenic (T)	0.00565 J, B	0.00623 J, B	NC
Barium (T)	0.103 B	0.104 B	1
Bromide	0.249	0.251	1
Cadmium (T)	0.000263 J	0.000263 J	NC
Calcium (T)	57.2	58.0	1
Calcium (D)	57.1	57.9	1
Chloride	49.0 B	44.9 B	9
Chromium (T)	0.00105 J	0.00125 J	NC
Cobalt (T)	0.000177 J	0.000182 J	NC
Copper (T)	0.000925 J	0.000993 J	NC
Fluoride	0.852 B	0.867 B	2
Gross Alpha	24.5 pCi/L	4.00 pCi/L	144
Gross Beta	7.43 pCi/L	4.23 pCi/L	55
Iron (T)	0.303	0.318	5
Magnesium (T)	21.2	20.3	4
Magnesium (D)	21.0	21.9	4
Manganese (T)	0.00457 J	0.00483 J	NC
Nickel (T)	0.00452	0.00489	8
Nitrate plus Nitrite, as N	1.94	1.94	0
Potassium (T)	4.81	4.94	3
Potassium (D)	4.96	4.91	1
Selenium (T)	0.00434 J, B	0.00481 J, B	NC
Sodium (T)	47.2	47.4	0
Sodium (D)	46.7	49.1	5
Sulfate	36.7 B	36.6 B	0
Uranium, Total (T)	0.00628	0.00624	1
Uranium-238 (T)	0.00624	0.0062	1
Uranium-235 (T)	0.000041 J	0.000041 J	NC
Vanadium (T)	0.0098 J	0.0101 J	NC
Zinc (T)	0.023	0.0225	2

[a]Parameters not detected in both samples are not listed. RPD is not calculated for estimated values.

B Analyte detected in associated laboratory method blank.

D Analysis result is on a dissolved basis. The sample was filtered in the field through a 0.45-micron, glass-fiber filter.

J Analyte detected below practical quantitation limit or reported as an estimated concentration.

mg/L Milligram(s) per liter.

N Nitrogen.

NC Not able to calculate.

pCi/L Picocurie(s) per liter.

RPD Relative percent difference is calculated with the following equation and rounded to nearest whole number:

$$RPD = \frac{|R_1 - R_2|}{[(R_1 + R_2)/2]} \times 100$$

where:

R_1 = analysis result

R_2 = duplicate analysis result

T Analysis result is on a total, unfiltered basis.

Table 9
Groundwater Elevations, Pump Setting Depths, and Monitoring Well Completion Information
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Quarterly Groundwater Sampling for Perchlorate Analysis
April 2004 to February 2005

Well Number	Date of Measurement	Measurement Point Elevation (FAMSL[a])	Depth to Water (FBTOC)	Groundwater Elevation (FAMSL[a])	Total Well Depth[b] (FBTOC)	Static Water Height (feet)	Pump Setting Depth (FBTOC)
MWL-MW1	04-12-04	5381.54	466.57	4914.97	478	11	477
MWL-MW1	08-27-04	5381.54	466.77	4914.77	478	11	478
MWL-MW1	11-12-04	5381.54	466.81	4914.73	478	11	478
MWL-MW1	02-11-05	5381.54	466.92	4914.62	478	11	478
MWL-BW1	04-13-04	5384.51	469.98	4914.53	477	7	475
MWL-BW1	08-25-04	5384.51	470.22	4914.29	477	7	474
MWL-BW1	11-08-04	5384.51	470.31	4914.20	477	7	474
MWL-BW1	02-09-05	5384.51	470.29	4914.22	477	7	474

[a]Measurement point is the top of well casing.
[b]Total well depth to bottom of sump.
FAMSL Feet above mean sea level.
FBTOC Feet below top of casing.

Table 10
Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Quarterly Groundwater Sampling for Perchlorate Analysis
April 2004 to February 2005

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	pH (at 25°C)	Temp (°C)	Specific Conductivity (µmhos/cm)	Turbidity (NTU)	E_h (mV)	DO (% Sat)
MWL-MW1[a]	Before sampling:	28	7.69	16.88	666	6.04	230.2	71.9
Date purge began:		33	7.80	19.63	670	6.24	223.9	69.4
04-12-04		35	7.83	19.90	669	6.59	222.9	68.1
Date sampled:	After sampling:	NM	NM	NM	NM	NM	NM	NM
04-16-04								
MWL-MW1[a]	Before sampling:	25	8.10	18.86	540	4.30	170.3	75.6
Date purge began:		28	8.21	20.08	539	6.14	169.3	73.3
08-27-04		31	8.19	20.55	538	6.78	170.1	76.5
Date sampled:	After sampling:	NM	NM	NM	NM	NM	NM	NM
08-31-04								
MWL-MW1[a]	Before sampling:	30	7.73	16.46	522	4.33	230.4	75.2
Date purge began:		32	7.73	17.32	524	6.92	221.3	74.0
11-12-04		34	7.73	17.62	523	8.91	215.7	73.2
Date sampled:	After sampling:	NM	NM	NM	NM	NM	NM	NM
11-16-04								
MWL-MW1[a]	Before sampling:	25	7.67	10.52	541	32.2	183.0	98.5
Date purge began:		29	7.69	14.99	570	14.1	178.6	68.3
02-11-05		33	7.65	17.00	568	9.23	172.1	73.0
Date sampled:	After sampling:	NM	NM	NM	NM	NM	NM	NM
02-21-05								
MWL- BW1[a]	Before sampling:	13.5	8.05	17.51	697	4.32	317	67.8
Date purged:		14.5	8.05	17.73	698	4.19	316	67.0
04-13-04		15.5	8.06	17.73	695	4.08	313	71.6
Date sampled:	After sampling:	NM	NM	NM	NM	NM	NM	NM
04-20-04								
MWL- BW1[a]	Before sampling:	8	9.11	16.49	3	1.46	184.2	69.1
Date purged:		10	7.83	16.61	467	1.17	169.4	83.1
08-25-04		11	7.81	17.4	518	0.99	157.3	83.6
Date sampled:	After sampling:	NM	NM	NM	NM	NM	NM	NM
09-01-04								

Refer to footnotes at end of table.

Table 10 (Continued)
Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Quarterly Groundwater Sampling for Perchlorate Analysis
April 2004 to February 2005

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	pH (at 25°C)	Temp (°C)	Specific Conductivity (µmhos/cm)	Turbidity (NTU)	E_h (mV)	DO (% Sat)
MWL-BW1[a]	Before sampling:	10	5.68	14.61	2	0.37	267.6	77.6
Date purge began:		12	6.83	13.88	112	0.87	252.7	97.3
11-08-04		14	8.02	14.06	504	0.74	234.8	68.8
Date sampled:	After sampling:	NM	NM	NM	NM	NM	NM	NM
11-15-04								
MWL- BW1[a]	Before sampling:	6	7.42	15.02	529	0.91	201.2	61.7
Date purge began:		8	8.64	11.88	546	16.9	128.2	92.6
02-09-05		9	8.21	15.83	543	NM	147.6	68.8
Date sampled:	After sampling:	NM	NM	NM	NM	NM	NM	NM
02-16-05								

[a]Wells were purged to dryness. Purge volumes show total gallons removed prior to sampling.

°C Degrees Celsius.
DO Dissolved oxygen.
E_h Oxidation/reduction potential.
µmhos/cm Micro-mhos per centimeter.
mV Millivolts.
NM Not measured.
NTU Nephelometric turbidity units.
% Sat Percent saturation.
pH Potential of hydrogen.
Temp Temperature.

Table 11
Perchlorate Analysis Results, EPA Method 314.0
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Quarterly Groundwater Sampling
April 2004 to April 2005

		Analyte	**Perchlorate**
		Practical Quantitation Limit (mg/L)	**0.012**
		MCL (mg/L)	**NE**
Sample Location	**Sample Date**	**Sample No.**	**All Results in mg/L**
MWL-MW1	04-16-04	64694	ND (0.004)
MWL-MW1	08-31-04	65695	ND (0.004)
MWL-MW1	11-16-04	66268	ND (0.004)
MWL-MW1	02-21-05	66940	ND (0.004)
MWL-MW1	04-11-05	68139	ND (0.004)
MWL-BW1	04-20-04	64707	ND (0.004)
MWL-BW1	09-01-04	65696	ND (0.004)
MWL-BW1	11-15-04	66267	ND (0.004)
MWL-BW1	02-16-05	66939	ND (0.004)
MWL-BW1	04-15-05	68135	ND (0.004)
MWL-MW2	04-12-05	68143	ND (0.004)
MWL-MW6	04-14-05	68154	ND (0.004)

CFR Code of Federal Regulations.
EPA U.S. Environmental Protection Agency.
MCL Maximum Contaminant Level, U.S. Environmental Protection Agency Drinking Water Standards, 40 CFR 141, Subparts B and as revised in Subpart G.
mg/L Milligram(s) per liter.
ND Not detected above the method detection limit shown in parentheses.
NE Not established.

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Volume VII

TAB 2

Mixed Waste Landfill Annual Groundwater Monitoring Report
April 2006 Sampling Event

From: SNL/Wagner
To: NMED/Bearzi

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SNL MWL 06

06-030

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

DEC 13 2006

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. James Bearzi
Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Rd. East, Building 1
Santa Fe, New Mexico 87505

Dear Mr. Bearzi:

On behalf of the Department of Energy (DOE) and Sandia Corporation (Sandia), DOE is submitting the Mixed Waste Landfill (MWL) Annual Groundwater Monitoring Report, April 2006. The report presents groundwater monitoring data from the annual sampling event conducted at the MWL in April 2006. The results of the groundwater monitoring showed constituent concentrations within historical ranges for the MWL.

If you have any questions, please contact me at (505) 845-6036, or John Gould of my staff at (505) 845-6089.

Sincerely,

Kimberly A Davis for

Patty Wagner
Manager

Enclosure

cc w/enclosure:
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CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

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Document authors: **Mark L. Lyon, Shaw**

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Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
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Patty Wagner for
Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
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Date

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MIXED WASTE LANDFILL
ANNUAL GROUNDWATER MONITORING REPORT
APRIL 2006
SAMPLING EVENT
SANDIA NATIONAL LABORATORIES/NEW MEXICO

Prepared for:

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Prepared by:

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Albuquerque, New Mexico 87108

November 2006

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Executive Summary

Annual groundwater sampling was conducted at the Sandia National Laboratories Mixed Waste Landfill (MWL) in April 2006. Seven monitoring wells were sampled using a Bennett™ pump in accordance with the April 2006 Mini-Sampling and Analysis Plan for the MWL (SNL/NM 2006). The samples were analyzed off site at General Engineering Laboratories, Inc. for a broad suite of radiochemical and chemical parameters, and the results are presented in this report. The results show constituent concentrations within historical ranges for the site and indicate no evidence of groundwater contamination from the landfill.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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2	Mixed Waste Landfill Monitoring Well Locations

Acronyms and Abbreviations

AOP	Administrative Operating Procedure
EB	equipment blank
E_h	oxidation/reduction potential
EPA	U.S. Environmental Protection Agency
DO	dissolved oxygen
DOE	U. S. Department of Energy
FOP	Field Operating Procedure
GEL	General Engineering Laboratories, Inc.
HWB	Hazardous Waste Bureau
L	liter(s)
MCL	maximum contaminant level
MDA	minimum detectable activity
MDL	method detection limit
µg	microgram(s)
mg	milligram(s)
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
pCi	picocurie(s)
pH	potential of hydrogen
PQL	practical quantitation limit
PVC	polyvinyl chloride
QC	quality control
RPD	relative percent difference
SNL/NM	Sandia National Laboratories/New Mexico
SWMU	solid waste management unit
TAL	target analyte list
TB	trip blank
USGS	U.S. Geological Society
VOC	volatile organic compound

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1.0 Introduction

Sandia National Laboratories/New Mexico (SNL/NM), operated for the U.S. Department of Energy (DOE), National Nuclear Security Administration by Sandia Corporation, a division of Lockheed Martin Corporation, is located on Kirtland Air Force Base. The purpose of this report is to document the annual groundwater monitoring activities and results conducted in April 2006 at the Mixed Waste Landfill (MWL). The MWL is located in Technical Area 3 and is shown on Figure 1.

The MWL monitoring well network consists of seven wells that serve as a detection monitoring system for potential contaminant releases to groundwater from the landfill. Five of these wells were installed between 1988 and 1993.

The locations of MWL monitoring wells are shown in Figure 2. Monitoring wells MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3 were installed in a one-upgradient, three-downgradient configuration, respectively, based upon regional groundwater flow direction determined in 1988. Monitoring well MWL-MW1 was installed in October 1988 using air rotary casing hammer techniques. Monitoring wells MWL-BW1, MWL-MW2, and MWL-MW3 were installed between June and September 1989 using bentonite-based drilling mud.

Monitoring well MWL-BW1 is located approximately 500 feet southeast of the MWL. MWL-BW1 was established as the background monitoring well. Current groundwater flow direction at the MWL (west) indicates MWL-BW1 is actually cross-gradient to the MWL. However, MWL-BW1 is located far enough away from the landfill to provide background water quality. Monitoring well MWL-MW4 was installed in 1993 directly beneath a disposal trench in which 204,000 gallons of coolant wastewater from the Sandia Engineering Reactor Facility were disposed of in 1967 (Peace et al. September 2002). MWL-MW4 was completed at an angle of 6 degrees from vertical and is screened at two discrete intervals 20 feet apart to evaluate vertical anisotropy, vertical potentiometric gradients, and changes in aquifer parameters with depth. An inflatable packer separates the screened intervals.

Monitoring wells MWL-MW5 and MWL-MW6 were installed in 2000 at a distance of 200 and 500 feet west of the landfill, respectively.

All seven monitoring wells are constructed of 5-inch Schedule 80 polyvinyl chloride (PVC) casing. Wells MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3 have screens made of slotted Type 304 stainless steel. Wells MWL-MW4, MWL-MW5, and MWL-MW6 have screens made of slotted Schedule 80 PVC.

Table 2-1 presents well construction information and water levels measured in each MWL monitoring well.

2.0 Regulatory Criteria

Historically, the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) has provided regulatory oversight of the MWL, as solid waste management unit (SWMU) 76 under the Hazardous and Solid Waste Amendments module of the facility Resource Conservation and Recovery Act (RCRA) permit. The NMED confirmed that the MWL is properly designated as a SWMU (Dinwiddie June 1998), and as such, must comply with the corrective action program defined in the 20.4.1.50 New Mexico Administrative Code, incorporating Title 40 Code of Federal Regulations, Section 264.101. Requirements for corrective action at the MWL, including groundwater monitoring requirements, are established through the corrective measures process.

The NMED issued the Compliance Order on Consent (the Order) in April 2004. Regulatory authority for the groundwater sampling at the MWL was transferred to the Order (NMED April 2004). Although this report is not a deliverable under the Order, it has been formatted to address the content criteria set forth in the Order for Periodic Monitoring Reports. The following crosswalk lists the required elements from the Order and the corresponding section(s) in which these elements are addressed in this report.

Required Elements of the Order (NMED April 2004)	MWL Groundwater Monitoring Report April 2006 Sampling Event
1. Title Page and Signature Block (for the name, title and organization of the preparer and the responsible DOE and Sandia representative)	Title Page Signatures for full SNL/NM and DOE chain of command on the transmittal paperwork that travels with the report from SNL/NM to DOE to NMED
2. Executive Summary (Abstract)	Executive Summary and in Chapter 8.0
3. Table of Contents	Table of Contents
4. Introduction	Chapter 1.0 Introduction
5. Scope of Activities	Chapter 3.0 Scope of Activities
6. Regulatory Criteria	Chapter 2.0 Regulatory Criteria
7. Monitoring Results	Chapter 6.0 Summary of Analytical Results
8. Conclusions	Chapter 9.0 Summary and Conclusions
9. Tables	Appear at the end of the report
10. Figures	Appear at the end of the report
11. Appendices	Not applicable

3.0 Scope of Activities

Annual groundwater sampling was conducted at the MWL located in Technical Area 3 at SNL/NM. Sampling was conducted from April 3 through April 18, 2006. All seven monitoring wells at the MWL were sampled, including background monitoring well MWL-BW1, on-site monitoring well MWL-MW4, and downgradient monitoring wells MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW5, and MWL-MW6.

Although monitoring well MWL-MW4 is screened in two discrete intervals (Chapter 1.0), only the upper interval was sampled, as this is the uppermost water-bearing interval beneath the MWL. References in this report to groundwater samples from MWL-MW4 refer to groundwater withdrawn from the upper interval.

Sampling was conducted in accordance with the MWL April 2006 Mini-Sampling and Analysis Plan (SNL/NM 2006). The chemical analytical parameters selected for monitoring included

volatile organic compounds (VOCs), target analyte list (TAL) metals, total uranium, nitrate plus nitrite, bromide, fluoride, chloride, and sulfate. Alkalinity titrations were performed in the field on groundwater collected at each well. Radiochemical analysis performed included gross alpha/beta radioactivity, tritium, isotopic uranium, and gamma-emitting radionuclides.

The MWL groundwater samples were submitted to General Engineering Laboratories, Inc. (GEL) located in Charleston, South Carolina, for chemical and radiochemical analysis. All groundwater samples were collected using a Bennett™ pump.

Field quality control (QC) samples submitted to GEL included one field duplicate sample for the full-suite of analyses, three equipment blank (EB) samples for VOCs, TAL metals, total uranium, and uranium-235 and -238 analyses only, and eight trip blank (TB) samples for VOC analysis.

The remainder of this report is organized as follows: Chapter 3.0 provides a discussion of field methods and measurements used during this sampling activity; Chapter 4.0 discusses analytical methods; Chapter 5.0 provides a summary of the analytical results; Chapter 6.0 presents QC results; and Chapter 7.0 addresses variances from requirements in the MWL April 2006 Mini-Sampling and Analysis Plan (SNL/NM 2006). Summaries of findings for the April 2006 sampling event are presented in Chapter 8.0. References are included in Chapter 9.0.

Tables summarizing field measurements and analytical results are included at the end of this report. Tables 1 and 2 present groundwater elevations and associated information and monitoring well purge indicator parameter measurements, respectively. Table 3 lists analytical parameters, test methods, and quantitation limits. Table 4 presents metals analytical results. Table 5 presents the general chemistry analytical results. Table 6 summarizes the organic compounds. Table 7 summarizes the radiochemical analytical results, and Table 8 compares the duplicate sample analysis results to the associated environmental sample results. Complete field and laboratory documentation are on file at the SNL/NM Customer Funded Records Center.

4.0 Field Methods and Measurements

Field measurements performed during annual groundwater sampling activities included groundwater elevation measurements and water quality measurements. The following sections present a more detailed discussion of field activities and methods.

4.1 Groundwater Elevation

Depth-to-groundwater measurements were obtained using a Solinst™ depth-to-water well sounder prior to purging activities. Depth-to-groundwater measurements were performed in accordance with "Measurement of Ground-Water Level," Field Operating Procedure (FOP) 95-02 (SNL/NM 1995). Measurements were obtained from all monitoring wells. Table 1 presents groundwater elevations, static water heights, and monitoring well completion information.

4.2 Well Purging and Water Quality Measurements

Prior to sample collection, each monitoring well was purged to remove stagnant well casing water. Most MWL monitoring wells recharge slowly, and multiple days were required to purge and sample these wells. The monitoring wells were purged to dryness, allowed to recover, and then sampled to collect the most representative groundwater sample possible, given the low yields of these wells. The recovery period was based on the recharge rate of the well and volume necessary for each sample. Total purge volumes presented in Table 2 are based on measured volumes evacuated from each monitoring well prior to sample collection.

Field analytical measurements were collected in accordance with FOP 94-46, "Field Analytical Measurement of Groundwater" (SNL/NM 1994a). Groundwater temperature, specific conductance, potential of hydrogen (pH), oxidation/reduction potential (E_h), and dissolved oxygen (DO) were measured using a YSI™ Model 6820 flow cell and multi-parameter water quality meter. Turbidity was measured with a Hach™ Model 2100P portable turbidity meter. In addition, a Hach™ field kit was used to perform alkalinity titrations. Water quality measurements were recorded on Field Measurement Log forms. Groundwater pH, temperature,

specific conductance, turbidity, DO, and E_h were measured during purging, before sample collection. Table 2 shows the final three measurements taken before the samples were collected. Water quality parameter field measurements were not taken after sample collection.

4.3 Pump Decontamination

The Bennett™ pump and tubing bundle used to collect groundwater samples were decontaminated prior to installation in MWL monitoring wells according to FOP 94-26, "General Equipment Decontamination" (SNL/NM 1994b). The EB samples were collected after decontamination to verify the effectiveness of the procedure. Three EB samples were collected during the April 2006 annual groundwater sampling event. The EB samples are discussed in Section 5.1.1.

4.4 Sample Collection

All groundwater samples were collected directly from the pump discharge tube into prepared laboratory-provided sample containers. Where appropriate for the requested analysis, chemical preservatives were added to the sample containers at the laboratory prior to shipment.

4.5 Sample Handling and Shipment

Immediately after collection, all sample containers were custody-taped, sealed in plastic bags, and placed on ice in shipping containers. Analysis Request/Chain-of-Custody forms were completed at the time of collection. The samples for chemical and radiochemical analyses were shipped via the SNL/NM Sample Management Office to the contracted analytical laboratory. Sample management activities followed SNL/NM FOP 94-34, "Field Sample Management and Custody" (SNL/NM 1994c).

4.6 Waste Management

All purge and decontamination water was containerized on site pending the results of the analyses. Waste labels were placed on all drums, and the corresponding sample numbers were

marked on the outside of the drum with a permanent marker. The wastes were recorded on a Daily Log of Wastes Generated form and submitted to the SNL/NM Environmental Restoration Project Waste Disposal Coordinator.

5.0 Analytical Methods

Table 3 specifies parameters, appropriate test methods, and target analyte quantitation limits for analytical parameters. A discussion of analytical methods follows.

5.1 Chemical Analytical Methods

All chemical analyses were performed in accordance with the U.S. Environmental Protection Agency (EPA) test methods (EPA 1979, EPA 1986, and EPA 1988). Environmental samples were submitted to GEL and analyzed for VOCs by EPA Test Method 8260B, TAL metals by EPA Test Methods 6020 and 7470A, and total and isotopic uranium by EPA Test Method 6020. General chemistry parameters and methods included nitrate plus nitrite by EPA Method 353.1 and bromide, fluoride, chloride, and sulfate by EPA Method 9056.

5.2 Radiochemical Analytical Methods

Radiochemical parameters and methods included gross alpha and beta radioactivity by EPA Method 900.0, gamma-emitting radionuclides by EPA 901.1, and tritium by EPA 906.0. Radiochemical analytical methods are also summarized in Table 3.

6.0 Summary of Analytical Results

Tables summarizing the groundwater monitoring results are included at the end of this report. Table 4 summarizes the metals analytical results, and Table 5 summarizes the general chemistry analytical results. Table 6 summarizes the organic constituents; Table 7 summarizes the radiochemical analytical results.

The results for chemical and radiological constituents are compared to established EPA Safe Drinking Water Act Regulations Maximum Contaminant Levels (MCL) (EPA 2001), where applicable.

6.1 Metals

Table 4 summarizes the metals parameters from all groundwater samples collected during the annual groundwater sampling at the MWL. Unfiltered samples were analyzed for total TAL metals. Chromium concentrations in the sample and duplicate sample from MWL-MW1 (0.219 and 0.208 milligrams [mg]/liter [L], respectively) and in the sample from MWL-MW3 (0.133 mg/L) exceed the EPA MCL of 0.1 mg/L. The samples were reanalyzed for chromium on June 14, 2006, and the reanalysis results confirmed the original analyses. The analytical results for both the original analyses and the reanalysis are included in Table 4. The chromium concentration in MWL-MW3 represents the first time the MCL has been exceeded in this well. Chromium concentrations exceeding EPA MCL values correlate with nickel results and are attributed to corrosion of Type 304 stainless steel well screens (Oakley and Korte 1996, SNL/NM 2002).

Total uranium results from the April 2006 samples were consistent with data from previous sampling events, and are well within the range of total uranium concentrations established by the U.S. Geological Survey (USGS) for the Middle Rio Grande Basin (USGS 2002).

6.2 General Chemistry Parameters

No general chemistry parameters exceed established MCLs in the groundwater samples. Nitrate plus nitrite (as nitrogen) was detected below the MCL of 10 mg/L at concentrations ranging from 0.877 mg/L at MWL-MW6 to 4.58 mg/L at MWL-BW1. Fluoride was detected below the MCL of 4.0 mg/L at concentrations ranging from 0.766 mg/L at MWL-BW1 to 0.997 mg/L at MWL-MW4. The general chemistry analytical results are presented in Table 5.

6.3 Organic Compounds

Groundwater samples from the MWL monitoring wells showed no detections for VOCs greater than the practical quantitation limits (PQLs) except in one sample. Acetone was detected in the sample from MWL-MW6 (1.89 micrograms [µg]/L) at an estimated concentration less than the PQL but greater than the method detection limit (MDL) due to similar acetone concentrations in one or more QC blank samples. Detections of acetone in MWL-MW1 (but not the field QC duplicate from MWL-MW1), MWL-MW3, MWL-MW4, and MWL-MW5 were qualified as not detected during data validation due to results from the QC samples. Acetone was also detected in the sample from MWL-BW1, but the result was qualified as not detected due to a contamination source introduced at the laboratory from non-SNL samples (see Chapter 8.0). These results are shown in Table 6.

Samples from MWL-MW1 and MWL-MW2 also contained low concentrations of carbon disulfide and toluene. These results were qualified as not detected during data validation because of similar concentrations of the compounds in associated QC samples.

6.4 Radiochemistry

Groundwater samples from the MWL monitoring wells were analyzed for gamma-emitting radionuclides, gross alpha/beta activity, isotopic uranium, and tritium. The results, presented in Table 7 were compared to the established EPA MCLs. No radiological parameters were detected above established MCLs.

Gross alpha and beta activity levels were detected above laboratory reporting limits in all environmental samples. Gross alpha activity levels range from 2.13 ± 0.547 picocuries (pCi)/L in the MWL-BW1 sample to 14.7 ± 2.23 pCi/L in the MWL-MW3 sample. Gross beta activity levels range from 3.11 ± 0.963 pCi/L in the MWL-BW1 sample to 16.1 ± 2.65 pCi/L in the MWL-MW3 sample.

Neither tritium, analyzed by EPA Method 906.0, nor gamma-emitting isotopes, analyzed by EPA Method 901.1, were detected above the minimum detectable activity (MDA) in any of the groundwater samples.

The uranium isotopes uranium-238 and uranium-235 were determined as mass concentrations during metals analysis on the inductively-coupled plasma mass spectrometer using EPA Method 6020. The isotopic mass concentrations, reported in mg/L, were converted to the radioactivity concentrations shown in Tables 7.

7.0 Quality Control Results

QC samples were prepared in the field and in the laboratory in order to assess the quality of the data generated during the annual sampling activities. All data were reviewed in accordance with AOP [Administrative Operating Procedure] 00-03, "Data Validation Procedure for Chemical and Radiochemical Data" (SNL/NM 2003). Results for each QC analysis and the impact on data quality are discussed in the following sections.

7.1 Field Quality Control Samples

The QC samples collected in the field included EB samples, laboratory-prepared TB samples, and field duplicate samples. The following sections discuss each QC sample type.

7.1.1 Equipment Blank Samples

Three EB samples were collected during the annual sampling activities. The first EB sample, MWL-EB1, was collected on April 11, 2006, after sampling at MWL-MW2 on April 10, 2006, and prior to sampling MWL-MW1 on April 12, 2006. The second EB sample, MWL-EB2, was collected on April 12, 2006, after sampling MWL-MW1, and prior to sampling MWL-MW3 on April 13, 2006. The third EB sample, MWL-EB3, was collected after sampling MWL-MW3 on April 13, 2006 and prior to purging and sampling MWL-MW6 on April 14, 2006. The EB samples were analyzed for VOCs, TAL metals, total uranium, and uranium-235 and -238.

The common laboratory contaminant acetone was detected at a concentration greater than the PQL in EB sample MWL-EB2, and at estimated concentrations greater than the MDL and less than the PQL in the MWL-EB1 and MWL-EB3 EB samples. Similar acetone concentrations in associated MWL groundwater samples from MWL-MW1, MWL-MW3, MWL-MW4, and MWL-MW5 were qualified as not detected during data validation based on the EB analytical results.

An estimated concentration, less than relevant PQLs, for carbon disulfide was reported in the MWL-EB3 sample. A concentration of carbon disulfide in a MWL environmental sample was qualified as not detected during data validation due to the presence of the compound in the EB.

In the metals analyses, aluminum, iron, calcium, and copper were detected in MWL-EB1 at concentrations slightly above the relevant PQLs. In MWL-EB2, magnesium, calcium, and zinc were detected above their PQLs. All those elements, plus chromium, lead, nickel, and sodium were also detected in one or more EB samples as estimated concentrations less than the relevant PQLs.

The low levels of VOCs and metals detected in the EB samples indicate the effectiveness of the decontamination procedures. Associated environmental samples with analytical results less than five times the EB concentrations were qualified as not detected or estimated values in accordance with AOP 00-03, "Data Validation Procedure for Chemical and Radiochemical Data" (SNL/NM 2003).

7.1.2 Trip Blank Samples

A laboratory-prepared TB sample was returned to the laboratory with each shipment containing samples for VOC analysis. Eight TB samples that were submitted during annual groundwater sampling were used to assess VOC contamination that might have occurred during sample shipping and storage. Low levels of VOCs were detected in TB samples MWL-TB4 and MWL-TB7 associated with the environmental or EB samples from MWL-MW2 and MWL-MW4, respectively. An estimated concentration of toluene, a common laboratory contaminant, was detected in MWL-TB4 (0.313 µg/L). Acetone was detected in MWL-TB7 at

an estimated concentration of 1.66 µg/L. Similar levels of toluene and acetone in the environmental samples from MWL-MW2 and MWL-MW4, respectively, were qualified as not detected during data validation.

7.1.3 Field Duplicate Samples

Duplicate groundwater samples were collected at MWL-MW1. Relative percent differences (RPD) precision measurements for constituents detected above the PQL in both the environmental and duplicate samples are presented in Table 8. All calculated RPD measurements for chemical analyses are less than 10, indicating acceptable precision.

7.2 Laboratory Quality Control Samples

Internal laboratory QC samples, including method blank samples and duplicate laboratory control samples, were analyzed concurrently with all groundwater samples. Additionally, batch matrix spike and matrix spike duplicate samples were analyzed by GEL. All laboratory data were reviewed and qualified in accordance with AOP 00-03, "Data Validation Procedure for Chemical and Radiochemical Data" (SNL/NM 2003). Data review findings and assigned qualifiers are contained in the data validation memoranda and spreadsheets on file at the SNL/NM Customer Funded Records Center. Data validation qualifiers accompany analytical results in the report tables. While some data qualifiers were assigned based on blank sample results or outlying QC sample results, no data were rejected and all data reported are acceptable for use.

8.0 Variances and Nonconformances

All analytical and field methods met the requirements specified in the MWL Mini-Sampling and Analysis Plan (SNL/NM 2006) and there were no variances from the plan.

During the data validation process there was a nonconformance report issued for the sample from MWL-BW1. The initial concentration of acetone reported did not receive a qualifier in the data

validation process. However, the result was suspect because historically, acetone has not been identified in samples from this well. SNL requested that the laboratory perform a review of the sample results. Based on the review, the laboratory recommended that the low-level detects for acetone be qualified as not detect at 11.3 µg/L. The justification for this determination was identified by the laboratory as contaminated samples from non-SNL samples that contained high levels of acetone that were analyzed on the same day. This affected numerous sample results for that day that the analysis was performed. MWL-BW1 was the only MWL sample affected.

9.0 Summary and Conclusions

Annual groundwater sampling was conducted at the MWL in April 2006. Chromium in the samples from MWL-MW1 and MWL-MW3 exceed the EPA MCL. The chromium concentration in MWL-MW3 represents the first time the MCL has been exceeded in this well. Sample reanalysis of chromium confirmed the original results. No other inorganic or organic parameters were detected above the corresponding MCLs in any samples.

Groundwater samples collected in April 2006 from the MWL monitoring wells showed no organic compounds detected greater than the PQL after data validation and assignment of qualifiers. Estimated concentrations for acetone, less than the PQL but greater than the MDL, are likely inadvertent laboratory-introduced contamination.

Metals analytical results greater than the established MCL were reported for chromium in groundwater samples from MWL-MW1 and MWL-MW3 in April 2006. The chromium concentrations are attributed to corrosion of the stainless steel screens in the monitoring wells (Oakley and Korte 1996, SNL/NM 2002). Total uranium results from the April 2006 samples were consistent with data from previous sampling events, and are well within the range of total uranium concentrations established by the USGS for the Middle Rio Grande Basin (USGS 2002).

No general chemistry parameters exceed established MCLs in any of the groundwater samples. Radioactivity and radionuclides were not detected at levels greater than the corresponding MCL.

10.0 References

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FIGURES

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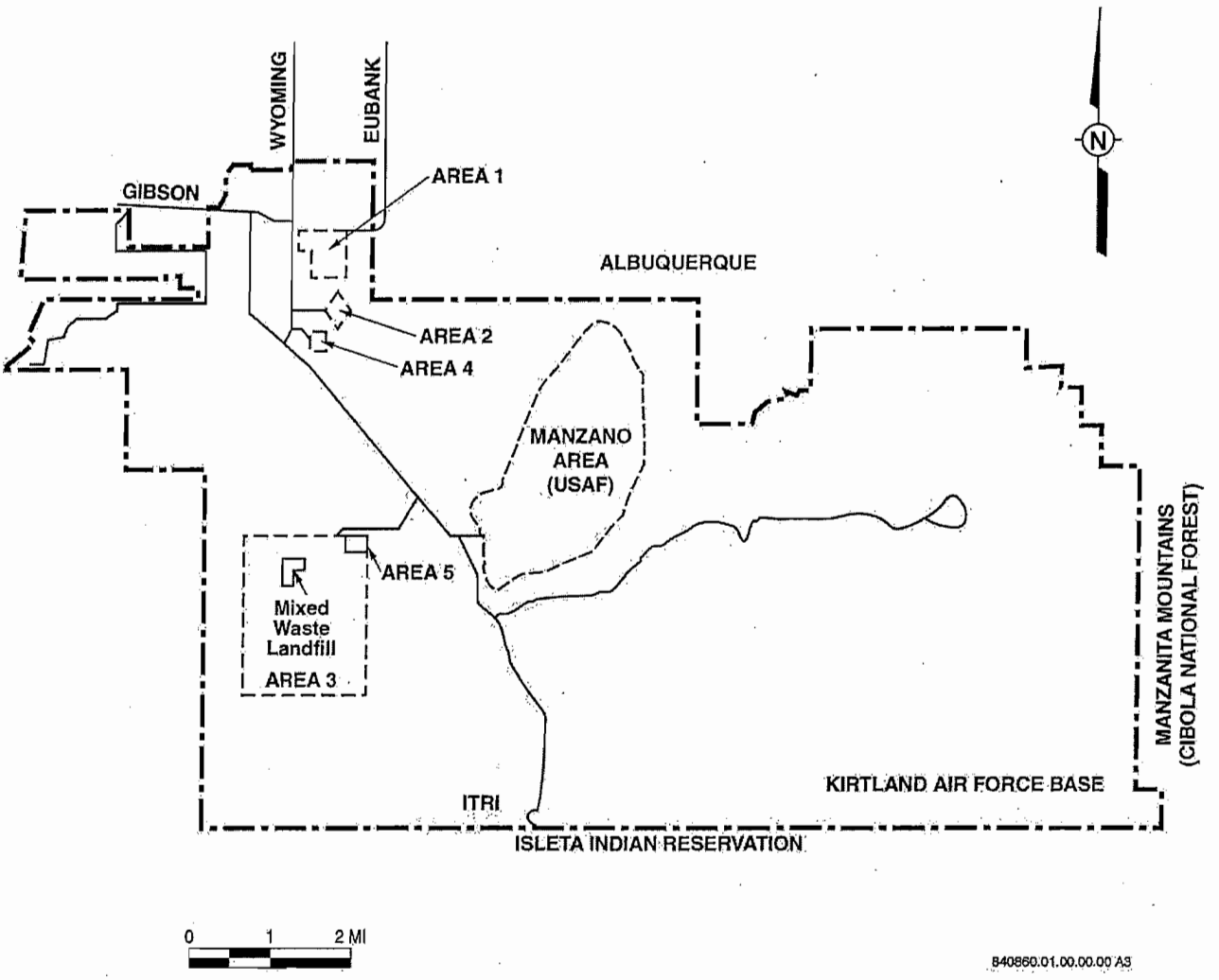

Figure 1 Location of the Mixed Waste Landfill

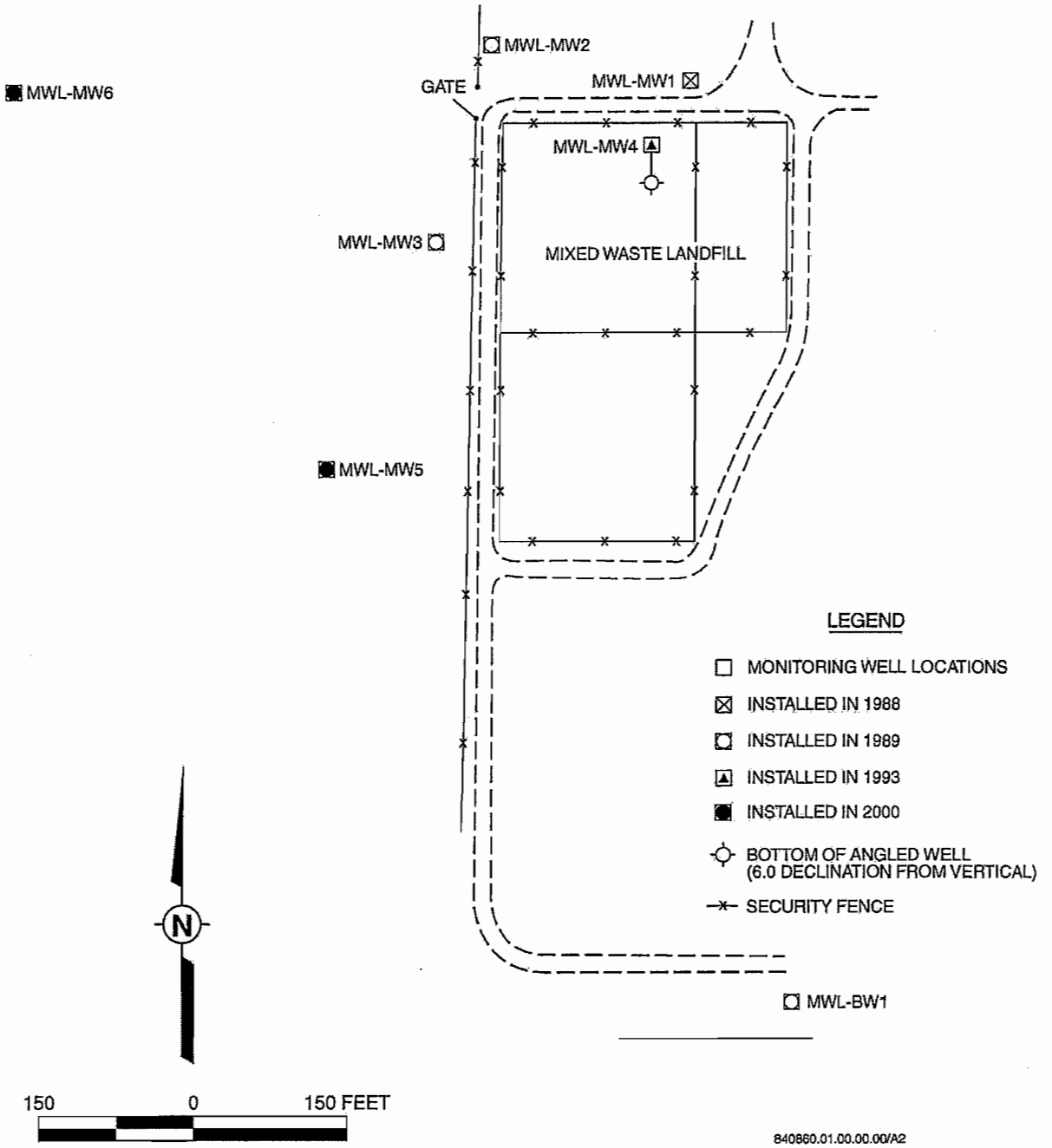

Figure 2 Mixed Waste Landfill Monitoring Well Locations

TABLES

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Table 1

Groundwater Elevations, Pump Setting Depths, and Monitoring Well Completion Information Mixed Waste Landfill, Sandia National Laboratories/New Mexico Annual Groundwater Monitoring, April 2006

Well Number	Date of Measurement	Measurement Point Elevation (FAMSL[a])	Depth to Water (FBTOC)	Groundwater Elevation (FAMSL[a])	Total Well Depth[b] (FBTOC)	Static Water Height (feet)	Pump Setting Depth (FBTOC)
MWL-MW1	04-05-06	5381.54	467.62	4913.92	478	10	478
MWL-MW2	04-03-06	5377.26	464.05	4913.21	477	12	471
MWL-MW3	04-07-06	5381.32	469.28	4912.04	479	9	474
MWL-MW4	04-05-06	5383.46	497.90	4888.29[c]	548	11[d]	509
MWL-MW5	04-14-06	5379.89	492.04	4887.85	521.5	29	509
MWL-MW6	04-17-06	5372.64	486.00	4886.64	530.5	44	518
MWL-BW1	04-04-06	5384.51	472.31	4912.20	477	4	474

[a]Measurement point is the top of well casing.
[b]Total well depth to bottom of sump.
[c]Elevation shown reflects well MWL-MW4 orientation of 6 degrees from vertical.
[d]Depth to the top of the packer is 509.67 FBTOC.
FAMSL = Feet above mean sea level.
FBTOC = Feet below top of casing.

Table 2

Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2006

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	pH (at 25°C)	Temp (°C)	Specific Conductivity (µmhos/cm)	Turbidity (NTU)	E_h (mV)	DO (% Sat)
MWL-MW1[a] Date purge began: 04-05-06	Before sampling:	30	7.53	14.38	585	13.7	93.3	73.8
		32	7.61	17.44	590	16.3	84.0	68.5
		34	7.64	18.66	590	14.0	75.7	69.6
Date sampled: 04-12-06	After sampling:	NM	NM	NM	NM	NM	NM	NM
MWL-MW2[a] Date purge began: 04-03-06	Before sampling:	12	7.85	17.63	588	2.62	90.5	13.7
		16	7.33	20.05	558	2.82	90.8	56.5
		20	7.78	20.43	592	3.25	68.3	29.8
Date sampled: 04-10-06	After sampling:	NM	NM	NM	NM	NM	NM	NM
MWL-MW3[a] Date purge began: 04-07-06	Before sampling:	6	7.86	16.55	495	41.4	133.2	61.6
		8	7.90	16.96	496	62.6	137.8	59.5
		13	7.56	16.91	485	76.2	83.6	91.3
Date sampled: 04-13-06	After sampling:	NM	NM	NM	NM	NM	NM	NM
MWL-MW4[a] Date purge began: 04-05-06	Before sampling:	41	7.40	18.58	624	1.97	431.8	58.1
		46	7.37	19.47	626	0.41	295.6	7.7
		51	7.39	19.51	626	0.69	290.5	13.2
Date sampled: 04-06-06	After sampling:	NM	NM	NM	NM	NM	NM	NM
MWL-MW5 Date purged: 04-14-06	Before sampling:	65	7.15	20.70	912	1.88	32.3	32.0
		70	7.14	20.72	914	1.58	32.1	32.2
		72	7.14	20.78	914	1.32	32.2	32.3
Date sampled: 04-14-06	After sampling:	NM	NM	NM	NM	NM	NM	NM

Refer to footnotes at end of table.

Table 2 *(Continued)*

Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2006

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	pH (at 25°C)	Temp (°C)	Specific Conductivity (µmhos/cm)	Turbidity (NTU)	E_h (mV)	DO (% Sat)
MWL-MW6	Before sampling:	65	7.26	21.26	847	0.36	-13.8	32.6
Date purged:		70	7.25	21.28	849	0.34	-13.7	32.1
04-17-06		72	7.25	21.30	849	0.39	-13.9	32.3
Date sampled: 04-17-06	After sampling:	NM	NM	NM	NM	NM	NM	NM
MWL-BW1[a]	Before sampling:	NM	NM	NM	NM	NM	NM	NM
Date purge began:		6	7.57	15.27	469	2.35	125.3	89.4
04-04-06		8	7.24	14.28	490	3.94	42.8	84.3
Date sampled: 04-18-06	After sampling:	NM	NM	NM	NM	NM	NM	NM

[a]Wells were purged to dryness. Purge volumes show total gallons removed prior to sampling.

°C = Degrees Celsius.
DO = Dissolved oxygen.
E_h = Oxidation/reduction potential.
µmhos/cm = Micro-mhos per centimeter.
mV = Millivolts.
NM = Not measured.
NTU = Nephelometric turbidity units.
% Sat = Percent saturation.
pH = Potential of hydrogen.
Temp = Temperature.

Table 3

Analytical Parameters, Test Methods, and Target Quantitation Limits Mixed Waste Landfill, Sandia National Laboratories/New Mexico Annual Groundwater Monitoring, April 2006

Analytical Parameter	Test Method[a]	Target Quantitation Limit[b]
Total metals TAL, major cations, and uranium	EPA 6020 EPA 7470A	0.0002–0.250 mg/L
Volatile organic compounds	EPA 8260B	1–5 µg/L
Nitrate plus nitrite (as nitrogen)	EPA 353.1	0.250 mg/L
Major anions Bromide, fluoride, chloride, and sulfate	EPA 9056	0.100–0.800 mg/L
Radionuclides		
Gamma-emitting radionuclides	EPA 901.1	MDA is isotope-specific
Gross alpha	EPA 900.0	2.5 pCi/L
Gross beta	EPA 900.0	3.5 pCi/L
Tritium	EPA 906.0	200 pCi/L
Uranium-238 / 235	EPA 6020	0.0168/0.0216 pCi/L[c]

[a]Analytical methods used are referenced to either U.S. Environmental Protection Agency, 1979, "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, U.S. Environmental Protection Agency, Cincinnati, Ohio, or U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C. Radiochemistry method for isotopic plutonium is referenced to the U.S. Department of Homeland Security, 1997, "Procedures Manual of the Environmental Measurements Laboratory," *HASL-300*, Volume 1, 28th Ed., U.S. Department of Homeland Security, New York.

[b]For target compounds only. Reporting limits may be elevated if an interfering component is present or if sample dilution is required.

[c]Target quantitation limits for uranium-238 and uranium-235 are calculated from mass concentration quantitation limits reported for EPA Method 6020.

EPA = U.S. Environmental Protection Agency.
MDA = Minimum detectable activity.
µg/L = Microgram(s) per liter.
mg/L = Milligram(s) per liter.
pCi/L = Picocurie(s) per liter.
TAL = Target Analyte List.

Table 4

Metals Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2006

				Sample No.:	076304	076305	076307	076311
				Well ID:	MWL-MW1	MWL-MW1	MWL-MW2	MWL-MW3
				Sampling Date:	04-12-06	04-12-06	04-10-06	04-13-06
				Sample Type:	Environmental	Duplicate	Environmental	Environmental
Parameter	Analytical Method[a]	Practical Quantitation Limit (mg/L)	MCL (mg/L)		All Results in mg/L			
Aluminum	6020	0.015	NE		0.0244 J, B, B2	0.0302 B	0.048	3.63 J, A2
Antimony	6020	0.002	0.006		0.000535 J, B, B3	ND (0.0005 B)	ND (0.0005)	ND (0.0005)
Arsenic	6020	0.005	0.010		ND (0.0015)	ND (0.0015)	0.00203 J	0.00244 J, B
Barium	6020	0.002	2.0		0.0636	0.0655	0.0992	0.110
Beryllium	6020	0.0005	0.004		ND (0.0001)	ND (0.0001)	ND (0.0001)	0.000208 J
Cadmium	6020	0.001	0.005		ND (0.0001)	ND (0.0001)	ND (0.0001)	0.000569 J
Calcium	6020	0.100	NE		47.5 B	48.3 B	50.1 B	50.5 B
Chromium	6020	0.003	0.1		**0.219**	**0.208**	0.00271 J, B	**0.133 B, J, P1**
Chromium[b]	6020	0.003	0.1		**0.232 J[b]**	**0.197 J[b]**	NA	**0.169 J[b]**
Cobalt	6020	0.001	NE		0.00177	0.00178	0.000535 J	0.00331
Copper	6020	0.001	1.3[c]		0.00703 J, B	0.00677 J, B	0.0015	0.0136
Iron	6020	0.025	NE		1.67 B	1.64 B	0.377 J, B	4.22
Lead	6020	0.002	0.015[c]		ND (0.0005)	ND (0.0005)	0.00088 J	0.00558 J, P1
Magnesium	6020	0.015	NE		17.2	17.4	18.1	14.5 J
Manganese	6020	0.005	NE		0.0236	0.0232	0.00551	0.0771
Mercury	7470A	0.0002	0.002		ND (0.00005)	0.00081	ND (0.00005 UJ, B3)	ND (0.00005)
Nickel	6020	0.002	NE		0.467	0.477	0.00676	0.157
Potassium	6020	0.300	NE		3.13	3.37	4.52	4.36
Selenium	6020	0.005	0.05		ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)
Silver	6020	0.001	NE		ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)
Sodium	6020	0.250	NE		44.3	47.7	44.6	43.6

Refer to footnotes at end of table.

Table 4 *(Continued)*

Metals Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2006

				Sample No.:	076304	076305	076307	076311
				Well ID:	MWL-MW1	MWL-MW1	MWL-MW2	MWL-MW3
				Sampling Date:	04-12-06	04-12-06	04-10-06	04-13-06
				Sample Type:	Environmental	Duplicate	Environmental	Environmental
Parameter	Analytical Method[a]	Practical Quantitation Limit (mg/L)	MCL (mg/L)	All Results in mg/L				
Thallium	6020	0.001	0.002	0.000518 J	ND (0.0004)	0.00058 J	ND (0.0004)	
Uranium, Total	6020	0.0002	0.030	0.00531	0.00537	0.00623	0.005	
Vanadium	6020	0.030	NE	ND (0.002)	ND (0.002)	0.00721 J	ND (0.010 UJ, A2)	
Zinc	6020	0.010	NE	0.0111 J, B, B2	0.0105 J, B, B2	0.0286 B	0.126 B	

Refer to footnotes at end of table.

Table 4 *(Continued)*

Metals Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2006

				Sample No.:	076313	076317	076319	076300
				Well ID:	MWL-MW4	MWL-MW5	MWL-MW6	MWL-BW1
				Sampling Date:	04-06-06	04-14-06	04-17-06	04-18-06
				Sample Type:	Environmental	Environmental	Environmental	Environmental
Parameter	Analytical Method[a]	Practical Quantitation Limit (mg/L)	MCL (mg/L)		All Results in mg/L			
Aluminum	6020	0.015	NE		0.045 J, B, P1	0.0244	ND (0.005)	0.091
Antimony	6020	0.002	0.006		ND (0.0005)	ND (0.0005 B)	ND (0.0005 B)	0.000582 J, B3
Arsenic	6020	0.005	0.010		0.00813 J, B	ND (0.0015)	ND (0.0015)	0.00189 J
Barium	6020	0.002	2.0		0.0925	0.126	0.109	0.0625
Beryllium	6020	0.0005	0.004		ND (0.0001)	ND (0.0001)	ND (0.0001)	ND (0.0001)
Cadmium	6020	0.001	0.005		ND (0.0001)	ND (0.0001)	ND (0.0001)	0.000193 J
Calcium	6020	0.100	NE		58.8	95.2 B	89.6 B	26.5 B
Chromium	6020	0.003	0.1		0.00265 J, B	0.00109 J, B2	0.00123 J	0.0234
Cobalt	6020	0.001	NE		0.00028 J	0.000266 J, B2	0.000225 J	0.000349 J
Copper	6020	0.001	1.3[c]		0.00116 J, B	0.000909 J	0.000939 J	0.00415
Iron	6020	0.025	NE		0.441	0.411	0.316	0.361 B
Lead	6020	0.002	0.015[c]		0.00145 J	ND (0.005)	ND (0.0005)	0.00167 J
Magnesium	6020	0.015	NE		18.7	31.6	28.7	19.0
Manganese	6020	0.005	NE		0.00844	0.0132	ND (0.001)	0.0054
Mercury	7470A	0.0002	0.002		ND (0.00005 UJ, B3)	ND (0.00005 UJ, B3)	ND (0.00005 UJ, B3)	ND (0.00005 UJ, B3)
Nickel	6020	0.002	NE		0.00297	0.00197 J	0.00162 J	0.068
Potassium	6020	0.300	NE		4.77	5.71	5.61	4.12
Selenium	6020	0.005	0.05		ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)
Silver	6020	0.001	NE		ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)
Sodium	6020	0.250	NE		39.5	71.8	65.9	49.3
Thallium	6020	0.001	0.002		ND (0.0004)	ND (0.0004)	ND (0.0004)	0.00059 J
Uranium, Total	6020	0.0002	0.030		0.00595	0.0099	0.0101	0.00554
Vanadium	6020	0.030	NE		0.0189 J, B	0.00659 J	0.0073 J	0.00434 J
Zinc	6020	0.010	NE		0.0197	0.0077 J, B, B2	0.00267 J, B	0.0455 B

Refer to footnotes at end of table.

Table 4 *(Continued)*

Metals Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2006

Note: Values in **bold** exceed EPA MCL.

[a]Analytical methods from U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.

[b]Selected samples reanalyzed for chromium on June 14, 2006.

[c]Values shown are EPA Action Levels.

A2 = Matrix spike percent recovery exceeded acceptance criteria.
B = Analyte detected in the associated laboratory method blank.
B2 = Analyte detected in associated equipment blank sample.
B3 = Analyte detected in associated initial calibration blank or continuing calibration blank.
CFR = Code of Federal Regulations.
EPA = U.S. U.S. Environmental Protection Agency.
ID = Identification.
J = Analyte detected below practical quantitation limit or reported as an estimated concentration.
MCL = Maximum Contaminant Level, U.S. EPA Primary Drinking Water Standards, 40 CFR Part 141, Subpart B and as revised in Subpart G.
mg/L = Milligram(s) per liter.
NA = Not analyzed.
ND = The analyte was not detected above the method detection limit indicated in parentheses.
NE = Not established.
P1 = Replicate sample precision exceeds 20 relative percent difference.
UJ = The material was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

Table 5

General Chemistry Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2006

				Sample No.:	076304	076305	076307	076311
				Well ID:	MWL-MW1	MWL-MW1	MWL-MW2	MWL-MW3
				Sampling Date:	04-12-06	04-12-06	04-10-06	04-13-06
				Sample Type	Environmental	Duplicate	Environmental	Environmental
Parameter	Analytical Method[a]	Practical Quantitation Limit[b] (mg/L)	MCL (mg/L)		All Results in mg/L			
Bromide	9056	0.200	NE		0.243	0.230	0.249	0.263
Chloride	9056	0.400	NE		32.1	32.3	39.5	31.0
Fluoride	9056	0.100	4.0		0.927	0.903	0.838 B	0.951
Sulfate	9056	0.800	NE		44.2	43.6	38.6 B	39.2
Nitrate plus Nitrite, as N	353.1	0.200	10		4.49	4.47	3.23	3.79
Alkalinity, field measurement[c]	HACH	1	NE		192	NA	196	175
				Sample No.:	076313	076317	076319	076300
				Well ID:	MWL-MW4	MWL-MW5	MWL-MW6	MWL-BW1
				Sampling Date:	04-06-06	04-14-06	04-17-06	04-18-06
				Sample Type	Environmental	Environmental	Environmental	Environmental
Bromide	9056	0.200	NE		0.287	0.486	0.430	0.234
Chloride	9056	0.400	NE		49.1	85.1	74.4	26.8
Fluoride	9056	0.100	4.0		0.997 B	0.786	0.793	0.766
Sulfate	9056	0.800	NE		35.5 B	54.7	50.5	42.2
Nitrate plus Nitrite, as N	353.1	0.200	10		1.91 B	0.911	0.877	4.58
Alkalinity, field measurement[c]	HACH	1	NE		186	298	286	193

[a]Analytical methods used are referenced to either U.S. Environmental Protection Agency, 1979, "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, U.S. Environmental Protection Agency, Cincinnati, Ohio or U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.

[b]Reporting limits may be elevated in the event an interfering component is present or if sample dilution is required.

[c]Alkalinity titration performed in the field using HACH field titrator. Alkalinity results units are mg/L as calcium carbonate.

Table 5 *(Continued)*

General Chemistry Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2006

B = Analyte detected in the associated laboratory method blank.
CFR = Code of Federal Regulations.
EPA = U.S. U.S. Environmental Protection Agency.
ID = Identification.
MCL = Maximum Contaminant Level, U.S. EPA Primary Drinking Water Standards, 40 CFR Part 141, Subpart B and as revised in Subpart G.
mg/L = Milligram(s) per liter.
N = Nitrogen.
NA = Not analyzed.
NE = Not established.

Table 6

Volatile Organic Compounds
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2006

Analyte		Acetone	Carbon Disulfide	Toluene
Practical Quantitation Limit (µg/L)		5.00	5.00	1.00
MCL (µg/L)		NE	NE	1000
Sample Location	Sample Date	Results in µg/L	Results in µg/L	Results in µg/L
MWL-MW1	04-12-06	5.00 U, B2	5.00 U, B2	ND (0.250)
MWL-MW1 (Duplicate)	04-12-06	ND (1.25)	ND (1.25)	ND (0.250)
MWL-MW2	04-10-06	ND (1.25)	ND (1.25)	1.00 U, B1
MWL-MW3	04-13-06	6.53 U, B2	ND (1.25)	ND (0.250)
MWL-MW4	04-06-06	5.00 U, B1	ND (1.25)	ND (0.250)
MWL-MW5	04-14-06	5.00 U, B2	ND (1.25)	ND (0.250)
MWL-MW6	04-17-06	1.89 J	ND (1.25)	ND (0.250)
MWL-BW1	04-18-06	11.3 U	ND (1.25)	ND (0.250)

B1 = Compound also detected in the trip blank.
B2 = Compound also detected in the associated equipment rinse blank sample.
CFR = Code of Federal Regulations.
J = Analyte detected below practical quantitation limit or reported as an estimated concentration.
MCL = Maximum Contaminant Level, U.S. Environmental Protection Agency Drinking Water Standards, 40 CFR 141, Subparts B and as revised in Subpart G.
µg/L = Microgram(s) per liter.
ND = Not detected above the method detection limit shown in parentheses.
NE = Not established.
U = The analyte was analyzed for was not detected.

Table 7

Radiochemical Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2006

	Sample No.:	076304	
	Well ID:	MWL-MW1	
	Sampling Date:	04-12-06	
All results in pCi/L			
Analyte	MCL[a]	Results[b] ± TPU	MDA[c]
Gross Alpha	15[d]	8.38 ± 1.40	0.982
Gross Beta	4 (mrem/year dose)	6.07 ± 2.02	3.30
Tritium	NE	-77.6 ± 128 U	230
Uranium-235	NE	0.080[e]	0.022[e]
Uranium-238	NE	1.771[e]	0.017[e]
	Sample No.:	076305	
	Well ID:	MWL-MW1 (Duplicate)	
	Sampling Date:	04-12-06	
Gross Alpha	15[d]	7.91 ± 1.52	1.11
Gross Beta	4 (mrem/year dose)	6.09 ± 1.60	2.40
Tritium	NE	39.2 ± 135 U	232
Uranium-235	NE	0.078[e]	0.022[e]
Uranium-238	NE	1.791[e]	0.017[e]
	Sample No.:	076307	
	Well ID:	MWL-MW2	
	Sampling Date:	04-10-06	
Gross Alpha	15[d]	11.5 ± 1.78	1.52
Gross Beta	4 (mrem/year dose)	10.8 ± 2.11	3.07
Tritium	NE	-35.5 ± 107 U	190
Uranium-235	NE	0.099[e]	0.022[e]
Uranium-238	NE	2.080[e]	0.017[e]
	Sample No.:	076311	
	Well ID:	MWL-MW3	
	Sampling Date:	04-13-06	
Gross Alpha	15[d]	14.7 ± 2.23	1.75
Gross Beta	4 (mrem/year dose)	16.1 ± 2.65	3.52
Tritium	NE	144 ± 115 U	189
Uranium-235	NE	0.076[e]	0.022[e]
Uranium-238	NE	1.667[e]	0.017[e]

Refer to footnotes at end of table.

Table 7 *(Continued)*

Radiochemical Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2006

	Sample No.:	076313	
	Well ID:	MWL-MW4	
	Sampling Date:	04-06-06	
All results in pCi/L			
Analyte	MCL[a]	Results[b] ± TPU	MDA[c]
Gross Alpha	15[d]	7.75 ± 2.03	2.60
Gross Beta	4 (mrem/year dose)	9.47 ± 2.15	3.30
Tritium	NE	38.9 ± 130 U	224
Uranium-235	NE	0.089[e]	0.022[e]
Uranium-238	NE	1.986[e]	0.017[e]
	Sample No.:	076317	
	Well ID:	MWL-MW5	
	Sampling Date:	04-14-06	
Gross Alpha	15[d]	8.59 ± 4.29	6.17
Gross Beta	4 (mrem/year dose)	10.3 ± 3.42 J, P1	5.94
Tritium	NE	-63.9 ± 106 U	191
Uranium-235	NE	0.138[e]	0.022[e]
Uranium-238	NE	3.303[e]	0.017[e]
	Sample No.:	076319	
	Well ID:	MWL-MW6	
	Sampling Date:	04-17-06	
Gross Alpha	15[d]	10.3 ± 1.65	0.807
Gross Beta	4 (mrem/year dose)	12.8 ± 3.45 J, P1	5.50
Tritium	NE	78.9 ± 113 U	190
Uranium-235	NE	0.143[e]	0.022[e]
Uranium-238	NE	3.394[e]	0.017[e]

Refer to footnotes at end of table.

Table 7 *(Continued)*

Radiochemical Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2006

		Sample No.: 076300 Well ID: MWL-BW1 Sampling Date: 04-18-06	
All results in pCi/L			
Analyte	MCL[a]	Results[b] ± TPU	MDA[c]
Gross Alpha	15[d]	2.13 ± 0.547	0.694
Gross Beta	4 (mrem/year dose)	3.11 ± 0.963	1.63
Tritium	NE	7.40 ± 106 U	184
Uranium-235	NE	0.084[e]	0.022[e]
Uranium-238	NE	1.848[e]	0.017[e]

Note: Values in **bold** exceed EPA MCL.

[a]U.S. Environmental Protection Agency Primary Drinking Water Standards, 40 CFR Part 141, Subpart B and as revised in Subpart G.

[b]Laboratory results have a TPU; if the TPU value equals or exceeds the count value, the isotope is considered not to be present.

[c]MDA in pCi/L.

[d]Excluding uranium and radon, but including radium-226.

[e]Sample analysis results and MDA values for uranium isotopes are calculated from concentrations determined by inductively-coupled plasma mass spectrometry, EPA Method 6020. TPU was not reported.

CFR = Code of Federal Regulations.
EPA = U.S. Environmental Protection Agency.
ID = Identification.
J = Estimated activity, quality control exceedence noted in data validation.
MCL = Maximum contaminant level.
MDA = Minimum detectable activity.
mrem = Millirem.
NE = Not established.
P1 = Replicate error ratio exceeds precision criteria.
pCi/L = Picocurie(s) per liter.
TPU = Total propagated uncertainty.
U = Laboratory qualifier indicating result is less than the MDA.

Table 8

Duplicate Sample Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2006

Sample No. Sample Location	076304 MWL-MW1	076305 MWL-MW1 (Duplicate)	
	Results (R_1)	Results (R_2)	
Parameter[a]	All results in mg/L, except as noted		RPD
Aluminum	0.0244 J, B, B2	0.0302 B	NC
Barium	0.0636	0.0655	3
Bromide	0.243	0.230	5
Calcium	47.5 B	48.3 B	2
Chloride	32.1	32.3	1
Chromium	0.219	0.208	5
Chromium[b]	0.232 J	0.197 J	NC
Cobalt	0.00177	0.00178	1
Copper	0.00703 J, B	0.00677 J, B	NC
Fluoride	0.927	0.903	3
Gross Alpha	8.38 pCi/L	7.91 pCi/L	6
Gross Beta	6.07 pCi/L	6.09 pCi/L	<1
Iron	1.67 B	1.64 B	2
Magnesium	17.2	17.4	1
Manganese	0.0236	0.0232	2
Nickel	0.467	0.477	2
Nitrate plus Nitrite, as N	4.49	4.47	<1
Potassium	3.13	3.37	7
Sodium	44.3	47.7	7
Sulfate	44.2	43.6	1
Uranium, Total	0.00531	0.00537	1
Uranium-238	0.00527	0.00533	1
Uranium-235	0.000037 J	0.000036 J	NC
Zinc	0.0111 J, B, B2	0.0105 J, B, B2	NC

[a]Parameters not detected in both samples are not listed. RPD is not calculated for estimated values.

[b]Reanalysis for chromium on June 14, 2006.

B = Analyte detected in associated laboratory method blank.
B2 = Analyte detected in associated equipment blank sample.
J = Analyte detected below practical quantitation limit or reported as an estimated concentration.
mg/L = Milligram(s) per liter.
N = Nitrogen.
NC = Not calculated.
pCi/L = Picocurie(s) per liter.

Table 8 *(continued)*

Duplicate Sample Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, April 2006

$$RPD = \frac{|R_1 - R_2|}{[(R_1 + R_2)/2]} \times 100$$

RPD = Relative percent difference is calculated with the following equation and rounded to nearest whole number:

where:

R_1 = analysis result

R_2 = duplicate analysis result

Volume VII

TAB 3

Mixed Waste Landfill Annual Groundwater Monitoring Report
Spring 2007 Sampling Event

From: SNL/Wagner
To: NMED/Bearzi

Back of Tab 3

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

FEB 21 2008

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

RECEIVED
MAR 05 2008

Mr. James Bearzi
Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East Building E
Santa Fe, New Mexico 87505

Dear Mr. Bearzi:

On behalf of the Department of Energy (DOE) and Sandia Corporation (Sandia), DOE is submitting the Mixed Waste Landfill (MWL) Annual Groundwater Monitoring Report, Spring 2007 Sampling Event. This report presents the groundwater monitoring data from the annual sampling event conducted at the MWL in the spring of 2007. The results of the groundwater monitoring showed constituent concentrations within the historical ranges for the MWL.

If you have any questions regarding this submittal, please contact me at (505) 845-6036, or Dan Pellegrino of my staff, at (505) 845-5398.

Sincerely,

Patty Wagner
Manager

Enclosure

cc w/enclosure:
W. Moats, NMED-HWB (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB
B. Birch, NMED-OB

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P. Freshour, SNL/NM, Org. 6765, MS 1089
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Document authors: **Stacy Griffith, Department 6765**

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Signature: _____ 1/28/08
Date

Fran B. Nimick
Deputy Director to the
Nuclear Energy & Global Security Technologies
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Albuquerque, New Mexico 87185
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and

Signature: _____ 2-28-08
Date

Patty Wagner
Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Sandia National Laboratories/New Mexico Environmental Restoration Project

MIXED WASTE LANDFILL
ANNUAL GROUNDWATER MONITORING REPORT
SPRING 2007 SAMPLING EVENT

January 2008

United States Department of Energy
Sandia Site Office

Sandia is a multiprogram laboratory managed and operated by Sandia Corporation, a wholly-owned subsidiary of Lockheed Martin Corporation, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

EXECUTIVE SUMMARY

Annual groundwater sampling was conducted at the Sandia National Laboratories Mixed Waste Landfill (MWL) during Spring (April and June) 2007. Six of the seven monitoring wells were sampled using a Bennett™ pump in accordance with the MWL Groundwater Monitoring Mini-Sampling and Analysis Plan for Fiscal 2007 Annual Sampling (SNL/NM April 2007a). The background monitoring well was not sampled due to an insufficient amount of water. The samples were analyzed at off-site laboratories for a broad suite of chemical parameters and radionuclides, and the results are presented in this report. The results show that constituent concentrations are within the historical ranges for the site.

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ACRONYMS AND ABBREVIATIONS

AOP	Administrative Operating Procedure
COC	constituent of concern
DO	dissolved oxygen
DOE	U.S. Department of Energy
EB	equipment blank
EPA	U.S. Environmental Protection Agency
FOP	Field Operating Procedure
GEL	General Engineering Laboratories, Inc.
L	liter(s)
LTES	Long-Term Environmental Stewardship
MCL	maximum contaminant level
MDA	minimum detectable activity
MDL	method detection limit
mg	milligram(s)
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
ORP	oxidation/reduction potential
P&A	Plug and Abandonment
pCi	picocurie(s)
pH	potential of hydrogen
PQL	practical quantitation limit
PVC	polyvinyl chloride
QC	quality control
RPD	relative percent difference
Sandia	Sandia Corporation
SNL/NM	Sandia National Laboratories/New Mexico
SWMU	Solid Waste Management Unit
TA	Technical Area
TAL	target analyte list
TB	trip blank
USGS	U.S. Geological Society
VOC	volatile organic compound

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1.0 INTRODUCTION

The Mixed Waste Landfill (MWL) is located on Kirtland Air Force Base 4 miles south of Sandia National Laboratories/New Mexico (SNL/NM) Technical Area (TA)-I facilities, and 5 miles southeast of Albuquerque International Sunport. The landfill is a 2.6-acre site in the north-central portion of TA-III (Figure 1-1). The MWL was established in 1959 as a disposal area for low-level radioactive and mixed waste generated by SNL/NM research facilities. The landfill accepted low-level radioactive and minor amounts of mixed waste from March 1959 through December 1988. Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies (at the time of disposal) of activity were disposed of in the landfill.

Groundwater in the area of the MWL has been extensively characterized since 1990 for major ion chemistry, volatile organic compounds (VOCs), nitrate, metals, radionuclides, and perchlorate. Sixteen years of data indicate that groundwater has not been contaminated by releases from the MWL (Goering et al. 2002; SNL/NM July 2001, November 2001, January 2002, April 2002, July 2002, October 2002, April 2003, September 2003, April 2004; Lyon and Goering April 2005; SNL/NM April 2006).

The MWL monitoring well network consists of seven wells completed within interfingering, fine-grained alluvial fan deposits and coarse-grained Ancestral Rio Grande deposits (Goering et al. 2002). This network includes one background well (MWL-BW1), one on-site well (MWL-MW4), and five downgradient or cross-gradient wells (MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW5, and MWL-MW6). All seven wells are constructed of 5-inch, Schedule 80 polyvinyl chloride (PVC) casing. Wells MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3 have screens composed of slotted Type 304 stainless steel. Wells MWL-MW4, MWL-MW5, and MWL-MW6 have screens composed of slotted Schedule 80 PVC. Table A-1 presents well completion information and recent water levels.

Monitoring Well MWL-MW4 was installed in 1993 directly beneath a disposal trench in which 204,000 gallons of coolant wastewater from the SNL/NM Engineering Reactor Facility were disposed of in 1967 (Peace et al. September 2002). MWL-MW4 was completed at an angle of 6 degrees from vertical and is screened at two discrete intervals 20 feet apart to evaluate vertical anisotropy, vertical potentiometric gradients, and changes in aquifer parameters with depth. The approximate horizontal extent of MWL-MW4 is shown in Figure 1-2. An inflatable packer separates the screened intervals, and pressure is maintained in the packer to prevent mixing water from the two screened sections of the aquifer.

Six of the seven wells were sampled during the Spring 2007 monitoring event according to the MWL Mini-Sampling and Analysis Plan for Fiscal 2007 Annual Sampling (SNL/NM April 2007a). The background monitoring well, MWL-BW1, was not sampled due to an insufficient amount of water in the well as a result of declining water levels in the regional aquifer.

The monitoring well network is being updated for long-term monitoring at the MWL. A Long-Term Monitoring and Maintenance Plan has been prepared and submitted to the New Mexico Environment Department (NMED) (SNL/NM September 2007) that provides specific information about groundwater monitoring at the MWL. The four oldest wells, MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3, were installed in 1988 and 1989, and although they have provided data of excellent quality over the years, these wells are becoming increasingly problematic.

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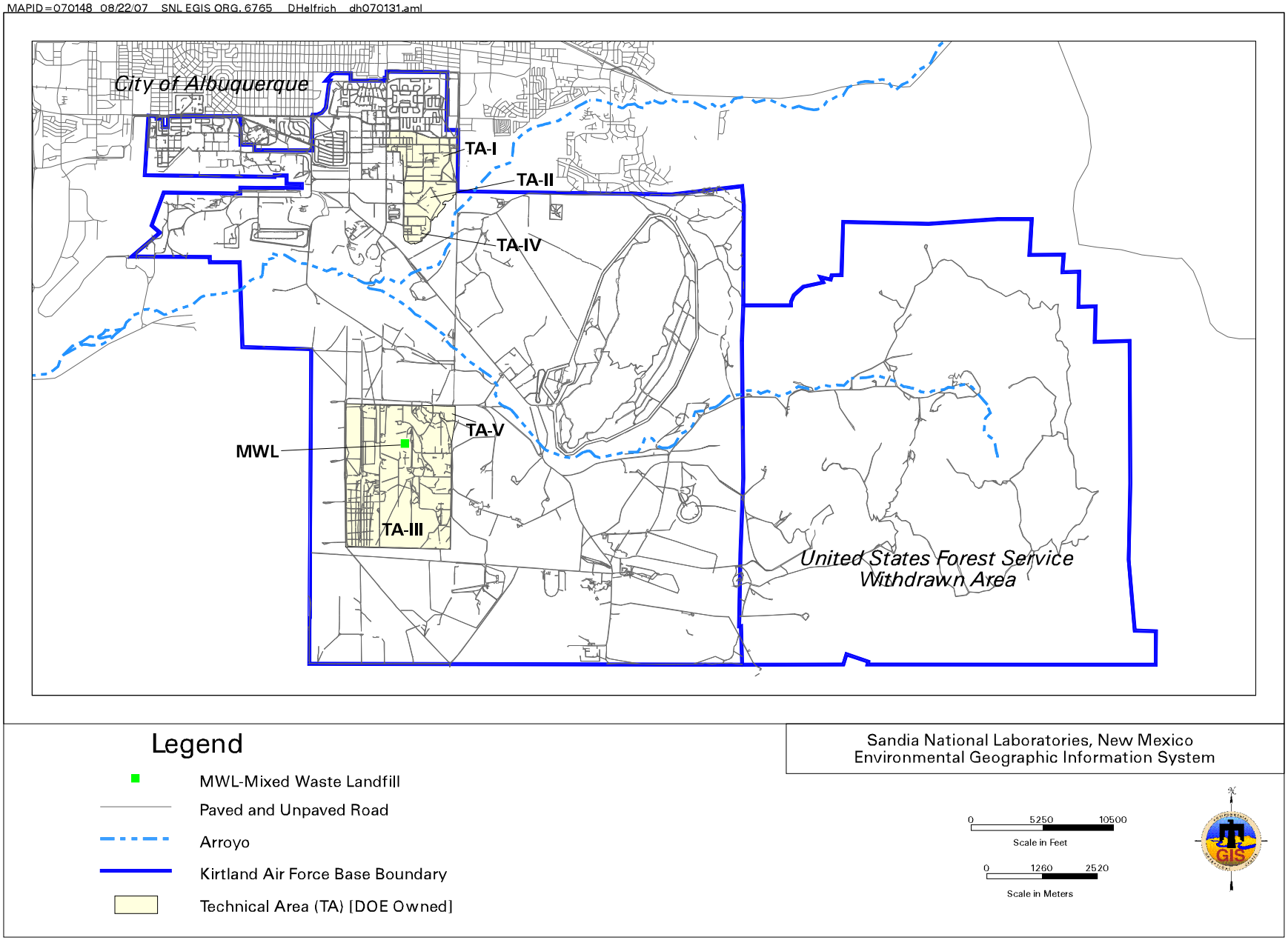

Figure 1-1 Location of Sandia National Laboratories and Kirtland Air Force Base

Legend

- Angled Monitoring Well (showing horizontal extent)
- Groundwater Monitoring Well
- Road
- Fence
- MWL Extent

Figure 1-2
Mixed Waste Landfill
Groundwater Monitoring Wells

0 100 200
Scale in Feet

0 24 48
Scale in Meters

N

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Environmental Geographic Information System

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Two of these wells, MWL-BW1 and MWL-MW3, are nearly dry due to declining water levels in the regional aquifer. Groundwater levels beneath the MWL declined at an average rate of 0.5 feet/year between April 2001 and October 2006. As of April 2007, approximately 1 foot of water remained above the well screen in MWL-BW1, and approximately 3 feet of water remained above the well screen in MWL-MW3.

In March 2007, the NMED requested that MWL-BW1 be plugged and abandoned and replaced (Bearzi March 2007). A Monitoring Well Plug and Abandonment (P&A) Plan and Replacement Well Construction Plan for MWL-BW1 was submitted to the NMED on April 17, 2007 (SNL/NM April 2007b). However, the NMED submitted a Notice of Disapproval regarding this plan in June 2007 (Bearzi June 2007), and the U.S. Department of Energy and Sandia Corporation (DOE/Sandia) resubmitted a P&A and Replacement Well Construction Plan for MWL-BW1 in July 2007 (SNL/NM July 2007a).

On July 2, 2007, the NMED requested replacement of monitoring wells MWL-MW1 and MWL-MW3 because of low water levels in MWL-MW3 and problems with corrosion of the stainless-steel screens in both these wells (Bearzi July 2007). The DOE/Sandia submitted a P&A and Replacement Well Construction Plan for both of these wells in July 2007 (SNL/NM July 2007b).

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2.0 REGULATORY CRITERIA

Historically, the NMED Hazardous Waste Bureau has provided regulatory oversight of the MWL as Solid Waste Management Unit (SWMU) 76 under the Hazardous and Solid Waste Amendments module of the facility Resource Conservation and Recovery Act permit. The NMED confirmed that the MWL is properly designated as a SWMU (Dinwiddie June 1998) and, as such, must comply with the corrective action program defined in Title 20, New Mexico Administrative Code, Section 4.1.50, incorporating Title 40, Code of Federal Regulations, Section 264.101. The requirements for corrective action at the MWL, including those for groundwater monitoring, are established through the corrective measures process.

The NMED issued the Compliance Order on Consent (the Consent Order) in April 2004, which transferred the regulatory authority for groundwater sampling at the MWL to the Consent Order (NMED April 2004). Although this report is not a deliverable under the Consent Order, it has been formatted to address the content criteria set forth in the Consent Order for Periodic Monitoring Reports. The following crosswalk lists the required elements from the Consent Order and the corresponding section(s) in which these elements are addressed in this report.

Required Elements of the Consent Order (NMED April 2004)	MWL Groundwater Monitoring Report Spring 2007 Sampling Event
1. Title Page and Signature Block (for the name, title, and organization of the preparer and the responsible DOE and Sandia representative)	Title Page Signatures for full SNL/NM and DOE chain of command on the transmittal paperwork that accompanies the report from SNL/NM to the DOE to the NMED
2. Executive Summary (Abstract)	Executive Summary and Chapter 8.0
3. Table of Contents	Table of Contents
4. Introduction	Chapter 1.0 Introduction
5. Scope of Activities	Chapter 3.0 Scope of Activities
6. Regulatory Criteria	Chapter 2.0 Regulatory Criteria
7. Monitoring Results	Chapter 6.0 Summary of Analytical Results
8. Conclusions	Chapter 9.0 Summary and Conclusions
9. Tables	Appendix A
10. Figures	Chapter 1.0
11. Appendices	Appendix A at end of the report

Although radionuclides are being monitored at the MWL, the information related to radionuclides is provided voluntarily by the DOE/Sandia. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements imposed by the NMED, as specified in Section III.A of the Consent Order (NMED April 2004).

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3.0 SCOPE OF ACTIVITIES

Annual groundwater sampling was conducted at the MWL located in TA-III at SNL/NM. Six of the seven monitoring wells at the MWL were sampled, including on-site monitoring well MWL-MW4 and downgradient monitoring wells MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW5, and MWL-MW6. Sampling was conducted from April 2 through April 11, and on June 4 and June 5, 2007.

Although monitoring well MWL-MW4 is screened in two discrete intervals, only the upper interval was sampled, as this is the uppermost water-bearing interval beneath the MWL. References in this report to groundwater samples from MWL-MW4 refer to groundwater withdrawn from the upper interval. Maintenance was performed on the dedicated pump and packer in MWL-MW4 in May 2007. The pump and packer were brought to the surface and inspected. The air line and fittings (used to inflate the packer separating the two screened intervals) were replaced on the packer. The pump was reset into the well in the first (shallowest) screened interval. The packer was inflated to the appropriate pressure and sampling of this well was performed in June 2007.

Sampling was conducted in accordance with the MWL Groundwater Monitoring Mini-Sampling and Analysis Plan for Fiscal 2007 Annual Sampling (SNL/NM April 2007a). The chemical analytical parameters selected for monitoring included target analyte list (TAL) metals, total uranium, VOCs, nitrate plus nitrite, bromide, fluoride, chloride, sulfate, manganese II, total organic carbon, carbon dioxide, total dissolved solids, ferrous iron, and biochemical oxygen demand. Alkalinity titrations were performed in the field on groundwater collected at each well. Radiochemical analysis included gross alpha/beta radioactivity, tritium, and gamma-emitting radionuclides.

The MWL groundwater samples were submitted for analysis to General Engineering Laboratories, Inc. (GEL) located in Charleston, South Carolina; Hall Analytical in Albuquerque, New Mexico; and Metrohm Peak in Houston, Texas. All groundwater samples were collected using a Bennett™ pump.

Field quality control (QC) samples submitted to GEL included one field duplicate sample for the full suite of analyses, three equipment blank (EB) samples for VOCs, TAL metals, total uranium, and uranium-235 and -238 analyses, and six trip blank (TB) samples for VOC analysis.

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4.0 FIELD METHODS AND MEASUREMENTS

Field measurements performed during annual groundwater sampling activities included groundwater elevation and water quality. The following sections present a more detailed discussion of field activities and methods.

4.1 Groundwater Elevation

Depth-to-groundwater measurements were obtained using a Solinst™ depth-to-water well sounder prior to purging activities. Depth-to-groundwater measurements were performed in accordance with the Field Operating Procedure (FOP) "Long-Term Environmental Stewardship (LTES) Groundwater Monitoring Well Sampling and Field Analytical Measurements," FOP 05-01 (SNL/NM August 2007a). Measurements were obtained from all monitoring wells. Table A-1 (Appendix A) presents groundwater elevations, static water heights, and monitoring well completion information.

Groundwater occurs approximately 500 feet below ground surface within Santa Fe Group deposits (basin fill), in either fine-grained alluvial fan deposits or coarse-grained Ancestral Rio Grande deposits. Hydraulic conductivities average 1.64×10^{-2} feet/day in the alluvial fan deposits and 1.81 feet/day in the Ancestral Rio Grande deposits. Groundwater flows westward at an average velocity of 0.17 feet/year in the alluvial fan deposits and 18.5 feet/year in the Ancestral Rio Grande deposits. Figure 4.1-1 shows the regional potentiometric surface of the basin fill aquifer west of the Sandia fault complex. Figure 4.1-2 shows the localized potentiometric surface of the basin fill aquifer at TA-III. Groundwater levels beneath the MWL are declining at an average rate of 0.5 feet/year as a result of pumping from regional production wells.

4.2 Well Purging and Water Quality Measurements

Prior to sample collection, each monitoring well was purged to remove stagnant well casing water. Most MWL monitoring wells recharge slowly, and multiple days were required to purge and sample these wells. The monitoring wells were purged to dryness, allowed to recover, and then sampled to collect the most representative groundwater sample possible, given the low yields of these wells. The recovery period was based upon the recharge rate of the well and volume necessary for each sample. Total purge volumes presented in Table A-2 (Appendix A) are based upon measured volumes evacuated from each monitoring well prior to sample collection.

Field analytical measurements were collected in accordance with FOP 05-01 (SNL/NM August 2007a). Groundwater temperature, specific conductance, potential of hydrogen (pH), oxidation/reduction potential (ORP), and dissolved oxygen (DO) were measured using a YSI™ Model 6820 flow cell and multi-parameter water quality meter. Turbidity was measured with a Hach™ Model 2100P portable turbidity meter. In addition, a Hach™ field kit was used to perform alkalinity titrations. Water quality measurements were recorded on Field Measurement Log forms. Groundwater pH, temperature, specific conductance, turbidity, DO, and ORP were measured during purging, before sample collection. Table A-2 shows the final

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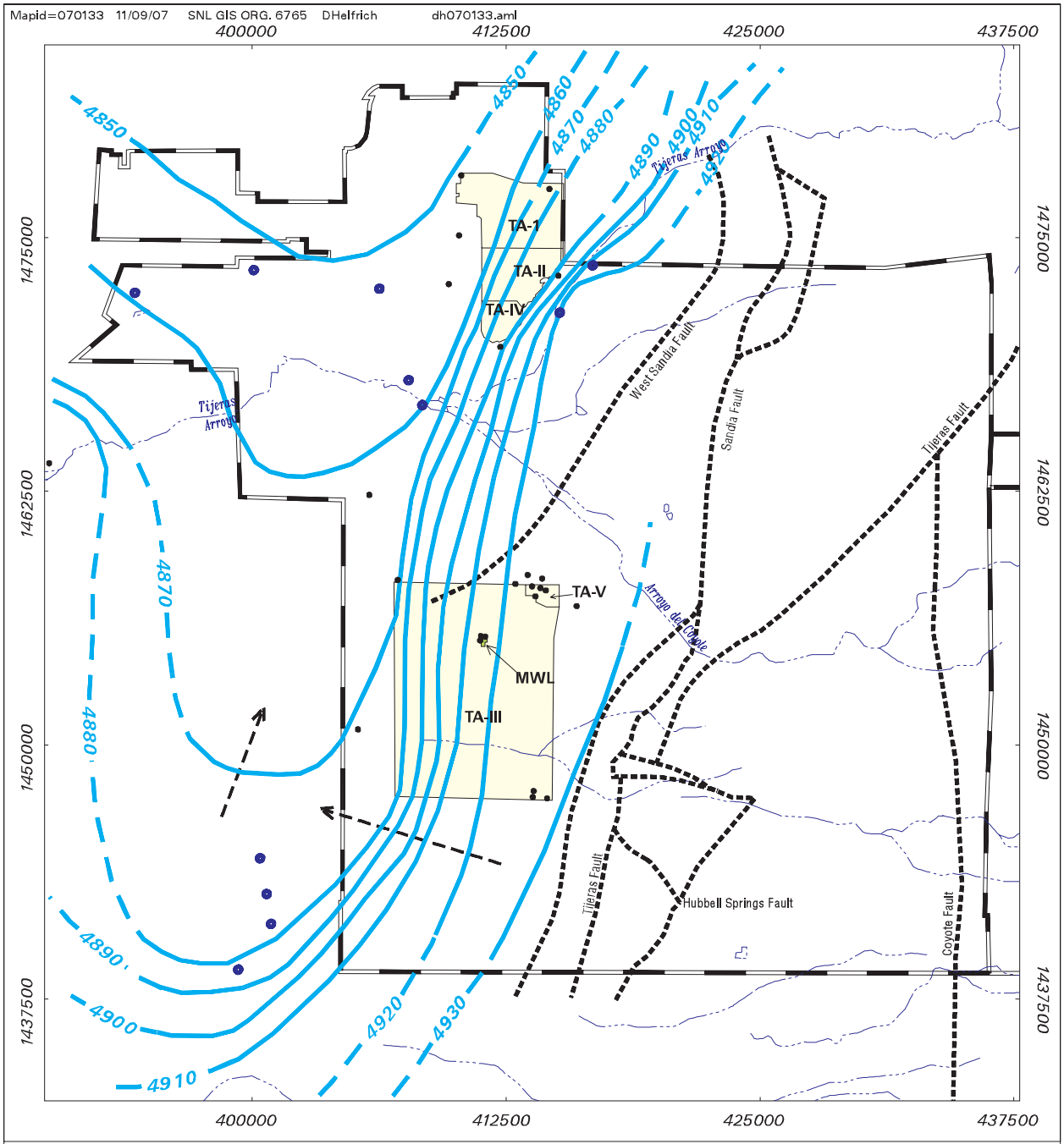

Legend

- Monitoring Well used to construct potentiometric surface (measured Jan. - March 2007)
- Monitoring Well used to construct potentiometric surface (measured July 2006 and March 2007)
- Potentiometric Surface Contour (feet above mean sea level, dashed where approximate)
- Kirtland Air Force Base Boundary
- Direction of groundwater flow
- Surface Drainage
- Fault
- Technical Area
- MWL - Mixed Waste Landfill

Figure 4.1-1
Potentiometric Surface of Basin Fill Aquifer West of Fault Complex

0 4000 8000
Scale in Feet

0 960 1920
Scale in Meters

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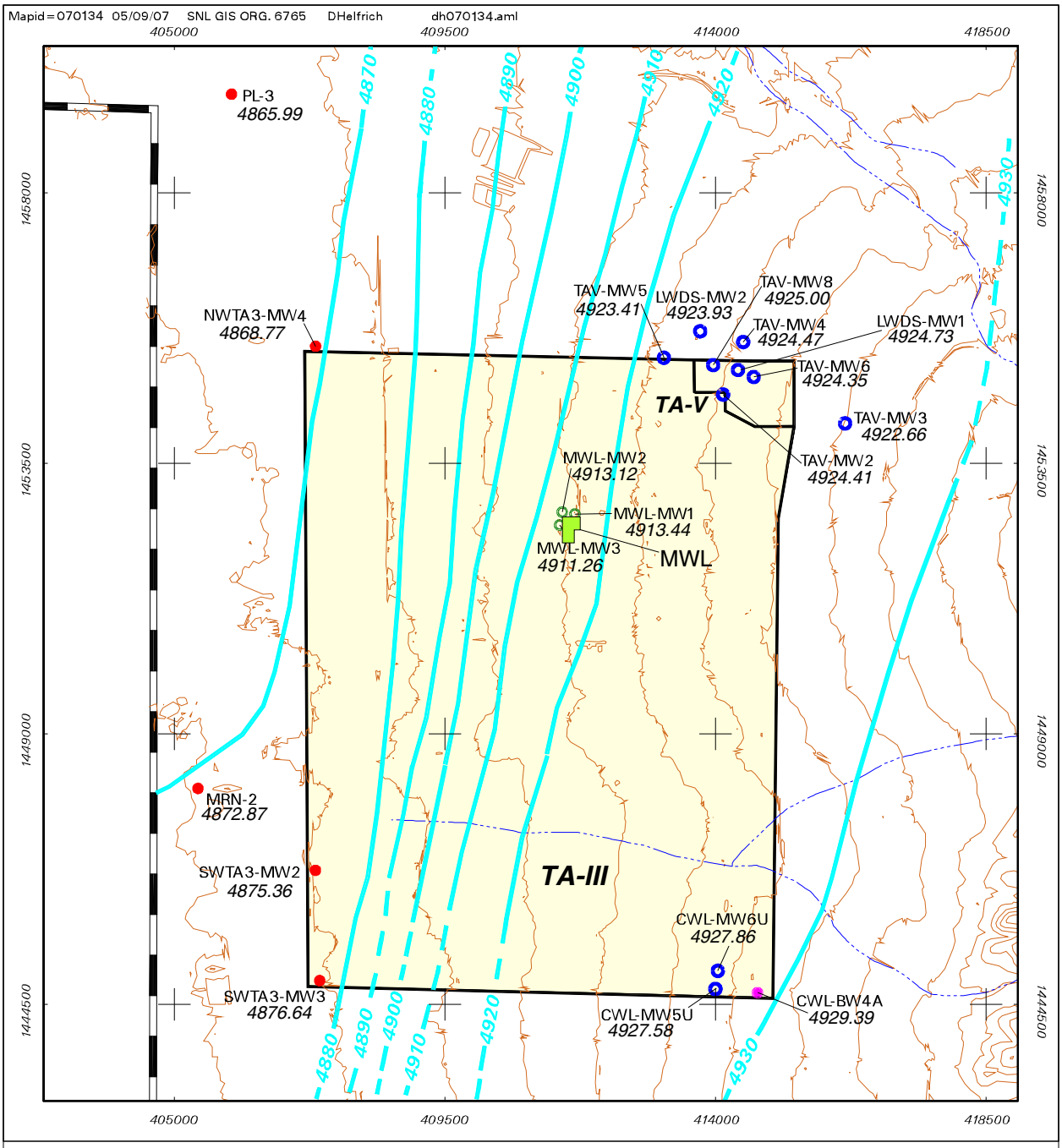

Legend

- Monitoring Well (groundwater elevation measured Jan. 2007, feet above mean sea level)
- Monitoring Well (groundwater elevation measured March 2007)
- Monitoring Well (groundwater elevation measured April 2007)
- Monitoring Well (groundwater elevation measured Oct. 2006)
- 20-foot Ground Surface Contour Interval
- Kirtland Air Force Base Boundary
- Potentiometric Surface Contour (feet above mean sea level, dashed where approximate)
- Technical Area
- MWL - Mixed Waste Landfill

0 1350 2700
Scale in Feet

0 324 648
Scale in Meters

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Figure 4.1-2 Localized Potentiometric Surface of Basin Fill Aquifer at Technical Area III

measurements taken before the samples were collected. Water quality parameter field measurements were not taken following sample collection.

4.3 Pump Decontamination

The Bennett™ pump and tubing bundle used to collect groundwater samples were decontaminated prior to installation in MWL monitoring wells according to "LTES Groundwater Sampling Equipment and Decontamination," FOP 05-03 (SNL/NM August 2007b). The EB samples were collected after decontamination to verify the effectiveness of the decontamination procedure. Three EB samples were collected during the Spring 2007 annual groundwater sampling event. The EB samples are discussed in Section 7.1.1.

4.4 Sample Collection

All groundwater samples were collected directly from the pump discharge tube into prepared laboratory-provided sample containers. Where appropriate for the requested analysis, chemical preservatives were added to the sample containers at the laboratory prior to shipment.

Two groundwater samples were collected from each monitoring well for metals analyses. One unfiltered sample was collected for total metals analyses. The other sample was filtered through a 0.45-micrometer filter for dissolved metals analyses.

4.5 Sample Handling and Shipment

Immediately after collection, all sample containers were custody-taped, sealed in plastic bags, and placed on cold packs in shipping containers. Analysis Request/Chain-of-Custody forms were completed at the time of collection. The samples for chemical and radiochemical analyses were shipped via the SNL/NM Sample Management Office to the contracted analytical laboratory. Sample management activities followed SNL/NM "Sample Management and Custody," Administrative Operating Procedure (AOP) 95-16 (SNL/NM February 2007).

4.6 Waste Management

All purge and decontamination water was managed according to "LTES Groundwater Monitoring Waste Management," FOP 05-04 (SNL/NM August 2007c) and was containerized on site pending the results of the analyses. Waste labels were placed on all drums, and the corresponding sample numbers were marked on the outside of the drum with a permanent marker. The wastes were recorded on a Daily Log of Wastes Generated form and submitted to the SNL/NM Environmental Restoration Project Waste Disposal Coordinator.

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5.0 ANALYTICAL METHODS

Table A-3 (Appendix A) specifies parameters, appropriate test methods, and target analyte quantitation limits for analytical parameters. The analytical methods are discussed in the following sections.

5.1 Chemical Analytical Methods

All chemical analyses were performed in accordance with the U.S. Environmental Protection Agency (EPA) test methods (EPA 1979, 1986, and 1988). Environmental samples were submitted to the following laboratories for the analyses listed:

- GEL:
  - VOCs by EPA Method 8260B
  - TAL metals by EPA Methods 6020 and 7470A (including total and isotopic uranium by EPA Method 6020)
  - Nitrate plus nitrite by EPA Method 353.2
  - Bromide, fluoride, chloride, and sulfate by EPA Method 9056
  - Total organic carbon by EPA Method 9060
  - Carbon dioxide by Laboratory-Specific Method SM 4500 CO2 D
  - Total alkalinity as calcium carbonate by EPA Method 310.1
  - Total dissolved solids by EPA Method 160.1
- Hall Analytical:
  - Ferrous iron by Laboratory-Specific Method 3500M Fe2+
  - Biochemical oxygen demand by EPA Method 405.1
- Metro-Ohm Peak:
  - Manganese II by Laboratory-Specific Method C2-100 Mn2+

5.2 Radiochemical Analytical Methods

Radiochemical parameters and methods included gamma-emitting radionuclides by EPA Method 901.1, gross alpha/beta radioactivity by EPA Method 900.0, and tritium by EPA Method 906.0.

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6.0 SUMMARY OF ANALYTICAL RESULTS

Tables summarizing field measurements and analytical results are included in this report as Appendix A. Complete field and laboratory documentation are on file at the SNL/NM Customer-Funded Records Center.

The results for chemical and radiological constituents are compared with established EPA Safe Drinking Water Act Regulations maximum contaminant levels (MCLs) (EPA 2001), where applicable.

6.1 General Chemistry Parameters

The general chemistry analytical results are presented in Table A-4 (Appendix A). No general chemistry parameters exceeded the MCLs (where established) in the groundwater samples. Nitrate plus nitrite (as nitrogen) and fluoride are the only two parameters that have established MCLs (10 milligrams [mg]/liter [L] and 4.0 mg/L, respectively). Nitrate plus nitrite (as nitrogen) concentrations ranged from 1.57 mg/L at MWL-MW6 to 5.21 mg/L at MWL-MW1. Fluoride was detected at concentrations ranging from 0.733 mg/L at MWL-MW5 to 1.04 mg/L at MWL-MW3.

6.2 Metals

Table A-5 (Appendix A) summarizes the metals results from all unfiltered groundwater samples collected during the annual groundwater sampling at the MWL. Samples were analyzed for total TAL metals. The chromium concentration in the sample from MWL-MW1 (0.426 mg/L) exceeded the EPA MCL of 0.1 mg/L. Chromium concentrations are attributed to corrosion of the Type 304 stainless-steel well screen (Oakley and Korte 1996, Goering et al. 2002).

Total uranium results from the Spring 2007 unfiltered samples were less than the MCL of 0.03 mg/L. The data are consistent with previous sampling events and are well within the range of total uranium concentrations established by the U.S. Geological Survey (USGS) for the Middle Rio Grande Basin (USGS 2002).

The uranium isotopes uranium-235 and uranium-238 were determined as mass concentrations during metals analysis on the inductively-coupled plasma mass spectrometer using EPA Method 6020. The isotopic mass concentrations are reported in units of mg/L and are included in Table A-5 with the other unfiltered samples analyzed by this method. No corresponding uranium-235 and -238 MCLs are established for comparison. Uranium-235 values ranged from 0.000034 mg/L in MWL-MW3 to 0.000069 mg/L in MWL-MW5. Uranium-238 values ranged from 0.00489 mg/L MWL-MW3 to 0.00954 mg/L in MWL-MW5. These values are consistent with past results.

Table A-6 (Appendix A) summarizes the results for TAL metals analysis for the filtered samples collected during the Spring 2007 monitoring event. No detections of any metal in the filtered samples exceed the respective MCLs.

6.3 Volatile Organic Compounds

Table A-7 (Appendix A) summarizes the detected VOC results, and Table A-8 (Appendix A) presents the method detection limits (MDLs) for VOCs. Groundwater samples from the MWL monitoring wells revealed detections of acetone and toluene greater than MDLs but less than or equal to the practical quantitation limits (PQLs), and some results are reported with data validation qualifiers. Acetone was detected in all samples above the MDL but these results were associated with laboratory blank contamination and qualified during data validation as not detected at the PQL. Toluene was detected above the MDL in samples collected from MWL-MW3 and MWL-MW4 but the results were below the PQL.

6.4 Radiochemistry

Groundwater samples from the MWL monitoring wells were analyzed for gamma-emitting radionuclides, gross alpha/beta activity, and tritium. The results for tritium and gross alpha/beta activity are presented in Table A-9 (Appendix A) and are compared with the established EPA MCLs. No radiological parameters were detected above established MCLs.

Gross alpha/beta activity levels were detected above laboratory reporting limits in all environmental samples. Gross alpha activity levels range from 5.56 ± 01.36 picocuries (pCi)/L in the MWL-MW3 sample to 12.0 ± 2.55 pCi/L in the MWL-MW6 sample. Gross beta activity levels range from 3.92 ± 1.16 pCi/L in the MWL-MW5 sample to 8.94 ± 1.21 pCi/L in the MWL-MW2 sample.

Neither tritium, analyzed by EPA Method 906.0, nor gamma-emitting isotopes, analyzed by EPA Method 901.1, were detected above the minimum detectable activity (MDA) in any of the groundwater samples.

Although there were no detections of tritium above the MDA, the results are presented in Table A-9 (Appendix A) as tritium is considered a constituent of concern (COC) at the MWL. Because no gamma-emitting radionuclides were detected above the MDA, and none are considered COCs at the MWL, the gamma spectroscopy results (all less than the MDA) are not included in Table A-9.

7.0 QUALITY CONTROL RESULTS

QC samples were prepared in the field and in the laboratory in order to assess the quality of the data generated during the annual sampling activities. All data were reviewed in accordance with "Data Validation Procedure for Chemical and Radiochemical Data," AOP 00-03 (SNL/NM January 2003). The results for each QC analysis and the impact on data quality are discussed in the following sections.

7.1 Field Quality Control Samples

The QC samples collected in the field included EB samples, laboratory-prepared TB samples, and field duplicate samples. The following sections discuss each QC sample type.

7.1.1 Equipment Blank Samples

Three EB samples were collected during the annual sampling activities. The first EB sample, MWL-EB1, was collected on April 6, 2007, after sampling at MWL-MW1 on April 5, 2007, and prior to sampling MWL-MW2 on April 6, 2007. The second EB sample, MWL-EB2, was collected on April 10, 2007, after sampling MWL-MW3 and prior to sampling MWL-MW5 on April 10, 2007. The third EB sample, MWL-EB3, was collected on April 11, 2007, after sampling MWL-MW5 on April 10, 2007, and prior to purging and sampling MWL-MW6 on April 12, 2007. The EB samples were analyzed for VOCs and TAL metals (including total and isotopic uranium).

The common laboratory contaminant acetone was detected in all three EB samples, MWL-EB1, MWL-EB2, and MWL-EB3 at concentrations between the MDL and the PQL. However, due to laboratory blank contamination, these EB sample results were qualified as not detected at the PQL and do not affect other sample results. Other compounds were detected in various EB samples including bromodichloromethane, chloroform, dibromochloromethane, and toluene. These compounds were not detected in associated environmental samples.

In the metals analyses, calcium, copper, nickel, zinc, total uranium, and uranium-238 were detected in MWL-EB2 at concentrations greater than the MDL, but were qualified as estimated values due to laboratory blank contamination.

7.1.2 Trip Blank Samples

A laboratory-prepared TB sample was returned to the laboratory with each shipment containing environmental samples for VOC analysis. Six TB samples that were submitted during annual groundwater sampling were used to assess VOC contamination that might have occurred during sample storage and shipping. Low levels (between the MDL and the PQL) of acetone were detected in TB samples MWL-TB1, MWL-TB3, and MWL-TB7. However, due to laboratory blank contamination, these TB samples were qualified as not detected at the PQL and do not affect other sample results.

7.1.3 Field Duplicate Samples

Duplicate groundwater samples were collected at MWL-MW2. Relative percent difference (RPD) precision measurements for constituents detected above the PQL in both the environmental and duplicate samples are presented in Table A-10 (Appendix A). All calculated RPD measurements for chemical analyses are less than or equal to 10 (except for one sample), indicating acceptable precision.

7.2 Laboratory Quality Control Samples

Internal laboratory QC samples, including method blank samples and duplicate laboratory control samples, were analyzed concurrently with all groundwater samples. All laboratory data were reviewed and qualified in accordance with AOP 00-03 (SNL/NM January 2003). Data review findings and assigned qualifiers are contained in the data validation memoranda and spreadsheets on file at the SNL/NM Customer-Funded Records Center. Data validation qualifiers accompany the analytical results in the report tables provided in Appendix A. Data qualifiers were assigned to environmental samples as well as EB and TB samples based upon laboratory blank sample results or outlying QC sample results. Some data results were rejected in the data validation process due to calibration problems. However, all rejected values were nondetections for the respective analytes.

8.0 VARIANCES AND NONCONFORMANCES

All analytical and field methods met the requirements specified in the "MWL Groundwater Monitoring Mini-Sampling and Analysis Plan for Fiscal 2007 Annual Sampling" (SNL/NM April 2007a) and there were no variances from the plan.

During the data validation process, two nonconformance reports were issued. In both reports, corrections were made that removed "B2" blank contamination qualifiers from sample results, as the EB samples were incorrectly associated with these samples (the EB qualifiers did not apply to the filtered samples for the batch).

The maintenance performed on MWL-MW4 in May 2007 and described in Chapter 3.0 delayed the sampling of this well until June 2007. Representatives from the NMED Oversight Bureau were on site during the sampling of MWL-MW4. They collected samples for VOCs, perchlorate, filtered and unfiltered metals, tritium, gross alpha/beta activity, gamma-emitting radionuclides, and iso-radium.

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9.0 SUMMARY AND CONCLUSIONS

Annual groundwater sampling was conducted at the MWL during Spring 2007. Chromium was detected in the unfiltered sample from MWL-MW1 at a concentration of 0.426 mg/L, exceeding the EPA MCL of 0.1 mg/L. No other inorganic or organic parameters were detected above the corresponding MCLs in any of the groundwater samples.

Groundwater samples collected for the Spring 2007 sampling event from the MWL monitoring wells showed no detected organic compounds greater than the PQL after data validation and assignment of qualifiers. Toluene was detected at concentrations less than the PQL but greater than the MDL in two samples.

The only metals analytical result greater than the established MCL occurred for chromium in the unfiltered groundwater sample from MWL-MW1 for the Spring 2007 monitoring event. The chromium concentration is attributed to corrosion of the stainless-steel screen in the monitoring well (Oakley and Korte 1996, Goering et al. 2002). Total uranium results from the Spring 2007 samples were consistent with data from previous sampling events, and are well within the range of total uranium concentrations established by the USGS for the Middle Rio Grande Basin (USGS 2002).

No general chemistry parameters exceeded the established MCLs in any of the groundwater samples. The analytical results for radioactivity and radionuclides showed no levels greater than the corresponding MCLs. The results of the MWL Spring 2007 monitoring event show that constituent concentrations are within the historical ranges for the site.

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10.0 REFERENCES

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APPENDIX A
Summary Tables of Field Measurements and Analytical Results

Table A-1
Groundwater Elevations, Pump Setting Depths, and Monitoring Well Completion Information
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well Number	Date of Measurement	Measurement Point Elevation (FAMSL[a])	Depth to Water (FBTOC)	Groundwater Elevation (FAMSL[a])	Total Well Depth[b] (FAMSL)	Static Water Height (feet)	Pump Setting Depth (FBTOC)
MWL-MW1	04-02-07	5381.54	468.10	4913.44	4901.12	12.32	477
MWL-MW2	04-02-07	5377.26	464.14	4913.12	4898.71	14.41	473
MWL-MW3	04-02-07	5381.32	470.06	4911.26	4902.67	8.59	473
MWL-MW4	04-02-07	5383.46	494.19	4891.98[c]	4878.59[c]	13.39[d]	503[c]
MWL-MW4	06-04-07	5383.46	494.36	4891.81[c]	4878.59[c]	13.22[d]	503[c]
MWL-MW5	04-02-07	5379.89	492.31	4887.58	4856.15	31.43	518
MWL-MW6	04-02-07	5372.64	486.25	4886.39	4839.46	46.93	528
MWL-BW1	04-02-07	5384.51	472.94	4911.57	4905.53	6.04	NA

[a]Measurement point is the top of well casing.
[b]Total well depth to bottom of sump.
[c]Elevation, well depth, and pump depth reflects well MWL-MW4 orientation of 6 degrees from vertical.
[d]Depth to the bottom of the dedicated pump is 503.01 feet below ground surface.
BW = Background well.
FAMSL = Feet above mean sea level.
FBTOC = Feet below top of casing.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
NA = Not applicable.

Table A-2
Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	pH (at 25°C)	Temp (°C)	Specific Conductivity (μmhos/cm)	Turbidity (NTU)	ORP (mV)	DO (% Sat)
MWL-MW1[a] Date purge began: 04-04-07 Date sampled: 04-05-07	Before sampling:	14	7.64	19.44	560	9.39	186.2	80.9
		15	7.62	19.36	560	11.0	188.4	68.6
		16	7.62	19.56	560	47.5	188.5	64.1
MWL-MW2[a] Date purge began: 04-02-07 Date sampled: 04-06-07	Before sampling:	10	7.73	19.83	561	1.27	101.8	7.6
		11	7.58	18.50	564	1.36	255.8	45.6
		12	7.69	18.75	565	1.24	248.1	39.5
MWL-MW3[a] Date purge began: 04-03-07 Date sampled: 04-11-07	Before sampling:	7	7.99	21.19	462	1.31	229.0	76.1
		8	6.85	14.15	459	1.86	328.5	86.9
		9	7.83	14.11	458	1.97	317.6	87.1
MWL-MW4[a] Date purge began: 06-04-07 Date sampled: 06-05-07	Before sampling:	27	7.24	19.16	576	2.14	367.0	84.3
		28	7.20	19.59	577	0.52	367.4	31.6
		29	7.19	19.80	577	0.43	377.8	17.4
MWL-MW5 Date purged: 04-10-07 Date sampled: 04-10-07	Before sampling:	52	7.13	19.40	849	0.47	216.0	26.5
		54	7.13	19.47	849	0.51	215.8	26.7
		56	7.13	19.50	849	0.44	216.0	26.6

Refer to footnotes at end of table.

Table A-2 (Concluded)
Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	pH (at 25°C)	Temp (°C)	Specific Conductivity (μmhos/cm)	Turbidity (NTU)	ORP (mV)	DO (% Sat)
MWL-MW6 Date purge began: 04-12-07 Date sampled: 04-12-07	Before sampling:	52	7.30	18.58	794	0.38	249.8	28.2
		54	7.30	18.62	793	0.40	249.0	28.1
		56	7.30	18.62	794	0.41	249.6	28.1

[a]Wells were purged to dryness. Purge volumes show total gallons removed prior to sampling.

°C = Degrees Celsius.
DO = Dissolved oxygen.
μmhos/cm = Micro-mhos per centimeter.
mV = Millivolts.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
NTU = Nephelometric turbidity units.
ORP = Oxidation/reduction potential.
% Sat = Percent saturation.
pH = Potential of hydrogen.
Temp = Temperature.

Table A-3
Analytical Parameters, Test Methods, and Target Quantitation Limits
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Analytical Parameter	Test Method[a]	Target Quantitation Limit[b]
Total Metals TAL and Uranium	SW846-6020 SW846-7470A	0.00007–2.5 mg/L
Volatile Organic Compounds	SW846-8260B	1.0–5.0 μg/L
Nitrate plus Nitrite (as nitrogen)	EPA 353.2	0.50 mg/L
Major Anions Bromide, Fluoride, Chloride, and Sulfate	SW846-9056	0.100–4.0 mg/L
Total Organic Carbon	SW846-9060	1.0 mg/L
Carbon Dioxide	SM 4500 CO2 D[c]	1.0 mg/L
Total Alkalinity as Calcium Carbonate	EPA 310.1	1.0–2.0 mg/L
Total Dissolved Solids	EPA 160.1	10 mg/L
Ferrous Iron	3500M Fe2+[c]	0.01–0.10 mg/L
Biochemical Oxygen Demand	EPA 405.1	2.0–4.0 mg/L
Manganese II	C2-100 Mn2+[c]	0.320 mg/L
Radionuclides		
Gamma-Emitting Radionuclides	EPA 901.1[d]	MDA is isotope-specific
Gross Alpha Activity	EPA 900.0[d]	1.06–2.33 pCi/L
Gross Beta Activity	EPA 900.0[d]	1.26–1.75 pCi/L
Tritium	EPA 906.0[d]	159–198 pCi/L

[a]Analytical methods used are referenced to either U.S. Environmental Protection Agency, 1979. "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, U.S. Environmental Protection Agency, Cincinnati, Ohio, or U.S. Environmental Protection Agency, 1986. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.
[b]For target compounds only. Reporting limits may be elevated if an interfering component is present or if sample dilution is required.
[c]Laboratory-specific analytical methods.
[d]U.S. Environmental Protection Agency, 1980. "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032, U.S. Environmental Protection Agency, Cincinnati, Ohio.
EPA = U.S. Environmental Protection Agency.
MDA = Minimum detectable activity.
μg/L = Microgram(s) per liter.
mg/L = Milligram(s) per liter.
pCi/L = Picocurie(s) per liter.
TAL = Target analyte list.

Table A-4
General Chemistry Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW1	Alkalinity, Total	220	0.725	1.00	NE			084453-016	EPA 310.1
05-Apr-07	Bromide	0.400	0.066	0.200	NE			084453-016	SW846-9056
	Chloride	33.0	0.330	1.00	NE			084453-016	SW846-9056
	Fluoride	0.845	0.033	0.100	4.00			084453-016	SW846-9056
	Sulfate	43.4	0.500	2.00	NE			084453-016	SW846-9056
	Nitrate plus Nitrite, as N	5.21	0.100	0.500	10.0			084453-018	EPA 353.2
	Total Organic Carbon, Average	0.738	0.330	1.00	NE	J		084453-004	SW846-9060
	Carbon Dioxide, Free	13.9	0.725	1.00	NE	B	B, J	084453-007	SM 4500 CO2 D[g]
	Carbon Dioxide, Total	207	0.725	1.00	NE	B		084453-007	SM 4500 CO2 D[g]
	Total Dissolved Solids	384	2.38	10.0	NE			084453-013	EPA 160.1
	Biochemical Oxygen Demand	ND	2.00	4.00	NE	U	None	084453-031	EPA 405.1
	Ferrous Iron	ND	0.028	0.100	NE	U	None	084453-012	3500M Fe2+[g]
	Manganese II	ND	0.320	NR	NE	U	None	084453-011	C2-100 Mn2+[g]
	Alkalinity, field measurement	195	NA	1.00	NE	None	None	Field	HACH 8203
MWL-MW2	Alkalinity, Total	233	1.45	2.00	NE			084455-016	EPA 310.1
06-Apr-07	Bromide	0.418	0.066	0.200	NE			084455-016	SW846-9056
	Chloride	42.9	0.330	1.00	NE			084455-016	SW846-9056
	Fluoride	0.866	0.033	0.100	4.00			084455-016	SW846-9056
	Sulfate	38.0	0.500	2.00	NE			084455-016	SW846-9056
	Nitrate plus Nitrite, as N	3.49	0.100	0.500	10.0			084455-018	EPA 353.2
	Total Organic Carbon, Average	0.672	0.330	1.00	NE	J		084455-004	SW846-9060
	Carbon Dioxide, Free	6.52	0.725	1.00	NE	B	B, J	084455-007	SM 4500 CO2 D[g]
	Carbon Dioxide, Total	206	0.725	1.00	NE	B		084455-007	SM 4500 CO2 D[g]
	Total Dissolved Solids	359	2.38	10.0	NE			084455-013	EPA 160.1
	Biochemical Oxygen Demand	15.8	2.00	4.00	NE		None	084455-031	EPA 405.1
	Ferrous Iron	ND	0.028	0.100	NE	U	None	084455-012	3500M Fe2+[g]
	Manganese II	ND	0.320	NR	NE	U	None	084455-011	C2-100 Mn2+[g]
	Alkalinity, field measurement	199	NA	1.00	NE	None	None	Field	HACH 8203

Refer to footnotes at end of table.

Table A-4 (Continued)
General Chemistry Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW2 (Duplicate)	Alkalinity, Total	229	0.725	1.00	NE			084456-016	EPA 310.1
06-Apr-07	Bromide	0.487	0.066	0.200	NE			084456-016	SW846-9056
	Chloride	42.5	0.330	1.00	NE			084456-016	SW846-9056
	Fluoride	0.878	0.033	0.100	4.00			084456-016	SW846-9056
	Sulfate	37.6	0.500	2.00	NE			084456-016	SW846-9056
	Nitrate plus Nitrite, as N	3.16	0.100	0.500	10.0			084456-018	EPA 353.2
	Total Organic Carbon, Average	0.622	0.330	1.00	NE	J		084456-004	SW846-9060
	Carbon Dioxide, Free	9.16	0.725	1.00	NE	B	B, J	084456-007	SM 4500 CO2 D[g]
	Carbon Dioxide, Total	207	0.725	1.00	NE	B		084456-007	SM 4500 CO2 D[g]
	Total Dissolved Solids	379	2.38	10.0	NE			084456-013	EPA 160.1
MWL-MW3	Alkalinity, Total	190	0.725	1.00	NE	B		084458-016	EPA 310.1
11-Apr-07	Bromide	0.251	0.066	0.200	NE		B, J	084458-016	SW846-9056
	Chloride	32.1	0.660	2.00	NE			084458-016	SW846-9056
	Fluoride	1.04	0.033	0.100	4.00			084458-016	SW846-9056
	Sulfate	35.5	1.00	4.00	NE			084458-016	SW846-9056
	Nitrate plus Nitrite, as N	3.75	0.100	0.500	10.0			084458-018	EPA 353.2
	Total Organic Carbon, Average	0.354	0.330	1.00	NE	J		084458-004	SW846-9060
	Carbon Dioxide, Free	3.97	0.725	1.00	NE			084458-007	SM 4500 CO2 D[g]
	Carbon Dioxide, Total	184	0.725	1.00	NE	B		084458-007	SM 4500 CO2 D[g]
	Total Dissolved Solids	308	2.38	10.0	NE			084458-013	EPA 160.1
	Biochemical Oxygen Demand	ND	2.00	4.00	NE	U	None	084458-031	EPA 405.1
	Ferrous Iron	ND	0.028	0.100	NE	U	None	084458-012	3500M
	Manganese II	ND	0.320	NR	NE	U	None	084458-011	C2-100 Mn2+[g]
	Alkalinity, field measurement	179	NA	1.00	NE	None	None	Field	HACH 8203
MWL-MW4	Alkalinity, Total	208	1.45	2.00	NE	B		084460-016	EPA 310.1
05-Jun-07	Bromide	0.329	0.066	0.200	NE			084460-016	SW846-9056
	Chloride	50.2	0.330	1.00	NE			084460-016	SW846-9056
	Fluoride	0.948	0.033	0.100	4.00			084460-016	SW846-9056
	Sulfate	35.3	0.100	0.400	NE			084460-016	SW846-9056
	Nitrate plus Nitrite, as N	2.27	0.100	0.500	10.0			084460-018	EPA 353.2
	Total Organic Carbon, Average	0.713	0.330	1.00	NE	J		084460-004	SW846-9060
	Carbon Dioxide, Free	10.7	0.725	1.00	NE	B	B, J	084460-007	SM 4500 CO2 D[g]
	Carbon Dioxide, Total	195	0.725	1.00	NE	B		084460-007	SM 4500 CO2 D[g]
	Total Dissolved Solids	396	2.38	10.0	NE			084460-013	EPA 160.1
	Biochemical Oxygen Demand	18.2	2.00	4.00	NE		None	084460-031	EPA 405.1
	Ferrous Iron	ND	0.028	0.100	NE	U	None	084460-012	3500M Fe2+[g]
	Manganese II	ND	0.320	NR	NE	U	None	084460-011	C2-100 Mn2+[g]

Refer to footnotes at end of table.

Table A-4 (Continued)
General Chemistry Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW5	Alkalinity, Total	363	1.45	2.00	NE	B		084462-016	EPA 310.1
10-Apr-07	Bromide	0.466	0.066	0.200	NE			084462-016	SW846-9056
	Chloride	82.2	0.660	2.00	NE			084462-016	SW846-9056
	Fluoride	0.733	0.033	0.100	4.00			084462-016	SW846-9056
	Sulfate	51.5	1.00	4.00	NE			084462-016	SW846-9056
	Nitrate plus Nitrite, as N	1.67	0.100	0.500	10.0			084462-018	EPA 353.2
	Total Organic Carbon, Average	0.706	0.330	1.00	NE	J		084462-004	SW846-9060
	Carbon Dioxide, Free	11.3	0.725	1.00	NE			084462-007	SM 4500 CO2 D[g]
	Carbon Dioxide, Total	173	0.725	1.00	NE	B		084462-007	SM 4500 CO2 D[g]
	Total Dissolved Solids	545	2.38	10.0	NE			084462-013	EPA 160.1
	Biochemical Oxygen Demand	ND	2.00	4.00	NE	U	None	084462-031	EPA 405.1
	Ferrous Iron	ND	0.028	0.100	NE	U	None	084462-012	3500M Fe2+[g]
	Manganese II	ND	0.320	NR	NE	U	None	084462-011	C2-100 Mn2+[g]
	Alkalinity, field measurement	298	NA	1.00	NE	None	None	Field	HACH 8203
MWL-MW6	Alkalinity, Total	123	0.725	1.00	NE	B		084464-016	EPA 310.1
12-Apr-07	Bromide	0.616	0.066	0.200	NE			084464-016	SW846-9056
	Chloride	75.8	0.660	2.00	NE			084464-016	SW846-9056
	Fluoride	0.751	0.033	0.100	4.00			084464-016	SW846-9056
	Sulfate	50.0	1.00	4.00	NE			084464-016	SW846-9056
	Nitrate plus Nitrite, as N	1.57	0.100	0.500	10.0			084464-018	EPA 353.2
	Total Organic Carbon, Average	0.418	0.330	1.00	NE	J		084464-004	SW846-9060
	Carbon Dioxide, Free	13.4	0.725	1.00	NE			084464-007	SM 4500 CO2 D[g]
	Carbon Dioxide, Total	168	0.725	1.00	NE	B		084464-007	SM 4500 CO2 D[g]
	Total Dissolved Solids	578	2.38	10.0	NE			084464-013	EPA 160.1
	Biochemical Oxygen Demand	ND	2.00	4.00	NE	U	None	084464-031	EPA 405.1
	Ferrous Iron	ND	0.028	0.100	NE	U	None	084464-012	3500M Fe2+[g]
	Manganese II	ND	0.320	NR	NE	U	None	084464-011	C2-100 Mn2+[g]
	Alkalinity, field measurement	290	NA	1.00	NE	None	None	Field	HACH 8203

[a]MDL is the minimum concentration that can be measured and reported with 99% confidence that the analyte is greater than zero; analyte is matrix-specific.

[b]PQL is the lowest concentration of analytes in a sample that can be reliably determined within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions.

[c]MCL is established by the U.S. Environmental Protection Agency Primary Water Regulations (40 CFR 141.11[b]), and subsequent amendments or the New Mexico Environmental Improvement Board in Title 20, Chapter 7, Part 1 of the New Mexico Administrative Code (20 NMAC 7.1).

Table A-4 (Concluded)
General Chemistry Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

[d]Laboratory Qualifiers:
B = Analyte is detected in associated laboratory method blank.
J = Amount detected is below the PQL.
None = No qualifiers for field analysis.
U = Analyte is absent or below the MDL.

[e]Validation Qualifiers (If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.):
B = Method blank contamination at concentration greater than PQL.
J = The associated value is an estimated quantity.
None = Data was not validated.

[f]Analytical methods used are referenced to either U.S. Environmental Protection Agency, 1979. "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, U.S. Environmental Protection Agency, Cincinnati, Ohio, or U.S. Environmental Protection Agency, 1986. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.

[g]Laboratory-specific analytical methods.

CFR = Code of Federal Regulations.
EPA = U.S. Environmental Protection Agency.
HACH = Hach Company.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
MW = Monitoring well.
MWL = Mixed waste Landfill.
N = Nitrogen.
NA = Not applicable.
ND = Not detected (at method detection limit).
NE = Not established.
NMAC = New Mexico Administrative Code.
NR = Not reported.
PQL = Practical quantitation limit.

Table A-5
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW1	Aluminum	0.0469	0.005	0.015	NE			084453-009	SW846-6020
05-Apr-07	Antimony	ND	0.0005	0.002	0.006	U		084453-009	SW846-6020
	Arsenic	0.00156	0.0015	0.005	0.010	B, J	B, J	084453-009	SW846-6020
	Barium	0.0792	0.0005	0.002	2.00			084453-009	SW846-6020
	Beryllium	ND	0.0001	0.0005	0.004	U		084453-009	SW846-6020
	Cadmium	0.000576	0.0001	0.001	0.005	J		084453-009	SW846-6020
	Calcium	50.0	0.100	0.500	NE	B		084453-009	SW846-6020
	Chromium	**0.426**	0.001	0.003	0.100	B		084453-009	SW846-6020
	Cobalt	0.00404	0.0001	0.001	NE			084453-009	SW846-6020
	Copper	0.0244	0.0002	0.001	NE			084453-009	SW846-6020
	Iron	6.10	0.010	0.025	NE	B		084453-009	SW846-6020
	Lead	ND	0.0005	0.002	NE	U		084453-009	SW846-6020
	Magnesium	18.4	0.025	0.075	NE			084453-009	SW846-6020
	Manganese	0.0586	0.001	0.005	NE			084453-009	SW846-6020
	Mercury	ND	0.00006	0.0002	0.002	U		084453-009	SW846-7470
	Nickel	0.436	0.0005	0.002	NE		J	084453-009	SW846-6020
	Potassium	3.13	0.080	0.300	NE			084453-009	SW846-6020
	Selenium	ND	0.0025	0.005	0.05	U		084453-009	SW846-6020
	Silver	0.000824	0.0002	0.001	NE	J		084453-009	SW846-6020
	Sodium	46.4	0.400	1.25	NE			084453-009	SW846-6020
	Thallium	0.000431	0.0004	0.001	0.002	J		084453-009	SW846-6020
	Uranium	0.00595	0.00005	0.0002	0.030	B		084453-009	SW846-6020
	Uranium-235	0.000044	0.00001	0.00007	NE	J		084453-009	SW846-6020
	Uranium-238	0.0059	0.00005	0.0002	NE	B		084453-009	SW846-6020
	Vanadium	ND	0.050	0.150	NE	U	A2, UJ	084453-009	SW846-6020
	Zinc	0.0178	0.002	0.010	NE			084453-009	SW846-6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW2	Aluminum	0.0251	0.005	0.015	NE		B2, J	084455-009	SW846-6020
06-Apr-07	Antimony	ND	0.0005	0.002	0.006	B, U		084455-009	SW846-6020
	Arsenic	0.00169	0.0015	0.005	0.010	B, J	B, J	084455-009	SW846-6020
	Barium	0.105	0.0005	0.002	2.00			084455-009	SW846-6020
	Beryllium	ND	0.0001	0.0005	0.004	U		084455-009	SW846-6020
	Cadmium	ND	0.0001	0.001	0.005	U		084455-009	SW846-6020
	Calcium	58.3	0.100	0.500	NE	B		084455-009	SW846-6020
	Chromium	0.013	0.001	0.003	0.100			084455-009	SW846-6020
	Cobalt	0.00051	0.0001	0.001	NE	J		084455-009	SW846-6020
	Copper	0.00156	0.0002	0.001	NE		B2, J	084455-009	SW846-6020
	Iron	0.351	0.010	0.025	NE	B		084455-009	SW846-6020
	Lead	ND	0.0005	0.002	NE	U		084455-009	SW846-6020
	Magnesium	20.9	0.005	0.015	NE			084455-009	SW846-6020
	Manganese	0.00342	0.001	0.005	NE	J		084455-009	SW846-6020
	Mercury	ND	0.00006	0.0002	0.002	U		084455-009	SW846-7470
	Nickel	0.00734	0.0005	0.002	NE			084455-009	SW846-6020
	Potassium	4.65	0.400	1.50	NE			084455-009	SW846-6020
	Selenium	ND	0.0025	0.005	0.05	U		084455-009	SW846-6020
	Silver	ND	0.0002	0.001	NE	U		084455-009	SW846-6020
	Sodium	49.8	0.400	1.25	NE			084455-009	SW846-6020
	Thallium	0.000437	0.0004	0.001	0.002	J		084455-009	SW846-6020
	Uranium	0.00651	0.00005	0.0002	0.030			084455-009	SW846-6020
	Uranium-235	0.000047	0.00001	0.00007	NE	J		084455-009	SW846-6020
	Uranium-238	0.00646	0.00005	0.0002	NE			084455-009	SW846-6020
	Vanadium	ND	0.010	0.030	NE	U		084455-009	SW846-6020
	Zinc	0.0118	0.002	0.010	NE			084455-009	SW846-6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW2 (Duplicate) 06-Apr-07	Aluminum	0.0208	0.005	0.015	NE		B2, J	084456-009	SW846-6020
	Antimony	ND	0.0005	0.002	0.006	B, U		084456-009	SW846-6020
	Arsenic	ND	0.0015	0.005	0.010	B, U		084456-009	SW846-6020
	Barium	0.102	0.0005	0.002	2.00			084456-009	SW846-6020
	Beryllium	ND	0.0001	0.0005	0.004	U		084456-009	SW846-6020
	Cadmium	ND	0.0001	0.001	0.005	U		084456-009	SW846-6020
	Calcium	57.1	0.100	0.500	NE	B		084456-009	SW846-6020
	Chromium	0.0135	0.001	0.003	0.100			084456-009	SW846-6020
	Cobalt	0.000518	0.0001	0.001	NE	J		084456-009	SW846-6020
	Copper	0.00157	0.0002	0.001	NE		B2, J	084456-009	SW846-6020
	Iron	0.330	0.010	0.025	NE	B		084456-009	SW846-6020
	Lead	ND	0.0005	0.002	NE	U		084456-009	SW846-6020
	Magnesium	21.4	0.005	0.015	NE			084456-009	SW846-6020
	Manganese	0.00331	0.001	0.005	NE	J		084456-009	SW846-6020
	Mercury	ND	0.00006	0.0002	0.002	U		084456-009	SW846-7470
	Nickel	0.00706	0.0005	0.002	NE			084456-009	SW846-6020
	Potassium	4.31	0.080	0.300	NE			084456-009	SW846-6020
	Selenium	ND	0.0025	0.005	0.05	U		084456-009	SW846-6020
	Silver	ND	0.0002	0.001	NE	U		084456-009	SW846-6020
	Sodium	49.1	0.400	1.25	NE			084456-009	SW846-6020
	Thallium	ND	0.0004	0.001	0.002	U		084456-009	SW846-6020
	Uranium	0.00639	0.00005	0.0002	0.030			084456-009	SW846-6020
	Uranium-235	0.000043	0.00001	0.00007	NE	J		084456-009	SW846-6020
	Uranium-238	0.00634	0.00005	0.0002	NE			084456-009	SW846-6020
	Vanadium	ND	0.010	0.030	NE	U		084456-009	SW846-6020
	Zinc	0.0126	0.0020	0.010	NE			084456-009	SW846-6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW3	Aluminum	0.0232	0.005	0.015	NE			084458-009	SW846-6020
11-Apr-07	Antimony	ND	0.0005	0.002	0.006	U		084458-009	SW846-6020
	Arsenic	0.00152	0.0015	0.005	0.010	J		084458-009	SW846-6020
	Barium	0.0833	0.0005	0.002	2.00			084458-009	SW846-6020
	Beryllium	ND	0.0001	0.0005	0.004	U		084458-009	SW846-6020
	Cadmium	0.000115	0.0001	0.001	0.005	J		084458-009	SW846-6020
	Calcium	41.0	0.020	0.100	NE	B		084458-009	SW846-6020
	Chromium	0.0113	0.001	0.003	0.100			084458-009	SW846-6020
	Cobalt	0.000347	0.0001	0.001	NE	J		084458-009	SW846-6020
	Copper	0.00116	0.0002	0.001	NE			084458-009	SW846-6020
	Iron	0.269	0.010	0.025	NE			084458-009	SW846-6020
	Lead	ND	0.0005	0.002	NE	U		084458-009	SW846-6020
	Magnesium	13.5	0.005	0.015	NE			084458-009	SW846-6020
	Manganese	0.00327	0.001	0.005	NE	J		084458-009	SW846-6020
	Mercury	ND	0.00006	0.0002	0.002	U	B3, UJ	084458-009	SW846-7470
	Nickel	0.0848	0.0005	0.002	NE			084458-009	SW846-6020
	Potassium	3.46	0.080	0.300	NE			084458-009	SW846-6020
	Selenium	ND	0.0025	0.005	0.05	U		084458-009	SW846-6020
	Silver	ND	0.0002	0.001	NE	U		084458-009	SW846-6020
	Sodium	44.2	0.080	0.250	NE			084458-009	SW846-6020
	Thallium	0.00055	0.0004	0.001	0.002	J		084458-009	SW846-6020
	Uranium	0.00493	0.00005	0.0002	0.030			084458-009	SW846-6020
	Uranium-235	0.000034	0.00001	0.00007	NE	J		084458-009	SW846-6020
	Uranium-238	0.00489	0.00005	0.0002	NE			084458-009	SW846-6020
	Vanadium	ND	0.010	0.030	NE	U		084458-009	SW846-6020
	Zinc	0.00649	0.002	0.010	NE	J		084458-009	SW846-6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW4	Aluminum	0.0139	0.005	0.015	NE	J		084460-009	SW846-6020
05-Jun-07	Antimony	ND	0.0005	0.002	0.006	B, U		084460-009	SW846-6020
	Arsenic	0.00381	0.0015	0.005	0.010	B, J	B, B3, J	084460-009	SW846-6020
	Barium	0.0965	0.0005	0.002	2.00			084460-009	SW846-6020
	Beryllium	ND	0.0001	0.0005	0.004	U		084460-009	SW846-6020
	Cadmium	ND	0.0001	0.001	0.005	U		084460-009	SW846-6020
	Calcium	63.6	0.100	0.500	NE			084460-009	SW846-6020
	Chromium	0.0013	0.001	0.003	0.100	B, J	B, J, P1	084460-009	SW846-6020
	Cobalt	0.000888	0.0001	0.001	NE	J		084460-009	SW846-6020
	Copper	0.000385	0.0002	0.001	NE	J		084460-009	SW846-6020
	Iron	0.250	0.010	0.025	NE	B		084460-009	SW846-6020
	Lead	0.00051	0.0005	0.002	NE	J		084460-009	SW846-6020
	Magnesium	23.2	0.025	0.075	NE		J	084460-009	SW846-6020
	Manganese	0.0299	0.001	0.005	NE			084460-009	SW846-6020
	Mercury	ND	0.00006	0.0002	0.002	U	B3, UJ	084460-009	SW846-7470
	Nickel	0.00805	0.0005	0.002	NE			084460-009	SW846-6020
	Potassium	4.81	0.080	0.300	NE			084460-009	SW846-6020
	Selenium	ND	0.0025	0.005	0.05	U		084460-009	SW846-6020
	Silver	ND	0.0002	0.001	NE	U		084460-009	SW846-6020
	Sodium	55.0	0.400	1.25	NE			084460-009	SW846-6020
	Thallium	0.000432	0.0004	0.001	0.002	J		084460-009	SW846-6020
	Uranium	0.00571	0.00005	0.0002	0.030			084460-009	SW846-6020
	Uranium-235	0.000038	0.00001	0.00007	NE	J		084460-009	SW846-6020
	Uranium-238	0.00567	0.00005	0.0002	NE			084460-009	SW846-6020
	Vanadium	0.0136	0.010	0.030	NE	J		084460-009	SW846-6020
	Zinc	0.0193	0.0020	0.010	NE			084460-009	SW846-6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW5	Aluminum	0.0114	0.005	0.015	NE	J	B2, J	084462-009	SW846-6020
10-Apr-07	Antimony	ND	0.0005	0.002	0.006	B, U		084462-009	SW846-6020
	Arsenic	ND	0.0015	0.005	0.010	U		084462-009	SW846-6020
	Barium	0.128	0.0005	0.002	2.00			084462-009	SW846-6020
	Beryllium	ND	0.0001	0.0005	0.004	U		084462-009	SW846-6020
	Cadmium	ND	0.0001	0.001	0.005	U		084462-009	SW846-6020
	Calcium	88.8	0.100	0.500	NE	B		084462-009	SW846-6020
	Chromium	ND	0.001	0.003	0.100	B, U		084462-009	SW846-6020
	Cobalt	0.000202	0.0001	0.001	NE	B, J	B, J	084462-009	SW846-6020
	Copper	0.000787	0.0002	0.001	NE	B, J	B, J	084462-009	SW846-6020
	Iron	0.346	0.010	0.025	NE	B		084462-009	SW846-6020
	Lead	ND	0.0005	0.002	NE	U		084462-009	SW846-6020
	Magnesium	30.7	0.005	0.015	NE			084462-009	SW846-6020
	Manganese	0.00677	0.001	0.005	NE			084462-009	SW846-6020
	Mercury	ND	0.00006	0.0002	0.002	U		084462-009	SW846-7470
	Nickel	0.00143	0.0005	0.002	NE	B, J	B, B2, J	084462-009	SW846-6020
	Potassium	5.46	0.080	0.300	NE			084462-009	SW846-6020
	Selenium	ND	0.0025	0.005	0.05	U		084462-009	SW846-6020
	Silver	ND	0.0002	0.001	NE	U		084462-009	SW846-6020
	Sodium	68.5	0.400	1.25	NE			084462-009	SW846-6020
	Thallium	ND	0.0004	0.001	0.002	U		084462-009	SW846-6020
	Uranium	0.00961	0.00005	0.0002	0.030	B		084462-009	SW846-6020
	Uranium-235	0.000069	0.00001	0.00007	NE	J		084462-009	SW846-6020
	Uranium-238	0.00954	0.00005	0.0002	NE	B		084462-009	SW846-6020
	Vanadium	ND	0.010	0.030	NE	U		084462-009	SW846-6020
	Zinc	0.00491	0.002	0.010	NE	B, J	B, J	084462-009	SW846-6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW6	Aluminum	0.0094	0.005	0.015	NE	B, J	B, B2, J	084464-009	SW846-6020
12-Apr-07	Antimony	ND	0.0005	0.002	0.006	U		084464-009	SW846-6020
	Arsenic	ND	0.0015	0.005	0.010	U		084464-009	SW846-6020
	Barium	0.128	0.0005	0.002	2.00			084464-009	SW846-6020
	Beryllium	ND	0.0001	0.0005	0.004	U		084464-009	SW846-6020
	Cadmium	ND	0.0001	0.001	0.005	U		084464-009	SW846-6020
	Calcium	88.7	0.200	1.00	NE	B		084464-009	SW846-6020
	Chromium	0.00114	0.001	0.003	0.100	J	B2, J	084464-009	SW846-6020
	Cobalt	0.000198	0.0001	0.001	NE	J		084464-009	SW846-6020
	Copper	0.000871	0.0002	0.001	NE	J	B2, J	084464-009	SW846-6020
	Iron	0.344	0.010	0.025	NE			084464-009	SW846-6020
	Lead	ND	0.0005	0.002	NE	U		084464-009	SW846-6020
	Magnesium	26.5	0.005	0.015	NE			084464-009	SW846-6020
	Manganese	ND	0.001	0.005	NE	U		084464-009	SW846-6020
	Mercury	ND	0.00006	0.0002	0.002	U		084464-009	SW846-7470
	Nickel	0.00114	0.0005	0.002	NE	J		084464-009	SW846-6020
	Potassium	5.03	0.08	0.300	NE			084464-009	SW846-6020
	Selenium	ND	0.0025	0.005	0.05	U		084464-009	SW846-6020
	Silver	ND	0.0002	0.001	NE	U		084464-009	SW846-6020
	Sodium	60.2	0.800	2.50	NE			084464-009	SW846-6020
	Thallium	0.000499	0.0004	0.001	0.002	J		084464-009	SW846-6020
	Uranium	0.00942	0.00005	0.0002	0.030			084464-009	SW846-6020
	Uranium-235	0.000068	0.00001	0.00007	NE	J		084464-009	SW846-6020
	Uranium-238	0.00935	0.00005	0.0002	NE			084464-009	SW846-6020
	Vanadium	ND	0.010	0.030	NE	U		084464-009	SW846-6020
	Zinc	0.00477	0.002	0.010	NE	B, J	B, B2, J	084464-009	SW846-6020

Note: Values in **bold** exceed the established MCL.

[a]MDL is the minimum concentration that can be measured and reported with 99% confidence that the analyte is greater than zero; analyte is matrix-specific.

[b]PQL is the lowest concentration of analytes in a sample that can be reliably determined within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions.

[c]MCL is established by the U.S. Environmental Protection Agency Primary Water Regulations (40 CFR 141.11[b]), and subsequent amendments or the New Mexico Environmental Improvement Board in Title 20, Chapter 7, Part 1 of the New Mexico Administrative Code (20 NMAC 7.1).

Table A-5 (Concluded)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

[d]Laboratory Qualifiers:
B = Analyte is detected in associated laboratory method blank.
J = Amount detected is below the PQL.
U = Analyte is absent or below the MDL.

[e]Validation Qualifiers (If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.):
A2 = Laboratory accuracy and/or bias measurements for the matrix spike and/or matrix spike duplicate samples do not meet acceptance criteria.
B = Method blank contamination at concentration greater than PQL.
B2 = Field/equipment blank contamination at concentration greater than PQL.
B3 = Calibration blank contamination at concentration greater than PQL.
J = The associated value is an estimated quantity.
P1 = Laboratory precision measurements for the matrix spike and matrix spike duplicate do not meet acceptance criteria.
UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

[f]U.S. Environmental Protection Agency, 1986. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.
CFR = Code of Federal Regulations.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
ND = Not detected (at method detection limit).
NE = Not established.
NMAC = New Mexico Administrative Code.
PQL = Practical quantitation limit.

Table A-6
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW1	Aluminum	0.00922	0.005	0.015	NE	J		084453-010	SW846-6020
05-Apr-07	Antimony	ND	0.0005	0.002	0.006	U		084453-010	SW846-6020
	Arsenic	ND	0.0015	0.005	0.010	B, U		084453-010	SW846-6020
	Barium	0.0669	0.0005	0.002	2.00			084453-010	SW846-6020
	Beryllium	ND	0.0001	0.0005	0.004	U		084453-010	SW846-6020
	Cadmium	0.000244	0.0001	0.001	0.005	J		084453-010	SW846-6020
	Calcium	49.2	0.100	0.500	NE	B		084453-010	SW846-6020
	Chromium	0.00381	0.001	0.003	0.100	B	B, J	084453-010	SW846-6020
	Cobalt	0.000255	0.0001	0.001	NE	J		084453-010	SW846-6020
	Copper	0.00372	0.0002	0.001	NE			084453-010	SW846-6020
	Iron	0.231	0.010	0.025	NE	B		084453-010	SW846-6020
	Lead	ND	0.0005	0.002	NE	U		084453-010	SW846-6020
	Magnesium	17.8	0.025	0.075	NE			084453-010	SW846-6020
	Manganese	0.00211	0.001	0.005	NE	J		084453-010	SW846-6020
	Mercury	ND	0.00006	0.0002	0.002	U		084453-010	SW846-7470
	Nickel	0.284	0.0005	0.002	NE		J	084453-010	SW846-6020
	Potassium	3.02	0.080	0.300	NE			084453-010	SW846-6020
	Selenium	ND	0.0025	0.005	0.050	U		084453-010	SW846-6020
	Silver	ND	0.0002	0.001	NE	U		084453-010	SW846-6020
	Sodium	47.0	0.400	1.25	NE			084453-010	SW846-6020
	Thallium	ND	0.0004	0.001	0.002	U		084453-010	SW846-6020
	Vanadium	ND	0.010	0.030	NE	U	A2, UJ	084453-010	SW846-6020
	Zinc	0.00668	0.002	0.010	NE	J		084453-010	SW846-6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW2	Aluminum	0.00702	0.005	0.015	NE	J		084455-010	SW846-6020
06-Apr-07	Antimony	ND	0.0005	0.002	0.006	B, U		084455-010	SW846-6020
	Arsenic	ND	0.0015	0.005	0.010	B, U		084455-010	SW846-6020
	Barium	0.102	0.0005	0.002	2.00			084455-010	SW846-6020
	Beryllium	ND	0.0001	0.0005	0.004	U		084455-010	SW846-6020
	Cadmium	ND	0.0001	0.001	0.005	U		084455-010	SW846-6020
	Calcium	58.6	0.100	0.500	NE	B		084455-010	SW846-6020
	Chromium	0.00174	0.001	0.003	0.100	J		084455-010	SW846-6020
	Cobalt	0.000138	0.0001	0.001	NE	J		084455-010	SW846-6020
	Copper	0.000902	0.0002	0.001	NE	J		084455-010	SW846-6020
	Iron	0.217	0.010	0.025	NE	B		084455-010	SW846-6020
	Lead	ND	0.0005	0.002	NE	U		084455-010	SW846-6020
	Magnesium	21.3	0.005	0.015	NE			084455-010	SW846-6020
	Manganese	ND	0.001	0.005	NE	U		084455-010	SW846-6020
	Mercury	ND	0.00006	0.0002	0.002	U		084455-010	SW846-7470
	Nickel	0.00541	0.0005	0.002	NE			084455-010	SW846-6020
	Potassium	4.22	0.080	0.300	NE			084455-010	SW846-6020
	Selenium	ND	0.0025	0.005	0.050	U		084455-010	SW846-6020
	Silver	ND	0.0002	0.001	NE	U		084455-010	SW846-6020
	Sodium	50.3	0.400	1.25	NE			084455-010	SW846-6020
	Thallium	ND	0.0004	0.001	0.002	U		084455-010	SW846-6020
	Vanadium	ND	0.010	0.030	NE	U		084455-010	SW846-6020
	Zinc	0.00729	0.002	0.010	NE	J		084455-010	SW846-6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW2 (Duplicate) 06-Apr-07	Aluminum	ND	0.005	0.015	NE	U		084456-010	SW846-6020
	Antimony	ND	0.0005	0.002	0.006	B, U		084456-010	SW846-6020
	Arsenic	ND	0.0015	0.005	0.010	B, U		084456-010	SW846-6020
	Barium	0.108	0.0005	0.002	2.00			084456-010	SW846-6020
	Beryllium	ND	0.0001	0.0005	0.004	U		084456-010	SW846-6020
	Cadmium	ND	0.0001	0.001	0.005	U		084456-010	SW846-6020
	Calcium	56.1	0.100	0.500	NE	B		084456-010	SW846-6020
	Chromium	0.00189	0.001	0.003	0.100	J		084456-010	SW846-6020
	Cobalt	0.000148	0.0001	0.001	NE	J		084456-010	SW846-6020
	Copper	0.000944	0.0002	0.001	NE	J		084456-010	SW846-6020
	Iron	0.239	0.010	0.025	NE	B		084456-010	SW846-6020
	Lead	ND	0.0005	0.002	NE	U		084456-010	SW846-6020
	Magnesium	21.5	0.005	0.015	NE			084456-010	SW846-6020
	Manganese	ND	0.001	0.005	NE	U		084456-010	SW846-6020
	Mercury	ND	0.00006	0.0002	0.002	U		084456-010	SW846-7470
	Nickel	0.00558	0.0005	0.002	NE			084456-010	SW846-6020
	Potassium	4.18	0.080	0.300	NE			084456-010	SW846-6020
	Selenium	ND	0.0025	0.005	0.050	U		084456-010	SW846-6020
	Silver	ND	0.0002	0.001	NE	U		084456-010	SW846-6020
	Sodium	48.5	0.400	1.25	NE			084456-010	SW846-6020
	Thallium	ND	0.0004	0.001	0.002	U		084456-010	SW846-6020
	Vanadium	ND	0.010	0.030	NE	U		084456-010	SW846-6020
	Zinc	0.00734	0.002	0.010	NE	J		084456-010	SW846-6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW3	Aluminum	0.00588	0.005	0.015	NE	J		084458-010	SW846-6020
11-Apr-07	Antimony	ND	0.0005	0.002	0.006	U		084458-010	SW846-6020
	Arsenic	ND	0.0015	0.005	0.010	U		084458-010	SW846-6020
	Barium	0.0802	0.0005	0.002	2.00			084458-010	SW846-6020
	Beryllium	ND	0.0001	0.0005	0.004	U		084458-010	SW846-6020
	Cadmium	ND	0.0001	0.001	0.005	U		084458-010	SW846-6020
	Calcium	41.0	0.020	0.100	NE	B		084458-010	SW846-6020
	Chromium	0.00452	0.001	0.003	0.100			084458-010	SW846-6020
	Cobalt	0.000433	0.0001	0.001	NE	J		084458-010	SW846-6020
	Copper	0.000896	0.0002	0.001	NE	J		084458-010	SW846-6020
	Iron	0.137	0.010	0.025	NE			084458-010	SW846-6020
	Lead	ND	0.0005	0.002	NE	U		084458-010	SW846-6020
	Magnesium	14.1	0.005	0.015	NE			084458-010	SW846-6020
	Manganese	0.00416	0.001	0.005	NE	J		084458-010	SW846-6020
	Mercury	ND	0.00006	0.0002	0.002	U	B3, UJ	084458-010	SW846-7470
	Nickel	0.12	0.0005	0.002	NE			084458-010	SW846-6020
	Potassium	3.74	0.080	0.300	NE			084458-010	SW846-6020
	Selenium	ND	0.0025	0.005	0.050	U		084458-010	SW846-6020
	Silver	ND	0.0002	0.001	NE	U		084458-010	SW846-6020
	Sodium	48.9	0.400	1.25	NE			084458-010	SW846-6020
	Thallium	ND	0.0004	0.001	0.002	U		084458-010	SW846-6020
	Vanadium	ND	0.010	0.030	NE	U		084458-010	SW846-6020
	Zinc	0.0038	0.002	0.010	NE	J		084458-010	SW846-6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW4	Aluminum	0.00547	0.005	0.015	NE	J		084460-010	SW846-6020
05-Jun-07	Antimony	ND	0.0005	0.002	0.006	B, U		084460-010	SW846-6020
	Arsenic	0.00312	0.0015	0.005	0.010	B, J	B, B3, J	084460-010	SW846-6020
	Barium	0.0925	0.0005	0.002	2.00			084460-010	SW846-6020
	Beryllium	ND	0.0001	0.0005	0.004	U		084460-010	SW846-6020
	Cadmium	ND	0.0001	0.001	0.005	U		084460-010	SW846-6020
	Calcium	62.9	0.100	0.500	NE			084460-010	SW846-6020
	Chromium	0.00162	0.001	0.003	0.100	B, J	B, J, P1	084460-010	SW846-6020
	Cobalt	0.000903	0.0001	0.001	NE	J		084460-010	SW846-6020
	Copper	ND	0.0002	0.001	NE	U		084460-010	SW846-6020
	Iron	0.230	0.010	0.025	NE	B		084460-010	SW846-6020
	Lead	ND	0.0005	0.002	NE	U		084460-010	SW846-6020
	Magnesium	25.7	0.025	0.075	NE		J	084460-010	SW846-6020
	Manganese	0.0302	0.001	0.005	NE			084460-010	SW846-6020
	Nickel	0.00778	0.0005	0.002	0.002			084460-010	SW846-6020
	Potassium	4.59	0.080	0.300	NE			084460-010	SW846-6020
	Selenium	ND	0.0025	0.005	NE	U		084460-010	SW846-6020
	Silver	ND	0.0002	0.001	0.050	U		084460-010	SW846-6020
	Sodium	52.8	0.400	1.25	NE			084460-010	SW846-6020
	Thallium	ND	0.0004	0.001	NE	U		084460-010	SW846-6020
	Vanadium	0.0132	0.010	0.030	0.002	J		084460-010	SW846-6020
	Zinc	0.0181	0.002	0.010	NE			084460-010	SW846-6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW5	Aluminum	0.0078	0.005	0.015	NE	J		084462-010	SW846-6020
10-Apr-07	Antimony	ND	0.0005	0.002	0.006	B, U		084462-010	SW846-6020
	Arsenic	ND	0.0015	0.005	0.010	U		084462-010	SW846-6020
	Barium	0.131	0.0005	0.002	2.00			084462-010	SW846-6020
	Beryllium	ND	0.0001	0.0005	0.004	U		084462-010	SW846-6020
	Cadmium	ND	0.0001	0.001	0.005	U		084462-010	SW846-6020
	Calcium	89.1	0.100	0.500	NE	B		084462-010	SW846-6020
	Chromium	0.00113	0.001	0.003	0.100	B, J	B, J	084462-010	SW846-6020
	Cobalt	0.000194	0.0001	0.001	NE	B, J	B, J	084462-010	SW846-6020
	Copper	0.000807	0.0002	0.001	NE	B, J	B, J	084462-010	SW846-6020
	Iron	0.340	0.010	0.025	NE	B		084462-010	SW846-6020
	Lead	ND	0.0005	0.002	NE	U		084462-010	SW846-6020
	Magnesium	29.3	0.005	0.015	NE			084462-010	SW846-6020
	Manganese	0.00576	0.001	0.005	NE			084462-010	SW846-6020
	Mercury	ND	0.00006	0.0002	0.002	U		084462-010	SW846-7470
	Nickel	0.00164	0.0005	0.002	NE	B, J	B, J	084462-010	SW846-6020
	Potassium	5.42	0.080	0.300	NE			084462-010	SW846-6020
	Selenium	ND	0.0025	0.005	0.050	U		084462-010	SW846-6020
	Silver	ND	0.0002	0.001	NE	U		084462-010	SW846-6020
	Sodium	65.7	0.400	1.25	NE			084462-010	SW846-6020
	Thallium	ND	0.0004	0.001	0.002	U		084462-010	SW846-6020
	Vanadium	ND	0.010	0.030	NE	U		084462-010	SW846-6020
	Zinc	0.00741	0.002	0.010	NE	B, J	B, J	084462-010	SW846-6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW6	Aluminum	0.00809	0.005	0.015	NE	B, J	B, J	084464-010	SW846-6020
12-Apr-07	Antimony	ND	0.0005	0.002	0.006	U		084464-010	SW846-6020
	Arsenic	ND	0.0015	0.005	0.010	U		084464-010	SW846-6020
	Barium	0.120	0.0005	0.002	2.00			084464-010	SW846-6020
	Beryllium	ND	0.0001	0.0005	0.004	U		084464-010	SW846-6020
	Cadmium	ND	0.0001	0.001	0.005	U		084464-010	SW846-6020
	Calcium	86.3	0.200	1.00	NE	B		084464-010	SW846-6020
	Chromium	0.0012	0.001	0.003	0.100	J		084464-010	SW846-6020
	Cobalt	0.000169	0.0001	0.001	NE	J		084464-010	SW846-6020
	Copper	0.000842	0.0002	0.001	NE	J		084464-010	SW846-6020
	Iron	0.341	0.010	0.025	NE			084464-010	SW846-6020
	Lead	ND	0.0005	0.002	NE	U		084464-010	SW846-6020
	Magnesium	28.8	0.005	0.015	NE			084464-010	SW846-6020
	Manganese	ND	0.001	0.005	NE	U		084464-010	SW846-6020
	Mercury	ND	0.00006	0.0002	0.002	U		084464-010	SW846-7470
	Nickel	0.00111	0.0005	0.002	NE	J		084464-010	SW846-6020
	Potassium	4.54	0.080	0.300	NE			084464-010	SW846-6020
	Selenium	ND	0.0025	0.005	0.050	U		084464-010	SW846-6020
	Silver	ND	0.0002	0.001	NE	U		084464-010	SW846-6020
	Sodium	59.0	0.800	2.50	NE			084464-010	SW846-6020
	Thallium	ND	0.0004	0.001	0.002	U		084464-010	SW846-6020
	Vanadium	ND	0.010	0.030	NE	U		084464-010	SW846-6020
	Zinc	0.00462	0.002	0.010	NE	B, J	B, J	084464-010	SW846-6020

[a]MDL is the minimum concentration that can be measured and reported with 99% confidence that the analyte is greater than zero; analyte is matrix-specific.

[b]PQL is the lowest concentration of analytes in a sample that can be reliably determined within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions.

[c]MCL is established by the U.S. Environmental Protection Agency Primary Water Regulations (40 CFR 141.11[b]), and subsequent amendments or the New Mexico Environmental Improvement Board in Title 20, Chapter 7, Part 1 of the New Mexico Administrative Code (20 NMAC 7.1).

[d]Laboratory Qualifiers:
B = Analyte is detected in associated laboratory method blank.
J = Amount detected is below the PQL.
U = Analyte is absent or below the MDL.

Table A-6 (Concluded)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

[e]Validation Qualifiers (If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.):

A2 = Laboratory accuracy and/or bias measurements for the matrix spike and/or matrix spike duplicate samples do not meet acceptance criteria.
B = Method blank contamination at concentration greater than PQL.
B3 = Calibration blank contamination at concentration greater than PQL.
J = The associated value is an estimated quantity.
P1 = Laboratory precision measurements for the matrix spike and matrix spike duplicate do not meet acceptance criteria.
UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

[f]U.S. Environmental Protection Agency, 1986. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.

CFR = Code of Federal Regulations.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
ND = Not detected (at method detection limit).
NE = Not established.
NMAC = New Mexico Administrative Code.
PQL = Practical quantitation limit.

Table A-7
Summary of Detected Volatile Organic Compounds
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Result (μg/L)	MDL[a] (μg/L)	PQL[b] (μg/L)	MCL[c] (μg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW1 05-Apr-07	Acetone	2.34	1.25	5.00	NE	B, J	U, B	084453-001	SW846-8260
MWL-MW2 06-Apr-07	Acetone	2.06	1.25	5.00	NE	B, J	U, B	084455-001	SW846-8260
MWL-MW2 (Duplicate) 06-Apr-07	Acetone	1.68	1.25	5.00	NE	B, J	U, B	084456-001	SW846-8260
MWL-MW3	Acetone	1.68	1.25	5.00	NE	B, J	U, B	084458-001	SW846-8260
11-Apr-07	Toluene	0.275	0.250	1.00	1,000	J		084458-001	SW846-8260
MWL-MW4	Acetone	1.48	1.25	5.00	NE	B, J	UJ, B	084460-001	SW846-8260
05-Jun-07	Toluene	0.321	0.250	1.00	1,000	J		084460-001	SW846-8260
MWL-MW5 10-Apr-07	Acetone	1.90	1.25	5.00	NE	B, J	U, B	084462-001	SW846-8260
MWL-MW6 12-Apr-07	Acetone	2.48	1.25	5.00	NE	B, J	U, B	084464-001	SW846-8260

[a]MDL is the minimum concentration that can be measured and reported with 99% confidence that the analyte is greater than zero; analyte is matrix-specific.

[b]PQL is the lowest concentration of analytes in a sample that can be reliably determined within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions.

[c]MCL is established by the U.S. Environmental Protection Agency Primary Water Regulations (40 CFR 141.11[b]), and subsequent amendments or the New Mexico Environmental Improvement Board in Title 20, Chapter 7, Part 1 of the New Mexico Administrative Code (20 NMAC 7.1).

[d]Laboratory Qualifiers:
B = Analyte is detected in associated laboratory method blank.
J = Amount detected is below the PQL.

[e]Validation Qualifiers (If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.):
B = Method blank contamination at concentration greater than PQL.
U = The analyte was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.
UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

[f]U.S. Environmental Protection Agency, 1986. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.

CFR = Code of Federal Regulations.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
μg/L = Microgram(s) per liter.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
NE = Not established.
NMAC = New Mexico Administrative Code.
PQL = Practical quantitation limit.

Table A-8
Method Detection Limits for Volatile Organic Compounds
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Analyte	MDL[a] (μg/L)	Analytical Method[b]
Acetone	1.25	SW846-8260
Benzene	0.300	SW846-8260
Bromodichloromethane	0.250	SW846-8260
Bromoform	0.250	SW846-8260
Bromomethane	0.500	SW846-8260
2-Butanone	1.25	SW846-8260
Carbon disulfide	1.25	SW846-8260
Carbon tetrachloride	0.250	SW846-8260
Chlorobenzene	0.250	SW846-8260
Chloroethane	0.500	SW846-8260
Chloroform	0.250	SW846-8260
Chloromethane	0.500	SW846-8260
Dibromochloromethane	0.250	SW846-8260
1,1-Dichloroethane	0.300	SW846-8260
1,2-Dichloroethane	0.250	SW846-8260
1,1-Dichloroethene	0.300	SW846-8260
cis-1,2-Dichloroethene	0.300	SW846-8260
trans-1,2-Dichloroethene	0.300	SW846-8260
1,2-Dichloropropane	0.250	SW846-8260
cis-1,3-Dichloropropene	0.250	SW846-8260
trans-1,3-Dichloropropene	0.250	SW846-8260
Ethyl benzene	0.250	SW846-8260
2-Hexanone	1.25	SW846-8260
Methylene chloride	2.00	SW846-8260
4-Methyl-2-pentanone	1.25	SW846-8260
Styrene	0.250	SW846-8260
1,1,2,2-Tetrachloroethane	0.250	SW846-8260
Tetrachloroethene	0.250	SW846-8260
Toluene	0.250	SW846-8260
1,1,1-Trichloroethane	0.300	SW846-8260
1,1,2-Trichloroethane	0.250	SW846-8260
Trichloroethene	0.250	SW846-8260
Vinyl acetate	1.50	SW846-8260
Vinyl chloride	0.500	SW846-8260
Xylene	0.250	SW846-8260

[a]MDL is the minimum concentration that can be measured and reported with 99% confidence that the analyte is greater than zero; analyte is matrix-specific.
[b]U.S. Environmental Protection Agency, 1986. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.
MDL = Method detection limit.
μg/L = Microgram(s) per liter.

Table A-9
Summary of Tritium, Gross Alpha, and Gross Beta Activity Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d] (pCi/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW1 05-Apr-07	Tritium	4.46 ± 114	196	95.4	NE	U		084453-036	EPA 906.0 M
	Gross Alpha	9.92 ± 2.09	1.64	0.746	15			084453-034	EPA 900.0
	Gross Beta	7.91 ± 1.18	1.49	0.716	4 mrem/yr			084453-034	EPA 900.0
MWL-MW2 06-Apr-07	Tritium	-33.8 ± 114	198	96.2	NE	U		084455-036	EPA 906.0 M
	Gross Alpha	9.68 ± 2.00	1.45	0.650	15			084455-034	EPA 900.0
	Gross Beta	8.94 ± 1.21	1.46	0.699	4 mrem/yr			084455-034	EPA 900.0
MWL-MW2 (Duplicate) 06-Apr-07	Tritium	-29.1 ± 113	197	95.5	NE	U		084456-036	EPA 906.0 M
	Gross Alpha	9.33 ± 1.89	1.23	0.544	15			084456-034	EPA 900.0
	Gross Beta	4.67 ± 1.14	1.65	0.794	4 mrem/yr			084456-034	EPA 900.0
MWL-MW3 11-Apr-07	Tritium	126 ± 99.6	159	70.4	NE	U		084458-036	EPA 906.0 M
	Gross Alpha	5.56 ± 1.36	1.06	0.461	15			084458-034	EPA 900.0
	Gross Beta	5.35 ± 1.18	1.70	0.821	4 mrem/yr			084458-034	EPA 900.0
MWL-MW4 05-Jun-07	Tritium	-41.8 ± 97.9	173	83.5	NE	U		084460-036	EPA 906.0 M
	Gross Alpha	7.69 ± 2.81	1.83	0.641	15			084460-034	EPA 900.0
	Gross Beta	6.64 ± 2.12	2.16	0.975	4 mrem/yr			084460-034	EPA 900.0
MWL-MW5 10-Apr-07	Tritium	42.9 ± 89.9	159	70.7	NE	U		084462-036	EPA 906.0 M
	Gross Alpha	9.20 ± 1.98	1.49	0.665	15			084462-034	EPA 900.0
	Gross Beta	3.92 ± 1.16	1.75	0.845	4 mrem/yr			084462-034	EPA 900.0
MWL-MW6 12-Apr-07	Tritium	98.0 ± 96.8	160	70.8	NE	U		084464-036	EPA 906.0 M
	Gross Alpha	12.0 ± 2.55	2.33	1.08	15			084464-034	EPA 900.0
	Gross Beta	6.19 ± 1.02	1.26	0.599	4 mrem/yr			084464-034	EPA 900.0

[a]Activities of zero or less are considered to be not detected.

[b]The MDA or minimum measured activity in a sample required to ensure a 95% probability that the measured activity is accurately quantified above the critical level.

[c]Critical level is the minimum activity that can be measured and reported with 99% confidence that the analyte is greater than zero; analyte is matrix-specific.

[d]MCL is established by the U.S. Environmental Protection Agency Primary Water Regulations (40 CFR 141.11[b]), and subsequent amendments or the New Mexico Environmental Improvement Board in Title 20, Chapter 7, Part 1 of the New Mexico Administrative Code (20 NMAC 7.1). The following are the MCLs for gross alpha particles and beta particles in community water systems: 15 pCi/L = Gross alpha particle activity (including radium-226 but excluding radon and total uranium), 4 mrem/yr = any combination of beta and/or gamma emitting radionuclides (as dose rate).

[e]Laboratory Qualifiers:
U = Analyte is absent or below the method detection limit.

[f]Validation Qualifiers (If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.)

[g]U.S. Environmental Protection Agency, 1980. "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032, U.S. Environmental Protection Agency, Cincinnati, Ohio.

CFR = Code of Federal Regulations.
EPA = U.S. Environmental Protection Agency.
ID = Identification.
MCL = Maximum contaminant level.
MDA = Minimum detectable activity.
mrem/yr = Millirem per year.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
NE = Not established.
NMAC = New Mexico Administrative Code.
pCi/L = Picocurie(s) per liter.

Table A-10
Duplicate Sample Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Annual Groundwater Monitoring, Spring 2007

Sample No. Sample Location	084455 MWL-MW2 (Environmental, unfiltered)	0084456 MWL-MW2 (Duplicate, unfiltered)	
	Result (R_1)	Result (R_2)	
Parameter[a]	All results in mg/L, except as noted		RPD[b]
Aluminum	0.0251 J	0.0208 J	NC
Barium	0.105	0.102	3
Bromide	0.418	0.487	15
Calcium	58.3	57.1	2
Chloride	42.9	42.5	1
Chromium	0.013	0.0135	4
Cobalt	0.00051	0.000518	2
Copper	0.00156 J	0.00157 J	NC
Fluoride	0.866	0.878	1
Iron	0.351	0.33	6
Magnesium	21.4	20.9	2
Manganese	0.00342	0.00331	3
Nickel	0.00734	0.00706	4
Nitrate plus Nitrite, as N	3.49	3.16	10
Potassium	4.65	4.31	8
Sodium	49.8	49.1	1
Sulfate	38.0	37.6	1
Uranium, Total	0.00651	0.00639	2
Uranium-235	0.000047	0.000043	9
Uranium-238	0.00646	0.00634	2
Zinc	0.0118	0.0126	7

[a]Parameters not detected in both samples are not listed.
[b]RPD is not calculated for estimated values.
J = Analyte detected below practical quantitation limit or reported as an estimated concentration.
mg/L = Milligram(s) per liter.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
N = Nitrogen.
NC = Not calculated.
RPD = Relative percent difference is calculated with the following equation and rounded to nearest whole number:

$$RPD = \frac{|R_1 - R_2|}{[(R_1 + R_2)/2]} \times 100$$

where:
R_1 = analysis result
R_2 = duplicate analysis result

Volume VII

TAB 4

Mixed Waste Landfill Annual Groundwater Monitoring Report,
Calendar Year 2008

From: SNL/Davis
To: NMED/Bearzi

Back of Tab 4

ENTERED

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

MAY 2 7 2009

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

RECEIVED
JUN 2009
NMED Hazardous Waste Bureau

Mr. James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East Bldg 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

On behalf of the Department of Energy/National Nuclear Security Administration (DOE/NNSA) and Sandia Corporation (Sandia), DOE/NNSA is submitting the Mixed Waste Landfill (MWL) Annual Groundwater Monitoring Report, Calendar Year 2008. This report presents the groundwater monitoring data from the annual sampling event conducted at the MWL in 2008.

During 2008, four monitoring wells at the MWL were plugged and abandoned (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) and four new monitoring wells were installed (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9). The new wells added to the MWL monitoring well network require sampling for eight consecutive quarters for a defined suite of parameters. In addition, sampling for perchlorate is required at the new wells for at least four consecutive quarters. Based on the results of the 2008 groundwater monitoring events, constituent concentrations remain within the historical ranges for the site at monitoring wells MWL-MW4, MWL-MW5, and MWL-MW6. Results for the new wells do not indicate any variance from historical ranges.

Should you have any questions regarding this submittal, please contact me at (505) 845-6036, or John Gould of my staff, at (505) 845-6089.

Sincerely,

Kimberly A. Davis
Acting Manager

Enclosure

cc w/enclosure:
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L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB
B. Birch, NMED-OB
J. Gould, SSO

cc w/o enclosure:
T. Longo, HQ/GTN, NA-56
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M. Skelly, SNL/NM, Org. 6765, MS-0718
M. Mitchell, SNL/NM, Org. 6765, MS-0718
Records Center, SNL/NM, Org.6765, MS-1089
J. Estrada, SSO, MS-0184

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Mixed Waste Landfill Groundwater Monitoring Report Calendar Year 2008**

Document author: **Kathy Turnham, Department 06765**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 5/5/09
Date

Francis B. Nimick
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Albuquerque, New Mexico 87185
Operator

and

Signature: _____ 5/27/09
Date

Kimberly A. Davis
Acting Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Sandia National Laboratories

Sandia National Laboratories/New Mexico Environmental Restoration Project

MIXED WASTE LANDFILL GROUNDWATER MONITORING REPORT CALENDAR YEAR 2008

May 2009

United States Department of Energy
Sandia Site Office

Sandia is a multiprogram laboratory managed and operated by Sandia Corporation, a wholly-owned subsidiary of Lockheed Martin Corporation, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

EXECUTIVE SUMMARY

Groundwater sampling was conducted at the Sandia National Laboratories Mixed Waste Landfill (MWL) in April, July, and October 2008. During 2008, four monitoring wells at the MWL were plugged and abandoned (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) and four new monitoring wells were installed (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9). The new wells added to the MWL monitoring well network require sampling for eight consecutive quarters for a defined suite of parameters. In addition, sampling for perchlorate is required at the new wells for at least four consecutive quarters. Monitoring wells were sampled in accordance with appropriate field operating procedures for groundwater sampling activities and mini-sampling and analysis plans (SNL/NM March 2008, June 2008, and October 2008). The field activities and results for this year's groundwater sampling events are presented in this report. Based on the results of the 2008 groundwater monitoring events, constituent concentrations remain within the historical ranges for the site.

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A Summary Tables of Field Measurements and Analytical Results

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ACRONYMS AND ABBREVIATIONS

AOP	Administrative Operating Procedure
COC	constituent of concern
DO	dissolved oxygen
DOE	U.S. Department of Energy
EB	equipment blank
EPA	U.S. Environmental Protection Agency
FB	field blank
FOP	Field Operating Procedure
GEL	General Engineering Laboratories, Inc.
L	liter(s)
LTES	Long-Term Environmental Stewardship
MCL	maximum contaminant level
MDA	minimum detectable activity
MDL	method detection limit
µg	microgram(s)
mg	milligram(s)
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
ORP	oxidation-reduction potential
P&A	Plug and Abandon
pCi	picocurie(s)
pH	potential of hydrogen
PQL	practical quantitation limit
PVC	polyvinyl chloride
QC	quality control
RPD	relative percent difference
Sandia	Sandia Corporation
SAP	Sampling and Analysis Plan
SNL/NM	Sandia National Laboratories/New Mexico
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TA	Technical Area
TAL	target analyte list
VOC	volatile organic compound

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1.0 INTRODUCTION

Groundwater monitoring of seven wells was conducted at the Sandia National Laboratories/New Mexico (SNL/NM) Mixed Waste Landfill (MWL) throughout the 2008 calendar year. This report describes the field activities conducted during the sampling events and presents the analytical results. During 2008, fieldwork completed at the MWL included the plugging and abandonment of four wells and subsequent installation of four new groundwater monitoring wells. Because the MWL groundwater monitoring well network was revised, the 2008 groundwater monitoring at the MWL encompasses three sampling events that took place in April, July, and October 2008. In addition, for the 2008 monitoring event, perchlorate was added to the list of analytical parameters selected for monitoring at the MWL.

The MWL is located on Kirtland Air Force Base, 4 miles south of the SNL/NM Technical Area (TA)-I facilities and 5 miles southeast of Albuquerque International Sunport. The landfill is a 2.6-acre site in the north-central portion of TA-III (Figure 1-1). The MWL was established in 1959 as a disposal area for low-level radioactive and mixed waste generated by SNL/NM research facilities. The landfill accepted low-level radioactive and minor amounts of mixed waste from March 1959 through December 1988. Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies (at the time of disposal) of activity were disposed of in the landfill.

Groundwater in the area of the MWL has been extensively characterized since 1990 for major ion chemistry, volatile organic compounds (VOCs), nitrate, metals, and radionuclides. Eighteen years of quarterly, semiannual, and annual data indicate that groundwater has not been contaminated by releases from the MWL (Goering et al. 2002; SNL/NM December 2001, January 2002, March 2002, July 2002, August 2002, October 2002, June 2003, September 2003, July 2004; Lyon and Goering January 2006; SNL/NM November 2006 and January 2008).

The MWL groundwater monitoring well network was revised in 2008. Four monitoring wells were plugged and abandoned (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) and four new monitoring wells were installed (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9). Figure 1-2 shows the current groundwater monitoring well network at the MWL. The well network consists of seven wells completed within the interfingering, fine-grained, alluvial fan deposits and coarse-grained, Ancestral Rio Grande deposits. The monitoring well network consists of one background well (MWL-BW2), one on-site well (MWL-MW4), and five downgradient or cross-gradient wells (MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9) (Figure 1-2).

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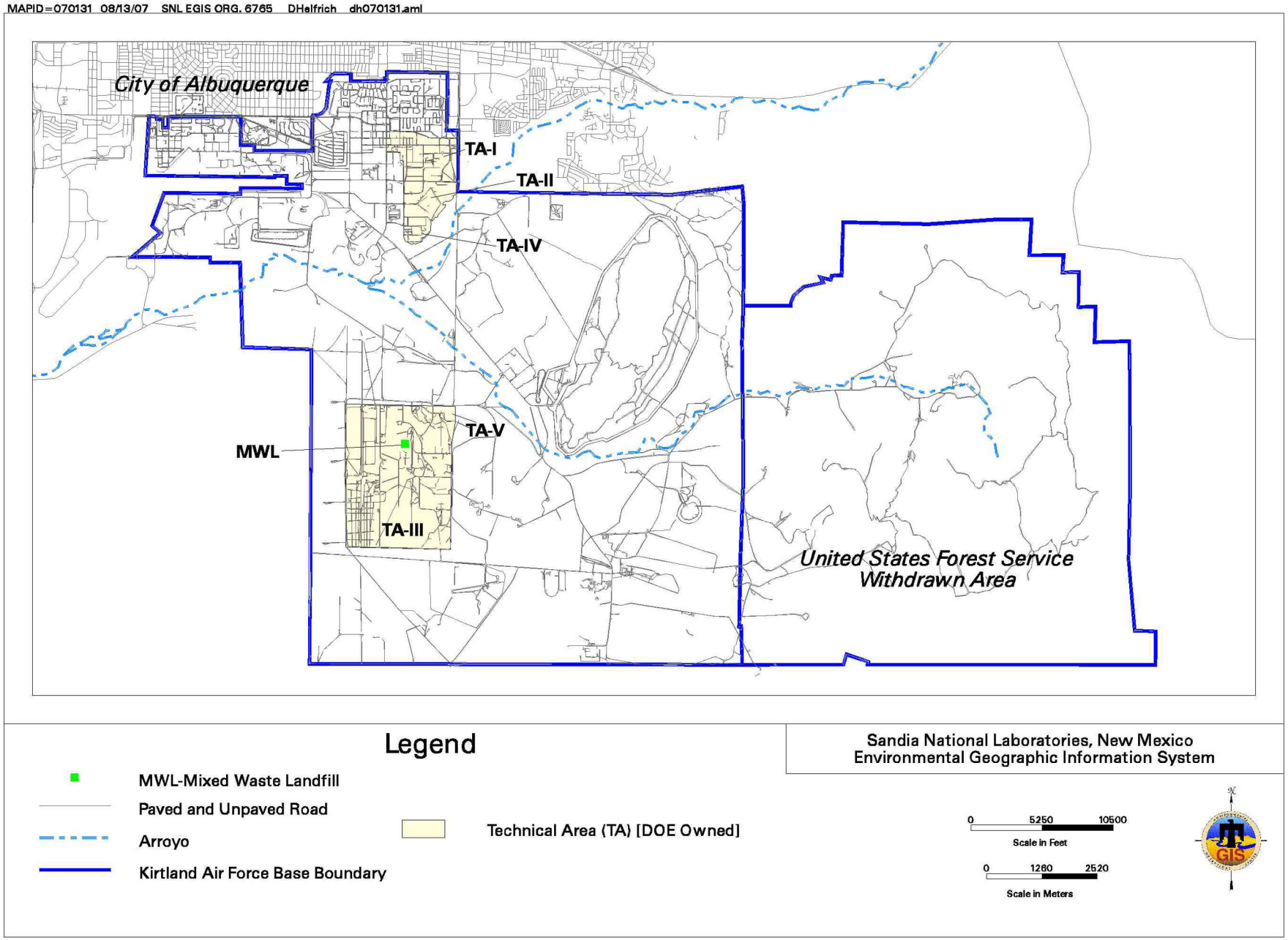
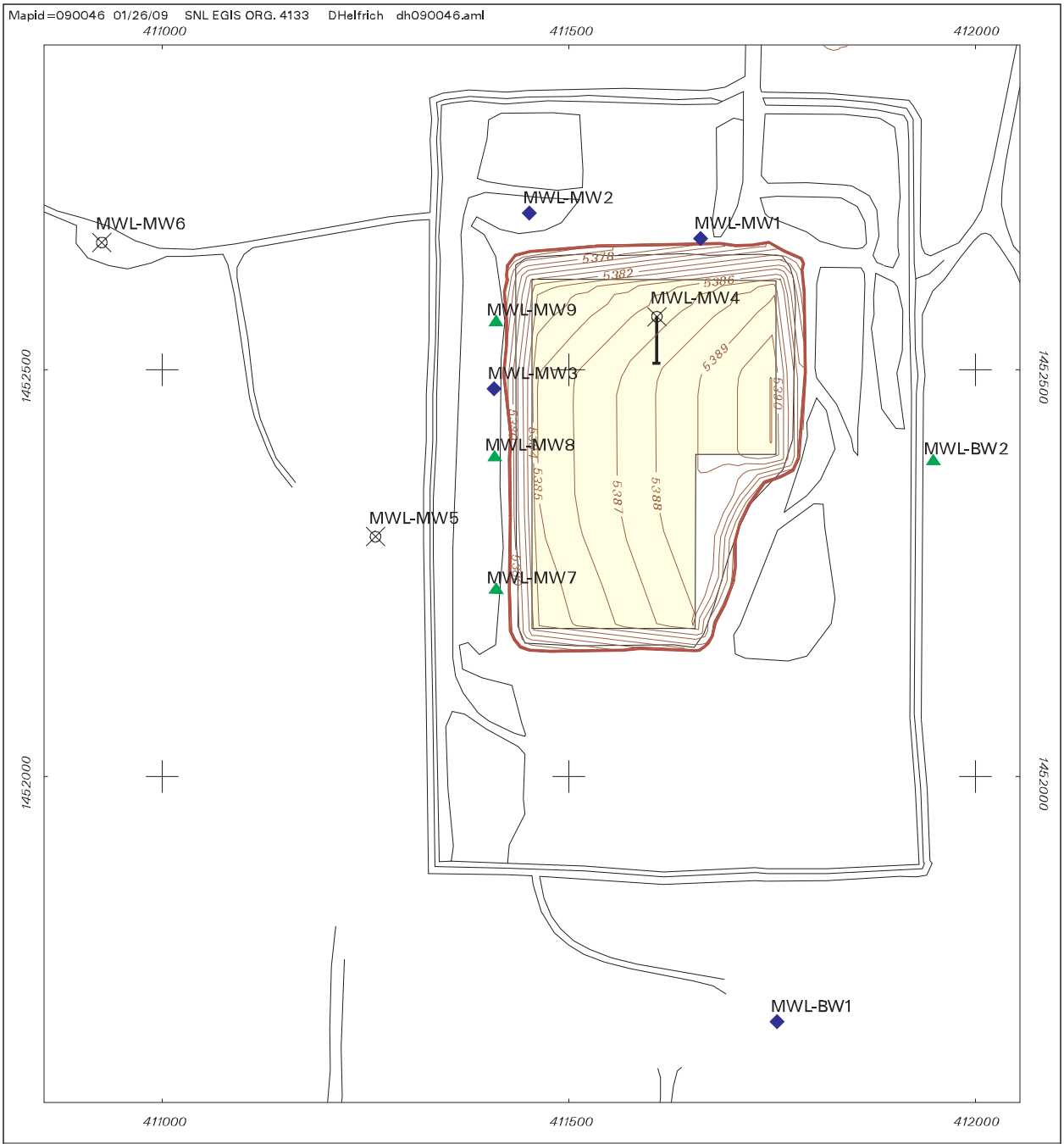


Figure 1-1 Location of Sandia National Laboratories and Kirtland Air Force Base



Legend

- Recently Installed Groundwater Monitoring Well
- Recently Plugged and Abandoned Groundwater Monitoring Well
- Groundwater Monitoring Well MWL-MW4 (showing horizontal extent)
- Groundwater Monitoring Well
- 1-ft Contour Interval for Proposed Soil Cover
- Toe of Proposed Soil Cover
- Road
- MWL Extent

Figure 1-2
Location of Recently Plugged and Abandoned Groundwater Monitoring Wells and Recently Installed Groundwater Monitoring Wells at the Mixed Waste Landfill

0 100 200
Scale in Feet

0 24 48
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04300000 A6

2.0 REGULATORY CRITERIA

Historically, the New Mexico Environment Department (NMED) Hazardous Waste Bureau has provided regulatory oversight of the MWL as Solid Waste Management Unit (SWMU) 76 under the Hazardous and Solid Waste Amendments module of the facility Resource Conservation and Recovery Act permit. The NMED confirmed that the MWL is properly designated as a SWMU (Dinwiddie June 1998) and, as such, must comply with the corrective action program defined in Title 20, New Mexico Administrative Code, Section 4.1.50, incorporating Title 40, Code of Federal Regulations, Section 264.101. The requirements for corrective action at the MWL, including those for groundwater monitoring, are established through the corrective measures process.

The NMED issued the Compliance Order on Consent (the Consent Order) in April 2004, which transferred the regulatory requirements for groundwater sampling at the MWL to the Consent Order (NMED April 2004). This report has been formatted to address the content criteria set forth in the Consent Order for Periodic Monitoring Reports. The following "crosswalk" table lists the required elements from the Consent Order and the corresponding section(s) in which these elements are addressed in this report.

Required Elements of the Consent Order (NMED April 2004)	MWL Groundwater Monitoring Report 2008 Sampling Events
1. Title Page and Signature Block (for the name, title, and organization of the preparer and the responsible U.S Department of Energy (DOE) and Sandia Corporation (Sandia) representative)	Title Page Signatures for full Sandia and DOE chain of command on the transmittal paperwork that accompanies the report from Sandia to the DOE to the NMED
2. Executive Summary (Abstract)	Executive Summary and Chapter 9.0
3. Table of Contents	Table of Contents
4. Introduction	Chapter 1.0 Introduction
5. Scope of Activities	Chapter 3.0 Scope of Activities
6. Regulatory Criteria	Chapter 2.0 Regulatory Criteria
7. Monitoring Results	Chapter 6.0 Summary of Analytical Results
8. Conclusions	Chapter 9.0 Summary and Conclusions
9. Tables	Appendix A
10. Figures	Chapter 1.0 Introduction; Chapter 4.0 Field Methods and Measurements
11. Appendices	Appendix A

Although radionuclides are being monitored at the MWL, the information related to radionuclides is provided voluntarily by the DOE/Sandia. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements imposed by the NMED, as specified in Section III.A of the Consent Order (NMED April 2004).

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3.0 SCOPE OF ACTIVITIES

Groundwater sampling was conducted at the MWL in 2008 in accordance with the appropriate field operating procedures (FOPs) and Mini-Sampling and Analysis Plans (SAPs) (SNL/NM March 2008, June 2008, and October 2008). The monitoring well network changed in 2008. Four wells were plugged and abandoned and four replacement wells were installed. Seven monitoring wells at the MWL were sampled, including one on-site monitoring well (MWL-MW4), one background well (MWL-BW2), and five downgradient monitoring wells (MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9). Three sampling events occurred at the MWL during 2008 on the following dates: April 8 to April 16; July 14 to July 17; and October 1 to October 8. Table 3-1 graphically represents the well installation, plugging and abandonment, and groundwater sampling events that took place in 2008.

Table 3-1
2008 Groundwater Sampling Events and Monitoring Well Network Changes at the Mixed Waste Landfill

Well ID	**Jan 2008**	**April 2008**	**May 2008**	**July 2008**	**Oct 2008**
MWL-BW1	Plugged and Abandoned				
MWL-BW2	Well Installed	1st Quarterly Sampling		2nd Quarterly Sampling	3nd Quarterly Sampling
MWL-MW1		Plugged and Abandoned			
MWL-MW2			Plugged and Abandoned		
MWL-MW3		Plugged and Abandoned			
MWL-MW4		Annual Sampling			
MWL-MW5		Annual Sampling			
MWL-MW6		Annual Sampling			
MWL-MW7			Well Installed	1st Quarterly Sampling	2nd Quarterly Sampling
MWL-MW8			Well Installed	1st Quarterly Sampling	2nd Quarterly Sampling
MWL-MW9			Well Installed	1st Quarterly Sampling	2nd Quarterly Sampling

BW = Background well.
ID = Identification.
MW = Monitoring well.
MWL = Mixed Waste Landfill.

3.1 Analytical Parameters

The analytical parameters selected for monitoring include target analyte list (TAL) metals, total uranium, VOCs and semivolatile organic compounds (SVOCs), nitrate plus nitrite, bromide, fluoride, chloride, sulfate, manganese II, total organic carbon, carbon dioxide, total dissolved solids, ferrous iron, and biochemical oxygen demand. Perchlorate analysis has been added to the analyte list for the newly installed wells for four quarters unless it is detected above the screening level of 4 micrograms (μg) per liter (L) (NMED April 2004, Table XI-1). Alkalinity titrations were performed in the field on groundwater samples collected from each well. Analyses for radiological parameters include gross alpha/beta activity, tritium, and gamma-emitting radionuclides.

3.2 Modification of Monitoring Well Network

In early 2007, it was determined that due to declining groundwater levels, MWL-BW1 was no longer useful for sampling; consequently, the NMED requested that MWL-BW1 be plugged and abandoned and replaced (Bearzi March 2007). At the time of the annual groundwater monitoring sampling event in 2007, approximately 1 foot of water was present within the well screen of MWL-BW1, and the well could not be sampled. On April 17, 2007, a monitoring well plug and abandon (P&A) plan for MWL-BW1 and replacement well construction plan for MWL-BW2 were submitted to the NMED (SNL/NM April 2007). In January 2008, MWL-BW1 was plugged in situ, and MWL-BW2 was installed according to the approved plan (SNL/NM April 2008).

In 2007, the NMED also requested the replacement of monitoring wells MWL-MW1 and MWL-MW3 because of low water levels in MWL-MW3 and problems with corrosion of the stainless-steel screens in both these wells (Bearzi July 2007). The DOE/Sandia submitted a P&A plan for MWL-MW1 and MWL-MW3 and replacement well construction plan for two new wells identified as MWL-MW7 and MWL-MW8 (SNL/NM July 2007a). On April 23 and April 24, 2008, MWL-MW1 and MWL-MW3 were abandoned in situ, and subsequently, in May 2008, monitoring wells MWL-MW7 and MWL-MW8 were installed (SNL/NM September 2008).

In February 2008, the NMED requested a work plan to P&A MWL-MW2 and to install a third new well (MWL-MW9), which was submitted to the NMED (SNL/NM February 2008). The NMED approved the work plan in March 2008 (Bearzi March 2008), and in May 2008, MWL-MW2 was plugged and abandoned and MWL-MW9 was installed (SNL/NM September 2008).

The monitoring wells MWL-MW7, MWL-MW8, and MWL-MW9 and background well MWL-BW2 are considered new wells and, as required by the Consent Order, Section XI, Table XI-1 (NMED April 2004), will be sampled for eight consecutive quarters for a defined suite of parameters, in addition to being sampled for perchlorate for at least four consecutive quarters. Preexisting wells MWL-MW4, MWL-MW5, and MWL-MW6 will continue to be sampled on an annual basis in April for the constituents listed in Section 3.1.

Installation reports for the new wells were submitted in April and September 2008 (SNL/NM April 2008 and September 2008) and approved by the NMED (Bearzi October 2008 and January 2009). All seven MWL wells are constructed of 5-inch, Schedule 80 polyvinyl

chloride (PVC) casing and have screens composed of slotted Schedule 80 PVC. Table A-1 (Appendix A) presents water levels measured during the 2008 sampling events.

In 1993, MWL-MW4 was completed at an angle of 6 degrees from vertical and is screened at two discrete intervals 20 feet apart (SNL/NM September 2002) to evaluate vertical anisotropy, vertical potentiometric gradients, and changes in aquifer parameters with depth. An inflatable packer separates the screened intervals, and pressure is maintained in the packer to prevent combining groundwater from the two screened sections of the aquifer. Although monitoring well MWL-MW4 is screened in two discrete intervals, only the upper interval was sampled, as this is the uppermost water-bearing interval beneath the MWL. References in this report to groundwater samples from MWL-MW4 refer to groundwater withdrawn from the upper interval. The total well depth measurement of MWL-MW4, presented in Table A-1, represents the upper interval distance from the top of the packer to the top of the casing.

The MWL groundwater samples were submitted for analysis to General Engineering Laboratories, Inc. (GEL) located in Charleston, South Carolina; Hall Analytical in Albuquerque, New Mexico; and Metro-Ohm Peak in Houston, Texas. All groundwater samples were collected using a Bennett™ pump.

Field quality control (QC) samples submitted to GEL included field duplicate samples, equipment blank (EB) samples, and field blank (FB) samples. Chapter 7.0 discusses the QC sample results.

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4.0 FIELD METHODS AND MEASUREMENTS

Field measurements performed during groundwater sampling activities included groundwater elevations and water quality parameters. The following sections present a detailed discussion of field activities and methods.

4.1 Groundwater Elevation Measurements

Depth-to-groundwater measurements were obtained using a Solinst™ depth-to-water well sounder prior to purging activities. Depth-to-groundwater measurements were performed in accordance with FOP 05-01, "Long-Term Environmental Stewardship (LTES) Groundwater Monitoring Well Sampling and Field Analytical Measurements" (SNL/NM August 2007a). Measurements were obtained from all monitoring wells available at the time of sampling. Table A-1 (Appendix A) presents groundwater elevations and static water height information.

Groundwater occurs approximately 500 feet below ground surface within Santa Fe Group deposits (basin fill) in either fine-grained, alluvial fan deposits or coarse-grained, Ancestral Rio Grande deposits. Hydraulic conductivity values average 1.64×10^{-2} feet/day in the alluvial fan deposits and 1.81 feet/day in the Ancestral Rio Grande deposits. Figure 4.1-1 shows the regional potentiometric surface of the basin fill aquifer west of the Sandia fault complex. Figure 4.1-2 shows the localized potentiometric surface of the basin fill aquifer at the MWL. The localized flow pattern shown in Figure 4.1-2 exhibits more variation in the flow field. The general regional flow gradient is from east-southeast to west-northwest, which is supported by the data presented in Figure 4.1-1.

4.2 Well Purging and Water Quality Measurements

Prior to sample collection, each monitoring well was purged to remove stagnant well casing water. Most MWL monitoring wells recharge slowly, and multiple days were required to purge and sample these wells. The monitoring wells were purged to dryness, allowed to recover, and then sampled to collect the most representative groundwater sample possible, given the low yields of these wells. The recovery period was based upon the recharge rate of the well and volume necessary for each sample. Total purge volumes presented in Table A-2 (Appendix A) are based upon measured volumes evacuated from each monitoring well prior to sample collection.

Well MWL-BW2 was purged a minimum of one saturated screen volume before sampling in conformance with FOP 05-01 (SNL/NM August 2007a). Wells MWL-MW7, MWL-MW8, and MWL-MW9 are low-yield monitoring wells. These wells were purged to dryness and allowed to recover before sampling to ensure the most representative groundwater sample possible.

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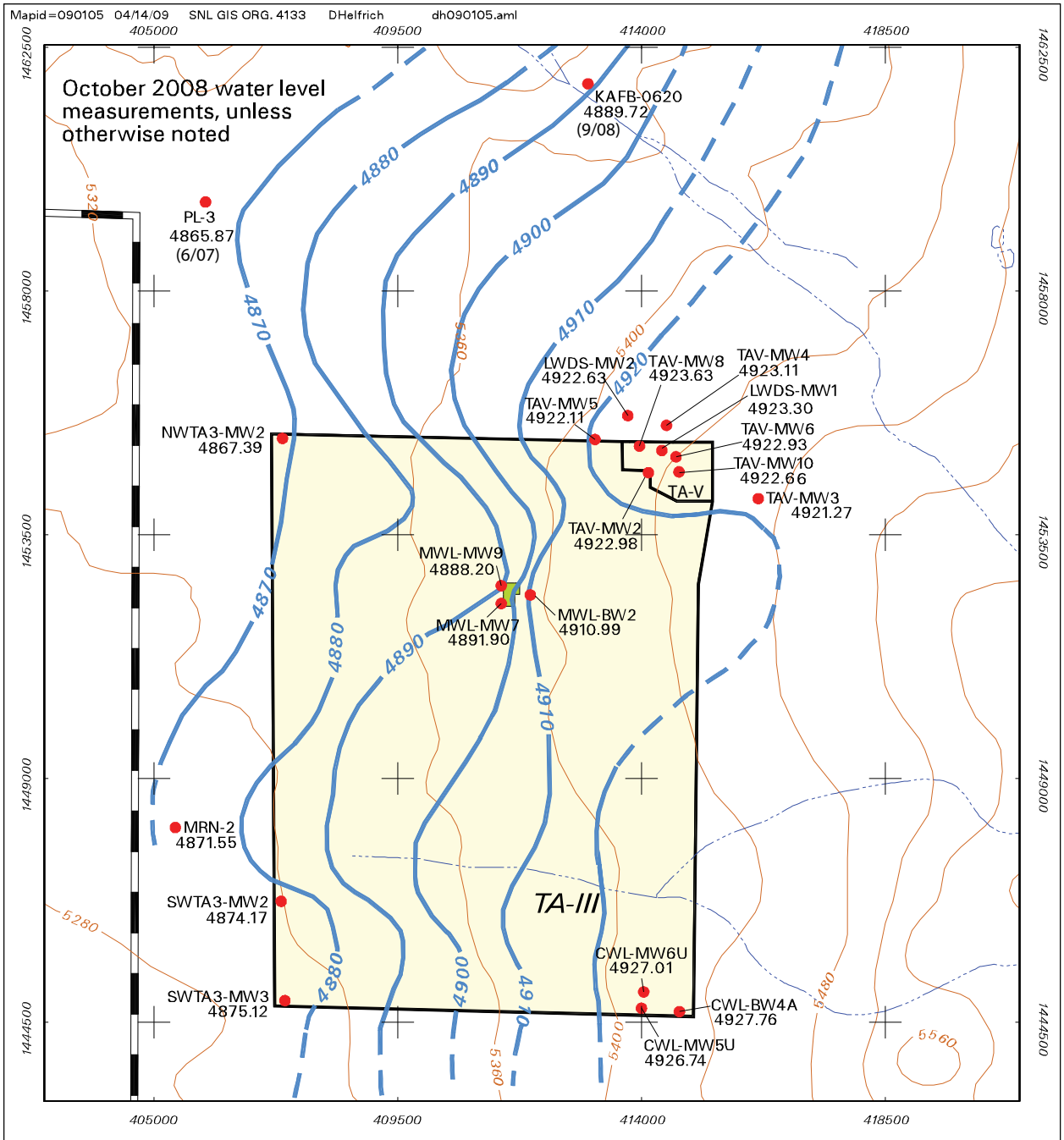

Legend

- 4875.12 — Monitoring Well with Water Table Elevation (feet above mean sea level)
- Surface Drainage
- 40-ft Ground Surface Contour Interval
- Kirtland Air Force Base Boundary
- Groundwater Elevation Contour (10-ft interval, dashed = inferred)
- Technical Area Boundary
- MWL - Mixed Waste Landfill

Figure 4.1-1
Regional Potentiometric Surface of the Basin Fill Aquifer in the Vicinity of Technical Area III

0 1500 3000
Scale in Feet

0 360 720
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04300000 A7

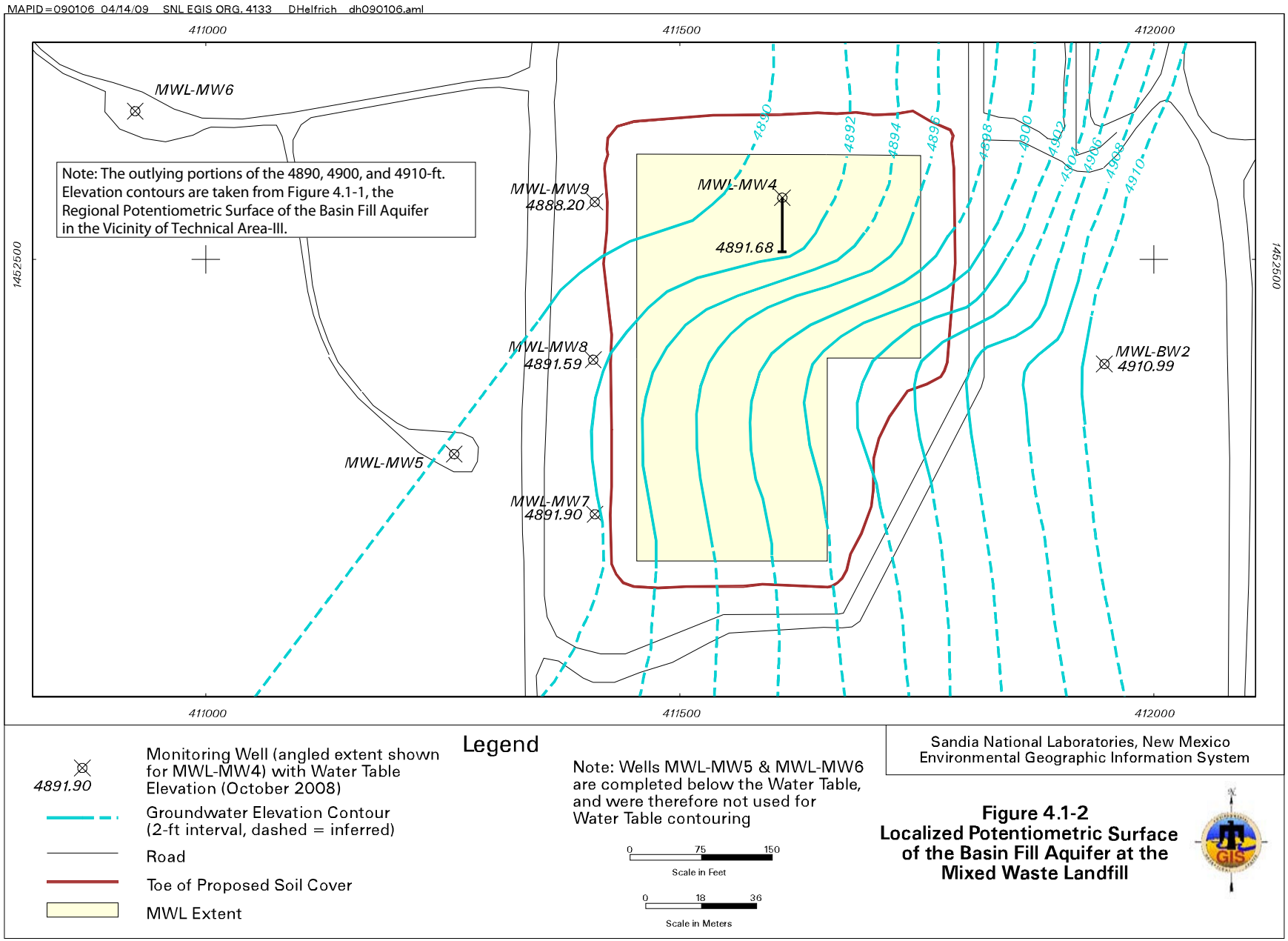

Figure 4.1-2
Localized Potentiometric Surface of the Basin Fill Aquifer at the Mixed Waste Landfill

Field analytical measurements were collected in accordance with FOP 05-01 (SNL/NM August 2007a). Groundwater temperature, specific conductance, potential of hydrogen (pH), oxidation-reduction potential (ORP), and dissolved oxygen (DO) were measured using a YSI™ Model 6820 flow cell and multiparameter water quality meter. Turbidity was measured with a Hach™ Model 2100P portable turbidity meter. In addition, a Hach™ field kit was used to perform alkalinity titrations. Water quality measurements were recorded on Field Measurement Log forms. Groundwater pH, temperature, specific conductance, turbidity, DO, and ORP were measured during purging, before sample collection. Table A-2 shows the final measurements taken before the samples were collected.

4.3 Pump Decontamination

The Bennett™ pump and tubing bundle used to collect groundwater samples were decontaminated prior to installation in MWL monitoring wells according to FOP 05-03, "LTES Groundwater Sampling Equipment and Decontamination" (SNL/NM August 2007b). The EB samples collected during the 2008 groundwater sampling events were collected after decontamination to verify the effectiveness of the decontamination procedure and are discussed in Section 7.1.1.

4.4 Sample Collection

All groundwater samples were collected directly from the pump discharge tube into prepared laboratory-provided sample containers. Where appropriate for the requested analysis, chemical preservatives were added to the sample containers at the laboratory prior to shipment.

Two groundwater samples were collected from each monitoring well for metals analyses. One unfiltered sample was collected for total metals analyses. The other sample was filtered through a 0.45-micron filter for dissolved metals analyses.

4.5 Sample Handling and Shipment

Immediately after collection, all sample containers were custody-taped, sealed in plastic bags, and placed on cold packs in shipping containers. Analysis Request/Chain-of-Custody forms were completed at the time of collection. The samples for chemical and radiological analyses were shipped via the SNL/NM Sample Management Office to the contracted analytical laboratory. Sample management activities followed SNL/NM Administrative Operating Procedure (AOP) 95-16, "Sample Management and Custody" (SNL/NM February 2007).

4.6 Waste Management

All purge and decontamination water was managed according to FOP 05-04, "LTES Groundwater Monitoring Waste Management" (SNL/NM August 2007c) and was containerized on site pending the results of the analyses. Waste labels were placed on all drums, and the corresponding sample numbers were marked on the outside of the drum with a permanent marker. The wastes were recorded on a Daily Log of Wastes Generated form and submitted to the SNL/NM Environmental Restoration Project Waste Disposal Coordinator.

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5.0 ANALYTICAL METHODS

Table A-3 (Appendix A) specifies the analytical parameters, appropriate test methods, and target analyte quantitation limits for sample analyses. The analytical methods are discussed in the following sections.

5.1 Chemical Analytical Methods

All chemical analyses were performed in accordance with the U.S. Environmental Protection Agency (EPA) test methods (EPA 1979, 1986, 1988, and 1999). Environmental samples were submitted to the following laboratories for the analyses listed:

- GEL:
  - VOCs by EPA Method 8260B
  - TAL metals by EPA Methods 6020 and 7470A (including total and isotopic uranium by EPA Method 6020)
  - Nitrate plus nitrite by EPA Method 353.2
  - Bromide, fluoride, chloride, and sulfate by EPA Method 9056
  - Total organic carbon by EPA Method 9060
  - Carbon dioxide by Laboratory-Specific Method SM 4500 CO2 D
  - Total alkalinity as calcium carbonate by EPA Method 310.1
  - Total dissolved solids by EPA Method 160.1
  - Perchlorate by EPA Method 314.0
- Hall Analytical:
  - Ferrous iron by Laboratory-Specific Method 3500M Fe2+
  - Biochemical oxygen demand by EPA Method 405.1
- Metro-Ohm Peak:
  - Manganese II by Laboratory-Specific Method C2-100 Mn2+

5.2 Radiological Analytical Methods

Radiological parameters and analytical methods include gamma-emitting radionuclides by EPA Method 901.1, gross alpha/beta activity by EPA Method 900.0, and tritium by EPA Method 906.0.

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6.0 SUMMARY OF ANALYTICAL RESULTS

Tables summarizing field measurements and analytical results are included in this report as Appendix A. Complete field and laboratory documentation are on file at the SNL/NM Customer Funded Records Center.

The results for chemical and radiological constituent analysis are compared with established EPA Safe Drinking Water Act Regulations maximum contaminant levels (MCLs) (EPA 2001), where applicable.

The QC samples associated with each sampling event are included in the analysis of results and are discussed in Chapter 7.0. Data qualifiers resulting from QC samples or data validation results are presented with the related data in respective data tables in Appendix A.

6.1 General Chemistry Parameters

The general chemistry analytical results are presented in Table A-4 (Appendix A). No general chemistry parameters exceed the MCLs (where established) in the groundwater samples. Nitrate plus nitrite (as nitrogen) and fluoride are the only two parameters that have established MCLs (10 and 4 milligrams [mg]/L, respectively). Nitrate plus nitrite (as nitrogen) concentrations range from 0.885 mg/L in the sample collected in July from MWL-MW8 to 3.24 mg/L in the sample collected in October from MWL-MW7. Fluoride was detected at concentrations ranging from 0.658 mg/L (April, MWL-BW2) to 1.06 mg/L (July, MWL-MW9).

6.2 Metals

Table A-5 (Appendix A) summarizes the metals results from all unfiltered groundwater samples collected during the 2008 groundwater monitoring events at the MWL. Samples were analyzed for TAL metals according to EPA Method 6020 (EPA 1986). No metals were detected in the unfiltered samples at concentrations that exceed the established MCLs.

Table A-6 (Appendix A) summarizes the results for TAL metals analysis for the filtered samples collected during the 2008 groundwater monitoring events. No detections of any metals in the filtered samples exceed the respective MCLs.

Samples from MWL-MW7, MWL-MW8, and MWL-MW9 were analyzed for total uranium during both quarterly sampling events (July and October). All results, presented in Tables A-5 and A-6, are less than the MCL of 0.03 mg/L and are consistent with previous sampling events at the MWL.

Uranium isotopes uranium-235 and uranium-238 were determined as mass concentrations during metals analysis on the inductively-coupled plasma mass spectrometer using EPA Method 6020. The isotopic mass concentrations are reported in units of mg/L and are presented in Tables A-5 and A-6 with the results for unfiltered and filtered samples analyzed by this method. All uranium isotope values are consistent with past results.

Uranium-235 values range from 0.000047 mg/L in unfiltered samples from MWL-BW2 in October and MWL-MW8 in July and the filtered sample from MWL-BW2 in April to 0.000066 mg/L in the filtered sample from MWL-MW5 (duplicate) in April. Uranium-238 values range from 0.00661 mg/L in the unfiltered sample from MWL-BW2 in April to 0.009 mg/L in the unfiltered sample from MWL-MW5 in April.

6.3 Volatile and Semivolatile Organic Compounds

Table A-7 (Appendix A) summarizes the results for detected VOCs and SVOCs, and Table A-8 (Appendix A) presents the analytical method and corresponding method detection limits (MDLs) for VOCs and SVOCs. Trace concentrations of acetone and toluene were reported for groundwater samples from the MWL monitoring wells. The MCL for toluene is 1,000 μg/L, and the concentration detected in the sample from MWL-MW9 collected in July was 0.51 μg/L. No MCL is established for acetone, and the concentrations detected in two samples collected in April were 3.82 mg/L (MWL-MW4) and 2.31 mg/L (MWL-MW6). The results for acetone and toluene presented in Table A-7 are qualified as estimated values and are less than the respective practical quantitation limits (PQLs).

6.4 Perchlorate

During 2008, recently installed groundwater monitoring wells MWL-MW7, MWL-MW8, and MWL-MW9 and background monitoring well MWL-BW2 were added to the perchlorate screening monitoring well network and require perchlorate screening.

The Consent Order (NMED April 2004) requires that new wells be sampled for perchlorate for a minimum of four quarters. If perchlorate is detected above the screening level in a specific well, monitoring will continue for that well at a frequency negotiated with the NMED. Four consecutive nondetections using the screening level of 4 μg/L are considered by the NMED to be evidence of the absence of perchlorate, such that additional monitoring for perchlorate in that well would not be required.

The sampling results for perchlorate for these wells are presented in Table A-9 (Appendix A). No detections of perchlorate at or above the screening level of 4 μg/L were reported for the environmental samples from the groundwater monitoring wells MWL-MW7, MWL-MW8, MWL-MW9, and MWL-BW2.

6.5 Radiological Parameters

Groundwater samples from the MWL monitoring wells were analyzed for gamma-emitting radionuclides, gross alpha/beta activity, and tritium. The results for tritium, gross alpha/beta, and gamma spectroscopy activity are presented in Table A-10 (Appendix A) and are compared with the established EPA MCLs (no MCL has been established for tritium). No radiological parameters were detected above established MCLs.

Gross alpha activity levels were detected above laboratory reporting limits in all environmental samples. Uncorrected gross alpha activity levels range from 4.06 ± 2.08 picocuries (pCi)/L in the MWL-MW7 sample from October to 17.8 ± 10.5 pCi/L in the MWL-MW6 sample from April.

Gross beta activity levels range from 3.25 ± 1.84 pCi/L in the MWL-BW2 sample from July to 12.1 ± 4.75 pCi/L in the MWL-MW5 sample from April.

A reanalysis of the uncorrected gross alpha sample from MWL-MW6 was requested. The reanalysis conducted included samples from MWL-MW4 and MWL-MW5, as these were contained in the same laboratory QC batch as the sample from MWL-MW6. The results from the reanalysis confirmed the initial results; however, after subtracting activity associated with uranium (corrected alpha activity), the values are below the established MCL (Table A-11).

Corrected gross alpha activity values (Table A-11) are obtained by subtracting uranium alpha contribution from the gross alpha activity. Two methods were used to determine corrected gross alpha activity (Table A-11). Neither method resulted in corrected gross alpha activity that exceeds the established MCL of 15 pCi/L.

Neither tritium, analyzed by EPA Method 906.0, nor gamma-emitting isotopes, analyzed by EPA Method 901.1, were detected above the minimum detectable activity (MDA) in any of the groundwater samples.

Although no detections of tritium above the MDA were reported, the results are presented in Table A-10 (Appendix A), as tritium is considered a constituent of concern (COC) at the MWL.

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7.0 QUALITY CONTROL SAMPLE RESULTS

The QC samples were prepared both in the field and in the laboratory in order to assess the quality of the data generated during the sampling activities. All data were reviewed in accordance with AOP 00-03, "Data Validation Procedure for Chemical and Radiochemical Data" (SNL/NM July 2007b). The results for each QC analysis and the impact on data quality are discussed in the following sections.

7.1 Field Quality Control Samples

The QC samples collected in the field included EB samples, laboratory-prepared FB samples, and field duplicate samples. An FB sample provides a method to check for potential sources of sample contamination or sampling error. An EB sample is collected to verify the effectiveness of the sampling equipment decontamination process, and a duplicate sample is collected immediately after a routine sample and provides information about sampling variability. The following sections discuss the analytical results for each QC sample type.

7.1.1 Equipment Blank Samples

A total of four EB samples were collected during the 2008 sampling events at the MWL. Two samples were collected during the April 2008 event, and one EB sample each was collected during the two quarterly events conducted in July and October 2008. The VOCs acetone, bromodichloromethane, and dibromochloromethane were detected in various EB samples. No corrective action is necessary, as these compounds were not detected in the associated environmental samples. Detected metal constituents include aluminum, calcium, chromium, iron, magnesium, and sodium. The results for these constituents, with the exception of chromium, in the associated environmental samples are either not detected at the laboratory MDL or detected at concentrations greater than five times the blank contamination; therefore, no corrective action is required for any metal, except chromium. Chromium was qualified as not detected in the MWL-MW5 duplicate sample from April 2008 because the sampling result is less than five times the blank contamination. General chemistry parameters chloride and sulfate were detected in the July 2008 EB sample, and alkalinity and fluoride in the October 2008 sample. The results for the associated environmental samples are not qualified as the results are greater than five times the blank contamination.

- April 2008—Two EB samples were collected prior to sampling MWL-BW2 and MWL-MW5. Detected VOCs include acetone and dibromochloromethane. No corrective action is required as these compounds were not detected in the associated environmental samples. Detected metal constituents include aluminum, calcium, chromium, iron, magnesium, and sodium. No corrective action is required for aluminum, calcium, iron, magnesium, or sodium as the results for the associated environmental samples are either not detected or detected at concentrations greater than five times the blank contamination. The chromium result in the MWL-MW5 duplicate sample was qualified as not detected as the result for the associated environmental sample is less than the blank contamination.

- July 2008 (Quarterly)—One EB sample was collected prior to sampling MWL-MW7. Sodium, chloride, and sulfate were detected in the EB sample. No corrective action is required as the results for the associated environmental samples are greater than five times the blank contamination.

- October 2008 (Quarterly)—One EB sample was collected prior to sampling MWL-BW2. The VOCs bromodichloromethane and dibromochloromethane were detected in the EB but not in the associated environmental samples. Magnesium was the only metal detected in the EB sample. The results for the associated environmental samples were not qualified as the results are greater than five times the blank contamination. Alkalinity and fluoride were also detected in the EB sample. The results for the associated environmental samples were not qualified as the results are greater than five times the blank contamination.

7.1.2 Field Blank Samples

An FB sample was collected in October 2008 at the MWL-MW8 sample collection point and submitted for VOC analysis only. Bromodichloromethane and dibromochloromethane were detected in the FB sample but not in the associated environmental sample.

7.1.3 Field Duplicate Samples

Duplicate groundwater samples were collected at MWL-MW5 (April), MWL-MW7 (July), and MWL-BW2 (October). Relative percent difference (RPD) precision measurements were performed for all detected chemical analytes between duplicate samples to measure sample variability and are presented in Table A-12 (Appendix A). The QC acceptance criteria for bromide in duplicate sample MWL-MW7 (July) showed an RPD of 81 percent. The remaining values are all less than the 20-percent threshold.

7.2 Laboratory Quality Control Samples

Although some analytical results were qualified as not detected or as estimated values during the data validation process, no significant data quality problems were noted for any 2008 MWL groundwater monitoring samples, except for potassium-40. Potassium-40 activities were qualified as unusable in three MWL samples, as the peak did not meet identification criteria during gamma spectroscopy analysis at the laboratory.

General laboratory QC issues included calibration verification samples and matrix spike samples outside acceptance criteria for organic analyses and method blank and calibration blank contamination for inorganic analyses.

8.0 VARIANCES AND NONCONFORMANCES

All analytical and field methods complied with the requirements specified in the annual and quarterly MWL Groundwater Monitoring Mini-SAPs (SNL/NM March 2008, June 2008, and September 2008) and there were no variances from the plans. Project-specific issues associated with the sampling events are noted as follows.

SNL/NM requested that GEL reanalyze gross alpha samples collected from MWL-MW4, MWL-MW5, and MWL-MW6. All associated groundwater samples were analyzed in the same laboratory analytical batch. The activity results initially reported for samples collected in April 2008 from MWL-MW4 and MWL-MW5 were slightly higher than historical results. The initial activity reported for the sample collected in April 2008 from MWL-MW6 exceeded the MCL of 15 pCi/L. The results from reanalysis of the samples verify the initial analytical results. For both the initial and reanalysis, the results are reported as uncorrected gross alpha activity (i.e., not corrected by subtracting activity associated with naturally occurring uranium or radium); when corrected, the values are below the MCL of 15 pCi/L (Table A-11).

Acetone and toluene were detected in three MWL groundwater monitoring samples. Neither compound is a COC at the MWL, although historically, toluene has been detected in MWL groundwater samples. Acetone concentrations in samples from MWL-MW4 and MWL-MW6 were qualified as estimated values during data validation, as calibration verification samples did not meet acceptance criteria. Toluene was detected well below the MCL of 1,000 µg/L in the sample from MWL-MW9. The laboratory qualified toluene as an estimated value because the concentration was detected below the effective laboratory PQL.

The bromide duplicate results from the newly installed well, MWL-MW7, showed a high RPD between the initial result and its duplicate sample. The RPD of 81 percent can be attributed to lack of sample population. In addition, MWL-MW7 is characteristically a low-yield well. The well was purged to dryness and allowed to recover before sampling to ensure the most representative sample possible given the low yield of this monitoring well. More data is necessary to determine whether a trend is occurring. Bromide is not a COC at the MWL.

The QC results indicate that a low level of sample contamination from bromodichloromethane and dibromochloromethane occurred in the analytical laboratory. Neither of these compounds are found in the environmental sample, and neither is considered a COC at the MWL.

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9.0 SUMMARY AND CONCLUSIONS

Groundwater sampling and analysis were conducted according to the mini-SAPs (SNL/NM March 2008, June 2008, and October 2008) at the MWL during three different monitoring events in 2008. No inorganic or organic constituents were detected at concentrations that exceed the respective MCLs in any of the groundwater samples. In addition, no detections of organic compounds greater than the MCLs (where applicable) or PQLs were reported. Toluene was detected at a concentration less than the MCL and PQL but greater than the MDL in one sample, and thus qualified as an estimated value.

Total uranium results from the 2008 samples were consistent with data from previous sampling events and are well within the range of historic MWL groundwater data. Groundwater data from the newly installed wells do not have a sufficient historical data set to identify trends for the results.

No general chemistry parameters exceed the established MCLs in any of the groundwater samples. The analytical results for radioactivity and radionuclides show no levels greater than the corresponding MCLs. Based on the results of the three MWL 2008 groundwater monitoring events, constituent concentrations remain within the historical ranges for the site.

The results for the laboratory QC samples and the data validation results indicate that the 2008 groundwater sampling results for the MWL are defensible as representative of the uppermost portion of the regional aquifer.

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APPENDIX A
Summary Tables of Field Measurements and Analytical Results

Table A-1
Groundwater Elevations, Pump Setting Depths, and Static Water Level Information
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well Number	Date of Measurement	Measurement Point Elevation (FAMSL[a])	Depth to Water (FBTOC)	Groundwater Elevation (FAMSL[a])	Total Well Depth[b] (FAMSL)	Static Water Height (feet)	Pump Setting Depth (FBTOC)
MWL-MW4	04-07-08	5383.46	494.44	4891.73[c]	4878.59[c]	13.14[c]	503[d]
MWL-MW5	04-07-08	5379.89	492.66	4887.23	4856.15	31.08	517
MWL-MW6	04-07-08	5372.64	486.53	4886.11	4839.46	46.65	527
MWL-MW7	07-16-08	5380.63	488.88	4891.75	4878.96	12.79	493
	10-06-08		488.82	4891.81		12.85	
MWL-MW8	07-14-08	5381.99	490.55	4891.44	4880.07	11.37	496.5
	10-07-08		490.71	4891.28		11.21	
MWL-MW9	07-15-08	5379.24	492.07	4887.17	4876.63	10.54	497
	10-08-08		491.23	4888.01		11.38	
MWL-BW2	04-07-08	5388.35	477.18	4911.17	4884.00	27.17	499
	07-17-08		477.47	4910.88		26.88	
	10-01-08		477.62	4910.73		26.73	

[a]Measurement point is the top of well casing.
[b]Total well depth to bottom of sump.
[c]Elevation, well depth, and pump depth reflects well MWL-MW4 orientation of 6 degrees from vertical.
[d]Depth to the bottom of the dedicated pump is 503.01 feet below ground surface; for MWL-MW4, the "bottom of the well" is measured from the top of the packer.
BW = Background well.
FAMSL = Feet above mean sea level.
FBTOC = Feet below top of casing.
MW = Monitoring well.
MWL = Mixed Waste Landfill.

Table A-2
Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	pH (at 25°C)	Temp (°C)	Specific Conductivity (μmhos/cm)	Turbidity (NTU)	ORP (mV)	DO (% Sat)
MWL-MW4[a] Date purge began: 04-15-08 Date sampled: 04-16-08	Before Sampling	26	7.36	19.32	601	3.58	20.0	18.8
		27	7.37	19.42	602	3.24	1.8	8.0
		28	7.30	19.42	601	3.17	-2.3	6.7
MWL-MW5 Date purge began: 04-10-08 Date sampled: 04-10-08	Before Sampling	52	7.04	15.98	868	0.79	149.3	26.7
		54	7.04	15.83	868	0.83	148.6	26.8
		56	7.04	15.18	869	0.77	147.9	26.5
MWL-MW6 Date purge began: 04-08-08 Date sampled: 04-08-08	Before Sampling	52	7.17	20.91	824	0.67	214.4	31.0
		54	7.17	20.88	824	0.63	214.3	31.4
		56	7.17	21.09	824	0.63	214.2	31.3
MWL-BW2 Date purge began: 04-09-08 Date sampled: 04-09-08	Before Sampling	62	7.13	18.98	704	1.51	114.4	14.3
		64	7.13	18.93	703	1.55	115.3	14.5
		66	7.13	18.78	704	1.53	114.9	14.3
MWL-MW7[a] Date purge began: 07-16-08 Date sampled: 07-16-08	Before Sampling	12	7.47	22.39	590	19.3	161.3	55.7
		13	7.47	22.40	590	16.8	160.0	54.8
		14	7.47	22.39	590	14.1	159.8	54.7
MWL-MW8[a] Date purge began: 07-14-08 Date sampled: 07-14-08	Before Sampling	11	7.51	28.75	617	8.34	121.8	45.6
		12	7.56	26.93	613	7.79	117.7	50.8
		13	7.35	23.05	607	7.25	138.9	69.8

Refer to footnotes at end of table.

Table A-2 (Continued)
Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	pH (at 25°C)	Temp (°C)	Specific Conductivity (μmhos/cm)	Turbidity (NTU)	ORP (mV)	DO (% Sat)
MWL-MW9[a] Date purge began: 07-15-08 Date sampled: 07-15-08	Before Sampling	2.5	7.37	20.76	529	1.06	231.9	41.9
		5.5	7.55	21.65	552	2.10	83.5	54.2
		6	7.58	23.55	556	0.82	77.9	55.0
MWL-BW2 Date purge began: 07-17-08 Date sampled: 07-17-08	Before Sampling	56	7.30	23.01	700	0.90	-79.3	22.0
		58	7.31	23.02	702	0.89	-55.2	29.5
		60	7.31	23.04	702	0.92	-31.7	29.6
MWL-MW7[a] Date purge began: 10-06-08 Date sampled: 10-06-08	Before Sampling	8	7.39	17.52	631	1.13	163.2	43.3
		9	7.39	17.77	633	1.23	164.2	43.6
		10	7.39	17.97	632	1.18	164.9	44.3
MWL-MW8[a] Date purge began: 10-07-08 Date sampled: 10-07-08	Before Sampling	7	7.36	18.55	633	3.50	155.1	35.7
		11.5	7.36	19.38	632	2.02	153.9	24.1
		12	7.36	19.49	634	1.91	151.2	23.7
MWL-MW9[a] Date purge began: 10-08-08 Date sampled: 10-08-08	Before Sampling	5.5	7.40	18.56	595	1.84	145.0	28.8
		10	7.33	19.37	621	3.66	148.1	32.9
		11	7.29	19.44	624	3.66	146.7	27.1

Refer to footnotes at end of table.

Table A-2 (Concluded)
Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	pH (at 25°C)	Temp (°C)	Specific Conductivity (μmhos/cm)	Turbidity (NTU)	ORP (mV)	DO (% Sat)
MWL-BW2	Before Sampling	36	7.18	21.42	766	0.89	119.0	6.4
Date purge began: 10-01-08		38	7.18	21.51	766	0.91	119.9	6.4
Date sampled: 10-01-08		39	7.18	21.54	766	0.70	119.7	6.3

[a]Wells were purged to dryness. Purge volumes show total gallons removed prior to sampling.

°C = Degrees Celsius.
% Sat = Percent saturation.
BW = Background well.
DO = Dissolved oxygen.
μmhos/cm = Micromhos per centimeter.
mV = Millivolts.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
NTU = Nephelometric turbidity units.
ORP = Oxidation-reduction potential.
pH = Potential of hydrogen.
Temp = Temperature.

Table A-3
Analytical Parameters, Test Methods, and Target Quantitation Limits
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Analytical Parameter	Test Method[a]	Target Quantitation Limit[b]
Total Metals TAL and Uranium	SW846-6020 SW846-7470A	0.00007–2.5 mg/L
Volatile Organic Compounds	SW846-8260B	1.0–5.0 μg/L
Nitrate plus Nitrite (as nitrogen)	EPA 353.2	0.50 mg/L
Major Anions Bromide, Fluoride, Chloride, and Sulfate	SW846-9056	0.100–4.0 mg/L
Total Organic Carbon	SW846-9060	1.0 mg/L
Carbon Dioxide	SM 4500 CO2 D[c]	1.0 mg/L
Total Alkalinity as Calcium Carbonate	EPA 310.1	1.0–2.0 mg/L
Total Dissolved Solids	EPA 160.1	10 mg/L
Perchlorate	EPA 314.0[d]	0.012 mg/L
Ferrous Iron	3500M Fe2+[c]	0.01–0.10 mg/L
Biochemical Oxygen Demand	EPA 405.1	2.0–4.0 mg/L
Manganese II	C2-100 Mn2+[c]	0.320 mg/L
Radionuclides Gamma-Emitting Radionuclides Gross Alpha Activity Gross Beta Activity Tritium	 EPA 901.1[e] EPA 900.0[e] EPA 900.0[e] EPA 906.0[e]	 MDA is isotope-specific 1.06–2.33 pCi/L 1.26–1.75 pCi/L 159–198 pCi/L

[a]Analytical methods used are referenced to either U.S. Environmental Protection Agency, 1979, "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, U.S. Environmental Protection Agency, Cincinnati, Ohio; or U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.
[b]For target compounds only. Reporting limits may be elevated if an interfering component is present or if sample dilution is required.
[c]Laboratory-specific analytical methods.
[d]U.S. Environmental Protection Agency, 1999. "Perchlorate in Drinking Water Using Ion Chromatography," EPA 815/R-00-014, U.S. Environmental Protection Agency, Washington, D.C.
[e]U.S. Environmental Protection Agency, 1980. "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032, U.S. Environmental Protection Agency, Cincinnati, Ohio.
EPA = U.S. Environmental Protection Agency.
MDA = Minimum detectable activity.
μg/L = Microgram(s) per liter.
mg/L = Milligram(s) per liter.
pCi/L = Picocurie(s) per liter.
TAL = Target analyte list.

Table A-4
General Chemistry Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-BW2 09-Apr-08	Alkalinity, Total	243	0.725	1.00	NE	B		085758-016	SM 2320B
	Bromide	0.400	0.067	0.200	NE			085758-016	SW846 9056
	Chloride	66.2	0.660	2.00	NE			085758-016	SW846 9056
	Fluoride	0.658	0.033	0.100	4.0			085758-016	SW846 9056
	Sulfate	46.4	1.00	4.00	NE			085758-016	SW846 9056
	Nitrate plus Nitrite as N	1.86	0.100	0.500	10			085758-018	EPA 353.2
MWL-MW4 16-Apr-08	Alkalinity, Total	219	0.725	1.00	NE	B		085770-016	SM 2320B
	Bromide	0.354	0.067	0.200	NE			085770-016	SW846 9056
	Chloride	49.1	0.660	2.00	NE			085770-016	SW846 9056
	Fluoride	0.893	0.033	0.100	4.0			085770-016	SW846 9056
	Sulfate	39.7	0.100	0.400	NE			085770-016	SW846 9056
	Nitrate plus Nitrite as N	1.09	0.050	0.250	10			085770-018	EPA 353.2
MWL-MW5 10-Apr-08	Alkalinity, Total	317	0.725	1.00	NE	B		085775-016	SM 2320B
	Bromide	0.496	0.067	0.200	NE			085775-016	SW846 9056
	Chloride	84.2	0.660	2.00	NE			085775-016	SW846 9056
	Fluoride	0.697	0.033	0.100	4.0			085775-016	SW846 9056
	Sulfate	53.0	1.00	4.00	NE			085775-016	SW846 9056
	Nitrate plus Nitrite as N	1.37	0.100	0.500	10			085775-018	EPA 353.2
MWL-MW5 (Duplicate) 10-Apr-08	Alkalinity, Total	316	0.725	1.00	NE	B		085776-016	SM 2320B
	Bromide	0.509	0.067	0.200	NE			085776-016	SW846 9056
	Chloride	85.6	0.660	2.00	NE			085776-016	SW846 9056
	Fluoride	0.709	0.033	0.100	4.0			085776-016	SW846 9056
	Sulfate	53.9	1.00	4.00	NE			085776-016	SW846 9056
	Nitrate plus Nitrite as N	1.36	0.100	0.500	10			085776-018	EPA 353.2
MWL-MW6 08-Apr-08	Alkalinity, Total	298	0.725	1.00	NE	B		085779-016	SM 2320B
	Bromide	0.469	0.067	0.200	NE			085779-016	SW846 9056
	Chloride	76.0	0.660	2.00	NE			085779-016	SW846 9056
	Fluoride	0.711	0.033	0.100	4.0			085779-016	SW846 9056
	Sulfate	49.9	1.00	4.00	NE			085779-016	SW846 9056
	Nitrate plus Nitrite as N	1.64	0.050	0.250	10			085779-018	EPA 353.2

Refer to footnotes at end of table.

Table A-4 (Continued)
General Chemistry Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-BW2 17-Jul-08	Alkalinity, Total	243	0.725	1.0	NE	B		086358-016	SM 2320B
	Bromide	0.403	0.067	0.200	NE			086358-016	SW846 9056
	Chloride	62.1	0.660	2.00	NE			086358-016	SW846 9056
	Fluoride	0.659	0.033	0.100	4.0			086358-016	SW846 9056
	Sulfate	44.5	1.00	4.00	NE			086358-016	SW846 9056
	Nitrate plus Nitrite as N	1.98	0.100	0.500	10	B		086358-018	EPA 353.2
MWL-MW7 16-Jul-08	Alkalinity, Total	212	0.725	1.00	NE	B		086362-016	SM 2320B
	Bromide	0.276	0.067	0.200	NE			086362-016	SW846 9056
	Chloride	42.0	0.660	2.00	NE			086362-016	SW846 9056
	Fluoride	0.995	0.033	0.100	4.0			086362-016	SW846 9056
	Sulfate	38.8	0.100	0.400	NE			086362-016	SW846 9056
	Nitrate plus Nitrite as N	3.13	0.100	0.500	10	B		086362-018	EPA 353.2
MWL-MW7 (Duplicate) 16-Jul-08	Alkalinity, Total	213	0.725	1.00	NE	B		086363-016	SM 2320B
	Bromide	0.650	0.067	0.200	NE			086363-016	SW846 9056
	Chloride	41.9	0.660	2.00	NE			086363-016	SW846 9056
	Fluoride	0.986	0.033	0.100	4.0			086363-016	SW846 9056
	Sulfate	38.9	0.100	0.400	NE			086363-016	SW846 9056
	Nitrate plus Nitrite as N	3.21	0.100	0.500	10	B		086363-018	EPA 353.2
MWL-MW8 14-Jul-08	Alkalinity, Total	220	0.725	1.00	NE	B		086365-016	SM 2320B
	Bromide	0.350	0.067	0.200	NE			086365-016	SW846 9056
	Chloride	48.8	0.660	2.00	NE			086365-016	SW846 9056
	Fluoride	0.949	0.033	0.100	4.0			086365-016	SW846 9056
	Sulfate	39.6	0.100	0.400	NE			086365-016	SW846 9056
	Nitrate plus Nitrite as N	0.885	0.050	0.250	10	B		086365-018	EPA 353.2
MWL-MW9 15-Jul-08	Alkalinity, Total	206	0.725	1.00	NE	B		086367-016	SM 2320B
	Bromide	0.286	0.067	0.200	NE			086367-016	SW846 9056
	Chloride	40.9	0.660	2.00	NE			086367-016	SW846 9056
	Fluoride	1.06	0.033	0.100	4.0			086367-016	SW846 9056
	Sulfate	36.9	1.00	4.00	NE			086367-016	SW846 9056
	Nitrate plus Nitrite as N	2.32	0.100	0.500	10	B		086367-018	EPA 353.2

Refer to footnotes at end of table.

Table A-4 (Continued)
General Chemistry Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-BW2 01-Oct-08	Alkalinity, Total	241	0.725	1.00	NE			086812-016	SM 2320B
	Bromide	0.328	0.067	0.200	NE			086812-016	SW846 9056
	Chloride	62.6	0.660	2.00	NE	B		086812-016	SW846 9056
	Fluoride	0.712	0.033	0.100	4.0			086812-016	SW846 9056
	Sulfate	44.5	1.00	4.00	NE			086812-016	SW846 9056
	Nitrate plus Nitrite as N	2.34	0.050	0.250	10	B		086812-018	EPA 353.2
MWL-BW2 (Duplicate) 01-Oct-08	Alkalinity, Total	241	0.725	1.00	NE			086813-016	SM 2320B
	Bromide	0.331	0.067	0.200	NE			086813-016	SW846 9056
	Chloride	62.3	0.660	2.00	NE	B		086813-016	SW846 9056
	Fluoride	0.719	0.033	0.100	4.0			086813-016	SW846 9056
	Sulfate	45.4	1.00	4.00	NE			086813-016	SW846 9056
	Nitrate plus Nitrite as N	1.98	0.050	0.250	10	B		086813-018	EPA 353.2
MWL-MW7 06-Oct-08	Alkalinity, Total	212	0.725	1.00	NE			086815-016	SM 2320B
	Bromide	0.294	0.067	0.200	NE			086815-016	SW846 9056
	Chloride	40.9	0.330	1.00	NE			086815-016	SW846 9056
	Fluoride	1.02	0.033	0.100	4.0			086815-016	SW846 9056
	Sulfate	36.9	0.100	0.400	NE			086815-016	SW846 9056
	Nitrate plus Nitrite as N	3.24	0.100	0.500	10	B	0.060 U	086815-018	EPA 353.2
MWL-MW8 07-Oct-08	Alkalinity, Total	217	0.725	1.00	NE	B		086817-016	SM 2320B
	Bromide	0.291	0.067	0.200	NE			086817-016	SW846 9056
	Chloride	45.2	0.330	1.00	NE			086817-016	SW846 9056
	Fluoride	1.02	0.033	0.100	4.0			086817-016	SW846 9056
	Sulfate	35.4	0.100	0.400	NE			086817-016	SW846 9056
	Nitrate plus Nitrite as N	1.36	0.050	0.250	10	B	0.060 U	086817-018	EPA 353.2
MWL-MW9 08-Oct-08	Alkalinity, Total	210	0.725	1.00	NE			086820-016	SM 2320B
	Bromide	0.292	0.067	0.200	NE			086820-016	SW846 9056
	Chloride	40.9	0.330	1.00	NE			086820-016	SW846 9056
	Fluoride	0.952	0.033	0.100	4.0			086820-016	SW846 9056
	Sulfate	37.5	1.00	4.00	NE			086820-016	SW846 9056
	Nitrate plus Nitrite as N	2.03	0.050	0.250	10	B	0.060 U	086820-018	EPA 353.2

[a]MDL is the minimum concentration that can be measured and reported with 99% confidence that the analyte is greater than zero; analyte is matrix-specific.

[b]PQL is the lowest concentration of analytes in a sample that can be reliably determined within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions.

[c]MCL is established by the U.S. Environmental Protection Agency Primary Water Regulations (40 CFR 141.11[b]), and subsequent amendments or the New Mexico Environmental Improvement Board in 20 NMAC 7.1.

Table A-4 (Concluded)
General Chemistry Analytical Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

[d]Laboratory Qualifiers:
B = Analyte is detected in associated laboratory method blank.

[e]Validation Qualifiers (If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.):
U = The analyte was analyzed for but not detected. The associated numerical value is the sample quantitation limit.

[f]Analytical methods used are referenced to either U.S. Environmental Protection Agency, 1979, "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, U.S. Environmental Protection Agency, Cincinnati, Ohio; or U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.

BW = Background well.
CFR = Code of Federal Regulations.
EPA = U.S. Environmental Protection Agency.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
MW = Monitoring well.
MWL = Mixed waste Landfill.
N = Nitrogen.
NE = Not established.
NMAC = New Mexico Administrative Code.
PQL = Practical quantitation limit.

Table A-5
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-BW2	Aluminum	0.0861	0.010	0.020	NE			085758-009	SW846 6020
16-Apr-08	Antimony	ND	0.0005	0.002	0.006	B, U		085758-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	B, U		085758-009	SW846 6020
	Barium	0.0952	0.0005	0.002	2.00			085758-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		085758-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		085758-009	SW846 6020
	Calcium	63.2	0.100	0.500	NE			085758-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	U		085758-009	SW846 6020
	Cobalt	0.000366	0.0001	0.001	NE	B, J	0.00094 U	085758-009	SW846 6020
	Copper	0.00112	0.0003	0.001	NE			085758-009	SW846 6020
	Iron	0.716	0.0100	0.025	NE	B		085758-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		085758-009	SW846 6020
	Magnesium	23.0	0.025	0.075	NE			085758-009	SW846 6020
	Manganese	0.0199	0.001	0.005	NE			085758-009	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	085758-009	SW846 7470
	Nickel	0.00094	0.0005	0.002	NE	J		085758-009	SW846 6020
	Potassium	3.49	0.080	0.300	NE			085758-009	SW846 6020
	Selenium	0.00136	0.001	0.005	0.050	J		085758-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U	UJ	085758-009	SW846 6020
	Sodium	61.9	0.400	1.25	NE			085758-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		085758-009	SW846 6020
	Uranium-235	0.000049	0.00001	0.00007	0.030	J		085758-009	SW846 6020
	Uranium-238	0.00661	0.00005	0.0002	0.030			085758-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		085758-009	SW846 6020
	Zinc	0.00342	0.0026	0.010	NE	J		085758-009	SW846 6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW4	Aluminum	ND	0.010	0.020	NE	U		085770-009	SW846 6020
16-Apr-08	Antimony	ND	0.0005	0.002	0.006	U		085770-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		085770-009	SW846 6020
	Barium	0.105	0.0005	0.002	2.00			085770-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		085770-009	SW846 6020
	Cadmium	0.000136	0.00011	0.001	0.005	J		085770-009	SW846 6020
	Calcium	61.7	0.100	0.500	NE			085770-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	U		085770-009	SW846 6020
	Cobalt	0.000547	0.0001	0.001	NE	J		085770-009	SW846 6020
	Copper	0.000914	0.0003	0.001	NE	J		085770-009	SW846 6020
	Iron	0.569	0.010	0.025	NE			085770-009	SW846 6020
	Lead	0.000722	0.0005	0.002	NE	J		085770-009	SW846 6020
	Magnesium	19.1	0.005	0.015	NE			085770-009	SW846 6020
	Manganese	0.0542	0.001	0.005	NE			085770-009	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	085770-009	SW846 7470
	Molybdenum	0.00903	0.0001	0.0005	NE			085770-009	SW846 6020
	Nickel	0.00506	0.0005	0.002	NE			085770-009	SW846 6020
	Potassium	4.28	0.080	0.300	NE			085770-009	SW846 6020
	Selenium	0.00144	0.001	0.005	0.050	J		085770-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		085770-009	SW846 6020
	Sodium	45.0	0.080	0.250	NE			085770-009	SW846 6020
	Thallium	0.00039	0.0003	0.001	0.002	J		085770-009	SW846 6020
	Uranium-235	0.000055	0.00001	0.00007	0.030	J		085770-009	SW846 6020
	Uranium-238	0.00759	0.00005	0.0002	0.030			085770-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		085770-009	SW846 6020
	Zinc	0.010	0.0026	0.010	NE			085770-009	SW846 6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW5	Aluminum	0.0135	0.010	0.020	NE	J		085775-009	SW846 6020
10-Apr-08	Antimony	ND	0.0005	0.002	0.006	U		085775-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		085775-009	SW846 6020
	Barium	0.128	0.0005	0.002	2.00			085775-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		085775-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		085775-009	SW846 6020
	Calcium	94.5	0.100	0.500	NE	B		085775-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	U		085775-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	U		085775-009	SW846 6020
	Copper	0.00122	0.0003	0.001	NE	B	0.0032 U	085775-009	SW846 6020
	Iron	0.129	0.010	0.025	NE	B		085775-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		085775-009	SW846 6020
	Magnesium	28.1	0.005	0.015	NE			085775-009	SW846 6020
	Manganese	0.0124	0.001	0.005	NE			085775-009	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	085775-009	SW846 7470
	Molybdenum	0.00336	0.0001	0.0005	NE			085775-009	SW846 6020
	Nickel	0.00199	0.0005	0.002	NE	J		085775-009	SW846 6020
	Potassium	5.57	0.080	0.300	NE			085775-009	SW846 6020
	Selenium	0.00115	0.001	0.005	0.050	J		085775-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		085775-009	SW846 6020
	Sodium	70.1	0.400	1.25	NE			085775-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		085775-009	SW846 6020
	Uranium-235	0.000063	0.00001	0.00007	0.030	J	J+	085775-009	SW846 6020
	Uranium-238	0.009	0.00005	0.0002	0.030			085775-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		085775-009	SW846 6020
	Zinc	0.00435	0.0026	0.010	NE	J		085775-009	SW846 6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW5 (Duplicate)	Aluminum	0.0114	0.010	0.020	NE	J		085776-009	SW846 6020
10-Apr-08	Antimony	ND	0.0005	0.002	0.006	U		085776-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		085776-009	SW846 6020
	Barium	0.127	0.0005	0.002	2.00			085776-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		085776-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		085776-009	SW846 6020
	Calcium	90.2	0.100	0.500	NE	B		085776-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	U		085776-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	U		085776-009	SW846 6020
	Copper	0.00125	0.0003	0.001	NE	B	0.0032 U	085776-009	SW846 6020
	Iron	0.121	0.010	0.025	NE	B		085776-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		085776-009	SW846 6020
	Magnesium	29.0	0.005	0.015	NE			085776-009	SW846 6020
	Manganese	0.0107	0.001	0.005	NE			085776-009	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	085776-009	SW846 7470
	Molybdenum	0.00325	0.0001	0.0005	NE			085776-009	SW846 6020
	Nickel	0.00185	0.0005	0.002	NE	J		085776-009	SW846 6020
	Potassium	5.42	0.080	0.300	NE			085776-009	SW846 6020
	Selenium	0.00181	0.001	0.005	0.050	J		085776-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		085776-009	SW846 6020
	Sodium	64.1	0.400	1.25	NE			085776-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		085776-009	SW846 6020
	Uranium-235	0.000065	0.00001	0.00007	0.030	J	J+	085776-009	SW846 6020
	Uranium-238	0.00876	0.00005	0.0002	0.030			085776-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		085776-009	SW846 6020
	Zinc	0.00318	0.0026	0.010	NE	J		085776-009	SW846 6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW6	Aluminum	ND	0.010	0.020	NE	U		085779-009	SW846 6020
08-Apr-08	Antimony	ND	0.0005	0.002	0.006	B, U		085779-009	SW846 6020
	Arsenic	0.00295	0.0015	0.005	0.010	B, J		085779-009	SW846 6020
	Barium	0.115	0.0025	0.010	2.00			085779-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		085779-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		085779-009	SW846 6020
	Calcium	81.5	0.100	0.500	NE			085779-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	U		085779-009	SW846 6020
	Cobalt	0.000347	0.0001	0.001	NE	B, J	0.00094 U	085779-009	SW846 6020
	Copper	0.00138	0.0003	0.001	NE			085779-009	SW846 6020
	Iron	0.675	0.010	0.025	NE	B		085779-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		085779-009	SW846 6020
	Magnesium	29.2	0.025	0.075	NE			085779-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		085779-009	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	085779-009	SW846 6020
	Molybdenum	0.00274	0.0001	0.0005	NE			085779-009	SW846 6020
	Nickel	0.00111	0.0005	0.002	NE	J	NJ-	085779-009	SW846 6020
	Potassium	4.44	0.080	0.300	NE			085779-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	U		085779-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U	UJ	085779-009	SW846 6020
	Sodium	63.5	0.400	1.25	NE			085779-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		085779-009	SW846 6020
	Uranium-235	0.000059	0.00001	0.00007	0.030	J		085779-009	SW846 6020
	Uranium-238	0.00856	0.00005	0.0002	0.030			085779-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		085779-009	SW846 6020
	Zinc	0.00287	0.0026	0.010	NE	J		085779-009	SW846 6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-BW2	Aluminum	0.0449	0.005	0.015	NE			086358-009	SW846 6020
17-Jul-08	Antimony	ND	0.0005	0.002	0.006	U		086358-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		086358-009	SW846 6020
	Barium	0.118	0.0005	0.002	2.00			086358-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086358-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		086358-009	SW846 6020
	Calcium	67.3	0.200	1.00	NE	B		086358-009	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	U		086358-009	SW846 6020
	Cobalt	0.000421	0.0001	0.001	NE	J		086358-009	SW846 6020
	Copper	0.00064	0.0003	0.001	NE	J		086358-009	SW846 6020
	Iron	0.340	0.010	0.025	NE			086358-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086358-009	SW846 6020
	Magnesium	20.2	0.0052	0.015	NE			086358-009	SW846 6020
	Manganese	0.0704	0.001	0.005	NE			086358-009	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	086358-009	SW846 7470
	Nickel	0.00133	0.0005	0.002	NE	J		086358-009	SW846 6020
	Potassium	4.36	0.080	0.300	NE			086358-009	SW846 6020
	Selenium	0.00185	0.001	0.005	0.050	J		086358-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086358-009	SW846 6020
	Sodium	48.7	0.080	0.250	NE		J	086358-009	SW846 6020
	Thallium	0.000352	0.0003	0.001	0.002	J		086358-009	SW846 6020
	Uranium	0.00715	0.00005	0.0002	0.030			086358-009	SW846 6020
	Uranium-235	0.00005	0.00001	0.00007	0.030	J	J+	086358-009	SW846 6020
	Uranium-238	0.0071	0.00005	0.0002	0.030			086358-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		086358-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	B, U		086358-009	SW846 6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW7	Aluminum	0.00694	0.005	0.015	NE	J		086362-009	SW846 6020
16-Jul-08	Antimony	ND	0.0005	0.002	0.006	B, U		086362-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		086362-009	SW846 6020
	Barium	0.104	0.0005	0.002	2.00			086362-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086362-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		086362-009	SW846 6020
	Calcium	54.2	0.200	1.00	NE	B		086362-009	SW846 6020
	Chromium	0.0017	0.0015	0.003	0.100	B, J	0.0086 U	086362-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	U		086362-009	SW846 6020
	Copper	0.000792	0.0003	0.001	NE	J		086362-009	SW846 6020
	Iron	0.187	0.010	0.025	NE	B		086362-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086362-009	SW846 6020
	Magnesium	17.4	0.0052	0.015	NE			086362-009	SW846 6020
	Manganese	0.00926	0.001	0.005	NE			086362-009	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	086362-009	SW846 7470
	Nickel	0.0014	0.0005	0.002	NE	J		086362-009	SW846 6020
	Potassium	4.83	0.080	0.300	NE			086362-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	U		086362-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086362-009	SW846 6020
	Sodium	46.0	0.080	0.250	NE			086362-009	SW846 6020
	Thallium	0.000311	0.0003	0.001	0.002	J		086362-009	SW846 6020
	Uranium	0.00781	0.00005	0.0002	0.030			086362-009	SW846 6020
	Uranium-235	0.000056	0.00001	0.00007	0.030	J	J+	086362-009	SW846 6020
	Uranium-238	0.00775	0.00005	0.0002	0.030			086362-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		086362-009	SW846 6020
	Zinc	0.00261	0.0026	0.010	NE	J		086362-009	SW846 6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW7 (Duplicate)	Aluminum	0.0275	0.005	0.015	NE			086363-009	SW846 6020
16-Jul-08	Antimony	ND	0.0005	0.002	0.006	B, U		086363-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		086363-009	SW846 6020
	Barium	0.105	0.0005	0.002	2.00			086363-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086363-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		086363-009	SW846 6020
	Calcium	54.5	0.200	1.00	NE	B		086363-009	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	B, U		086363-009	SW846 6020
	Cobalt	0.000125	0.0001	0.001	NE	J	UJ	086363-009	SW846 6020
	Copper	0.000876	0.0003	0.001	NE	J		086363-009	SW846 6020
	Iron	0.194	0.010	0.025	NE	B		086363-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086363-009	SW846 6020
	Magnesium	16.8	0.0052	0.015	NE			086363-009	SW846 6020
	Manganese	0.01	0.001	0.005	NE			086363-009	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	086363-009	SW846 7470
	Nickel	0.00129	0.0005	0.002	NE	J		086363-009	SW846 6020
	Potassium	4.97	0.080	0.300	NE			086363-009	SW846 6020
	Selenium	0.00116	0.001	0.005	0.050	J		086363-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086363-009	SW846 6020
	Sodium	42.9	0.080	0.250	NE			086363-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		086363-009	SW846 6020
	Uranium	0.00808	0.00005	0.0002	0.030			086363-009	SW846 6020
	Uranium-235	0.000057	0.00001	0.00007	0.030	J	J+	086363-009	SW846 6020
	Uranium-238	0.00803	0.00005	0.0002	0.030			086363-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		086363-009	SW846 6020
	Zinc	0.00268	0.0026	0.010	NE	J		086363-009	SW846 6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW8	Aluminum	0.0211	0.005	0.015	NE			086365-009	SW846 6020
14-Jul-08	Antimony	0.000595	0.0005	0.002	0.006	B, J	0.0060 U	086365-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		086365-009	SW846 6020
	Barium	0.133	0.0005	0.002	2.00			086365-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086365-009	SW846 6020
	Cadmium	0.000195	0.00011	0.001	0.005	J		086365-009	SW846 6020
	Calcium	55.1	0.200	1.00	NE	B		086365-009	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	U		086365-009	SW846 6020
	Cobalt	0.000171	0.0001	0.001	NE	J		086365-009	SW846 6020
	Copper	0.00111	0.0003	0.001	NE			086365-009	SW846 6020
	Iron	0.167	0.010	0.025	NE	B		086365-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086365-009	SW846 6020
	Magnesium	17.3	0.0052	0.015	NE		J	086365-009	SW846 6020
	Manganese	0.238	0.001	0.005	NE			086365-009	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	086365-009	SW846 7470
	Nickel	0.00223	0.0005	0.002	NE			086365-009	SW846 6020
	Potassium	5.80	0.080	0.300	NE			086365-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	B, U		086365-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086365-009	SW846 6020
	Sodium	52.5	0.800	2.50	NE			086365-009	SW846 6020
	Thallium	0.000312	0.0003	0.001	0.002	J		086365-009	SW846 6020
	Uranium	0.00705	0.00005	0.0002	0.030			086365-009	SW846 6020
	Uranium-235	0.000047	0.00001	0.00007	0.030	J	J+	086365-009	SW846 6020
	Uranium-238	0.007	0.00005	0.0002	0.030			086365-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		086365-009	SW846 6020
	Zinc	0.00324	0.0026	0.010	NE	B, J	0.030 U	086365-009	SW846 6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW9	Aluminum	0.104	0.005	0.015	NE			086367-009	SW846 6020
15-Jul-08	Antimony	ND	0.0005	0.002	0.006	B, U		086367-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		086367-009	SW846 6020
	Barium	0.101	0.0005	0.002	2.00			086367-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086367-009	SW846 6020
	Cadmium	0.000127	0.00011	0.001	0.005	J		086367-009	SW846 6020
	Calcium	51.8	0.200	1.00	NE	B		086367-009	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	B, U		086367-009	SW846 6020
	Cobalt	0.000203	0.0001	0.001	NE	J	UJ	086367-009	SW846 6020
	Copper	0.00105	0.0003	0.001	NE			086367-009	SW846 6020
	Iron	0.300	0.010	0.025	NE	B		086367-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086367-009	SW846 6020
	Magnesium	16.8	0.0052	0.015	NE			086367-009	SW846 6020
	Manganese	0.023	0.001	0.005	NE			086367-009	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	086367-009	SW846 7470
	Nickel	0.00139	0.0005	0.002	NE	J		086367-009	SW846 6020
	Potassium	5.54	0.080	0.300	NE			086367-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	U		086367-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086367-009	SW846 6020
	Sodium	39.5	0.080	0.250	NE			086367-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		086367-009	SW846 6020
	Uranium	0.00879	0.00005	0.0002	0.030			086367-009	SW846 6020
	Uranium-235	0.000061	0.00001	0.00007	0.030	J	J+	086367-009	SW846 6020
	Uranium-238	0.00873	0.00005	0.0002	0.030			086367-009	SW846 6020
	Vanadium	ND	0.030	0.100	NE	U		086367-009	SW846 6020
	Zinc	0.00396	0.0026	0.010	NE	J		086367-009	SW846 6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-BW2	Aluminum	0.0166	0.005	0.015	NE	B	0.042 U	086812-009	SW846 6020
01-Oct-08	Antimony	ND	0.0005	0.002	0.006	U		086812-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		086812-009	SW846 6020
	Barium	0.0984	0.005	0.020	2.00			086812-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086812-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		086812-009	SW846 6020
	Calcium	67.3	0.200	1.00	NE	B		086812-009	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	U		086812-009	SW846 6020
	Cobalt	0.0001	0.0001	0.001	NE	J		086812-009	SW846 6020
	Copper	0.000713	0.0003	0.001	NE	J		086812-009	SW846 6020
	Iron	0.243	0.010	0.025	NE	B		086812-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086812-009	SW846 6020
	Magnesium	21.6	0.0052	0.015	NE			086812-009	SW846 6020
	Manganese	0.00267	0.001	0.005	NE	J		086812-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		086812-009	SW846 7470
	Nickel	0.000983	0.0005	0.002	NE	J		086812-009	SW846 6020
	Potassium	4.15	0.080	0.300	NE			086812-009	SW846 6020
	Selenium	0.00156	0.001	0.005	0.050	J		086812-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086812-009	SW846 6020
	Sodium	56.2	0.800	2.50	NE			086812-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		086812-009	SW846 6020
	Uranium	0.00697	0.00005	0.0002	0.030			086812-009	SW846 6020
	Uranium-235	0.000047	0.00001	0.00007	0.030	J	J+	086812-009	SW846 6020
	Uranium-238	0.00692	0.00005	0.0002	0.030		J	086812-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		086812-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	U		086812-009	SW846 6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-BW2 (Duplicate)	Aluminum	0.00578	0.005	0.015	NE	B, J	0.042 U	086813-009	SW846 6020
01-Oct-08	Antimony	ND	0.0005	0.002	0.006	U		086813-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		086813-009	SW846 6020
	Barium	0.0962	0.005	0.020	2.00			086813-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086813-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		086813-009	SW846 6020
	Calcium	68.1	0.200	1.00	NE	B		086813-009	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	U		086813-009	SW846 6020
	Cobalt	0.000113	0.0001	0.001	NE	J		086813-009	SW846 6020
	Copper	0.0005	0.0003	0.001	NE	J		086813-009	SW846 6020
	Iron	0.240	0.010	0.025	NE	B		086813-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086813-009	SW846 6020
	Magnesium	21.9	0.0052	0.015	NE			086813-009	SW846 6020
	Manganese	0.00262	0.001	0.005	NE	J		086813-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		086813-009	SW846 7470
	Nickel	0.00104	0.0005	0.002	NE	J		086813-009	SW846 6020
	Potassium	3.98	0.080	0.300	NE			086813-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	U		086813-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086813-009	SW846 6020
	Sodium	56.2	0.800	2.50	NE			086813-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		086813-009	SW846 6020
	Uranium	0.00696	0.00005	0.0002	0.030			086813-009	SW846 6020
	Uranium-235	0.000047	0.00001	0.00007	0.030	J	J+	086813-009	SW846 6020
	Uranium-238	0.00692	0.00005	0.0002	0.030		J	086813-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		086813-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	U		086813-009	SW846 6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW7	Aluminum	0.0162	0.005	0.015	NE	B	0.043 U	086815-009	SW846 6020
06-Oct-08	Antimony	ND	0.0005	0.002	0.006	U		086815-009	SW846 6020
	Arsenic	0.00253	0.0015	0.005	0.010	B, J	0.0087 U	086815-009	SW846 6020
	Barium	0.103	0.0005	0.002	2.00			086815-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086815-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		086815-009	SW846 6020
	Calcium	53.9	0.200	1.00	NE			086815-009	SW846 6020
	Chromium	0.00164	0.0015	0.003	0.100	J		086815-009	SW846 6020
	Cobalt	0.000185	0.0001	0.001	NE	J		086815-009	SW846 6020
	Copper	0.000992	0.0003	0.001	NE	J		086815-009	SW846 6020
	Iron	0.250	0.010	0.025	NE			086815-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086815-009	SW846 6020
	Magnesium	19.4	0.052	0.150	NE		J	086815-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		086815-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	086815-009	SW846 7470
	Nickel	0.00119	0.0005	0.002	NE	J		086815-009	SW846 6020
	Potassium	5.03	0.080	0.300	NE			086815-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	U		086815-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086815-009	SW846 6020
	Sodium	39.6	0.080	0.250	NE		J	086815-009	SW846 6020
	Thallium	0.000376	0.0003	0.001	0.002	J		086815-009	SW846 6020
	Uranium	0.00791	0.00005	0.0002	0.030			086815-009	SW846 6020
	Uranium-235	0.000056	0.00001	0.00007	0.030	J	J+	086815-009	SW846 6020
	Uranium-238	0.00785	0.00005	0.0002	0.030			086815-009	SW846 6020
	Vanadium	0.00651	0.003	0.010	NE	J		086815-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	U		086815-009	SW846 6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW8	Aluminum	0.216	0.005	0.015	NE	B		086817-009	SW846 6020
07-Oct-08	Antimony	ND	0.0005	0.002	0.006	U		086817-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		086817-009	SW846 6020
	Barium	0.118	0.0005	0.002	2.00			086817-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086817-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		086817-009	SW846 6020
	Calcium	55.1	0.200	1.00	NE			086817-009	SW846 6020
	Chromium	0.00201	0.0015	0.003	0.100	J		086817-009	SW846 6020
	Cobalt	0.000226	0.0001	0.001	NE	J		086817-009	SW846 6020
	Copper	0.00147	0.0003	0.001	NE			086817-009	SW846 6020
	Iron	0.483	0.010	0.025	NE			086817-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086817-009	SW846 6020
	Magnesium	20.1	0.052	0.150	NE		J	086817-009	SW846 6020
	Manganese	0.0221	0.001	0.005	NE			086817-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	086817-009	SW846 7470
	Nickel	0.00183	0.0005	0.002	NE	J		086817-009	SW846 6020
	Potassium	6.51	0.080	0.300	NE			086817-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	U		086817-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086817-009	SW846 6020
	Sodium	49.2	0.080	0.250	NE		J	086817-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		086817-009	SW846 6020
	Uranium	0.00809	0.00005	0.0002	0.030			086817-009	SW846 6020
	Uranium-235	0.000058	0.00001	0.00007	0.030	J	J+	086817-009	SW846 6020
	Uranium-238	0.00803	0.00005	0.0002	0.030			086817-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		086817-009	SW846 6020
	Zinc	0.00387	0.0026	0.010	NE	J		086817-009	SW846 6020

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW9	Aluminum	0.140	0.005	0.015	NE	B		086820-009	SW846 6020
08-Oct-08	Antimony	ND	0.0005	0.002	0.006	U		086820-009	SW846 6020
	Arsenic	0.00365	0.0015	0.005	0.010	B, J	0.0087 U	086820-009	SW846 6020
	Barium	0.0858	0.0005	0.002	2.00			086820-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086820-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		086820-009	SW846 6020
	Calcium	51.2	0.200	1.00	NE			086820-009	SW846 6020
	Chromium	0.00158	0.0015	0.003	0.100	J		086820-009	SW846 6020
	Cobalt	0.000255	0.0001	0.001	NE	J		086820-009	SW846 6020
	Copper	0.00102	0.0003	0.001	NE			086820-009	SW846 6020
	Iron	0.394	0.010	0.025	NE			086820-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086820-009	SW846 6020
	Magnesium	18.9	0.052	0.150	NE		J	086820-009	SW846 6020
	Manganese	0.0189	0.001	0.005	NE			086820-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	086820-009	SW846 7470
	Nickel	0.00122	0.0005	0.002	NE	J		086820-009	SW846 6020
	Potassium	4.67	0.080	0.300	NE			086820-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	U		086820-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086820-009	SW846 6020
	Sodium	40.7	0.080	0.250	NE		J	086820-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		086820-009	SW846 6020
	Uranium	0.00846	0.00005	0.0002	0.030			086820-009	SW846 6020
	Uranium-235	0.000059	0.00001	0.00007	0.030	J	J+	086820-009	SW846 6020
	Uranium-238	0.0084	0.00005	0.0002	0.030			086820-009	SW846 6020
	Vanadium	0.00849	0.003	0.010	NE	J		086820-009	SW846 6020
	Zinc	0.00324	0.0026	0.010	NE	J		086820-009	SW846 6020

[a]MDL is the minimum concentration that can be measured and reported with 99% confidence that the analyte is greater than zero; analyte is matrix-specific.

[b]PQL is the lowest concentration of analytes in a sample that can be reliably determined within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions.

[c]MCL is established by the U.S. Environmental Protection Agency Primary Water Regulations (40 CFR 141.11[b]), and subsequent amendments or the New Mexico Environmental Improvement Board in 20 NMAC 7.1.

[d]Laboratory Qualifiers:
B = Analyte is detected in associated laboratory method blank.
J = Amount detected is below the PQL.
U = Analyte is absent or below the MDL.

Table A-5 (Concluded)
Summary of Total Metals Results (Unfiltered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

[e]Validation Qualifiers (If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.):
J = The associated value is an estimated quantity.
J+ = The associated numerical value is an estimated quantity with suspected positive bias.
NJ- = Presumptive evidence of the presence of the material at an estimated quantity with a suspected negative bias.
U = The analyte was analyzed for but not detected. The associated numerical value is the sample quantitation limit.
UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

[f]U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.
BW = Background well.
CFR = Code of Federal Regulations.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
ND = Not detected (at method detection limit).
NE = Not established.
NMAC = New Mexico Administrative Code.
PQL = Practical quantitation limit.

Table A-6
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-BW2	Aluminum	ND	0.010	0.020	NE	U		085758-010	SW846 6020
09-Apr-08	Antimony	ND	0.0005	0.002	0.006	B, U		085758-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	B, U		085758-010	SW846 6020
	Barium	0.0969	0.0005	0.002	2.00			085758-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		085758-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		085758-010	SW846 6020
	Calcium	63.3	0.100	0.500	NE			085758-010	SW846 6020
	Chromium	0.00254	0.0025	0.010	0.100	J	0.013U	085758-010	SW846 6020
	Cobalt	0.000362	0.0001	0.001	NE	B, J	0.00094U	085758-010	SW846 6020
	Copper	0.00109	0.0003	0.001	NE			085758-010	SW846 6020
	Iron	0.626	0.010	0.025	NE	B		085758-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		085758-010	SW846 6020
	Magnesium	22.0	0.005	0.015	NE			085758-010	SW846 6020
	Manganese	0.0227	0.001	0.005	NE			085758-010	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	085758-010	SW846 7470
	Molybdenum	0.0021	0.0001	0.0005	NE			085758-010	SW846 6020
	Nickel	0.00102	0.0005	0.002	NE	J	NJ-	085758-010	SW846 6020
	Potassium	3.56	0.080	0.300	NE			085758-010	SW846 6020
	Selenium	0.00108	0.001	0.005	0.050	J		085758-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U	UJ	085758-010	SW846 6020
	Sodium	57.0	0.400	1.25	NE			085758-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		085758-010	SW846 6020
	Uranium-235	0.000047	0.00001	0.00007	0.030	J		085758-010	SW846 6020
	Uranium-238	0.00679	0.00005	0.0002	0.030			085758-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		085758-010	SW846 6020
	Zinc	0.00307	0.0026	0.010	NE	J		085758-010	SW846 6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW4	Aluminum	ND	0.010	0.020	NE	U		085770-010	SW846 6020
16-Apr-08	Antimony	ND	0.0005	0.002	0.006	U		085770-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		085770-010	SW846 6020
	Barium	0.110	0.0005	0.002	2.00			085770-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		085770-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		085770-010	SW846 6020
	Calcium	57.2	0.100	0.500	NE			085770-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	U		085770-010	SW846 6020
	Cobalt	0.000536	0.0001	0.001	NE	J		085770-010	SW846 6020
	Copper	0.000778	0.0003	0.001	NE	J		085770-010	SW846 6020
	Iron	0.390	0.010	0.025	NE			085770-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		085770-010	SW846 6020
	Magnesium	18.8	0.005	0.015	NE			085770-010	SW846 6020
	Manganese	0.0552	0.001	0.005	NE			085770-010	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	085770-010	SW846 7470
	Molybdenum	0.00866	0.0001	0.0005	NE			085770-010	SW846 6020
	Nickel	0.00498	0.0005	0.002	NE			085770-010	SW846 6020
	Potassium	4.60	0.080	0.300	NE			085770-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	U		085770-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		085770-010	SW846 6020
	Sodium	45.5	0.080	0.250	NE			085770-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		085770-010	SW846 6020
	Uranium-235	0.000057	0.00001	0.00007	0.030	J		085770-010	SW846 6020
	Uranium-238	0.00785	0.00005	0.0002	0.030			085770-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		085770-010	SW846 6020
	Zinc	0.00794	0.0026	0.010	NE	J		085770-010	SW846 6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW5	Aluminum	ND	0.010	0.020	NE	U		085775-010	SW846 6020
10-Apr-08	Antimony	ND	0.0005	0.002	0.006	U		085775-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		085775-010	SW846 6020
	Barium	0.126	0.0005	0.002	2.00			085775-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		085775-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		085775-010	SW846 6020
	Calcium	93.0	0.100	0.500	NE	B		085775-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	U		085775-010	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	U		085775-010	SW846 6020
	Copper	0.00233	0.0003	0.001	NE	B	0.0032U	085775-010	SW846 6020
	Iron	0.110	0.010	0.025	NE	B		085775-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		085775-010	SW846 6020
	Magnesium	28.4	0.005	0.015	NE			085775-010	SW846 6020
	Manganese	0.00801	0.001	0.005	NE			085775-010	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	085775-010	SW846 7470
	Molybdenum	0.00327	0.0001	0.0005	NE			085775-010	SW846 6020
	Nickel	0.00223	0.0005	0.002	NE			085775-010	SW846 6020
	Potassium	5.51	0.080	0.300	NE			085775-010	SW846 6020
	Selenium	0.00108	0.001	0.005	0.050	J		085775-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		085775-010	SW846 6020
	Sodium	63.7	0.400	1.25	NE			085775-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		085775-010	SW846 6020
	Uranium-235	0.000063	0.00001	0.00007	0.030	J	J+	085775-010	SW846 6020
	Uranium-238	0.00869	0.00005	0.0002	0.030			085775-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		085775-010	SW846 6020
	Zinc	0.00374	0.0026	0.010	NE	J		085775-010	SW846 6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW5 (Duplicate)	Aluminum	ND	0.010	0.020	NE	U		085776-010	SW846 6020
10-Apr-08	Antimony	ND	0.0005	0.002	0.006	U		085776-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		085776-010	SW846 6020
	Barium	0.129	0.0005	0.002	2.00			085776-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		085776-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		085776-010	SW846 6020
	Calcium	94.0	0.100	0.500	NE	B		085776-010	SW846 6020
	Chromium	0.0027	0.0025	0.010	0.100	J	0.016U	085776-010	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	U		085776-010	SW846 6020
	Copper	0.00127	0.0003	0.001	NE	B	0.0032U	085776-010	SW846 6020
	Iron	0.115	0.010	0.025	NE	B		085776-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		085776-010	SW846 6020
	Magnesium	29.9	0.005	0.015	NE			085776-010	SW846 6020
	Manganese	0.00884	0.001	0.005	NE			085776-010	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	085776-010	SW846 7470
	Molybdenum	0.00329	0.0001	0.0005	NE			085776-010	SW846 6020
	Nickel	0.00208	0.0005	0.002	NE			085776-010	SW846 6020
	Potassium	5.90	0.080	0.300	NE			085776-010	SW846 6020
	Selenium	0.00145	0.001	0.005	0.050	J		085776-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		085776-010	SW846 6020
	Sodium	64.3	0.400	1.25	NE			085776-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		085776-010	SW846 6020
	Uranium-235	0.000066	0.00001	0.00007	0.030	J	J+	085776-010	SW846 6020
	Uranium-238	0.00892	0.00005	0.0002	0.030			085776-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		085776-010	SW846 6020
	Zinc	0.00333	0.0026	0.010	NE	J		085776-010	SW846 6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW6	Aluminum	ND	0.010	0.020	NE	U		085779-010	SW846 6020
08-Apr-08	Antimony	ND	0.0005	0.002	0.006	B, U		085779-010	SW846 6020
	Arsenic	0.00169	0.0015	0.005	0.010	B, J		085779-010	SW846 6020
	Barium	0.112	0.0025	0.010	2.00			085779-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		085779-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		085779-010	SW846 6020
	Calcium	77.9	0.100	0.500	NE			085779-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	U		085779-010	SW846 6020
	Cobalt	0.000329	0.0001	0.001	NE	B, J	0.00094U	085779-010	SW846 6020
	Copper	0.00129	0.0003	0.001	NE			085779-010	SW846 6020
	Iron	0.698	0.010	0.025	NE	B		085779-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		085779-010	SW846 6020
	Magnesium	27.4	0.025	0.075	NE			085779-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		085779-010	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	085779-010	SW846 6020
	Molybdenum	0.00279	0.0001	0.0005	NE			085779-010	SW846 6020
	Nickel	0.00105	0.0005	0.002	NE	J	NJ-	085779-010	SW846 6020
	Potassium	4.52	0.080	0.300	NE			085779-010	SW846 6020
	Selenium	0.0011	0.001	0.005	0.050	J		085779-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U	UJ	085779-010	SW846 6020
	Sodium	61.9	0.400	1.25	NE			085779-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		085779-010	SW846 6020
	Uranium-235	0.000064	0.00001	0.00007	0.030	J		085779-010	SW846 6020
	Uranium-238	0.00895	0.00005	0.0002	0.030			085779-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		085779-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	U		085779-010	SW846 6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-BW2	Aluminum	ND	0.005	0.015	NE	U		086358-010	SW846 6020
17-Jul-08	Antimony	ND	0.0005	0.002	0.006	U		086358-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		086358-010	SW846 6020
	Barium	0.116	0.0005	0.002	2.00			086358-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086358-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		086358-010	SW846 6020
	Calcium	68.1	0.200	1.00	NE	B		086358-010	SW846 6020
	Chromium	0.00186	0.0015	0.003	0.100	J		086358-010	SW846 6020
	Cobalt	0.000389	0.0001	0.001	NE	J		086358-010	SW846 6020
	Copper	0.000539	0.0003	0.001	NE	J		086358-010	SW846 6020
	Iron	0.273	0.010	0.025	NE			086358-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086358-010	SW846 6020
	Magnesium	21.5	0.0052	0.015	NE			086358-010	SW846 6020
	Manganese	0.0608	0.001	0.005	NE			086358-010	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	086358-010	SW846 7470
	Molybdenum	0.00271	0.0001	0.0005	NE	B		086358-010	SW846 6020
	Nickel	0.00135	0.0005	0.002	NE	J		086358-010	SW846 6020
	Potassium	4.35	0.080	0.300	NE			086358-010	SW846 6020
	Selenium	0.00211	0.001	0.005	0.050	J		086358-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086358-010	SW846 6020
	Sodium	56.3	0.800	2.50	NE		J	086358-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		086358-010	SW846 6020
	Uranium	0.0072	0.00005	0.0002	0.030			086358-010	SW846 6020
	Uranium-235	0.00005	0.00001	0.00007	0.030	J	J+	086358-010	SW846 6020
	Uranium-238	0.00715	0.00005	0.0002	0.030			086358-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		086358-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	B, U		086358-010	SW846 6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW7	Aluminum	ND	0.005	0.015	NE	U		086362-010	SW846 6020
16-Jul-08	Antimony	0.000797	0.0005	0.002	0.006	B, J	0.0048U	086362-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		086362-010	SW846 6020
	Barium	0.106	0.0005	0.002	2.00			086362-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086362-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		086362-010	SW846 6020
	Calcium	51.5	0.200	1.00	NE	B		086362-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	B, U		086362-010	SW846 6020
	Cobalt	0.000114	0.0001	0.001	NE	J	UJ	086362-010	SW846 6020
	Copper	0.00089	0.0003	0.001	NE	J		086362-010	SW846 6020
	Iron	0.127	0.010	0.025	NE	B		086362-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086362-010	SW846 6020
	Magnesium	17.7	0.0052	0.015	NE			086362-010	SW846 6020
	Manganese	0.00914	0.001	0.005	NE			086362-010	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	086362-010	SW846 7470
	Molybdenum	0.0061	0.0001	0.0005	NE			086362-010	SW846 6020
	Nickel	0.00128	0.0005	0.002	NE	J		086362-010	SW846 6020
	Potassium	5.06	0.080	0.300	NE			086362-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	U		086362-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086362-010	SW846 6020
	Sodium	45.2	0.080	0.250	NE			086362-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		086362-010	SW846 6020
	Uranium	0.00818	0.00005	0.0002	0.030			086362-010	SW846 6020
	Uranium-235	0.000056	0.00001	0.00007	0.030	J	J+	086362-010	SW846 6020
	Uranium-238	0.00812	0.00005	0.0002	0.030			086362-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		086362-010	SW846 6020
	Zinc	0.0134	0.0026	0.010	NE			086362-010	SW846 6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW7 (Duplicate)	Aluminum	ND	0.005	0.015	NE	U		086363-010	SW846 6020
16-Jul-08	Antimony	ND	0.0005	0.002	0.006	B, U		086363-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		086363-010	SW846 6020
	Barium	0.104	0.0005	0.002	2.00			086363-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086363-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		086363-010	SW846 6020
	Calcium	53.3	0.200	1.00	NE	B		086363-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	B, U		086363-010	SW846 6020
	Cobalt	0.000118	0.0001	0.001	NE	J	UJ	086363-010	SW846 6020
	Copper	0.000778	0.0003	0.001	NE	J		086363-010	SW846 6020
	Iron	0.124	0.010	0.025	NE	B		086363-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086363-010	SW846 6020
	Magnesium	17.3	0.0052	0.015	NE			086363-010	SW846 6020
	Manganese	0.00862	0.001	0.005	NE			086363-010	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	086363-010	SW846 7470
	Molybdenum	0.00592	0.0001	0.0005	NE			086363-010	SW846 6020
	Nickel	0.00132	0.0005	0.002	NE	J		086363-010	SW846 6020
	Potassium	4.79	0.080	0.300	NE			086363-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	U		086363-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086363-010	SW846 6020
	Sodium	42.6	0.080	0.250	NE			086363-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		086363-010	SW846 6020
	Uranium	0.00807	0.00005	0.0002	0.030			086363-010	SW846 6020
	Uranium-235	0.000057	0.00001	0.00007	0.030	J	J+	086363-010	SW846 6020
	Uranium-238	0.00801	0.00005	0.0002	0.030			086363-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		086363-010	SW846 6020
	Zinc	0.00262	0.0026	0.010	NE	J		086363-010	SW846 6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW8	Aluminum	ND	0.005	0.015	NE	U		086365-010	SW846 6020
14-Jul-08	Antimony	0.000613	0.0005	0.002	0.006	B, J	0.00060U	086365-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		086365-010	SW846 6020
	Barium	0.132	0.0005	0.002	2.00			086365-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086365-010	SW846 6020
	Cadmium	0.000171	0.00011	0.001	0.005	J		086365-010	SW846 6020
	Calcium	53.5	0.200	1.00	NE	B		086365-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	U		086365-010	SW846 6020
	Cobalt	0.000133	0.0001	0.001	NE	J		086365-010	SW846 6020
	Copper	0.000858	0.0003	0.001	NE	J		086365-010	SW846 6020
	Iron	0.125	0.010	0.025	NE	B		086365-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086365-010	SW846 6020
	Magnesium	16.8	0.0052	0.015	NE		J	086365-010	SW846 6020
	Manganese	0.218	0.001	0.005	NE			086365-010	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	086365-010	SW846 7470
	Molybdenum	0.0241	0.0001	0.0005	NE	B		086365-010	SW846 6020
	Nickel	0.00207	0.0005	0.002	NE			086365-010	SW846 6020
	Potassium	5.31	0.080	0.300	NE			086365-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	B, U		086365-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086365-010	SW846 6020
	Sodium	47.3	0.080	0.250	NE			086365-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		086365-010	SW846 6020
	Uranium	0.00695	0.00005	0.0002	0.030			086365-010	SW846 6020
	Uranium-235	0.000048	0.00001	0.00007	0.030	J	J+	086365-010	SW846 6020
	Uranium-238	0.0069	0.00005	0.0002	0.030			086365-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		086365-010	SW846 6020
	Zinc	0.00342	0.0026	0.010	NE	B, J	0.030U	086365-010	SW846 6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW9	Aluminum	ND	0.005	0.015	NE	U		086367-010	SW846 6020
15-Jul-08	Antimony	ND	0.0005	0.002	0.006	B, U		086367-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		086367-010	SW846 6020
	Barium	0.096	0.0005	0.002	2.00			086367-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086367-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		086367-010	SW846 6020
	Calcium	46.4	0.200	1.00	NE	B		086367-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	B, U		086367-010	SW846 6020
	Cobalt	0.000128	0.0001	0.001	NE	J	UJ	086367-010	SW846 6020
	Copper	0.000973	0.0003	0.001	NE	J		086367-010	SW846 6020
	Iron	0.119	0.010	0.025	NE	B		086367-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086367-010	SW846 6020
	Magnesium	13.9	0.0052	0.015	NE			086367-010	SW846 6020
	Manganese	0.019	0.001	0.005	NE			086367-010	SW846 6020
	Mercury	ND	0.00003	0.0002	0.002	U	UJ	086367-010	SW846 7470
	Molybdenum	0.0143	0.0001	0.0005	NE			086367-010	SW846 6020
	Nickel	0.00127	0.0005	0.002	NE	J		086367-010	SW846 6020
	Potassium	6.48	0.080	0.300	NE			086367-010	SW846 6020
	Selenium	0.00196	0.001	0.005	0.050	J		086367-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086367-010	SW846 6020
	Sodium	39.0	0.080	0.250	NE			086367-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		086367-010	SW846 6020
	Uranium	0.00774	0.00005	0.0002	0.030			086367-010	SW846 6020
	Uranium-235	0.000056	0.00001	0.00007	0.030	J	J+	086367-010	SW846 6020
	Uranium-238	0.00769	0.00005	0.0002	0.030			086367-010	SW846 6020
	Vanadium	ND	0.030	0.100	NE	U		086367-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	U		086367-010	SW846 6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-BW2	Aluminum	0.0182	0.005	0.015	NE	B	0.042U	086812-010	SW846 6020
01-Oct-08	Antimony	ND	0.0005	0.002	0.006	U		086812-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		086812-010	SW846 6020
	Barium	0.0948	0.005	0.020	2.00			086812-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086812-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		086812-010	SW846 6020
	Calcium	65.3	0.200	1.00	NE	B		086812-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	U		086812-010	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	U		086812-010	SW846 6020
	Copper	0.000792	0.0003	0.001	NE	J		086812-010	SW846 6020
	Iron	0.232	0.010	0.025	NE	B		086812-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086812-010	SW846 6020
	Magnesium	21.5	0.0052	0.015	NE			086812-010	SW846 6020
	Manganese	0.00216	0.001	0.005	NE	J		086812-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		086812-010	SW846 7470
	Nickel	0.00112	0.0005	0.002	NE	J		086812-010	SW846 6020
	Potassium	4.21	0.080	0.300	NE			086812-010	SW846 6020
	Selenium	0.00188	0.001	0.005	0.050	J		086812-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086812-010	SW846 6020
	Sodium	53.4	0.800	2.50	NE			086812-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		086812-010	SW846 6020
	Uranium	0.00705	0.00005	0.0002	0.030			086812-010	SW846 6020
	Uranium-235	0.000051	0.00001	0.00007	0.030	J	J+	086812-010	SW846 6020
	Uranium-238	0.007	0.00005	0.0002	0.030		J	086812-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		086812-010	SW846 6020
	Zinc	0.00291	0.0026	0.010	NE	J		086812-010	SW846 6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-BW2 (Duplicate)	Aluminum	0.0799	0.005	0.015	NE	B		086813-010	SW846 6020
01-Oct-08	Antimony	ND	0.0005	0.002	0.006	U		086813-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		086813-010	SW846 6020
	Barium	0.100	0.005	0.020	2.00			086813-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086813-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		086813-010	SW846 6020
	Calcium	70.1	0.200	1.00	NE	B		086813-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	U		086813-010	SW846 6020
	Cobalt	0.000104	0.0001	0.001	NE	J		086813-010	SW846 6020
	Copper	0.00053	0.0003	0.001	NE	J		086813-010	SW846 6020
	Iron	0.234	0.010	0.025	NE	B		086813-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086813-010	SW846 6020
	Magnesium	22.7	0.0052	0.015	NE			086813-010	SW846 6020
	Manganese	0.00211	0.001	0.005	NE	J		086813-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		086813-010	SW846 7470
	Nickel	0.00109	0.0005	0.002	NE	J		086813-010	SW846 6020
	Potassium	3.95	0.080	0.300	NE			086813-010	SW846 6020
	Selenium	0.00199	0.001	0.005	0.050	J		086813-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086813-010	SW846 6020
	Sodium	58.2	0.800	2.50	NE			086813-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		086813-010	SW846 6020
	Uranium	0.00724	0.00005	0.0002	0.030			086813-010	SW846 6020
	Uranium-235	0.00005	0.00001	0.00007	0.030	J	J+	086813-010	SW846 6020
	Uranium-238	0.00719	0.00005	0.0002	0.030		J	086813-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		086813-010	SW846 6020
	Zinc	0.00285	0.0026	0.010	NE	J		086813-010	SW846 6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW7	Aluminum	0.0163	0.005	0.015	NE	B	0.043U	086815-010	SW846 6020
06-Oct-08	Antimony	0.000612	0.0005	0.002	0.006	J	0.014U	086815-010	SW846 6020
	Arsenic	0.00211	0.0015	0.005	0.010	B, J	0.0087U	086815-010	SW846 6020
	Barium	0.0973	0.0005	0.002	2.00			086815-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086815-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		086815-010	SW846 6020
	Calcium	53.8	0.200	1.00	NE			086815-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	U		086815-010	SW846 6020
	Cobalt	0.000123	0.0001	0.001	NE	J		086815-010	SW846 6020
	Copper	0.00095	0.0003	0.001	NE	J		086815-010	SW846 6020
	Iron	0.218	0.010	0.025	NE			086815-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086815-010	SW846 6020
	Magnesium	18.4	0.052	0.150	NE		J	086815-010	SW846 6020
	Manganese	0.00154	0.001	0.005	NE	J		086815-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	086815-010	SW846 7470
	Nickel	0.00111	0.0005	0.002	NE	J		086815-010	SW846 6020
	Potassium	5.09	0.080	0.300	NE			086815-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	U		086815-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086815-010	SW846 6020
	Sodium	42.5	0.080	0.250	NE		J	086815-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		086815-010	SW846 6020
	Uranium	0.00774	0.00005	0.0002	0.030			086815-010	SW846 6020
	Uranium-235	0.000054	0.00001	0.00007	0.030	J	J+	086815-010	SW846 6020
	Uranium-238	0.00768	0.00005	0.0002	0.030			086815-010	SW846 6020
	Vanadium	0.00462	0.003	0.010	NE	J		086815-010	SW846 6020
	Zinc	0.0133	0.0026	0.010	NE			086815-010	SW846 6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW8	Aluminum	0.00855	0.005	0.015	NE	B, J	0.043U	086817-010	SW846 6020
07-Oct-08	Antimony	ND	0.0005	0.002	0.006	U		086817-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	U		086817-010	SW846 6020
	Barium	0.117	0.0005	0.002	2.00			086817-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086817-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		086817-010	SW846 6020
	Calcium	54.9	0.200	1.00	NE			086817-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	U		086817-010	SW846 6020
	Cobalt	0.000129	0.0001	0.001	NE	J		086817-010	SW846 6020
	Copper	0.00102	0.0003	0.001	NE			086817-010	SW846 6020
	Iron	0.211	0.010	0.025	NE			086817-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086817-010	SW846 6020
	Magnesium	18.3	0.052	0.150	NE		J	086817-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		086817-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	086817-010	SW846 7470
	Nickel	0.00112	0.0005	0.002	NE	J		086817-010	SW846 6020
	Potassium	6.28	0.080	0.300	NE			086817-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	U		086817-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086817-010	SW846 6020
	Sodium	47.6	0.080	0.250	NE		J	086817-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		086817-010	SW846 6020
	Uranium	0.00811	0.00005	0.0002	0.030			086817-010	SW846 6020
	Uranium-235	0.000058	0.00001	0.00007	0.030	J	J+	086817-010	SW846 6020
	Uranium-238	0.00805	0.00005	0.0002	0.030			086817-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	U		086817-010	SW846 6020
	Zinc	0.00388	0.0026	0.010	NE	J		086817-010	SW846 6020

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW9	Aluminum	0.00786	0.005	0.015	NE	B, J	0.043U	086820-010	SW846 6020
08-Oct-08	Antimony	ND	0.0005	0.002	0.006	U		086820-010	SW846 6020
	Arsenic	0.00355	0.0015	0.005	0.010	B, J	0.0087U	086820-010	SW846 6020
	Barium	0.0872	0.0005	0.002	2.00			086820-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	U		086820-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		086820-010	SW846 6020
	Calcium	65.5	0.200	1.00	NE			086820-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	U		086820-010	SW846 6020
	Cobalt	0.000127	0.0001	0.001	NE	J		086820-010	SW846 6020
	Copper	0.000686	0.0003	0.001	NE	J		086820-010	SW846 6020
	Iron	0.206	0.010	0.025	NE			086820-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		086820-010	SW846 6020
	Magnesium	22.7	0.052	0.150	NE		J	086820-010	SW846 6020
	Manganese	0.00715	0.001	0.005	NE			086820-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	086820-010	SW846 7470
	Nickel	0.00108	0.0005	0.002	NE	J		086820-010	SW846 6020
	Potassium	4.77	0.080	0.30	NE			086820-010	SW846 6020
	Selenium	0.00157	0.001	0.005	0.050	J		086820-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		086820-010	SW846 6020
	Sodium	42.2	0.080	0.250	NE		J	086820-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	U		086820-010	SW846 6020
	Uranium	0.00868	0.00005	0.0002	0.030			086820-010	SW846 6020
	Uranium-235	0.000061	0.00001	0.00007	0.030	J	J+	086820-010	SW846 6020
	Uranium-238	0.00862	0.00005	0.0002	0.030			086820-010	SW846 6020
	Vanadium	0.00854	0.003	0.010	NE	J		086820-010	SW846 6020
	Zinc	0.0033	0.0026	0.010	NE	J		086820-010	SW846 6020

[a]MDL is the minimum concentration that can be measured and reported with 99% confidence that the analyte is greater than zero; analyte is matrix-specific.

[b]PQL is the lowest concentration of analytes in a sample that can be reliably determined within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions.

[c]MCL is established by the U.S. Environmental Protection Agency Primary Water Regulations (40 CFR 141.11[b]), and subsequent amendments or the New Mexico Environmental Improvement Board in 20 NMAC 7.1.

[d]Laboratory Qualifiers:
B = Analyte is detected in associated laboratory method blank.
J = Amount detected is below the PQL.
U = Analyte is absent or below the MDL.

Table A-6 (Concluded)
Summary of Total Metals Results (Filtered)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

[e]Validation Qualifiers (If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.):
J+ = The associated numerical value is an estimated quantity with suspected positive bias.
NJ- = Presumptive evidence of the presence of the material at an estimated quantity with a suspected negative bias.
U = The analyte was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.
UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

[f]U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.
BW = Background well.
CFR = Code of Federal Regulations.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
ND = Not detected (at method detection limit).
NE = Not established.
NMAC = New Mexico Administrative Code.
PQL = Practical quantitation limit.

Table A-7
Summary of Detected Volatile and Semivolatile Organic Compounds
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Result (μg/L)	MDL[a] (μg/L)	PQL[b] (μg/L)	MCL[c] (μg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW4 16-Apr-08	Acetone	3.82	1.25	5.00	NE	J	J-	085770-001	SW846 8260
MWL-MW6 08-Apr-08	Acetone	2.31	1.25	5.00	NE	J	J+	085779-001	SW846 8260
MWL-MW9 15-Jul-08	Toluene	0.510	0.250	1.00	1000	J		086367-001	SW846 8260

[a]MDL is the minimum concentration that can be measured and reported with 99% confidence that the analyte is greater than zero; analyte is matrix-specific.

[b]PQL is the lowest concentration of analytes in a sample that can be reliably determined within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions.

[c]MCL is established by the U.S. Environmental Protection Agency Primary Water Regulations (40 CFR 141.11[b]), and subsequent amendments or the New Mexico Environmental Improvement Board in 20 NMAC 7.1.

[d]Laboratory Qualifiers:
J = Amount detected is below the PQL.

[e]Validation Qualifiers (If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.):
J+ = The associated numerical value is an estimated quantity with suspected positive bias.
J- = The associated numerical value is an estimated quantity with suspected negative bias.

[f]U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.

CFR = Code of Federal Regulations.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
μg/L = Microgram(s) per liter.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
NE = Not established.
NMAC = New Mexico Administrative Code.
PQL = Practical quantitation limit.

Table A-8
Method Detection Limits for Volatile and Semivolatile Organic Compounds
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Analyte	MDL[a] (µg/L)	Analytical Method[b]
Acetone	1.25–5.00	SW846-8260
Benzene	0.300–1.00	SW846-8260
Bromodichloromethane	0.250	SW846-8260
Bromoform	0.250	SW846-8260
Bromomethane	0.500	SW846-8260
2-Butanone	1.25	SW846-8260
Carbon disulfide	1.25	SW846-8260
Carbon tetrachloride	0.250–0.260	SW846-8260
Chlorobenzene	0.250	SW846-8260
Chloroethane	0.300–0.500	SW846-8260
Chloroform	0.250	SW846-8260
Chloromethane	0.300–0.500	SW846-8260
Dibromochloromethane	0.250–0.260	SW846-8260
1,1-Dichloroethane	0.300	SW846-8260
1,2-Dichloroethane	0.250	SW846-8260
1,1-Dichloroethene	0.300	SW846-8260
cis-1,2-Dichloroethene	0.300	SW846-8260
trans-1,2-Dichloroethene	0.300	SW846-8260
1,2-Dichloropropane	0.250	SW846-8260
cis-1,3-Dichloropropene	0.250	SW846-8260
trans-1,3-Dichloropropene	0.250	SW846-8260
Ethyl benzene	0.250	SW846-8260
2-Hexanone	1.25	SW846-8260
Methylene chloride	2.00–5.00	SW846-8260
4-Methyl-2-pentanone	1.25	SW846-8260
Styrene	0.250	SW846-8260
1,1,2,2-Tetrachloroethane	0.250	SW846-8260
Tetrachloroethene	0.250–0.450	SW846-8260
Toluene	0.250–1.00	SW846-8260
1,1,1-Trichloroethane	0.300–0.325	SW846-8260
1,1,2-Trichloroethane	0.250	SW846-8260
Trichloroethene	0.250	SW846-8260
Vinyl acetate	1.50–5.00	SW846-8260
Vinyl chloride	0.500	SW846-8260
Xylene	0.250–0.600	SW846-8260
Acenaphthene	0.310–0.373	SW846-8270
Acenaphthylene	0.200–0.241	SW846-8270
Anthracene	0.200–0.241	SW846-8270
Benzo(a)anthracene	0.200–0.241	SW846-8270
Benzo(a)pyrene	0.200–0.241	SW846-8270
Benzo(b)fluoranthene	0.200–0.241	SW846-8270
Benzo(ghi)perylene	0.200–0.241	SW846-8270
Benzo(k)fluoranthene	0.200–0.241	SW846-8270
4-Bromophenyl phenyl ether	2.00–2.41	SW846-8270
Butylbenzyl phthalate	2.00–2.41	SW846-8270
Carbazole	0.200–0.241	SW846-8270
4-Chlorobenzenamine	2.00–2.41	SW846-8270
bis(2-Chloroethoxy)methane	3.00–3.61	SW846-8270
bis(2-Chloroethyl)ether	2.00–2.41	SW846-8270

Refer to footnotes at end of table.

Table A-8 (Continued)
Method Detection Limits for Volatile and Semivolatile Organic Compounds
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Analyte	MDL[a] (μg/L)	Analytical Method[b]
bis-Chloroisopropyl ether	2.00–2.41	SW846-8270
4-Chloro-3-methylphenol	2.00–2.41	SW846-8270
2-Chloronaphthalene	0.350–0.422	SW846-8270
2-Chlorophenol	2.00–2.41	SW846-8270
4-Chlorophenyl phenyl ether	2.00–2.41	SW846-8270
Chrysene	0.200–0.241	SW846-8270
m,p-Cresol	3.00–3.61	SW846-8270
o-Cresol	2.00–2.41	SW846-8270
Dibenz[a,h]anthracene	0.200–0.241	SW846-8270
Dibenzofuran	2.00–2.41	SW846-8270
1,2-Dichlorobenzene	2.00–2.41	SW846-8270
1,3-Dichlorobenzene	2.00–2.41	SW846-8270
1,4-Dichlorobenzene	2.00–2.41	SW846-8270
3,3'-Dichlorobenzidine	1.00–1.20	SW846-8270
2,4-Dichlorophenol	2.00–2.41	SW846-8270
Diethylphthalate	2.00–2.41	SW846-8270
2,4-Dimethylphenol	2.00–2.41	SW846-8270
Dimethylphthalate	2.00–2.41	SW846-8270
Di-n-butyl phthalate	2.00–2.41	SW846-8270
2,4-Dinitrophenol	10.0–12.0	SW846-8270
Dinitro-o-cresol	3.00–3.61	SW846-8270
2,4-Dinitrotoluene	2.00–2.41	SW846-8270
2,6-Dinitrotoluene	2.00–2.41	SW846-8270
Di-n-octyl phthalate	3.00–3.61	SW846-8270
Diphenyl amine	3.00–3.61	SW846-8270
bis(2-Ethylhexyl)phthalate	2.00–2.41	SW846-8270
Fluoranthene	0.200–0.241	SW846-8270
Fluorene	0.200–0.241	SW846-8270
Hexachlorobenzene	2.00–2.41	SW846-8270
Hexachlorobutadiene	2.00–2.41	SW846-8270
Hexachlorocyclopentadiene	2.00–2.41	SW846-8270
Hexachloroethane	2.00–2.41	SW846-8270
Indeno(1,2,3-c,d)pyrene	0.200–0.241	SW846-8270
Isophorone	2.00–2.41	SW846-8270
2-Methylnaphthalene	0.300–0.361	SW846-8270
Naphthalene	0.300–0.361	SW846-8270
2-Nitroaniline	2.00–2.41	SW846-8270
3-Nitroaniline	2.00–2.41	SW846-8270
4-Nitroaniline	3.00–3.61	SW846-8270
Nitrobenzene	3.00–3.61	SW846-8270
2-Nitrophenol	2.00–2.41	SW846-8270
4-Nitrophenol	2.00–2.41	SW846-8270
n-Nitrosodipropylamine	2.00–2.41	SW846-8270
Pentachlorophenol	2.00–2.41	SW846-8270
Phenanthrene	0.200–0.241	SW846-8270
Phenol	1.00–1.20	SW846-8270
Pyrene	0.300–0.361	SW846-8270

Refer to footnotes at end of table.

Table A-8 (Concluded)
Method Detection Limits for Volatile and Semivolatile Organic Compounds
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Analyte	MDL[a] (μg/L)	Analytical Method[b]
1,2,4-Trichlorobenzene	2.00–2.41	SW846-8270
2,4,5-Trichlorophenol	1.00–1.20	SW846-8270
2,4,6-Trichlorophenol	2.00–2.41	SW846-8270

[a]MDL is the minimum concentration that can be measured and reported with 99% confidence that the analyte is greater than zero; analyte is matrix-specific.
[b]U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.
MDL = Method detection limit.
μg/L = Microgram(s) per liter.

Table A-9
Summary of Perchlorate Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Perchlorate Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-BW2 09-Apr-08	ND	0.004	0.012	NE	U		085758-020	EPA 314.0
MWL-BW2 17-Jul-08	ND	0.004	0.012	NE	U		086358-020	EPA 314.0
MWL-MW7 16-Jul-08	ND	0.004	0.012	NE	U		086362-020	EPA 314.0
MWL-MW7 (Duplicate) 16-Jul-08	ND	0.004	0.012	NE	U		086363-020	EPA 314.0
MWL-MW8 14-Jul-08	ND	0.004	0.012	NE	U		086365-020	EPA 314.0
MWL-MW9 15-Jul-08	ND	0.004	0.012	NE	U		086367-020	EPA 314.0
MWL-BW2 01-Oct-08	ND	0.004	0.012	NE	U		086812-020	EPA 314.0
MWL-BW2 (Duplicate) 01-Oct-08	ND	0.004	0.012	NE	U		086813-020	EPA 314.0
MWL-MW7 06-Oct-08	ND	0.004	0.012	NE	U		086815-020	EPA 314.0
MWL-MW8 07-Oct-08	ND	0.004	0.012	NE	U		086817-020	EPA 314.0
MWL-MW9 08-Oct-08	ND	0.004	0.012	NE	U		086820-020	EPA 314.0

[a]MDL is the minimum concentration that can be measured and reported with 99% confidence that the analyte is greater than zero; analyte is matrix-specific.

[b]PQL is the lowest concentration of analytes in a sample that can be reliably determined within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions.

[c]MCL is established by the U.S. Environmental Protection Agency Primary Water Regulations (40 CFR 141.11[b]), and subsequent amendments or the New Mexico Environmental Improvement Board in 20 NMAC 7.1.

[d]Laboratory Qualifiers:
U = Analyte is absent or below the MDL.

Table A-9 (Concluded)
Summary of Perchlorate Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

[e]Validation Qualifiers (If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.)

[f]U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.

BW = Background well.
CFR = Code of Federal Regulations.
EPA = U.S. Environmental Protection Agency.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
ND = Not detected (at method detection limit).
NE = Not established.
NMAC = New Mexico Administrative Code.
PQL = Practical quantitation limit.

Table A-10
Summary of Gamma Spectroscopy, Gross Alpha/Beta Activity, and Tritium Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d] (pCi/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-BW2	Americium-241	-1.85 ± 14.3	18.9	9.47	NE	U	BD	085758-033	EPA 901.1
09-Apr-08	Cesium-137	0.821 ± 2.20	3.78	1.89	NE	U	BD	085758-033	EPA 901.1
	Cobalt-60	-0.507 ± 2.39	3.39	1.70	NE	U	BD	085758-033	EPA 901.1
	Potassium-40	34.5 ± 52.4	35.7	17.9	NE	U	BD	085758-033	EPA 901.1
	Gross Alpha	11.2 ± 2.92	1.16	0.478	15			085758-034	EPA 900.0
	Gross Beta	5.95 ± 1.61	1.81	0.871	4 mrem/yr			085758-034	EPA 900.0
	Tritium	77.8 ± 79.5	131	63.7	NE	U	BD	085758-036	EPA 906.0 M
MWL-MW4	Americium-241	2.05 ± 15.1	23.3	11.6	NE	U	BD	085770-033	EPA 901.1
16-Apr-08	Cesium-137	-1.7 ± 3.66	3.24	1.62	NE	U	BD	085770-033	EPA 901.1
	Cobalt-60	2.52 ± 2.17	3.73	1.87	NE	U	BD	085770-033	EPA 901.1
	Potassium-40	12.1 ± 58.2	32.4	16.2	NE	U	BD	085770-033	EPA 901.1
	Gross Alpha	15.5 ± 3.72	1.02	0.425	15			085770-034	EPA 900.0
	Gross Alpha (reanalysis)	15.9 ± 7.32	4.91	1.47	15			085770-R34	EPA 900.0
	Gross Beta	5.84 ± 1.89	1.78	0.769	4 mrem/yr			085770-034	EPA 900.0
	Tritium	-65.1 ± 76.3	136	66.0	NE	U	BD	085770-036	EPA 906.0 M
MWL-MW5	Americium-241	-1.97 ± 11.3	16.8	8.38	NE	U	BD	085775-033	EPA 901.1
10-Apr-08	Cesium-137	0.671 ± 2.01	3.21	1.61	NE	U	BD	085775-033	EPA 901.1
	Cobalt-60	0.812 ± 2.20	3.75	1.88	NE	U	BD	085775-033	EPA 901.1
	Potassium-40	9.64 ± 36.0	47.6	23.8	NE	U	BD	085775-033	EPA 901.1
	Gross Alpha	20.7 ± 5.07	1.65	0.692	15			085775-034	EPA 900.0
	Gross Alpha (reanalysis)	16.4 ± 9.19	8.87	2.92	15		J	085775-R34	EPA 900.0
	Gross Beta	12.1 ± 4.75	5.23	2.26	4 mrem/yr		J	085775-034	EPA 900.0
	Tritium	-5.05 ± 77.0	133	64.8	NE	U	BD	085775-036	EPA 906.0 M
MWL-MW5 (Duplicate)	Americium-241	1.23 ± 5.60	8.99	4.50	NE	U	BD	085776-033	EPA 901.1
10-Apr-08	Cesium-137	0.364 ± 1.55	2.60	1.30	NE	U	BD	085776-033	EPA 901.1
	Cobalt-60	0.227 ± 1.58	2.65	1.33	NE	U	BD	085776-033	EPA 901.1
	Potassium-40	30.4 ± 36.8	23.9	12.0	NE	X	R	085776-033	EPA 901.1
	Gross Alpha	17.0 ± 4.46	2.54	1.14	15			085776-034	EPA 900.0
	Gross Alpha (reanalysis)	15.7 ± 8.29	7.93	2.74	15		J	085776-R34	EPA 900.0
	Gross Beta	8.41 ± 3.75	4.08	1.70	4 mrem/yr		J	085776-034	EPA 900.0
	Tritium	-100 ± 73.7	132	64.2	NE	U	BD	085776-036	EPA 906.0 M

Refer to footnotes at end of table.

Table A-10 (Continued)
Summary of Gamma Spectroscopy, Gross Alpha/Beta Activity, and Tritium Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d] (pCi/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW6	Americium-241	5.17 ± 5.87	8.92	4.46	NE	U	BD	085779-033	EPA 901.1
08-Apr-08	Cesium-137	-0.33 ± 1.49	2.44	1.22	NE	U	BD	085779-033	EPA 901.1
	Cobalt-60	0.546 ± 1.87	2.75	1.38	NE	U	BD	085779-033	EPA 901.1
	Potassium-40	45.2 ± 40.8	21.2	10.6	NE	X	R	085779-033	EPA 901.1
	Gross Alpha	17.9 ± 4.42	1.42	0.588	15			085779-034	EPA 900.0
	Gross Alpha (reanalysis)	17.8 ± 10.5	15.5	7.14	15		J	085779-R34	EPA 900.0
	Gross Beta	6.62 ± 3.67	4.76	2.03	4 mrem/yr		J	085779-034	EPA 900.0
	Tritium	-5.01 ± 76.3	132	64.2	NE	U	BD	085779-036	EPA 906.0 M
MWL-BW2	Americium-241	0.510 ± 11.8	17.3	8.66	NE	U	BD	086358-033	EPA 901.1
17-Jul-08	Cesium-137	0.622 ± 2.00	3.46	1.73	NE	U	BD	086358-033	EPA 901.1
	Cobalt-60	-1.13 ± 2.09	3.29	1.65	NE	U	BD	086358-033	EPA 901.1
	Potassium-40	11.3 ± 47.2	33.3	16.7	NE	U	BD	086358-033	EPA 901.1
	Gross Alpha	10.8 ± 2.86	1.60	0.711	15			086358-034	EPA 900.0
	Gross Beta	3.25 ± 1.84	2.88	1.40	4 mrem/yr		J	086358-034	EPA 900.0
	Tritium	14.4 ± 90.6	176	73.5	NE	U	BD	086358-036	EPA 906.0 M
MWL-MW7	Americium-241	0.584 ± 6.17	9.07	4.54	NE	U	BD	086362-033	EPA 901.1
16-Jul-08	Cesium-137	-0.492 ± 1.65	2.69	1.35	NE	U	BD	086362-033	EPA 901.1
	Cobalt-60	2.09 ± 1.63	2.96	1.48	NE	U	BD	086362-033	EPA 901.1
	Potassium-40	3.87 ± 36.7	41.2	20.6	NE	U	BD	086362-033	EPA 901.1
	Gross Alpha	11.7 ± 2.65	1.11	0.483	15			086362-034	EPA 900.0
	Gross Beta	10.6 ± 2.13	1.52	0.733	4 mrem/yr			086362-034	EPA 900.0
	Tritium	-23.3 ± 80.2	171	71.6	NE	U	BD	086362-036	EPA 906.0 M
MWL-MW7 (Duplicate)	Americium-241	2.02 ± 8.92	13.4	6.72	NE	U	BD	086363-033	EPA 901.1
16-Jul-08	Cesium-137	1.09 ± 1.99	3.14	1.57	NE	U	BD	086363-033	EPA 901.1
	Cobalt-60	1.15 ± 1.76	3.08	1.54	NE	U	BD	086363-033	EPA 901.1
	Potassium-40	-25.1 ± 37.4	41.6	20.8	NE	U	BD	086363-033	EPA 901.1
	Gross Alpha	10.3 ± 2.56	1.43	0.646	15			086363-034	EPA 900.0
	Gross Beta	7.59 ± 1.74	1.72	0.833	4 mrem/yr			086363-034	EPA 900.0
	Tritium	102 ± 107	173	72.4	NE	U	BD	086363-036	EPA 906.0 M

Refer to footnotes at end of table.

Table A-10 (Continued)
Summary of Gamma Spectroscopy, Gross Alpha/Beta Activity, and Tritium Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d] (pCi/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW8	Americium-241	-7.78 ± 7.66	11.9	5.97	NE	U	BD	086365-033	EPA 901.1
14-Jul-08	Cesium-137	-0.748 ± 2.97	2.84	1.42	NE	U	BD	086365-033	EPA 901.1
	Cobalt-60	-0.0617 ± 1.79	3.01	1.50	NE	U	BD	086365-033	EPA 901.1
	Potassium-40	26.5 ± 37.1	30.1	15.1	NE	U	BD	086365-033	EPA 901.1
	Gross Alpha	9.43 ± 2.29	1.25	0.553	15			086365-034	EPA 900.0
	Gross Beta	6.53 ± 1.43	1.16	0.556	4 mrem/yr			086365-034	EPA 900.0
	Tritium	61.8 ± 99.7	174	72.9	NE	U	BD	086365-036	EPA 906.0 M
MWL-MW9	Americium-241	1.40 ± 4.60	7.86	3.93	NE	U	BD	086367-033	EPA 901.1
15-Jul-08	Cesium-137	-1.15 ± 3.44	2.88	1.44	NE	U	BD	086367-033	EPA 901.1
	Cobalt-60	-5.38 ± 4.89	3.13	1.57	NE	U	BD	086367-033	EPA 901.1
	Potassium-40	19.8 ± 43.4	27.4	13.7	NE	U	BD	086367-033	EPA 901.1
	Gross Alpha	11.6 ± 2.53	1.10	0.484	15			086367-034	EPA 900.0
	Gross Beta	6.50 ± 1.53	1.50	0.727	4 mrem/yr			086367-034	EPA 900.0
	Tritium	71.8 ± 99.6	170	71.1	NE	U	BD	086367-036	EPA 906.0 M
MWL-BW2	Americium-241	8.10 ± 9.18	14.1	7.05	NE	U	BD	086812-033	EPA 901.1
01-Oct-08	Cesium-137	1.11 ± 2.23	3.17	1.59	NE	U	BD	086812-033	EPA 901.1
	Cobalt-60	0.620 ± 1.93	3.29	1.65	NE	U	BD	086812-033	EPA 901.1
	Potassium-40	-5.87 ± 36.3	43.0	21.5	NE	U	BD	086812-033	EPA 901.1
	Gross Alpha	13.3 ± 5.99	5.13	1.80	15		J	086812-034	EPA 900.0
	Gross Beta	9.48 ± 4.15	5.28	2.38	4 mrem/yr		J	086812-034	EPA 900.0
	Tritium	21.9 ± 100	171	83.4	NE	U	BD	086812-036	EPA 906.0 M
MWL-BW2 (Duplicate)	Americium-241	7.52 ± 8.28	12.3	6.16	NE	U	BD	086813-033	EPA 901.1
01-Oct-08	Cesium-137	0.574 ± 1.63	2.78	1.39	NE	U	BD	086813-033	EPA 901.1
	Cobalt-60	-0.354 ± 1.94	3.22	1.61	NE	U	BD	086813-033	EPA 901.1
	Potassium-40	-19.0 ± 36.5	39.6	19.8	NE	U	BD	086813-033	EPA 901.1
	Gross Alpha	4.24 ± 3.21	3.93	1.28	15		J	086813-034	EPA 900.0
	Gross Beta	4.80 ± 2.79	3.83	1.66	4 mrem/yr		J	086813-034	EPA 900.0
	Tritium	107 ± 104	171	83.2	NE	U	BD	086813-036	EPA 906.0 M

Refer to footnotes at end of table.

Table A-10 (Continued)
Summary of Gamma Spectroscopy, Gross Alpha/Beta Activity, and Tritium Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d] (pCi/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW7	Americium-241	0.864 ± 11.4	12.3	6.13	NE	U	BD	086815-033	EPA 901.1
06-Oct-08	Cesium-137	0.514 ± 1.82	3.04	1.52	NE	U	BD	086815-033	EPA 901.1
	Cobalt-60	1.37 ± 1.90	3.33	1.67	NE	U	BD	086815-033	EPA 901.1
	Potassium-40	-11.9 ± 39.6	39.2	19.6	NE	U	BD	086815-033	EPA 901.1
	Gross Alpha	4.06 ± 2.08	1.59	0.466	15		J	086815-034	EPA 900.0
	Gross Beta	5.44 ± 1.66	2.15	1.04	4 mrem/yr		J	086815-034	EPA 900.0
	Tritium	85.1 ± 103	170	82.9	NE	U	BD	086815-036	EPA 906.0 M
MWL-MW8	Americium-241	-3.41 ± 7.91	12.6	6.30	NE	U	BD	086817-033	EPA 901.1
07-Oct-08	Cesium-137	1.33 ± 1.65	2.87	1.44	NE	U	BD	086817-033	EPA 901.1
	Cobalt-60	0.721 ± 1.84	3.18	1.59	NE	U	BD	086817-033	EPA 901.1
	Potassium-40	42.5 ± 41.3	29.1	14.6	NE	X	R	086817-033	EPA 901.1
	Gross Alpha	7.39 ± 1.96	0.969	0.389	15			086817-034	EPA 900.0
	Gross Beta	8.35 ± 2.10	2.36	1.15	4 mrem/yr			086817-034	EPA 900.0
	Tritium	56.2 ± 101	171	83.0	NE	U	BD	086817-036	EPA 906.0 M
MWL-MW9	Americium-241	-0.877 ± 3.84	5.01	2.51	NE	U	BD	086820-033	EPA 901.1
08-Oct-08	Cesium-137	0.820 ± 2.24	3.85	1.93	NE	U	BD	086820-033	EPA 901.1
	Cobalt-60	1.72 ± 2.38	4.18	2.09	NE	U	BD	086820-033	EPA 901.1
	Potassium-40	59.6 ± 28.4	59.7	27.3	NE	U	BD	086820-033	EPA 901.1
	Gross Alpha	10.5 ± 2.35	0.954	0.421	15			086820-034	EPA 900.0
	Gross Beta	8.57 ± 2.25	2.68	1.31	4 mrem/yr			086820-034	EPA 900.0
	Tritium	41.9 ± 101	172	83.5	NE	U	BD	086820-036	EPA 906.0 M

[a]Activity levels of zero or less are considered to be not detected.

[b]MDA is the minimal detectable activity or minimum measured activity in a sample required to ensure a 95% probability that the measured activity is accurately quantified above the critical level.

[c]Critical level is the minimum activity that can be measured and reported with 99% confidence that the analyte is greater than zero, analyte is matrix specific.

[d]MCL is established by the U.S. Environmental Protection Agency Primary Water Regulations (40 CFR 141.11[b]), and subsequent amendments or the New Mexico Environmental Improvement Board in 20 NMAC 7.1.

[e]Laboratory Qualifiers:

U = Analyte is absent or below the method detection limit.

X = Used in radiochemistry to identify data rejected due to interference, low abundance, peak not meeting identification criteria, or uncertain identification for gamma spectroscopy.

Table A-10 (Concluded)
Summary of Gamma Spectroscopy, Gross Alpha/Beta Activity, and Tritium Results
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

[f]Validation Qualifiers (If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.):
BD = Used in radiochemistry to identify results that are not statistically different from zero.
J = The associated value is an estimated quantity.
R = The data are unusable for their intended purpose. The analyte may or may not be present.

[g]U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.

BW = Background well.
CFR = Code of Federal Regulations.
EPA = U.S. Environmental Protection Agency.
ID = Identification.
MCL = Maximum contaminant level.
MDA = Minimal detectable activity.
mrem/yr = Millirem per year.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
NE = Not established.
NMAC = New Mexico Administrative Code.
pCi/L = Picocurie(s) per liter.

Table A-11
Corrected Gross Alpha Activity (only uranium subtracted)
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Well ID	Sample Date	Gross Alpha (pCi/L)	Method 1 Total Uranium[a] (pCi/L)	Gross Alpha Corrected (pCi/L)	Method 2 Total Uranium[b] (pCi/L)	Gross Alpha Corrected (pCi/L)
MWL-MW4	04-16-08	15.5	5.12	10.38	5.23	10.27
MWL-MW4 (reanalysis)	04-16-08	15.9	5.12	10.78	5.23	10.67
MWL-MW5	04-10-08	20.7	5.86	14.84	5.98	14.72
MWL-MW5 (reanalysis)	04-10-08	16.4	5.86	10.54	5.98	10.42
MWL-MW5 (duplicate)	04-10-08	17.0	5.86	11.14	5.98	11.02
MWL-MW5 (duplicate reanalysis)	04-10-08	15.7	5.86	9.84	5.98	9.72
MWL-MW6	04-08-08	17.9	5.77	12.13	5.89	12.01
MWL-MW6 (reanalysis)	04-08-08	17.8	5.77	12.03	5.89	11.91

Note: The MCL for gross alpha activity is 15 pCi/L; however, total uranium is not intended in the standard and can be subtracted as needed.
[a]Method 1: Used conversion factor of 670 pCi/mg natural uranium as listed in CFR, Vol. 65, No. 236, and in NMED, May 2003, "Recommendations for a Uranium Health-Based Ground Water Standard," New Mexico Environment Department, Santa Fe, New Mexico.
[b]Method 2: Used radiological unit converter at web link http://www.antenna.nl/wise/uranium/cunit.html.
CFR = Code of Federal Regulations.
ID = Identification.
MCL = Maximum contaminant level.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
NMED = New Mexico Environment Department.
pCi/L = Picocurie(s) per liter.
pCi/mg = Picocurie(s) per milligram.

Table A-12
Duplicate Sample Analytical Results for Chemical Analyses
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Sample No. Sample Location	085775 MWL-MW5 Environmental	085776 MWL-MW5 Duplicate	
	Result (R_1)	Result (R_2)	
Parameter[a]	All results in mg/L		RPD[b]
Bromide	0.496	0.509	3
Chloride	84.2	85.6	2
Fluoride	0.697	0.709	2
Sulfate	53	53.9	2
Nitrate plus Nitrite, as N	1.37	1.36	1
Alkalinity, Total	317	316	< 1
Aluminum	0.0135 J	0.0114 J	NC
Barium	0.128	0.127	1
Calcium	94.5	90.2	5
Iron	0.129	0.121	6
Magnesium	28.1	29.0	3
Manganese	0.0124	0.0107	15
Molybdenum	0.00336	0.00325	3
Nickel	0.00199 J	0.00185 J	NC
Potassium	5.57	5.42	3
Selenium	0.00115 J	0.00181 J	NC
Sodium	70.1	64.1	9
Uranium-235	0.000063 J	0.000065 J	NC
Uranium-238	0.009	0.00876	3
Zinc	0.00435 J	0.00318 J	NC
Barium (filtered)	0.126	0.129	2
Calcium (filtered)	93.0	94.0	1
Iron (filtered)	0.110	0.115	4
Magnesium (filtered)	28.4	29.9	5
Manganese (filtered)	0.00801	0.00884	10
Molybdenum (filtered)	0.00327	0.00329	1
Nickel (filtered)	0.00223	0.00208	7
Potassium (filtered)	5.51	5.90	7
Selenium (filtered)	0.00108 J	0.00145 J	NC
Sodium (filtered)	63.7	64.3	1
Uranium-235 (filtered)	0.000063 J	0.000066 J	NC
Uranium-238 (filtered)	0.00869	0.00892	3
Zinc (filtered)	0.00374 J	0.00333 J	NC

Refer to footnotes at end of table.

Table A-12 (Continued)
Duplicate Sample Analytical Results for Chemical Analyses
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Sample No. Sample Location	086362 MWL-MW7 Environmental	086363 MWL-MW7 Duplicate	
	Result (R_1)	Result (R_2)	
Parameter[a]	All results in mg/L		RPD[b]
Bromide	0.276	0.650	81
Chloride	42.0	41.9	< 1
Fluoride	0.995	0.986	1
Sulfate	38.8	38.9	0
Nitrate plus Nitrite, as N	3.13	3.21	3
Alkalinity, Total	212	213	< 1
Aluminum	0.00694 J	0.0275	NC
Barium	0.104	0.105	1
Calcium	54.2	54.5	1
Copper	0.000792 J	0.000876 J	NC
Iron	0.187	0.194	4
Magnesium	17.4	16.8	4
Manganese	0.00926	0.010	8
Nickel	0.0014 J	0.00129 J	NC
Potassium	4.83	4.97	3
Sodium	46.0	42.9	7
Uranium	0.00781	0.00808	3
Uranium-235	0.000056 J	0.000057 J	NC
Uranium-238	0.00775	0.00803	4
Zinc	0.00261 J	0.00268 J	NC
Barium (filtered)	0.106	0.104	2
Calcium (filtered)	51.5	53.3	3
Copper (filtered)	0.00089 J	0.000778 J	NC
Iron (filtered)	0.127	0.124	2
Magnesium (filtered)	17.7	17.3	2
Manganese (filtered)	0.00914	0.00862	6
Molybdenum (filtered)	0.0061	0.00592	3
Nickel (filtered)	0.00128 J	0.00132 J	NC
Potassium (filtered)	5.06	4.79	5
Sodium (filtered)	45.2	42.6	6
Uranium (filtered)	0.00818	0.00807	1
Uranium-235 (filtered)	0.000056 J	0.000057 J	NC
Uranium-238 (filtered)	0.00812	0.00801	1
Zinc (filtered)	0.0134	0.00262 J	NC

Refer to footnotes at end of table.

Table A-12 (Concluded)
Duplicate Sample Analytical Results for Chemical Analyses
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Sample No. Sample Location	086812 MWL-BW2 Environmental	086813 MWL-BW2 Duplicate	
	Result (R_1)	Result (R_2)	
Parameter[a]	All results in mg/L		RPD[b]
Bromide	0.328	0.331	1
Chloride	62.6	62.3	< 1
Fluoride	0.712	0.719	1
Sulfate	44.5	45.4	2
Nitrate plus Nitrite, as N	2.34	1.98	17
Alkalinity, Total	241	241	< 1
Barium	0.0984	0.0962	2
Calcium	67.3	68.1	1
Cobalt	0.0001 J	0.000113 J	NC
Copper	0.000713 J	0.0005 J	NC
Iron	0.243	0.240	1
Magnesium	21.6	21.9	1
Manganese	0.00267 J	0.00262 J	NC
Nickel	0.000983 J	0.00104 J	NC
Potassium	4.15	3.98	4
Sodium	56.2	56.2	< 1
Uranium	0.00697	0.00696	< 1
Uranium-235	0.000047 J	0.000047 J	NC
Uranium-238	0.00692 J	0.00692 J	NC
Barium (filtered)	0.0948	0.100	5
Calcium (filtered)	65.3	70.1	7
Copper (filtered)	0.000792 J	0.00053 J	NC
Iron (filtered)	0.232	0.234	1
Magnesium (filtered)	21.5	22.7	5
Manganese (filtered)	0.00216 J	0.00211 J	NC
Nickel (filtered)	0.00112 J	0.00109 J	NC
Potassium (filtered)	4.21	3.95	6
Selenium (filtered)	0.00188	0.00199 J	NC
Sodium (filtered)	53.4 J	58.2	9
Uranium (filtered)	0.00705	0.00724	3
Uranium-235 (filtered)	0.000051 J	0.000050 J	NC
Uranium-238 (filtered)	0.00700	0.00719	3
Zinc (filtered)	0.0029 J	0.00285 J	NC

[a]Parameters not detected in both samples are not listed.

[b]RPD is not calculated for estimated values.

BW = Background well.
J = Analyte detected below practical quantitation limit or reported as an estimated concentration.
mg/L = Milligram(s) per liter.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
N = Nitrogen.
NC = Not calculated.
RPD = Relative percent difference is calculated with the following equation and rounded to nearest whole number:

$$RPD = \frac{|R_1 - R_2|}{[(R_1 + R_2)/2]} \times 100$$

where:

R_1 = analysis result
R_2 = duplicate analysis result

Volume VII

TAB 5

NOD: Mixed Waste Landfill Groundwater Monitoring Report
Calendar Year 2008

From: NMED/Bearzi
To: SNL/Davis

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NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

October 29, 2009

Kimberly A. Davis
Acting Manager
U. S. Department of Energy
NNSA/Sandia Site Office
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Security Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: NOTICE OF DISAPPROVAL: MIXED WASTE LANDFILL GROUNDWATER MONITORING REPORT CALENDAR YEAR 2008, MAY 2009 SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518 HWB-SNL-09-012

Dear Ms. Davis and Mr. Nimick:

The New Mexico Environment Department (NMED) has reviewed the *Mixed Waste Landfill Groundwater Monitoring Report Calendar Year 2008*, dated May 2009, with cover letter dated May 27, 2009. The subject report was submitted by the U. S. Department of Energy (DOE) on behalf of the Sandia National Laboratories Facility. NMED has identified a number of deficiencies in the subject report, some which require a response from the DOE and Sandia Corporation (collectively, the Permittees).

The following comments must be addressed by the Permittees.

1. Page 1-1, last paragraph, the sentence states "...and five downgradient or cross-gradient wells (MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9) (Figure 1-2)" -- Indicate which well(s) the Permittees consider to be cross-gradient.
2. Page 4-1, 2nd paragraph in Section 4.1, second to last sentence -- Explain what is meant by "more variation in the flow field" in the localized flow pattern.
3. Figure 4.1-1, page 4-3 -- The groundwater elevation values shown for MWL-MW7, MWL-MW9, and MWL-BW2 are not the same as those listed in Table A-1, Appendix A,

page A-1. Indicate which values are correct. Indicate also whether the other groundwater elevation values shown on Figure 4.1-1 are correct.

4. Section 5.1, page 5-1, and in Table A-3, Appendix A, page A-5 -- There is no test method listed for semivolatile organic compounds (SVOCs) in Section 5.1. Also there is no Target Quantitation Limit for SVOCs on Table A-3. Indicate the method used and the Target Quantitation Limit for SVOCs.
5. Section 6.5 -- The last paragraph on page 6-2 seems to indicate the highest uncorrected gross activity level was 17.8 +/- 10.5 pCi/L in the April MWL-MW6 sample. Table A-10 indicates a gross alpha activity of 20.7 +/- 5.07 in the April MWL-MW5 sample. Indicate which number should be considered the highest level and explain your rationale for selecting the highest value.
6. Section 6.5 and Table A-11 – Uranium is being subtracted from the gross alpha activity levels reported in Table A-10 (these values are referred to as "corrected gross alpha activity"). A footnote at the end of Table A-11 states "The MCL for gross alpha activity is 15 pCi/L; however, total uranium is not intended in the standard and can be subtracted as needed". Given that the Mixed Waste Landfill (MWL) contains considerable depleted-uranium waste, provide an explanation as to why uranium should be subtracted from the gross alpha data for the MWL when the purpose of acquiring the data is to monitor the groundwater for contaminant releases.
7. In Table A-1, Appendix A, page A-1, the 6th Column seems to be elevation of bottom of sump, not "Total Well Depth". Clarify whether "Total Well Depth" is correct for the column heading. If "Total Well Depth" is incorrect as the column heading, submit a revised Table A-1 with the correct heading.
8. Tables A-5, A-6, and A-10, Appendix A, pages A-10 through A-41 and A-48 through A-52 – The Permittees are not required to revise the tables mentioned in this comment for the subject report. However, in future monitoring reports for the MWL, include in each similar table a column listing for each constituent their approved background concentrations. This applies to metals, radionuclides, and other inorganic substances which occur naturally in the environment or are found worldwide as a result of fallout from nuclear testing.
9. Page 6-1, Section 6.2, first paragraph and page 6-2, Section 6.5, first paragraph – In future reports, when discussing analytes and comparing them to MCLs or other water quality standards, state also if the analytes exceed background levels.

The Permittees must respond to the above comments no later than January 6, 2010. If you have any questions regarding this matter, please contact Sid Brandwein of my staff at (505) 222-9576.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
S. Brandwein, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
J. Cochran, SNL, MS 0719
J. Gould, SNL, MS 0184
File: SNL 2009 and Reading
SNL-09-012

Volume VII

TAB 6

Responses to NOD: Mixed Waste Landfill
Groundwater Monitoring Report, Calendar Year 2008

From: SNL/Wagner
To: NMED/Bearzi

Back of Tab 6

MWL

ENTERED

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

DEC 23 2009

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

RECEIVED
DEC 2009
NMED Hazardous Waste Bureau

James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Bldg. 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

On behalf of the U. S. Department of Energy/National Nuclear Security Administration (DOE/NNSA), and Sandia Corporation (Sandia), DOE/NNSA is submitting the DOE/Sandia Responses to New Mexico Environment Department's "Notice of Disapproval: Mixed Waste Landfill Groundwater Monitoring Report, Calendar Year 2008."

Should you have any questions regarding this response, please contact me at (505) 845-6036, or John Gould of my staff at (505) 845-6089.

Sincerely,

Kimberly A Davis for

Patty Wagner
Manager

Enclosure (1)

cc w/enclosure:
W. Moats, NMED (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB, MS-1396
B. Birch, NMED-OB, MS-1396
Records Center, SNL/NM, Org. 6765, MS-0718
Zimmerman Library, UNM

cc w/o enclosure
A. Blumberg, SNL/NM, MS-0141
M. Walck, SNL/NM, MS-0701
D. Miller, SNL/NM, MS-0718

J. Cochran, SNL/NM, MS-0719
B. Langkopf, SNL/NM, MS-0718
C. Daniel, SNL/NM, MS-0718
J. Estrada, SSO, MS-0184
J. Gould, SSO, MS-0184

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **DOE/Sandia Responses to NMED's "Notice of Disapproval: Mixed Waste Landfill Groundwater Monitoring Report, Calendar Year 2008."**

Document author: **Kathy Turnham, Department 06765**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: Marianne C Walck 12/14/09

Marianne Walck, Director
Nuclear Energy & Global Security Technologies
Center 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

Date

and

Signature: Kimberly A Davis for 12/23/09

Patty Wagner, Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Date

January 2010

DOE/Sandia Responses to the NMED

"NOTICE OF DISAPPROVAL: MIXED WASTE LANDFILL GROUNDWATER MONITORING REPORT CALENDAR YEAR 2008, MAY 2009 SANDIA NATIONAL LABORATORIES EPA ID# NM5890110518 HWB-SNL-09-012"

INTRODUCTION

This document responds to the comments received in a Notice of Disapproval (NOD) letter from the New Mexico Environment Department (NMED) to the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia) on October 29, 2009 regarding the Mixed Waste Landfill Groundwater Monitoring Report for Calendar Year 2008. The letter is entitled: "NOTICE OF DISAPPROVAL: THE MIXED WASTE LANDFILL GROUNDWATER MONITORING REPORT CALENDAR YEAR 2008, MAY 2009 SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518 HWB" (NMED August 2009).

This document lists each NMED comment in boldface, followed by the DOE/Sandia response written in normal font under "Response". Where applicable, revised change pages are included in Attachment A at the end of the comment/response section.

Sandia is a multiprogram laboratory managed and operated by Sandia Corporation, a wholly-owned subsidiary of Lockheed Martin Corporation, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

COMMENTS:

Comment #1

Page 1-1, last paragraph, the sentence states " ...and five downgradient or cross-gradient wells (MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9) (Figure 1-2)" --Indicate which wells the Permittees consider to be cross-gradient.

Response:

All wells listed in this segment of the sentence (MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9) are downgradient of some portion of the Mixed Waste Landfill (MWL). However, not all wells listed are downgradient of all parts of the MWL. For example, as seen in Figure 4.1-2 (page 4-5) MWL-MW5 is not downgradient of the northern portion of the MWL, but instead would be considered cross gradient to this portion of the landfill.

Comment #2

Page 4-1, 2nd paragraph in Section 4.1, second to last sentence -- Explain what is meant by "more variation in the flow field" in the localized flow pattern.

Response:

This is a relative term used to describe the differences in flow direction in the study area as seen on the regional potentiometric surface map (Figure 4.1-1) compared to the flow directions seen on the localized potentiometric surface (Figure 4.1-2). Flow direction is perpendicular to the groundwater elevation contours shown on the potentiometric surface map. In the study area, the regional flow direction (Figure 4.1-1) is slightly north of due west; whereas the localized flow direction (Figure 4.1-2) shows more variability from west-southwest to north-northwest.

Comment #3

Figure 4.1-1, page 4-3 -- The groundwater elevation values shown for MWL-MW7, MWL-MW9, and MWL-BW2 are not the same as those listed in Table A-1, Appendix A, page A-1. Indicate which values are correct. Indicate also whether the other groundwater elevation values shown on Figure 4.1-1 are correct.

Response:

The groundwater elevations listed in Table A-1 for the wells MWL-MW7, MWL-MW9, and MWL-BW2 differ from those used to generate the potentiometric surface maps in Figures 4.1-1 and 4.1-2. Groundwater sampling at the MWL for the ER Project during the first quarter of FY09 occurred October 1 through October 8, 2008 at MWL-MW7, MWL-MW8, MWL-MW9, and MWL-BW2. Water level measurements are taken before sample collection occurs at each well per SNL/NM FOP 05-01 (SNL 2007a). The water elevation measurements in Table A-1 are those measurements taken at the time of water sampling.

Sandia has a groundwater protection program (GWPP), and under SNL/NM FOP 03-02 (SNL 2007b), the program is responsible for collecting groundwater elevations at many groundwater wells. When the

potentiometric maps for Figure 4.1-1, and Figure 4.1-2 were generated, the most current GWPP groundwater elevation data was used (October 20, 2008). The difference in the values of the reported water level measurements between the table and the potentiometric surface maps would not change the contours; therefore we do not feel it would be pertinent to change the figures. In future reports, a footnote will be added to the figures to indicate the source of the water level measurement data.

Comment #4

Section 5.1, page 5-1, and in Table A-3, Appendix A, page A-5 -- There is no test method listed for semi-volatile organic compounds (SVOCs) in Section 5.1. Also there is no Target Quantitation Limit for SVOCs on Table A-3. Indicate the method used and the Target Quantitation Limit for SVOCs.

Response:

Section 5.1 page 5-1, and Table A-3, Appendix A, page A-5, has been revised to include the test method for SVOCs (SW-846 Method 8270). In addition, the Target Quantitation Limit range of 0.200 µg/L to 12 µg/L has been added to Table A-3, Appendix A, page A-5. Change pages are included as Attachment A to this response to NOD.

Comment #5

Section 6.5 --The last paragraph on page 6-2 seems to indicate the highest uncorrected gross activity level was 17.8 +/-10.5 pCi/L in the April MWL-MW6 sample. Table A-10 indicates a gross alpha activity of 20.7 +/-5.07 in the April MWL-MW5 sample. Indicate which number should be considered the highest level and explain your rationale for selecting the highest value.

Response:

The groundwater samples are screened for Gross Alpha/ Beta activity using EPA method 900.0 (EPA 2000). Reporting of the screening results include the calculated value (first number) along with the total uncertainty associated with that value, reported as plus or minus the uncertainty. To interpret the result, therefore, a range has to be calculated to take into account the uncertainty. To determine which MWL sample had the highest result reported in 2008, the ranges of values were calculated. Using the calculated value at MWL-MW6 of 17.8 pCi/L, then adding and subtracting the uncertainty associated with that sample (+/-10.5 pCi/L), the calculated value range is 7.3 to 28.3 pCi/L. For MWL-MW5, the reported value of 20.7 +/- 5.07 pCi/L would result in a range of 15.0 to 26.4 pCi/L. Examining the highest possible values between the two results, MWL-MW6 (taken in April 2008) has the highest value of 28.3pCi/L.

Comment #6

Section 6.5 and Table A-11 -Uranium is being subtracted from the gross alpha activity levels reported in Table A-10 (these values are referred to as "corrected gross alpha activity"). A footnote at the end of Table A-11 states "The MCL for gross alpha activity is 15 pCi/L; however, total uranium is not intended in the standard and can be subtracted as needed". Given that the Mixed Waste Landfill (MWL) contains considerable depleted uranium waste, provide an explanation as to why uranium should be subtracted from the gross alpha data for the MWL when the purpose of acquiring the data is to monitor the groundwater for contaminant releases.

Response:

Depleted uranium is not a contaminant of concern at the MWL. Tritium, organics and metals have been identified as contaminants of concern at the MWL. The gross alpha/beta determination is used to screen for radionuclides, not to specifically determine which ones are present. Tritium concentrations are analyzed for using EPA 906.0, and uranium by EPA SW846 6020 (see Table A-3, Appendix A, page A-5). The groundwater beneath the MWL is being monitored for potential contaminant release using the recommended GW quality parameters listed in 40 CFR 265 subpart F.

EPA states that the gross alpha particle activity MCL of 15 pCi/L, which is exclusive of radon and uranium, provides an effective screening level for the most likely alpha emitters in drinking water (EPA 2000). One of the main intentions of the 15 pCi/L MCL for gross alpha particle activity was to limit the concentrations of other naturally-occurring and man-made alpha emitters relative to radium^{226} (EPA 2000, pg. III-7).

Two standard methods for subtracting uranium from gross alpha and gross beta activity calculations are listed in the footnote in Table A-10.

Comment #7

In Table A-1, Appendix A, page A-1, the 6th Column seems to be elevation of bottom of sump, not "Total Well Depth". Clarify whether "Total Well Depth" is correct for the column heading. If "Total Well Depth" is incorrect as the column heading, submit a revised Table A-1 with the correct heading.

Response:

To better clarify the measurement reference point, the 6th column now reads “Elevation of Bottom of Well (FAMSL)” (where FAMSL= feet above mean sea level) and the footnote “b” has been removed. A change page is included as Attachment A in this response to NOD.

Comment #8

Tables A-5, A-6, and A-10, Appendix A, pages A-10 through A-41 and A-48 through A-52 - The Permittees are not required to revise the tables mentioned in this comment for the subject report. However, in future monitoring reports for the MWL, include in each similar table a column listing for each constituent their approved background concentrations. This applies to metals, radionuclides, and other inorganic substances which occur naturally in the environment or are found worldwide as a result of fallout from nuclear testing.

Response:

Background concentrations identified in the 1998 NMED Approved SNL Background Study (NMED 1998) will be included in the appropriate tables of the Calendar Year 2009 MWL AGWMR.

Comment #9

Page 6-1, Section 6.2, first paragraph and page 6-2, Section 6.5, first paragraph - In future reports, when discussing analytes and comparing them to MCLs or other water quality standards, state also if the analytes exceed background levels.

Response:

Background concentrations identified in the 1998 NMED Approved SNL Background Study (NMED 1998) will be included in the appropriate tables of the Calendar Year 2009 MWL AGWMR.

REFERENCES

NMED 1998 New Mexico Environment Department, November 1998. Approval, SNL Background Study: Background Concentrations of Constituents of Concern to the Sandia National Laboratories/New Mexico Environmental Restoration Project and the Kirtland Air Force base Installation Restoration Program, November 1998.

SNL 2007a Sandia National Laboratories/New Mexico (SNL/NM), August 2007a. "Long-Term Environmental Stewardship (LTES) Groundwater Monitoring Well Sampling and Field Analytical Measurements," *FOP 05-01*, *Revision 02*, Sandia National Laboratories, Albuquerque, New Mexico.

SNL 2007b Sandia National Laboratories/New Mexico (SNL/NM), November 2007. Environmental Programs and Assurance Department, Field Operating Procedure, *FOP 03-02, Revision 02*. Sandia National Laboratories, Albuquerque, New Mexico.

EPA 2000 U.S. Environmental Protection Agency (EPA), March 2000. *Radionuclides Notice of Data Availability Technical Support Document.* Targeting and Analysis Branch Standards and Risk Management Division; Office of Ground Water and Drinking Water U.S. Environmental Protection Agency, Washington, D.C.

Attachment A

Change Pages, A-1, 5-1, and A-5 to the
Mixed Waste Landfill Groundwater Monitoring Report Calendar Year 2008

5.0 ANALYTICAL METHODS

Table A-3 (Appendix A) specifies parameters, appropriate test methods, and target analyte quantitation limits for analytical parameters. The analytical methods are discussed in the following sections.

5.1 Chemical Analytical Methods

All chemical analyses were performed in accordance with the U.S. Environmental Protection Agency (EPA) test methods (EPA 1979, 1986, 1988, and 1999). Environmental samples were submitted to the following laboratories for the analyses listed:

- GEL:
  - VOCs by EPA Method 8260B
  - SVOCs by EPA Method 8270
  - TAL metals by EPA Methods 6020 and 7470A (including total and isotopic uranium by EPA Method 6020)
  - Nitrate plus nitrite by EPA Method 353.2
  - Bromide, fluoride, chloride, and sulfate by EPA Method 9056
  - Total organic carbon by EPA Method 9060
  - Carbon dioxide by Laboratory-Specific Method SM 4500 CO2 D
  - Total alkalinity as calcium carbonate by EPA Method 310.1
  - Total dissolved solids by EPA Method 160.1
  - Perchlorate by EPA Method 314.0
- Hall Analytical:
  - Ferrous iron by Laboratory-Specific Method 3500M Fe2+
  - Biochemical oxygen demand by EPA Method 405.1
- Metro-Ohm Peak:
  - Manganese II by Laboratory-Specific Method C2-100 Mn2+

5.2 Radiochemical Analytical Methods

Radiochemical parameters and methods included gamma-emitting radionuclides by EPA Method 901.1, gross alpha/beta radioactivity by EPA Method 900.0, and tritium by EPA Method 906.0.

Table A-1
Groundwater Elevations, Pump Setting Depths, and Monitoring Well Completion Information
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Calendar Year 2008

Well Number	Date of Measurement	Measurement Point Elevation (FAMSL[a])	Depth to Water (FBTOC)	Groundwater Elevation (FAMSL[a])	Elevation of Bottom of Well (FAMSL)	Static Water Height (feet)	Pump Setting Depth (FBTOC)
MWL-MW4	04-07-08	5383.46	494.44	4891.73[b]	4878.59[b]	13.14[b]	503[c]
MWL-MW5	04-07-08	5379.89	492.66	4887.23	4856.15	31.08	517
MWL-MW6	04-07-08	5372.64	486.53	4886.11	4839.46	46.65	527
MWL-MW7	07-16-08	5380.63	488.88	4891.75	4878.96	12.79	493
	10-06-08		488.82	4891.81		12.85	
MWL-MW8	07-14-08	5381.99	490.55	4891.44	4880.07	11.37	496.5
	10-07-08		490.71	4891.28		11.21	
MWL-MW9	07-15-08	5379.24	492.07	4887.17	4876.63	10.54	497
	10-08-08		491.23	4888.01		11.38	
MWL-BW2	04-07-08	5388.35	477.18	4911.17	4884.00	27.17	499
	07-17-08		477.47	4910.88		26.88	
	10-01-08		477.62	4910.73		26.73	

[a]Measurement point is the top of well casing.

[b]Elevation, well depth, and pump depth reflects well MWL-MW4 orientation of 6 degrees from vertical.

[c]Depth to the bottom of the dedicated pump is 503.01 feet below ground surface.

BW = Background well.
FAMSL = Feet above mean sea level.
FBTOC = Feet below top of casing.
MW = Monitoring well.
MWL = Mixed Waste Landfill.

Table A-3
Analytical Parameters, Test Methods, and Target Quantitation Limits
Mixed Waste Landfill, Sandia National Laboratories/New Mexico
Groundwater Monitoring, 2008

Analytical Parameter	Test Method[a]	Target Quantitation Limit[b]
Total Metals TAL and Uranium	SW846-6020 SW846-7470A	0.00007–2.5 mg/L
Volatile Organic Compounds	SW846-8260B	1.0–5.0 μg/L
Semi-Volatile Organic Compounds	SW-846- 8270	0.200 ug/L to 12 ug/L
Nitrate plus Nitrite (as nitrogen)	EPA 353.2	0.50 mg/L
Major Anions Bromide, Fluoride, Chloride, and Sulfate	SW846-9056	0.100–4.0 mg/L
Total Organic Carbon	SW846-9060	1.0 mg/L
Carbon Dioxide	SM 4500 CO2 D[c]	1.0 mg/L
Total Alkalinity as Calcium Carbonate	EPA 310.1	1.0–2.0 mg/L
Total Dissolved Solids	EPA 160.1	10 mg/L
Ferrous Iron	3500M Fe2+[c]	0.01–0.10 mg/L
Biochemical Oxygen Demand	EPA 405.1	2.0–4.0 mg/L
Manganese II	C2-100 Mn2+[c]	0.320 mg/L
Radionuclides Gamma-Emitting Radionuclides Gross Alpha Activity Gross Beta Activity Tritium	 EPA 901.1[d] EPA 900.0[d] EPA 900.0[d] EPA 906.0[d]	 MDA is isotope-specific 1.06–2.33 pCi/L 1.26–1.75 pCi/L 159–198 pCi/L

[a]Analytical methods used are referenced to either U.S. Environmental Protection Agency, 1979. "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, U.S. Environmental Protection Agency, Cincinnati, Ohio, or U.S. Environmental Protection Agency, 1986. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.

[b]For target compounds only. Reporting limits may be elevated if an interfering component is present or if sample dilution is required.

[c]Laboratory-specific analytical methods.

[d]U.S. Environmental Protection Agency, 1980. "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032, U.S. Environmental Protection Agency, Cincinnati, Ohio.

EPA = U.S. Environmental Protection Agency.
MDA= Minimum detectable activity.
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  - Nitrate plus nitrite by EPA Method 353.2
  - Bromide, fluoride, chloride, and sulfate by EPA Method 9056
  - Total organic carbon by EPA Method 9060
  - Carbon dioxide by Laboratory-Specific Method SM 4500 CO2 D
  - Total alkalinity as calcium carbonate by EPA Method 310.1
  - Total dissolved solids by EPA Method 160.1
  - Perchlorate by EPA Method 314.0
- Hall Analytical:
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TAL = Target analyte list.

Volume VII

TAB 7

Mixed Waste Landfill Groundwater Monitoring Report
Calendar Year 2009

From: SNL/Wagner
To: NMED/Bearzi

Back of Tab 7

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

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JUN 7 2010

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JUN 2010
NMED Hazardous Waste Bureau

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Bldg. 1
Santa Fe, NM 87505

Subject: Mixed Waste Landfill (MWL) Groundwater Monitoring Report Calendar Year (CY) 2009

Dear Mr. Bearzi:

On behalf of the Department of Energy/National Nuclear Security Administration (DOE/NNSA) and Sandia Corporation (Sandia), DOE/NNSA is submitting the *"Mixed Waste Landfill Groundwater Monitoring Report Calendar Year 2009"*. The report presents Groundwater Monitoring data from sampling events conducted at the MWL in 2009. Below is a brief summary of information contained in this CY2009 Report.

The results of the Groundwater Monitoring Report showed constituent concentrations within historical ranges for the MWL. Toluene and bis(2-ethylhexyl)phthalate have been detected during historic Groundwater Monitoring at the MWL and were detected in Groundwater samples from the newly installed wells during quarterly sampling performed in 2009. Both of these compounds are common laboratory contaminants; however, DOE/NNSA and Sandia initiated an investigation in late 2009 to confirm the source. New Mexico Environmental Department further provided direction in an April 30, 2010 letter for conducting a purging/sampling study of the Groundwater along with any other studies necessary to determine the source. This investigation is ongoing and will be completed in 2010.

Should you have any questions regarding this correspondence, please feel free to contact me at (505) 845-6036, or John Gould of my staff at (505) 845-6089.

Sincerely,

Patty Wagner for
Manager

Enclosure

JUN 7 2010

cc w/enclosure:
W. Moats, NMED (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB
B. Birch, NMED-OB
Records Center, SNL/NM, Org. 6765, MS-0718
Zimmerman Library, UNM

cc w/o enclosure:
A. Blumberg, SNL/NM, Org. 11100, MS-0141
M. Walck, SNL/NM, Org. 6700, MS-0701
D. Miller, SNL/NM, Org 6765, MS-0718
J. Cochran, SNL/NM, Org. 6765, MS-0719
S. Saltzstein, SNL/NM, Org. 6702, MS-0701
B. Langkopf, SNL/NM, Org. 6765, MS-0718
C. Daniel, SNL/NM, Org. 6765, MS-0718
J. Estrada, SSO
J. Gould, SSO
D. Pellegrino, SSO

AOP 95-45, 06

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Mixed Waste Landfill Groundwater Monitoring Report Calendar Year 2009**

Document author: **Alicia Aragon, Department 06765**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: Marianne C Walck 5-27-10

Marianne Walck
Director
Nuclear Energy & Global Security Technologies
Center 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: Kimberly A Davis for 6/7/10

Patty Wagner
Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Sandia National Laboratories

Sandia National Laboratories/New Mexico Environmental Restoration Project

MIXED WASTE LANDFILL GROUNDWATER MONITORING REPORT CALENDAR YEAR 2009

JUNE 2010

United States Department of Energy
Sandia Site Office

Sandia National Laboratories is a multi-program laboratory operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

EXECUTIVE SUMMARY

Groundwater sampling was conducted at a total of seven groundwater monitoring wells at the Sandia National Laboratories, New Mexico (SNL/NM) Mixed Waste Landfill (MWL) in January, April, July, and October 2009. During 2008, four new monitoring wells were installed (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) and required Consent Order compliant (NMED April 2004) sampling for eight consecutive quarters. In addition, sampling for perchlorate is required at the new wells for at least four consecutive quarters. The MWL monitoring wells were sampled in accordance with appropriate field operating procedures (SNL/NM August 2007a, 2007b, and 2007c) for groundwater sampling activities and mini-sampling and analysis plans (mini-SAPs) (SNL/NM January 2009, April 2009, July 2009, and October 2009). The results of the groundwater monitoring showed constituent concentrations within historical ranges for the MWL. The field activities and analytical results for Calendar Year 2009 groundwater sampling events are presented in this report.

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ACRONYMS AND ABBREVIATIONS

AOP	Administrative Operating Procedure
ARG	Ancestral Rio Grande
BW	background well
COA	City of Albuquerque
COC	constituent of concern
CY	Calendar Year
EB	equipment blank
EPA	U.S. Environmental Protection Agency
FB	field blank
FOP	Field Operating Procedure
GEL	General Engineering Laboratories, Inc.
KAFB	Kirtland Air Force Base
LTES	Long-Term Environmental Stewardship
MCL	maximum contaminant level
MDA	minimum detectable activity
MDL	method detection limit
μg/L	microgram(s) per liter
mg/L	milligram(s) per liter
MS	matrix spike
MW	monitoring well
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
NPN	nitrate plus nitrite
pCi/L	picocurie(s) per liter
PQL	practical quantitation limit
PVC	polyvinyl chloride
QC	quality control
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SC	specific conductance
SNL/NM	Sandia National Laboratories/New Mexico
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TA	Technical Area
TAL	target analyte list
TB	trip blank
VOC	volatile organic compound

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1.0 INTRODUCTION

Groundwater monitoring of seven wells was conducted at the Sandia National Laboratories/New Mexico (SNL/NM) Mixed Waste Landfill (MWL) throughout Calendar Year (CY) 2009. This report describes the field activities conducted during the sampling events and presents the analytical results. Appendix A presents summary tables of the field measurements and sampling results.

The MWL is located on Kirtland Air Force Base (KAFB), four miles south of the SNL/NM Technical Area (TA)-I facilities and 5 miles southeast of Albuquerque International Sunport. The MWL is a 2.6-acre site in the north-central portion of TA-III (Figure 1-1). The MWL was established in 1959 as a disposal area for low-level radioactive and mixed waste generated by SNL/NM research facilities and accepted low-level radioactive and minor amounts of mixed waste from March 1959 through December 1988. Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies (at the time of disposal) of activity were disposed of in the MWL.

The MWL consists of two distinct disposal areas: the classified area (occupying 0.6 acres) and the unclassified area (occupying 2.0 acres). Low-level radioactive and mixed waste was disposed of in each of these areas. Classified wastes were buried in cylindrical pits in the classified area. Unclassified wastes were buried in shallow trenches in the unclassified area. An evapotranspirative cover that includes a biointrusion barrier was installed during Fiscal Year 2009 (SNL/NM January 2010) in accordance with the New Mexico Environment Department (NMED)-approved "MWL Corrective Measures Implementation Plan" (SNL/NM November 2005).

Groundwater at the MWL has been extensively characterized since 1990 for major ion chemistry, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), nitrate plus nitrite (NPN), metals, radionuclides, and perchlorate. Twenty years of quarterly, semiannual, and annual data indicate that groundwater has not been contaminated by releases from the MWL (Goering et al. 2002; Lyon and Goering January 2006; SNL/NM December 2001, January 2002, March 2002, July 2002, August 2002, October 2002, June 2003, September 2003, July 2004, November 2006, January 2008, and May 2009).

The MWL groundwater monitoring well network was modified in 2008 (SNL/NM May 2009). Due to declining water levels, four monitoring wells were plugged and abandoned (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) and four new monitoring wells were installed (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9). Figure 1-2 shows the current groundwater monitoring well network at the MWL. The well network consists of seven wells completed within the interfingering, fine-grained, alluvial fan deposits and coarse-grained, Ancestral Rio Grande deposits. The monitoring well network currently consists of one background well (BW) (MWL-BW2), one on-site monitoring well (MW) (MWL-MW4), and five downgradient wells (MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9) (Figure 1-2).

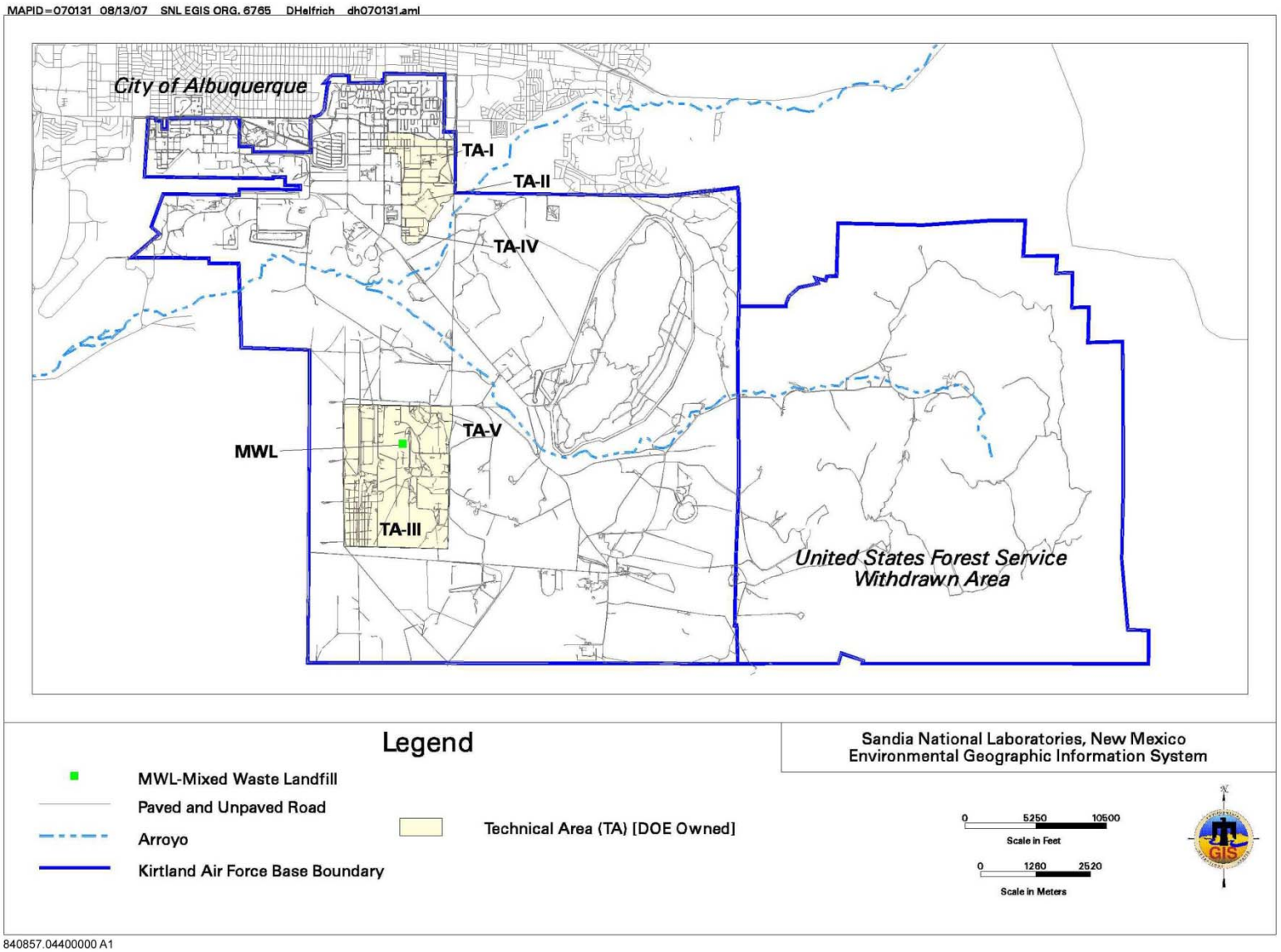

Figure 1-1
Location of Sandia National Laboratories and Kirtland Air Force Base

Figure 1-2
Location of Groundwater Monitoring Wells at the Mixed Waste Landfill

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2.0 REGULATORY CRITERIA

Historically, the NMED Hazardous Waste Bureau has provided regulatory oversight of the MWL as Solid Waste Management Unit (SWMU) 76 under the Hazardous and Solid Waste Amendments module of the facility Resource Conservation and Recovery Act permit. The NMED confirmed that the MWL is properly designated as a SWMU (Dinwiddie June 1998) and, as such, must comply with the corrective action program defined in Title 20, New Mexico Administrative Code, Section 4.1.500, incorporating Title 40, Code of Federal Regulations, Section 264.101. The requirements for corrective action at the MWL, including those for groundwater monitoring, are established through the corrective measures process.

The NMED issued the Compliance Order on Consent (the Consent Order) in April 2004, which transferred the regulatory requirements for groundwater sampling at the MWL to the Consent Order (NMED April 2004). This report has been formatted to address the content criteria set forth in the Consent Order for Periodic Monitoring Reports. Table 2-1 provides a "crosswalk" that lists the required elements from the Consent Order and the corresponding section(s) in which these elements are addressed in this report.

Table 2-1
Monitoring Report Crosswalk for Mixed Waste Landfill
Annual Groundwater Monitoring Report

Required Elements of the Consent Order (NMED April 2004)	MWL Groundwater Monitoring Report Calendar Year 2009
1. Title Page and Signature Block (for the name, title, and organization of the preparer and the responsible DOE and Sandia representative)	Title Page Signatures for full Sandia and DOE chain of command on the transmittal paperwork that accompanies the report from Sandia to the DOE to the NMED
2. Executive Summary (Abstract)	Executive Summary and Section 9.0
3. Table of Contents	Table of Contents
4. Introduction	Section 1.0 Introduction
5. Scope of Activities	Section 3.0 Scope of Activities
6. Regulatory Criteria	Section 2.0 Regulatory Criteria
7. Monitoring Results	Section 6.0 Summary of Analytical Results
8. Conclusions	Section 9.0 Summary and Conclusions
9. Tables	Appendix A
10. Figures	Section 1.0 Introduction; Section 4.0 Field Methods and Measurements Appendix B
11. Appendices	Appendix A and Appendix B

DOE = U.S. Department of Energy.
MWL = Mixed Waste Landfill.
NMED = New Mexico Environment Department.
Sandia = Sandia Corporation.

Although radionuclides are being monitored at the MWL, the information related to radionuclides is provided voluntarily by Sandia. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements imposed by the NMED, as specified in Section III.A of the Consent Order (NMED April 2004).

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3.0 SCOPE OF ACTIVITIES

Groundwater sampling was conducted during CY 2009 at the MWL in accordance with the appropriate field operating procedures (FOPs) (SNL/NM August 2007a, 2007b, and 2007c) and Mini-Sampling and Analysis Plans (SAPs) (SNL/NM January 2009, April 2009, July 2009, and October 2009). Seven monitoring wells at the MWL were sampled, including one background well (MWL-BW-2), one on-site monitoring well (MWL-MW4), and five downgradient monitoring wells (MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9).

3.1 Analytical Parameters

The analytical parameters selected for monitoring at the MWL groundwater wells during CY 2009 include target analyte list (TAL) metals, total uranium, VOCs, SVOCs, NPN, and major anions. For newly installed wells, the Consent Order requires perchlorate analysis for four quarters unless detected above the screening level of 4 micrograms per liter (µg/L) at which time a new sampling schedule is to be negotiated with the NMED (NMED April 2004, Table XI-1). Alkalinity titrations were performed in the field on groundwater collected from each well. Radiochemical analysis included gross alpha/beta radioactivity, tritium, and gamma-emitting radionuclides. The analytical results are presented in Section 6.0.

The MWL groundwater samples were submitted for analysis to General Engineering Laboratories, Inc. (GEL) in Charleston, South Carolina; Hall Analytical in Albuquerque, New Mexico; and Metrohm Peak in Houston, Texas. All groundwater samples were collected using a Bennett™ pump.

Field quality control (QC) samples submitted to GEL included field duplicate, equipment blank (EB), and field blank (FB) samples. In addition, trip blank (TB) samples were submitted with the samples for VOC analysis. Section 7.0 discusses the QC sample results.

3.2 Monitoring History

The groundwater monitoring well network at the MWL was originally installed in 1989. The wells have been sampled at various intervals since that time. During CY 2008, four monitoring wells were plugged and abandoned (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) and four new monitoring wells were installed (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) (Bearzi January 2009).

In 1993, MWL-MW4 was completed at an angle of 6 degrees from vertical and is screened at two discrete intervals 20 feet apart (Peace et al. September 2002) to evaluate vertical anisotropy, vertical potentiometric gradients, and changes in aquifer parameters with depth. An inflatable packer separates the screened intervals, and pressure is maintained in the packer to isolate the two screened intervals. Although monitoring well MWL-MW4 is screened in two discrete intervals, only the upper interval was sampled during CY 2009, as this is the uppermost water-bearing interval beneath the MWL. References in this report to groundwater samples from MWL-MW4 refer to groundwater withdrawn from the upper interval.

3.3 Monitoring Network

The MWL wells were sampled either quarterly or annually in CY 2009. The established wells (MWL-MW4, MWL-MW5, and MWL-MW6) are required to undergo only annual sampling and analysis. Wells MWL-MW7, MWL-MW8, MWL-MW9, and MWL-BW2 are considered new wells and, as required by the Consent Order (NMED April 2004), will be sampled for eight consecutive quarters for a defined suite of parameters in addition to sampling for perchlorate for at least four consecutive quarters. Figure 1-2 shows the current groundwater monitoring network consisting of seven wells completed within the interfingering, fine-grained, alluvial fan deposits and coarse-grained Ancestral Rio Grande alluvial deposits. All seven MWL wells are constructed of 5-inch diameter, Schedule 80 polyvinyl chloride (PVC) casing and screen.

Due to the timing of the installation of the new wells, the eight-quarter sampling requirement began at different times depending the availability of the wells. Four sampling events occurred at the MWL during CY 2009 on the following dates: January 5 to January 8, April 1 to April 13, July 6 to July 9, and October 5 to October 8. Table 3.3-1 summarizes the groundwater sampling events conducted at the MWL during CY 2009.

Table 3.3-1
Calendar Year 2009 Groundwater Sampling Events at the Mixed Waste Landfill

Well ID	January 2009	April 2009	July 2009	October 2009
MWL-BW-2	4th quarter sampling	5th quarter sampling	6th quarter sampling	7th quarter sampling
MWL-MW4		Annual sampling		
MWL-MW5		Annual sampling		
MWL-MW6		Annual sampling		
MWL-MW7	3rd quarter sampling	4th quarter sampling	5th quarter sampling	6th quarter sampling
MWL-MW8	3rd quarter sampling	4th quarter sampling	5th quarter sampling	6th quarter sampling
MWL-MW9	3rd quarter sampling	4th quarter sampling	5th quarter sampling	6th quarter sampling

ID = Identification.

4.0 FIELD METHODS AND MEASUREMENTS

Field measurements performed during groundwater sampling activities included groundwater elevations and water quality parameters. The following sections present a detailed discussion of field activities and methods.

4.1 Groundwater Elevation Measurements

Depth-to-groundwater measurements to support groundwater sampling activities were obtained using a Solinst™ water level meter prior to purging activities. Depth-to-groundwater measurements were performed in accordance with FOP 05-01, "Long-Term Environmental Stewardship (LTES) Groundwater Monitoring Well Sampling and Field Analytical Measurements" (SNL/NM August 2007a). Measurements were obtained from all sampled monitoring. Table A-1 presents depth to water and groundwater elevations.

Separate groundwater elevation measurements are collected in accordance with FOP 03-02, Revision 3, "LTES Groundwater Level Data Acquisition and Management" (SNL/NM November 2009) that are used to map the potentiometric surface at the MWL. October 2009 groundwater elevation data for the MWL monitoring well network are summarized in Table 4.1-1 and in Figure 4.1-1.

Table 4.1-1
Mixed Waste Landfill October 2009 Groundwater Elevation Data

Monitoring Well	Groundwater Elevation	Comments
MWL-BW2	4910.61	Used to contour top of water table
MWL-MW4	--	No measurement, packer not installed
MWL-MW5	4887.07	Not used, well screened below water table
MWL-MW6	4885.84	Not used, well screened below water table
MWL-MW7	4891.79	Used to contour top of water table
MWL-MW8	4891.50	Used to contour top of water table
MWL-MW9	4888.17	Used to contour top of water table

Groundwater occurs at approximately 500 feet below ground surface within Santa Fe Group deposits (basin fill) in either fine-grained, alluvial fan deposits or coarse-grained, Ancestral Rio Grande deposits.

Figure 4.1-1 shows the localized potentiometric surface of the regional aquifer at the MWL in October 2009. Only MWL wells screened across the water table (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) were used to contour the MWL potentiometric surface. Groundwater elevation data were not available in October 2009 for MWL-MW4. The inflatable packer, which was removed in May 2009 to allow the surface well casing to be extended as part of the MWL Evapotranspirative Cover construction activities, had not been reinstalled between the two screen intervals at the time groundwater elevation measurements were obtained. MWL-MW4 is the only well at the MWL with two screen intervals. Based upon the potentiometric surface contours, groundwater flows to the west-northwest.

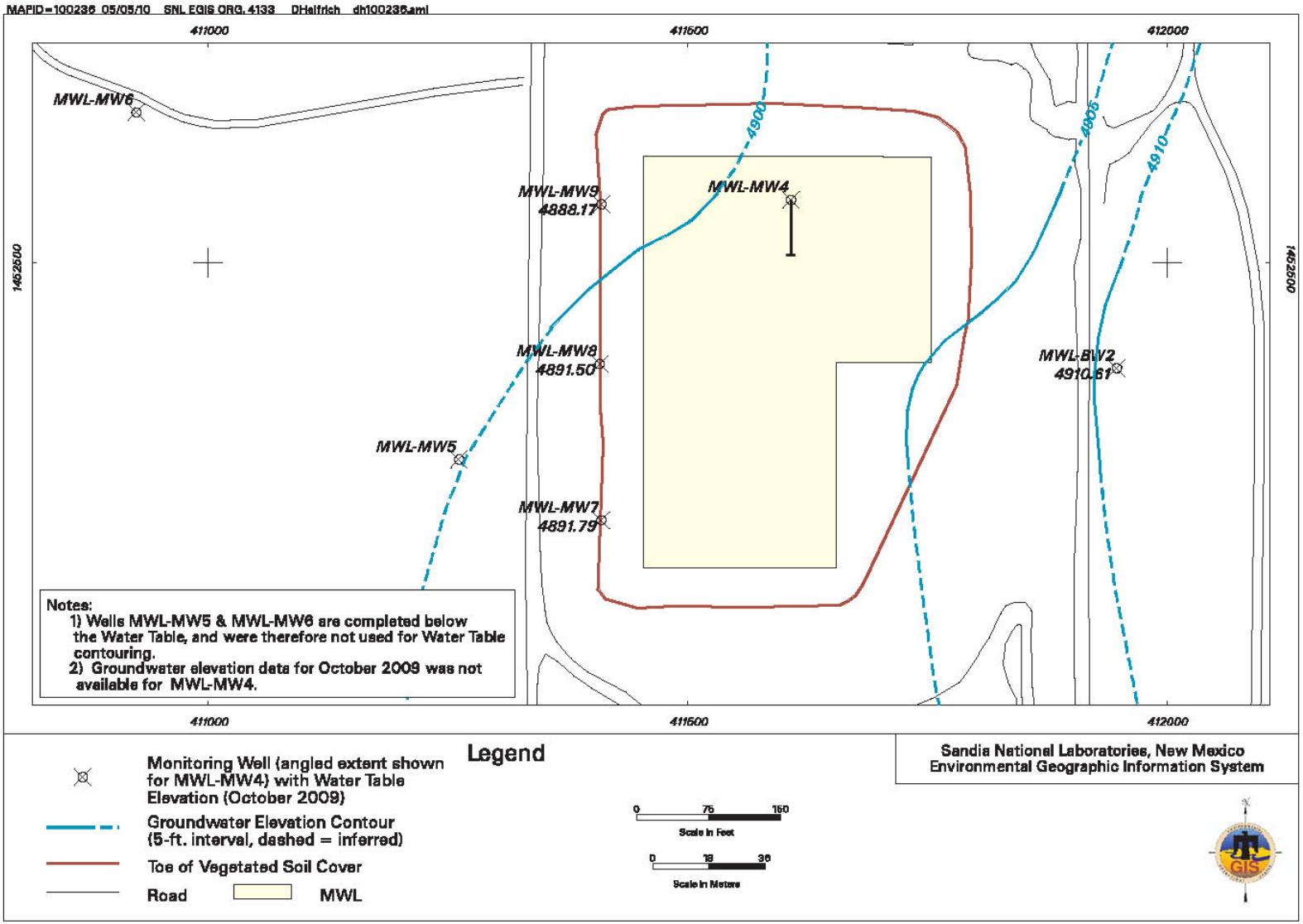

Figure 4.1-1
Potentiometric Surface of the Regional Aquifer at the Mixed Waste Landfill, October 2009

A hydrograph showing water level data for all MWL monitoring wells is provided as Figure 4.1-2. Groundwater elevations on the west side of the MWL decreased from 0.03 (MWL-MW9) to 0.11 feet (MWL-MW7). The largest decrease was observed at MWL-BW2 on the east side, which declined 0.38 feet. From 2005 through 2008, water levels at MWL-MW5, MWL-MW6, and MWL-MW4 declined an average of 0.40 feet per year. The decline is less between 2008 and 2009, ranging from 0.10 at MWL-MW5 to 0.15 feet per year at MWL-MW6 (no October 2009 data were available for MWL-MW4). No seasonal fluctuations are evident.

Installation of new wells MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9 in 2008 provided additional information regarding the regional aquifer beneath the MWL. This information augments the comprehensive conceptual model presented in the "Mixed Waste Landfill Groundwater Report, 1990 through 2001" (Goering et al December 2002) and the Phase 2 RCRA Facility Investigation Report (Peace et al. September 2002). In general, the groundwater elevation (i.e., top of the regional aquifer or water table) along the west side of the MWL is approximately 20 feet lower than it was in the older monitoring wells that were replaced (MWL-MW2 and MWL-MW3). This lower groundwater elevation appears to be related to two major factors. First, the geology of the upper part of the regional groundwater system, which is a stratified system, varies with depth from a low hydraulic conductivity layer (in which MWL-MW2 and MWL-MW3 were screened) to a medium conductivity layer (in which the lower parts of the screens of MWL-MW7, MWL-MW8, and MWL-MW9 reside) to a high conductivity layer corresponding to the Ancestral Rio Grande sediments (in which the lower screen of MWL-MW4, the MWL-MW6 screen, and the lower part of the MWL-MW5 screen are located). Second, the regional aquifer continues to decline as a result of historic and ongoing large-scale removal of water by the City of Albuquerque and KAFB. The overall effect at the MWL is that groundwater flow is predominantly vertically downward in the low and medium conductivity layers in response to this regional drawdown from pumping (i.e., a draining system).

Because the screen intervals of the new wells (MWL-MW7, MWL-MW8, and MWL-MW9) extend across the medium hydraulic conductivity layer and the screens in the wells they replaced (MWL-MW1, MWL-MW2, and MWL-MW3) were completely within the lower conductivity layer above the medium hydraulic conductivity layer, the vertical gradient has a larger impact on the groundwater elevation in the new wells. The end result is that the top of the regional water table is significantly lower in MWL-MW7, MWL-MW8, and MWL-MW9. Additional supporting hydrogeologic information is provided in Appendix B in the form of summary text, site-specific hydrogeologic cross sections, and generalized time-phased conceptual figures.

4.2 Well Purging and Water Quality Measurements

Prior to sample collection, each monitoring well was purged to remove stagnant water from the well so that a representative groundwater sample could be obtained. In accordance with procedures described in FOP 05-01 (SNL/NM August 2007a), all wells were purged a minimum of one saturated casing volume (the volume of the saturated screen plus the annulus). Purging continued until four stable measurements for turbidity, pH, temperature, and specific conductance (SC), were obtained prior to the collection of groundwater samples. Groundwater stability is considered acceptable when:

- Turbidity measurements are within 10% of 5 nephelometric turbidity units
- pH is within 0.1 units
- Temperature is within 1.0 degrees Celsius
- SC is within 5%

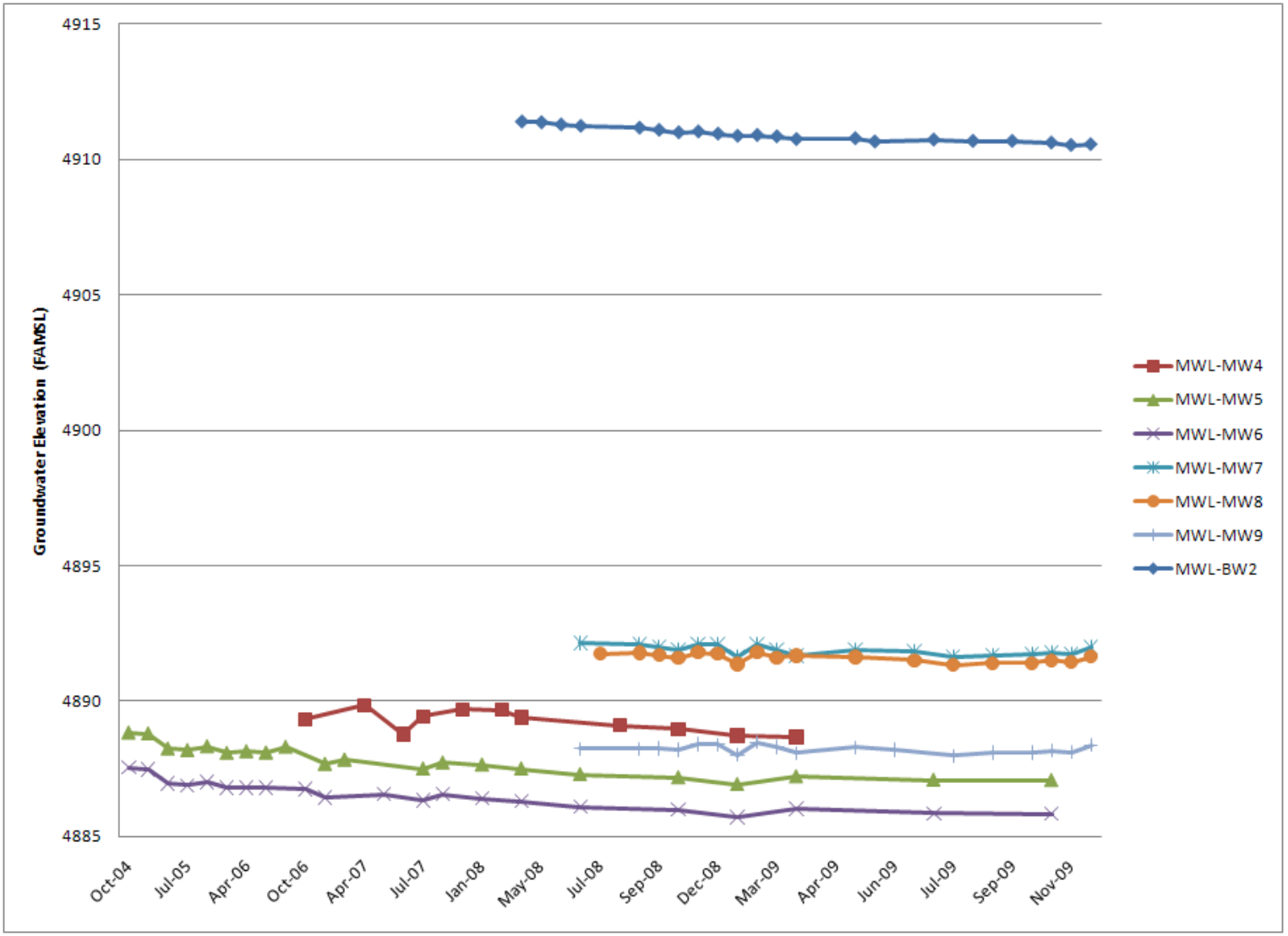

Figure 4.1-2
Hydrographs for MWL Monitoring Wells

Purge volumes and indicator parameter measurements are shown in Table A-2.

Some of the monitoring wells have low yield and were purged to dryness (see Table A-2), allowed to recover, and then sampled to collect representative groundwater samples.

Field analytical measurements of stabilization parameters were collected in accordance with FOP 05-01 (SNL/NM August 2007a). Groundwater temperature, SC, pH, oxidation-reduction potential, and dissolved oxygen were measured using a YSI™ Model 620 Water Quality Meter. Turbidity was measured with a Hach™ Model 2100P portable turbidity meter. Field alkalinity was measured by field personnel using HACH method 8203. Field water quality results are presented in Table A-3.

4.3 Pump Decontamination

The Bennett™ pump and tubing bundle used to collect groundwater samples were decontaminated prior to installation in MWL monitoring wells according to FOP 05-03, "LTES Groundwater Sampling Equipment and Decontamination" (SNL/NM August 2007b). The EB samples for the CY 2009 groundwater sampling events were collected after decontamination to verify the effectiveness of the decontamination procedure and are discussed in Section 7.1.2.

4.4 Sample Collection

A Bennett sampling system was used to collect the groundwater samples from all MWL monitoring wells. The pump intake was set near or at the bottom of each screen interval. The minimum flow rate, given limitations of equipment and well characteristics, was used for all purging and sampling activities. All groundwater samples were collected directly from the pump discharge tubing into laboratory-provided sample containers.

Two groundwater samples were collected from each monitoring well for metals analyses. One unfiltered sample was collected for total metals analyses. The other sample was filtered through a 0.45-micron filter for dissolved metals analyses. Where appropriate for the requested analysis, chemical preservatives were added to the sample containers at the laboratory prior to shipment.

4.5 Sample Handling and Shipment

Immediately after collection, all sample containers were custody-taped, sealed in plastic bags, and placed on cold packs in shipping containers. Analysis Request/Chain-of-Custody forms were completed at the time of collection. The samples for chemical and radiological analyses were shipped via the SNL/NM Sample Management Office to the contracted analytical laboratory. Sample management activities followed SNL/NM Administrative Operating Procedure (AOP) 95-16, "Sample Management and Custody" (SNL/NM February 2007).

4.6 Waste Management

All purge and decontamination water was managed according to FOP 05-04, “LTES Groundwater Monitoring Waste Management” (SNL/NM August 2007c) and was containerized on site pending the results of the analyses. All waste was managed as “nonregulated” waste, based upon historical sampling results and process knowledge of monitoring well locations. Results for the associated environmental samples provide supplemental data for approval to discharge water to the City of Albuquerque (COA) sanitary sewer system.

5.0 ANALYTICAL METHODS

Groundwater samples were submitted to GEL, Hall Analytical, and Metrohm Peak for chemical and radiological analyses. Analyses were performed in accordance with the U.S. Environmental Protection Agency (EPA) test methods (EPA 1979, 1980, 1986, and 1999a) and specified performance criteria (SNL/NM March 2003). Table A-4 specifies the analytical parameters, appropriate test methods, and target analyte quantitation limits for sample analyses.

Analytical reports including certificates of analyses, analytical methods, method detection limits (MDLs), practical quantitation limits (PQLs), dates of analyses, results of quality control (QC) analyses, and data validation findings are filed in the SNL/NM Customer Funded Records Center.

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6.0 SUMMARY OF ANALYTICAL RESULTS

Tables summarizing field measurements and analytical results are included as Appendix A. Complete field and laboratory documentation are on file at the SNL/NM Customer Funded Records Center.

The results for chemical and radiological constituent analysis are compared with established EPA Safe Drinking Water Act maximum contaminant levels (MCLs) (EPA 2009), where applicable.

The QC samples associated with each sampling event are included in the analysis of results and are discussed in Section 7.0. Data qualifiers resulting from QC samples or data validation results are presented with the related data in respective data tables in Appendix A.

6.1 General Chemistry Parameters

The general chemistry analytical results are presented in Table A-5 and Table A-6. No general chemistry parameters exceed the MCLs (where established) in the groundwater samples. The only two parameters that have established MCLs are NPN and fluoride (10 and 4 milligrams per liter [mg/L], respectively). Concentrations of NPN range from 0.175 mg/L in the sample collected in July from MWL-MW8 to 3.86 mg/L in the sample collected in April 2009 from MWL-MW7. Fluoride was detected at concentrations ranging from 0.679 mg/L (July 2009 sample from MWL-BW2) to 1.06 mg/L (October 2009 sample from MWL-MW9).

6.2 Metals

Table A-7 summarizes the metal results from all unfiltered groundwater samples collected during the CY 2009 groundwater monitoring events at the MWL and NMED-approved maximum background concentrations (Dinwiddie September 1997). Samples were analyzed for TAL metals according to EPA Method 6020 (EPA 1986). Barium exceeded the background concentration of 0.12 mg/L in five samples (including one duplicate sample) from MWL-MW8, with a range of 0.122 mg/L to 0.153 mg/L. One nickel and one cadmium result for MWL-MW4 exceeded the respective background concentrations (0.028 and 0.004 mg/L) in the April sample (nickel was 0.0291 mg/L and cadmium was 0.00275 mg/L), and one vanadium result exceeded the background concentration of 0.013 for MWL-MW9 (0.0179 mg/L) in October 2009. All unfiltered results are within historical ranges for metals at the MWL and no metals in the unfiltered samples exceed the respective MCLs.

Table A-8 summarizes the results for TAL metal analysis for the filtered samples collected during the CY 2009 groundwater monitoring events. Barium exceeded the background concentration of 0.12 mg/L in three samples from MWL-MW8, with a range of 0.15 to 0.128 mg/L. One nickel and one cadmium result for MWL-MW4 exceeded the respective background concentrations (0.028 and 0.004 mg/L) in the April sample (nickel was 0.0294 mg/L and cadmium was 0.00277 mg/L), and one vanadium result exceeded the background concentration of 0.013 mg/L for MWL-MW9 (0.0142 mg/L) in October 2009. All filtered results are within historical ranges for metals at the MWL. No detections of any metals in the filtered samples exceed the respective MCLs.

Samples from MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9 were analyzed for total uranium during all quarterly sampling events. Total uranium exceeded the background concentration of 0.005 mg/L in all MWL groundwater samples (unfiltered and filtered), ranging from 0.0059 to 0.0107 mg/L in the unfiltered samples and 0.00624 to 0.0107 mg/L in the filtered samples. The total uranium results are consistent with historical results, reflect a higher site-specific background concentration at the MWL (note concentration exceeded background at MWL-BW2), and are less than the MCL of 0.03 mg/L. The range in total uranium concentrations at the MWL are within the background concentration range established by Bexfield for the Middle Rio Grande Basin (USGS 2002) and the background concentration range measured during the SNL/NM KAFB background study (IT March 1996).

6.3 Volatile and Semivolatile Organic Compounds

Table A-9 summarizes the results for detected VOCs and SVOCs, and Table A-10 presents the analytical methods and corresponding MDLs for VOCs and SVOCs.

Trace concentrations of acetone and toluene were reported for groundwater samples from the MWL monitoring wells. The results for acetone and toluene presented in Table A-9 are qualified as estimated values and are less than the respective PQLs. No MCL is established for acetone; therefore, detections reported are those that exceed the laboratory MDL. Acteone was detected only in samples from the January sampling event, and the results vary from 3.65 µg/L in the duplicate sample from MWL-MW8 to 4.42 µg/L in the primary MWL-MW8 sample. Acetone results in both MWL-MW8 samples were qualified as not detected during data validation due to associated EB contamination. Acetone is a common laboratory contaminant (EPA 1999b) and has been frequently detected in blank and QC samples.

The MCL for toluene is 1,000 µg/L and the NMED maximum allowable concentration is 750 µg/L. Concentration results vary from 0.253 µg/L in the MWL-MW8 October 2009 sample to 0.852 µg/L in the MWL-MW9 January sample. All detections are below the practical quantitation limit (PQL) of 1 µg/L and are therefore qualified as estimated concentrations. An investigation of potential sources of toluene was initiated in late 2009. This investigation includes the analytical laboratory, sampling equipment, well construction materials. To evaluate the MWL as a potential source of the toluene detections, a review of the 1994 and 2008 soil gas sampling survey results (Peace et al. September 2002 and SNL/NM August 2008) and the Phase 2 RCRA Facility Investigation Report soil sampling results (Peace et al. September 2002) was performed. Based upon this evaluation the MWL is not the source of toluene in groundwater samples.

During the April sampling, 2-hexanone was detected in both MWL-MW6 samples but qualified as not detected during data validation due to associated laboratory method blank contamination (Section 4.7). The VOC 2-butanone was detected in the April sample from MWL-MW6 at a concentration of 1.37 µg/L. This compound was not detected above the laboratory MDL in the associated MWL-MW6 duplicate sample. The SVOC bis(2-ethylhexyl)phthalate was detected at a concentration of 4.52 µg/L, which is above the MDL, but below the MCL of 6 µg/L.

During the July sampling event, the SVOC bis(2-ethylhexyl)phthalate was detected above the MCL of 6.0 µg/L in the sample from MWL-MW7 at a concentration of 9.82 µg/L, which is below the PQL (i.e., this concentration is qualified as estimated). This SVOC was not detected in any other MWL-MW7 samples in 2009, is a common laboratory contaminant (EPA 1999b), is not a COC at the MWL, and has been frequently detected in blank and QC samples. In October, the

bis(2-ethylhexyl)phthalate result for the sample from MWL-MW9 was qualified as not detected during data validation due to laboratory method blank contamination.

6.4 Perchlorate

The Consent Order (NMED April 2004) requires that new wells be sampled for perchlorate for a minimum of four quarters. During CY 2008, groundwater monitoring wells MWL-MW7, MWL-MW8, and MWL-MW9 and background monitoring well MWL-BW2 were installed and therefore added to the perchlorate screening monitoring well network. If perchlorate is detected above the screening level in a specific well, monitoring will continue for that well at a frequency negotiated with the NMED. Four consecutive nondetections using the screening level of 4 µg/L are considered sufficient by the NMED to remove that well from the perchlorate screening monitoring network.

The sampling results for perchlorate for these wells (MWL-MW7, MWL-MW8, MWL-MW9, and MWL-BW2) are presented in Table A-11. No detections of perchlorate at or above the screening level of 4 µg/L were reported at these locations during their consecutive four quarters of groundwater monitoring. The final quarter of perchlorate sampling for MWL-BW2 coincided with the first quarter of CY09, while the final quarter of perchlorate sampling for MWL-MW7, MWL-MW8, and MWL-MW9 coincided with the second quarter of CY09. Based on these four consecutive nondetections, all MWL wells are no longer being sampled for perchlorate.

6.5 Radiological Parameters

Groundwater samples from the MWL monitoring wells were analyzed for gamma-emitting radionuclides, gross alpha/beta activity, and tritium. The results for tritium, gross alpha/beta, and gamma spectroscopy activity are presented in Table A-12 and are compared with the established EPA Safe Drinking Water Act MCLs (EPA 2009) (no MCL has been established for tritium).

Gamma spectroscopy activities for short-list radionuclides were less than associated minimum detectable activity (MDA), except for potassium-40. Potassium-40 was detected above the MDA during each sampling event from various wells (see Table A-12). However, all potassium-40 results were qualified as estimated values during data validation since the laboratory did not identify a definitive peak and the associated MDA was biased low.

Gross alpha activity is measured as a screening tool and according to 40 Code of Federal Regulations (CFR) Parts 9, 141, and 142, Table I-4, does not include uranium, which is measured independently as part of TAL metals list as described in Section 6.2. Therefore, gross alpha activity measurements were corrected by subtracting out the total uranium activity. Uranium concentrations in mg/L determined from TAL metal analyses are converted to pCi/L and subtracted from the overall gross alpha activity. A conversion factor of 670 pCi/mg natural uranium is used (40 CFR Parts 9, 141, and 142, Subpart I and Malcewska-Toth, Myers, Shuey, and Lewis May 2003). Corrected gross alpha activity results are all below the MCL of 15 pCi/L and range from 2.54 to 9.26 pCi/L. Gross beta activity results did not exceed established limits. Tritium activities were reported below laboratory MDAs in all groundwater samples. Because tritium is a constituent of concern (COC) at the MWL, the results are reported in Table A-12.

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7.0 QUALITY CONTROL SAMPLE RESULTS

Field and laboratory QC samples were prepared to determine the accuracy of the methods used and to detect inadvertent sample contamination that may have occurred during the sampling and analysis process. All data were reviewed in accordance with AOP 00-03 "Data Validation Procedure for Chemical and Radiochemical Data" (SNL/NM July 2007). The results for each QC analysis and the impact on data quality are discussed in the following sections.

7.1 Field Quality Control Samples

The QC samples collected in the field included TB, EB, FB, and field duplicate samples. A TB sample is collected to assess whether contamination occurred during shipment and storage. An EB sample is collected to verify the effectiveness of the sampling equipment decontamination process. An FB sample provides a method to check for potential sources of sample contamination or sampling error. A duplicate sample is collected immediately after the environmental sample and provides information about sampling variability. The following sections discuss the analytical results for each QC sample type.

7.1.1 Trip Blank Samples

TB samples were submitted whenever samples were collected for VOC analysis to assess whether contamination of the samples had occurred during shipment and storage. TB samples consist of laboratory reagent grade water with hydrochloric acid preservative contained in 40-mL volatile organic analysis vials prepared by the analytical laboratory, which accompany the empty sample containers supplied by the laboratory. TBs were brought to the field and accompanied each sample shipment.

January 2009. A total of five TBs were submitted with the January 2009 samples. No VOCs were detected above associated laboratory MDLs.

April 2009. A total of nine TBs were submitted with the April 2009 samples. No VOCs were detected above associated laboratory MDLs, except 2-hexanone, which was detected in the trip blank sample associated with MWL-MW6 samples. This compound was qualified during data validation as not detected due to associated laboratory method blank contamination.

July 2009. A total of four TBs were submitted with the July 2009 samples. No VOCs were detected above associated laboratory MDLs.

October 2009. A total of five TBs were submitted with the October 2009 samples. No VOCs were detected above associated laboratory MDLs, except chloromethane. No corrective action was required as chloromethane was not detected in the associated environmental sample.

7.1.2 Equipment Blank Samples

A total of four EB samples were collected during the CY 2009 sampling events at the MWL to verify the equipment decontamination process. The EB samples are collected prior to sampling various wells and submitted for all analytical parameters.

January 2009. One EB sample was collected prior to sampling MWL-MW8. Various organic and inorganic parameters detected in the EB included acetone, bromodichloromethane, chloroform, dibromochloromethane, chloride, chromium, copper, sodium, aluminum, magnesium, and total alkalinity. No corrective action was required for bromodichloromethane, chloroform, dibromochloromethane, chloride, sodium, aluminum, magnesium, or total alkalinity as these compounds were not detected in the environmental samples or detected in associated environmental samples at concentrations greater than five times the blank contamination. Acetone in MWL-MW8 environmental samples was qualified as not detected during data validation as the sampling results are less than 10 times the blank contamination. Both unfiltered and filtered fractions for chromium and copper in MWL-MW8 environmental samples were qualified as not detected during data validation as chromium and copper results are less than five times the blank contamination.

April 2009. EB samples were collected prior to sampling MWL-MW6 and MWL-MW7. Various organic and inorganic parameters detected in EB samples included bromodichloromethane, bromoform, chloroform, dibromochloromethane, chloride, sulfate, aluminum, copper, magnesium, sodium, vanadium, and total alkalinity. No corrective action was required for bromodichloromethane, bromoform, chloroform, dibromochloromethane, chloride, sulfate, magnesium, sodium, or total alkalinity as these analytes were not detected in the environmental samples or were detected in associated environmental samples at concentrations less than five times the blank contamination. The filtered fraction of vanadium in MWL-MW6 samples was qualified as not detected during data validation as the sampling results are less than five times the blank contamination. Both unfiltered and filtered fractions for aluminum and copper in MWL-MW7 samples were qualified as not detected during data validation as aluminum and copper reported for both environmental samples were less than five times the blank contamination.

July 2009. An EB sample was collected prior to sampling MWL-MW9. Various organic and inorganic parameters detected in the EB sample included 2-butanone, bromodichloromethane, chloroform, dibromochloromethane, chloride, copper, magnesium, and sodium. No corrective action was required for 2-butanone, bromodichloromethane, chloroform, dibromochloromethane, chloride, magnesium, or sodium as these analytes were not detected in the environmental samples or were detected in associated environmental samples at concentrations less than five times the blank contamination. Both unfiltered and filtered fractions for copper were qualified as not detected during data validation as copper was reported in associated environmental samples at less than five times the blank contamination.

October 2009. An EB sample was collected prior to sampling MWL-BW2. Various organic and inorganic parameters detected in the EB sample included bromodichloromethane, bromoform, chloroform, dibromochloromethane, alkalinity, chloride, copper, and sodium. No corrective action was required for all parameters as the analytes were not detected in the environmental samples or were detected at concentrations less than five times the blank contamination. The unfiltered fractions for copper were qualified as not detected during data validation as copper was reported in associated environmental samples at less than five times the blank contamination.

7.1.3 Field Blank Samples

FB samples were returned to the laboratory with each shipment containing environmental samples for VOC analysis to assess whether contamination of the samples resulted from ambient field conditions. FB samples are prepared by pouring deionized water into sample containers at the sampling point to simulate the transfer of environmental samples from the sampling system to the sample container.

January 2009. The FB sample was prepared by pouring deionized water into sample containers at the MWL-BW2 sampling point. Acetone, bromodichloromethane, and carbon disulfides were detected in the FB sample. No corrective action was required as these compounds were not detected in the associated environmental sample.

April 2009. The FB sample was prepared by pouring deionized water into sample containers at the MWL-MW5 sampling point. Dibromochloromethane was the only VOC detected in the FB sample. No corrective action was required as this compound was not detected in the associated environmental sample.

July 2009. FB samples were collected at all well locations due to equipment operation associated with MWL cover construction activities. Bromodichloromethane, chloroform, and dibromochloromethane were detected in every FB sample. No corrective action was required, however, as these compounds were not detected in the associated environmental samples.

October 2009. The FB sample was prepared by pouring deionized water into sample containers at the MWL-MW7 sampling point. Bromodichloromethane, bromoform, chloroform, and dibromochloromethane were detected in the FB sample from the October 2009 sampling event. No corrective action was required as these compounds were not detected in the associated environmental sample.

7.1.4 Field Duplicate Samples

Duplicate environmental samples were collected in order to estimate the overall reproducibility of the sampling and analytical processes. The duplicate samples were collected immediately after the original environmental sample in order to reduce variability caused by time and/or sampling mechanics. Duplicate samples were analyzed for all analytical parameters.

Relative percent difference (RPD) calculations between duplicate samples were performed for detected analytes. Table A-13 summarizes the results of duplicate sample analyses and presents calculated RPD values.

January 2009. A duplicate sample was collected from MWL-MW8. The MWL mini-SAP does not specify QC acceptance criteria for duplicate sample data; however, duplicate sample results show good correlation (low RPD values less than or equal to 20) for all calculated parameters, except aluminum, iron, and magnesium. The RPD for aluminum was calculated at 22 for the unfiltered sample and 55 for the filtered sample. Iron RPDs were 123 in the unfiltered sample and 143 in the filtered sample. The RPD for filtered magnesium was calculated at 22. The elevated RPD values may be attributed to changes in water chemistry due to the low yield characteristics of this well. The well was purged to dryness prior to meeting minimum purge volume requirements. The groundwater samples were collected after allowing the monitoring well to recover.

April 2009. A duplicate sample was collected from MWL-MW6. Duplicate sample results show good correlation for all calculated parameters, except aluminum and cobalt. The RPD for aluminum was calculated at 36 for the unfiltered sample. The RPD for unfiltered cobalt was calculated at 25. The elevated RPD values for both aluminum and cobalt are considered estimated values as reported concentrations were detected below the PQL.

July 2009. A duplicate sample was collected from MWL-MW9. Duplicate sample results show good correlation for all calculated parameters, except arsenic, iron, manganese, and zinc. The RPD values for arsenic, iron, and manganese were calculated at 31, 40, and 34, respectively, for the unfiltered sample. The RPD for zinc was calculated at 54 in the unfiltered sample and at 29 in the filtered sample. The RPD values for arsenic and zinc are considered estimated values as reported concentrations were detected below the PQL. The elevated RPD values may be attributed to changes in water chemistry due to the low yield characteristics of this well. The well was purged to dryness prior to meeting minimum purge volume requirements. The groundwater samples were collected after allowing the monitoring well to recover.

October 2009. A duplicate sample was collected from MWL-BW2. Duplicate sample results show good correlation for all calculated parameters, except total selenium. The RPD for total selenium was calculated at 34 for the unfiltered sample. The RPD value for selenium in the filtered sample was calculated at 4.

7.2 Laboratory Quality Control Samples

Internal laboratory QC samples, including method blanks and duplicate laboratory control samples were analyzed concurrently with all groundwater samples. Additionally, batch matrix spike (MS), matrix spike duplicate, and surrogate spike analyses were analyzed by GEL. The chemical data were reviewed and qualified in accordance with AOP 00-03 (SNL/NM July 2007).

Although some analytical results were qualified as not detected or as estimated values during the data validation process, no significant data quality problems were noted for any CY 2009 MWL groundwater monitoring samples.

January 2009. The potassium-40 result from the MWL-MW8 duplicate sample was qualified as unusable during data validation due to the peak not meeting identification criteria during gamma spectroscopy analysis at the laboratory.

April 2009. The results for SVOC 4-nitrophenol in the MWL-MW7, MWL-MW8, and MWL-MW9 samples were qualified as unusable during data validation due to low MS recoveries.

July 2009. The potassium-40 isotope result in the MWL-MW9 environmental sample was qualified as unusable during data validation due to the peak not meeting identification criteria.

October 2009. The potassium-40 isotope result in the MWL-MW7 environmental sample was qualified as unusable during data validation due to the peak not meeting identification criteria.

8.0 VARIANCES AND NONCONFORMANCES

All analytical and field methods were performed according to the requirements specified in the MWL groundwater monitoring mini-SAPs for CY 2009 (SNL/NM January 2009, April 2009, July 2009, and October 2009), and there were no variances from the plans. Project-specific issues associated with the sampling events are noted as follows.

Various parameters have been detected in field QC samples since SNL/NM changed suppliers for deionized water. SNL/NM is preparing to test and investigate the quality of deionized water currently in use. The results will be reported in the CY 2010 MWL Annual Groundwater Monitoring Report.

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9.0 SUMMARY AND CONCLUSIONS

Groundwater sampling and analysis were conducted at the MWL during four quarters in CY 2009 according to the mini-SAPs (SNL/NM January 2009, April 2009, July 2009, and October 2009).

Only one contaminant was detected above the MCL in CY 2009. The compound bis(2-ethylhexyl)phthalate was detected in the sample from MWL-MW7 during the July 2009 sampling event at a concentration of 9.82 µg/L, which is above the MCL of 6.0 µg/L but below the PQL of 10 µg/L. This compound was not detected in any other 2009 MWL-MW7 samples, is a common laboratory contaminant (EPA 1999b), and has been frequently detected in blank and QC samples. No other inorganic or organic constituents were detected at concentrations that exceed the respective MCLs (where applicable) in the groundwater samples. Toluene was detected at concentrations well below the MCL (1,000 µg/L) and below the PQL (1.0 µg/L) but greater than the MDL (0.250 µg/L) in several samples, including the January and July samples from background well MWL-BW2. Potential sources of toluene are being further investigated. A review of the 1994 and 2008 soil gas sampling survey results (Peace et al. September 2002 and SNL/NM August 2008) and the Phase 2 RCRA Facility Investigation Report soil sampling results (Peace et al. September 2002) indicates both toluene and bis(2-ethylhexyl)phthalate are not COCs and the MWL is not the source of toluene in the groundwater samples.

All filtered and unfiltered metals results are within historical ranges for metals at the MWL and below established MCLs. Barium in MWL-MW8, nickel and cadmium in MWL-MW4, and vanadium in MWL-MW9 were detected at concentrations exceeding background concentrations. In all MWL groundwater samples total uranium exceeded the background concentration. The total uranium results are consistent with historical results, reflect a higher site-specific background concentration at the MWL, are less than the MCL, and are consistent with background ranges for the Middle Rio Grande Basin (USGS 2002) and KAFB (IT March 1996).

No radiological or general chemistry parameters exceed the established MCLs in any of the groundwater samples. Based upon the results of the groundwater monitoring events conducted at the MWL during CY 2009, constituent concentration results remain within historical ranges for the site.

The results for the laboratory QC samples and data validation indicate that the CY 2009 groundwater sampling results for the MWL are defensible as representative of the uppermost portion of the regional aquifer.

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APPENDIX A
Summary Tables of Field Measurements and Analytical Results

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Table A-1
Groundwater Elevations, Pump Setting Depths, and Static Water Level Information
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Date of Measurement	Measurement Point Elevation[a] (FAMSL)	Depth to Water (FBTOC)	Groundwater Elevation[a] (FAMSL)	Elevation of Bottom of Well (FAMSL)	Static Water Height (feet)	Pump Setting Depth (FBTOC)
MWL-MW4	04/10/09	5383.46[b]	494.68	4891.49[c]	4878.59	12.90[c]	504
MWL-MW5	04/02/09	5379.89	492.72	4887.17	4856.15	31.02	517
MWL-MW6	04/03/09	5372.64	486.38	4886.26	4839.46	46.80	527
MWL-MW7	01/06/09	5380.63	488.42	4892.21	4878.96	13.25	493
	04/08/09		488.73	4891.90		12.94	493
	07/07/09		488.94	4891.69		12.73	492.5
	10/08/09		488.76	4891.87		12.91	493
MWL-MW8	01/07/09	5381.99	490.23	4891.76	4880.07	11.69	496.5
	04/07/09		490.62	4891.37		11.30	496.5
	07/08/09		490.60	4891.39		11.32	496.5
	10/07/09		490.51	4891.48		11.41	497
MWL-MW9	01/08/09	5379.24	490.88	4888.36	4876.63	11.73	497
	04/09/09		490.71	4888.53		11.90	497
	07/09/09		491.05	4888.19		11.56	496.5
	10/05/09		490.91	4888.33		11.70	497
MWL-BW2	01/05/09	5388.35	477.41	4910.94	4884.00	26.94	499
	04/01/09		477.44	4910.91		26.91	499
	07/06/09		478.59	4909.76		25.76	498.5
	10/06/09		477.85	4910.50		26.50	497.5

[a]Measurement point is the top of well casing.

[b]Represents the upper interval distance from the top of the packer to the top of the casing.

[c]Reflects well MWL-MW4 orientation of 6 degrees from vertical.
FAMSL = Feet above mean sea level.
FBTOC = Feet below top of casing.

Table A-2
Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	Temp (°C)	Specific Conductivity (μmhos/cm)	ORP (mV)	pH (at 25°C)	Turbidity (NTU)	DO (% Sat)
MWL-MW7[a]	Before Sampling	12	15.85	629	341.2	7.50	0.86	43.2
Date purge began: 1/6/2009		13	14.78	627	247.4	7.53	0.54	50.4
Date sampled: 1/6/2009		14	15.48	627	263.0	7.53	11.80	44.6
MWL-MW8[a]	Before Sampling	7	16.52	624	213.9	7.52	4.03	43.5
Date purge began: 1/7/2009		8	17.28	625	212.0	7.52	2.92	41.3
Date sampled: 1/7/2009		9	16.74	625	209.3	7.52	1.73	63.8
MWL-MW9	Before Sampling	10	15.98	626	219.9	7.34	1.12	15.1
Date purge began: 1/8/2009		11	16.09	626	219.0	7.35	1.08	17.8
Date sampled: 1/8/2009		12	15.99	626	219.2	7.34	1.05	18.1
MWL-BW2	Before Sampling	36	15.22	761	133.8	7.36	0.72	6.3
Date purge began: 1/5/2009		38	15.54	761	133.8	7.36	0.74	6.3
Date sampled: 1/5/2009		39	15.54	761	133.5	7.36	0.76	6.1
MWL-MW4[a]	Before Sampling	20	18.03	617	248.7	7.72	2.14	79.1
Date purge began: 4/10/2009		21	18.42	643	207.0	7.56	0.66	24.7
Date sampled: 4/13/2009		22	18.60	644	187.3	7.54	0.35	19.5
MWL-MW5	Before Sampling	34	19.34	949	121.7	7.23	0.39	27.4
Date purge began: 4/2/2009		36	19.20	950	121.1	7.23	0.37	27.1
Date sampled: 4/2/2009		37	19.21	951	121.0	7.23	0.36	27.1

Refer to footnotes at end of table.

Table A-2 (Continued)
Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	Temp (°C)	Specific Conductivity (μmhos/cm)	ORP (mV)	pH (at 25°C)	Turbidity (NTU)	DO (% Sat)
MWL-MW6	Before Sampling	34	19.71	903	115.7	7.37	0.17	30.6
Date purge began: 4/3/2009		36	19.82	902	115.1	7.37	0.20	30.6
Date sampled: 4/3/2009		37	19.89	903	115.0	7.36	0.21	30.7
MWL-MW7	Before Sampling	7	19.76	629	170.7	7.50	1.17	42.3
Date purge began: 4/8/2009		8	19.93	630	164.9	7.50	1.06	42.4
Date sampled: 4/8/2009		9	19.99	630	165.2	7.50	1.03	43.0
MWL-MW8[a]	Before Sampling	5	19.54	616	142.1	7.52	2.41	55.8
Date purge began: 4/7/2009		5.5	19.48	620	140.0	7.52	2.53	52.7
Date sampled: 4/7/2009		6	19.48	626	119.9	7.53	0.97	60.5
MWL-MW9[a]	Before Sampling	13	17.95	625	136.0	7.52	3.46	120.5
Date purge began: 4/9/2009		14	18.11	626	134.6	7.51	4.45	46.4
Date sampled: 4/9/2009		14.5	19.92	629	116.9	7.50	6.82	44.0
MWL-BW2	Before Sampling	36	17.51	762	108.7	7.34	0.39	7.0
Date purge began: 4/1/2009		38	17.52	763	108.8	7.34	0.23	6.8
Date sampled: 4/1/2009		39	17.51	762	108.8	7.34	0.25	6.7
MWL-MW7	Before Sampling	7	22.93	654	-8.1	7.82	0.64	51.3
Date purge began: 7/7/2009		8	23.11	655	-18.1	7.83	0.69	52.6
Date sampled: 7/7/2009		9	23.20	655	-19.9	7.82	0.69	53.2

Refer to footnotes at end of table.

Table A-2 (Continued)
Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	Temp (°C)	Specific Conductivity (μmhos/cm)	ORP (mV)	pH (at 25°C)	Turbidity (NTU)	DO (% Sat)
MWL-MW8[a]	Before Sampling	5	23.04	648	-2.8	7.85	2.36	54.2
Date purge began: 7/8/2009		6	23.26	651	-12.9	7.90	2.66	51.3
Date sampled: 7/8/2009		6.5	24.95	666	-53.1	8.00	2.05	96.6
MWL-MW9[a]	Before Sampling	2	24.60	635	-27.9	7.80	0.26	50.0
Date purge began: 7/9/2009		3	24.07	629	-32.2	7.90	0.31	58.8
Date sampled: 7/9/2009		3.5	26.32	657	-75.2	8.07	7.81	65.1
MWL-BW2	Before Sampling	36	21.31	793	-70.1	7.73	0.43	8.3
Date purge began: 7/6/2009		38	21.23	793	-70.2	7.73	0.40	8.4
Date sampled: 7/6/2009		39	21.28	793	-70.3	7.73	0.37	8.4
MWL-MW7	Before Sampling	7	19.33	554	196.6	7.46	0.81	45.9
Date purge began: 10/8/2009		8	19.32	554	195.2	7.46	0.63	47.2
Date sampled: 10/8/2009		9	19.24	555	195.4	7.46	0.48	47.5
MWL-MW8[a]	Before Sampling	7.5	17.85	562	192.9	7.41	2.11	40.3
Date purge began: 10/7/2009		8.5	20.64	572	153.8	7.36	1.34	40.1
Date sampled: 10/7/2009		9.5	20.93	569	152.9	7.36	0.83	26.9
MWL-MW9[a]	Before Sampling	4	19.23	538	214.1	7.46	0.75	43.4
Date purge began: 10/5/2009		4.5	19.35	538	211.6	7.46	1.11	43.9
Date sampled: 10/5/2009		5	21.19	544	166.0	7.38	1.10	33.1

Refer to footnotes at end of table.

Table A-2 (Concluded)
Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	Temp (°C)	Specific Conductivity (μmhos/cm)	ORP (mV)	pH (at 25°C)	Turbidity (NTU)	DO (% Sat)
MWL-BW2	Before Sampling	36	18.77	687	146.9	7.23	0.35	8.7
Date purge began: 10/6/2009		38	18.76	687	146.6	7.23	0.34	6.6
Date sampled: 10/6/2009		39	18.76	688	146.6	7.23	0.40	6.5

[a]Wells were purged to dryness. Purge volumes show total gallons removed prior to sampling.
°C = Degree(s) Celsius.
%sat = Percent saturation.
DO = Dissolved oxygen.
μmhos/cm = Micromhos per centimeter.
mV = Millivolt(s).
NTU = Nephelometric turbidity units.
ORP = Oxidation-reduction potential.
pH = Potential of hydrogen.
Temp = Temperature.

Table A-3
Summary of Field Water Quality Measurements
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Sample Date	Temperature (°C)	Specific Conductivity (μmhos/cm)	Oxidation Reduction Potential (mV)	pH	Turbidity (NTU)	Dissolved Oxygen (% Sat)	Dissolved Oxygen (mg/L)	Alkalinity (mg/L $CaCO_3$ at 4.5 pH)
MWL-BW2	05-Jan-09	15.54	761	133.5	7.36	0.76	6.1	0.61	216
MWL-MW7	06-Jan-09	15.48	627	263.0	7.53	11.8	44.6	4.44	163
MWL-MW8	07-Jan-09	16.74	625	209.3	7.52	1.73	63.8	6.11	182
MWL-MW9	08-Jan-09	15.99	626	219.2	7.34	1.05	18.1	1.80	177
MWL-BW2	01-Apr-09	17.51	762	108.8	7.34	0.25	6.7	0.64	NM
MWL-MW4	13-Apr-09	18.60	644	187.3	7.54	0.35	19.5	1.82	NM
MWL-MW5	02-Apr-09	19.21	951	121.0	7.23	0.36	27.1	2.50	NM
MWL-MW6	03-Apr-09	19.89	903	115.0	7.36	0.21	30.7	2.79	NM
MWL-MW7	08-Apr-09	19.99	630	165.2	7.50	1.03	43.0	3.90	NM
MWL-MW8	07-Apr-09	19.48	626	119.9	7.53	0.97	60.5	5.55	NM
MWL-MW9	09-Apr-09	19.92	629	116.9	7.50	6.82	44.0	4.00	NM
MWL-BW2	06-Jul-09	21.28	793	-70.3	7.73	0.37	8.4	0.75	NM
MWL-MW7	07-Jul-09	23.20	655	-19.9	7.82	0.69	53.2	4.45	NM
MWL-MW8	08-Jul-09	24.95	666	-53.1	8.02	2.05	96.6	7.99	NM
MWL-MW9	09-Jul-09	26.32	657	-75.2	8.07	7.81	65.1	5.24	NM
MWL-BW2	06-Oct-09	18.76	688	146.6	7.23	0.40	6.5	0.61	NM
MWL-MW7	08-Oct-09	19.24	555	195.4	7.46	0.48	47.5	4.37	NM
MWL-MW8	07-Oct-09	20.93	569	152.9	7.36	0.83	26.9	2.39	NM
MWL-MW9	05-Oct-09	21.19	544	166.0	7.38	1.10	33.1	2.91	NM

°C = Degree(s) Celsius.
%sat = Percent saturation.
$CaCO_3$ = Calcium carbonate.
ID = Identification.
μmhos/cm = Micromhos per centimeter.
mg/L = Milligram(s) per liter.
mV = Millivolt(s).
NM = Not measured.
NTU = Nephelometric turbidity units.
pH = Potential of hydrogen.

Table A-4
Analytical Parameters, Test Methods, and Target Quantitation Limits
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Analytical Parameter	Test Method[a]	Target Quantitation Limit[b]
Total Metals TAL and Uranium	SW846-6020 SW846-7470A	0.00007 – 2.50 mg/L
Volatile Organic Compounds	SW846-8260B	1.00 – 15.0 µg/L
Semivolatile Organic Compounds	SW846-8270C	1.00 – 24.1 µg/L
Nitrate plus Nitrite (as nitrogen)	EPA 353.2	0.250 – 0.500 mg/L
Major Anions Bromide, Fluoride, Chloride, and Sulfate	SW846-9056	0.100 – 4.0 mg/L
Total Alkalinity as Calcium Carbonate	SM 2320B	1.00 mg/L
Perchlorate	EPA 314.0	0.012 mg/L
Radionuclides Gamma-Emitting Radionuclides Gross Alpha Activity Gross Beta Activity Tritium	 EPA 901.1 EPA 900.0 EPA 900.0 EPA 906.0	 MDA is isotope specific 0.954 – 15.5 pCi/L 1.16 – 5.28 pCi/L 131 – 176 pCi/L

[a]Methods are from EPA, 1979, "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, U.S. Environmental Protection Agency, Cincinnati, Ohio; EPA, 1980, "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032, U.S. Environmental Protection Agency, Cincinnati, Ohio; EPA, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.; EPA, 1999, "Perchlorate in Drinking Water Using Ion Chromatography," EPA 815/R-00-014, U.S. Environmental Protection Agency, Washington, D.C.; or Clesceri, Greenburg, and Eaton, 1998, *Standard Methods for the Examination of Water and Wastewater*, 20th ed., Method 2320B.
[b]For target compounds only. Reporting limits may be elevated if an interfering component is present or if sample dilution is required.
EPA = U.S. Environmental Protection Agency.
MDA = Minimum detectable activity.
µg/L = Microgram(s) per liter.
mg/L = Milligram(s) per liter.
pCi/L = Picocurie(s) per liter.
SM = Standard Method.
SW = Solid waste.
TAL = Target analyte list.

Table A-5
Summary of Nitrate plus Nitrite Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier	Validation Qualifier[d]	Sample No.	Analytical Method[e]
MWL-BW2 05-Jan-09	Nitrate plus nitrite as N	2.12	0.100	0.500	10			086943-018	EPA 353.2
MWL-MW7 06-Jan-09	Nitrate plus nitrite as N	3.15	0.250	1.25	10			086946-018	EPA 353.2
MWL-MW8 07-Jan-09	Nitrate plus nitrite as N	1.11	0.050	0.250	10			086950-018	EPA 353.2
MWL-MW8 (Duplicate) 07-Jan-09	Nitrate plus nitrite as N	1.12	0.050	0.250	10			086951-018	EPA 353.2
MWL-MW9 08-Jan-09	Nitrate plus nitrite as N	1.82	0.250	1.25	10			086953-018	EPA 353.2
MWL-BW2 01-Apr-09	Nitrate plus nitrite as N	2.06	0.100	0.500	10			087151-018	EPA 353.2
MWL-MW4 13-Apr-09	Nitrate plus nitrite as N	0.920	0.050	0.250	10			087169-018	EPA 353.2
MWL-MW5 02-Apr-09	Nitrate plus nitrite as N	1.39	0.050	0.250	10			087153-018	EPA 353.2
MWL-MW6 03-Apr-09	Nitrate plus nitrite as N	1.52	0.050	0.250	10			087158-018	EPA 353.2
MWL-MW6 (Duplicate) 03-Apr-09	Nitrate plus nitrite as N	1.72	0.100	0.500	10			087159-018	EPA 353.2
MWL-MW7 08-Apr-09	Nitrate plus nitrite as N	3.86	0.100	0.500	10			087165-018	EPA 353.2
MWL-MW8 07-Apr-09	Nitrate plus nitrite as N	1.61	0.100	0.500	10			087161-018	EPA 353.2
MWL-MW9 09-Apr-09	Nitrate plus nitrite as N	2.18	0.100	0.500	10			087167-018	EPA 353.2
MWL-BW2 06-Jul-09	Nitrate plus nitrite as N	2.01	0.050	0.250	10			087489-018	EPA 353.2
MWL-MW7 07-Jul-09	Nitrate plus nitrite as N	3.03	0.050	0.250	10			087492-018	EPA 353.2
MWL-MW8 08-Jul-09	Nitrate plus nitrite as N	0.175	0.010	0.050	10			087495-018	EPA 353.2
MWL-MW9 09-Jul-09	Nitrate plus nitrite as N	2.03	0.050	0.250	10			087500-018	EPA 353.2
MWL-MW9 (Duplicate) 09-Jul-09	Nitrate plus nitrite as N	1.96	0.050	0.250	10			087501-018	EPA 353.2

Refer to footnotes at end of table.

Table A-5 (Concluded)
Summary of Nitrate plus Nitrite Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier	Validation Qualifier[d]	Sample No.	Analytical Method[e]
MWL-BW2 06-Oct-09	Nitrate plus nitrite as N	2.04	0.100	0.500	10			087769-018	EPA 353.2
MWL-BW2 (Duplicate) 06-Oct-09	Nitrate plus nitrite as N	1.98	0.100	0.500	10			087770-018	EPA 353.2
MWL-MW7 08-Oct-09	Nitrate plus nitrite as N	3.04	0.100	0.500	10			087774-018	EPA 353.2
MWL-MW8 07-Oct-09	Nitrate plus nitrite as N	0.850	0.050	0.250	10			087772-018	EPA 353.2
MWL-MW9 05-Oct-09	Nitrate plus nitrite as N	2.08	0.100	0.500	10			087765-018	EPA 353.2

[a]The MDL is the minimum concentration or activity that can be measured and reported with 99% confidence that the analyte is greater than zero.
[b]The PQL is the lowest concentration of analyte in a sample that can be reliably determined within specified limits of precision and accuracy by the indicated method under routine laboratory operating conditions.
[c]The MCL is established by the EPA Primary Water Regulations (40 CFR 141.11(b)), and subsequent amendments.
[d]If cell is blank, then all quality control samples meet acceptance criteria with respect to submitted samples.
[e]EPA 1979, "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, U.S. Environmental Protection Agency, Cincinnati, Ohio.
CFR = Code of Federal Regulations.
EPA = U.S. Environmental Protection Agency.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
PQL = Practical quantitation limit.

Table A-6
Summary of Alkalinity and Anion Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[a]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-BW2	Alkalinity, total as CaCO3	247	1.45	2.00	NE	B		086943-016	SM 2320B
05-Jan-09	Bromide	0.424	0.067	0.200	NE			086943-016	SW846 9056
	Chloride	62.2	0.660	2.00	NE			086943-016	SW846 9056
	Fluoride	0.680	0.033	0.100	4.0			086943-016	SW846 9056
	Sulfate	46.7	1.00	4.00	NE			086943-016	SW846 9056
MWL-MW7	Alkalinity, total as CaCO3	215	0.725	1.00	NE	B		086946-016	SM 2320B
06-Jan-09	Bromide	0.320	0.067	0.200	NE			086946-016	SW846 9056
	Chloride	42.2	0.330	1.00	NE			086946-016	SW846 9056
	Fluoride	1.00	0.033	0.100	4.0			086946-016	SW846 9056
	Sulfate	37.4	0.100	0.400	NE			086946-016	SW846 9056
MWL-MW8	Alkalinity, total as CaCO3	222	0.725	1.00	NE	B		086950-016	SM 2320B
07-Jan-09	Bromide	0.302	0.067	0.200	NE			086950-016	SW846 9056
	Chloride	44.7	0.660	2.00	NE			086950-016	SW846 9056
	Fluoride	1.05	0.033	0.100	4.0			086950-016	SW846 9056
	Sulfate	34.9	0.100	0.400	NE			086950-016	SW846 9056
MWL-MW8 (Duplicate)	Alkalinity, total as CaCO3	222	0.725	1.00	NE	B		086951-016	SM 2320B
07-Jan-09	Bromide	0.328	0.067	0.200	NE			086951-016	SW846 9056
	Chloride	44.4	0.660	2.00	NE			086951-016	SW846 9056
	Fluoride	1.02	0.033	0.100	4.0			086951-016	SW846 9056
	Sulfate	34.7	0.100	0.400	NE			086951-016	SW846 9056
MWL-MW9	Alkalinity, total as CaCO3	221	1.45	2.00	NE	B		086953-016	SM 2320B
08-Jan-09	Bromide	0.292	0.067	0.200	NE			086953-016	SW846 9056
	Chloride	40.0	0.660	2.00	NE			086953-016	SW846 9056
	Fluoride	1.04	0.033	0.100	4.0			086953-016	SW846 9056
	Sulfate	38.7	0.100	0.400	NE			086953-016	SW846 9056
MWL-BW2	Alkalinity, total as CaCO3	248	0.725	1.00	NE	B		087151-016	SM 2320B
01-Apr-09	Bromide	0.401	0.066	0.200	NE			087151-016	SW846 9056
	Chloride	63.0	0.660	2.00	NE			087151-016	SW846 9056
	Fluoride	0.698	0.033	0.100	4.0			087151-016	SW846 9056
	Sulfate	45.4	1.00	4.00	NE			087151-016	SW846 9056
MWL-MW4	Alkalinity, total as CaCO3	203	0.725	1.00	NE	B		087169-016	SM 2320B
13-Apr-09	Bromide	0.354	0.066	0.200	NE			087169-016	SW846 9056
	Chloride	53.1	0.330	1.00	NE			087169-016	SW846 9056
	Fluoride	0.869	0.033	0.100	4.0			087169-016	SW846 9056
	Sulfate	41.3	0.500	2.00	NE			087169-016	SW846 9056

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Alkalinity and Anion Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[a]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW5	Alkalinity, total as CaCO3	320	0.725	1.00	NE	B		087153-016	SM 2320B
02-Apr-09	Bromide	0.462	0.066	0.200	NE			087153-016	SW846 9056
	Chloride	82.7	0.660	2.00	NE			087153-016	SW846 9056
	Fluoride	0.791	0.033	0.100	4.0			087153-016	SW846 9056
	Sulfate	53.4	1.00	4.00	NE			087153-016	SW846 9056
MWL-MW6	Alkalinity, total as CaCO3	298	0.725	1.00	NE	B		087158-016	SM 2320B
03-Apr-09	Bromide	0.457	0.066	0.200	NE			087158-016	SW846 9056
	Chloride	76.1	0.660	2.00	NE			087158-016	SW846 9056
	Fluoride	0.726	0.033	0.100	4.0			087158-016	SW846 9056
	Sulfate	51.9	1.00	4.00	NE			087158-016	SW846 9056
MWL-MW6 (Duplicate)	Alkalinity, total as CaCO3	298	0.725	1.00	NE	B		087159-016	SM 2320B
03-Apr-09	Bromide	0.435	0.066	0.200	NE			087159-016	SW846 9056
	Chloride	75.9	0.660	2.00	NE			087159-016	SW846 9056
	Fluoride	0.746	0.033	0.100	4.0			087159-016	SW846 9056
	Sulfate	51.8	1.00	4.00	NE			087159-016	SW846 9056
MWL-MW7	Alkalinity, total as CaCO3	215	0.725	1.00	NE	B		087165-016	SM 2320B
08-Apr-09	Bromide	0.306	0.066	0.200	NE			087165-016	SW846 9056
	Chloride	41.7	0.330	1.00	NE			087165-016	SW846 9056
	Fluoride	0.982	0.033	0.100	4.0			087165-016	SW846 9056
	Sulfate	37.6	0.100	0.400	NE			087165-016	SW846 9056
MWL-MW8	Alkalinity, total as CaCO3	218	0.725	1.00	NE	B		087161-016	SM 2320B
07-Apr-09	Bromide	0.332	0.066	0.200	NE			087161-016	SW846 9056
	Chloride	44.2	0.330	1.00	NE			087161-016	SW846 9056
	Fluoride	1.03	0.033	0.100	4.0			087161-016	SW846 9056
	Sulfate	34.7	0.100	0.400	NE			087161-016	SW846 9056
MWL-MW9	Alkalinity, total as CaCO3	221	0.725	1.00	NE	B		087167-016	SM 2320B
09-Apr-09	Bromide	0.312	0.066	0.200	NE			087167-016	SW846 9056
	Chloride	40.2	0.330	1.00	NE			087167-016	SW846 9056
	Fluoride	1.02	0.033	0.100	4.0			087167-016	SW846 9056
	Sulfate	39.0	0.100	0.400	NE			087167-016	SW846 9056
MWL-BW2	Alkalinity, total as CaCO3	243	0.725	1.00	NE	B	J	087489-016	SM 2320B
06-Jul-09	Bromide	0.328	0.066	0.200	NE			087489-016	SW846 9056
	Chloride	61.2	0.660	2.00	NE			087489-016	SW846 9056
	Fluoride	0.679	0.033	0.100	4.0			087489-016	SW846 9056
	Sulfate	45.1	1.00	4.00	NE			087489-016	SW846 9056

Refer to footnotes at end of table.

Table A-6 (Continued)
Summary of Alkalinity and Anion Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[a]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW7	Alkalinity, total as CaCO3	213	0.725	1.00	NE	B	J	087492-016	SM 2320B
07-Jul-09	Bromide	0.217	0.066	0.200	NE			087492-016	SW846 9056
	Chloride	39.5	0.660	2.00	NE			087492-016	SW846 9056
	Fluoride	0.951	0.033	0.100	4.0			087492-016	SW846 9056
	Sulfate	36.5	0.100	0.400	NE			087492-016	SW846 9056
MWL-MW8	Alkalinity, total as CaCO3	219	0.725	1.00	NE	B	J	087495-016	SM 2320B
08-Jul-09	Bromide	0.318	0.066	0.200	NE			087495-016	SW846 9056
	Chloride	43.8	0.660	2.00	NE			087495-016	SW846 9056
	Fluoride	0.970	0.033	0.100	4.0			087495-016	SW846 9056
	Sulfate	33.8	0.100	0.400	NE			087495-016	SW846 9056
MWL-MW9	Alkalinity, total as CaCO3	217	0.725	1.00	NE	B	J	087500-016	SM 2320B
09-Jul-09	Bromide	0.267	0.066	0.200	NE			087500-016	SW846 9056
	Chloride	39.5	0.660	2.00	NE			087500-016	SW846 9056
	Fluoride	1.02	0.033	0.100	4.0			087500-016	SW846 9056
	Sulfate	37.7	0.100	0.400	NE			087500-016	SW846 9056
MWL-MW9 (Duplicate)	Alkalinity, total as CaCO3	220	0.725	1.00	NE	B	J	087501-016	SM 2320B
09-Jul-09	Bromide	0.291	0.066	0.200	NE			087501-016	SW846 9056
	Chloride	38.1	0.660	2.00	NE			087501-016	SW846 9056
	Fluoride	0.996	0.033	0.100	4.0			087501-016	SW846 9056
	Sulfate	37.8	0.100	0.400	NE			087501-016	SW846 9056
MWL-BW2	Alkalinity, total as CaCO3	252	0.725	1.00	NE	B		087769-016	SM 2320B
06-Oct-09	Bromide	0.374	0.066	0.200	NE			087769-016	SW846 9056
	Chloride	61.4	0.660	2.00	NE			087769-016	SW846 9056
	Fluoride	0.700	0.033	0.100	4.0			087769-016	SW846 9056
	Sulfate	43.0	1.00	4.00	NE			087769-016	SW846 9056
MWL-BW2 (Duplicate)	Alkalinity, total as CaCO3	248	0.725	1.00	NE	B		087770-016	SM 2320B
06-Oct-09	Bromide	0.365	0.066	0.200	NE			087770-016	SW846 9056
	Chloride	61.3	0.660	2.00	NE			087770-016	SW846 9056
	Fluoride	0.716	0.033	0.100	4.0			087770-016	SW846 9056
	Sulfate	42.8	1.00	4.00	NE			087770-016	SW846 9056
MWL-MW7	Alkalinity, total as CaCO3	221	0.725	1.00	NE	B		087774-016	SM 2320B
08-Oct-09	Bromide	0.300	0.066	0.200	NE			087774-016	SW846 9056
	Chloride	40.7	0.330	1.00	NE			087774-016	SW846 9056
	Fluoride	1.00	0.033	0.100	4.0			087774-016	SW846 9056
	Sulfate	36.4	0.100	0.400	NE			087774-016	SW846 9056

Refer to footnotes at end of table.

Table A-6 (Concluded)
Summary of Alkalinity and Anion Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[a]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW8	Alkalinity, total as CaCO3	231	0.725	1.00	NE	B		087772-016	SM 2320B
07-Oct-09	Bromide	0.306	0.066	0.200	NE			087772-016	SW846 9056
	Chloride	48.3	0.330	1.00	NE			087772-016	SW846 9056
	Fluoride	0.951	0.033	0.100	4.0			087772-016	SW846 9056
	Sulfate	35.1	0.100	0.400	NE			087772-016	SW846 9056
MWL-MW9	Alkalinity, total as CaCO3	224	0.725	1.00	NE	B		087765-016	SM 2320B
05-Oct-09	Bromide	0.281	0.066	0.200	NE			087765-016	SW846 9056
	Chloride	39.2	0.330	1.00	NE			087765-016	SW846 9056
	Fluoride	1.06	0.033	0.100	4.0			087765-016	SW846 9056
	Sulfate	37.5	0.100	0.400	NE			087765-016	SW846 9056

[a]Laboratory Qualifier.
B = Analyte is detected in associated laboratory method blank.
[b]Validation Qualifier.
If cell is blank, then all quality control samples meet acceptance criteria with respect to submitted samples.
J = The associated value is an estimated quantity.
[c]Analytical Method.
EPA 1986,"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.
Clesceri, Greenburg, and Eaton, 1998, *Standard Methods for the Examination of Water and Wastewater*, 20th ed., Method 2320B.CaCO3 = Calcium carbonate.

EPA = U.S. Environmental Protection Agency.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
NE = Not established.
PQL = Practical quantitation limit.
SM = Standard Method.
SW = Solid waste.

Table A-7
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-BW2	Aluminum	0.00856	0.005	0.015	NE	NE	J		086943-009	SW846 6020
05-Jan-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		086943-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		086943-009	SW846 6020
	Barium	0.0955	0.0005	0.002	2.00	0.12			086943-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		086943-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		086943-009	SW846 6020
	Calcium	71.7	0.100	0.500	NE	NE	B		086943-009	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		086943-009	SW846 6020
	Cobalt	0.000129	0.0001	0.001	NE	0.0025	J		086943-009	SW846 6020
	Copper	0.000528	0.0003	0.001	NE	<0.05	J		086943-009	SW846 6020
	Iron	0.189	0.010	0.025	NE	NE	B		086943-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		086943-009	SW846 6020
	Magnesium	22.6	0.0052	0.015	NE	NE			086943-009	SW846 6020
	Manganese	0.00136	0.001	0.005	NE	NE	J		086943-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		086943-009	SW846 7470
	Nickel	0.0013	0.0005	0.002	NE	0.028	J	J+	086943-009	SW846 6020
	Potassium	4.03	0.080	0.300	NE	NE			086943-009	SW846 6020
	Selenium	0.00151	0.001	0.005	0.050	0.005	J		086943-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		086943-009	SW846 6020
	Sodium	53.0	0.400	1.25	NE	NE			086943-009	SW846 6020
	Thallium	0.000467	0.0003	0.001	0.002	0.002	J		086943-009	SW846 6020
	Uranium	0.0077	0.00005	0.0002	0.030	0.0052	B		086943-009	SW846 6020
	Vanadium	0.00419	0.003	0.010	NE	0.013	J		086943-009	SW846 6020
	Zinc	0.00281	0.0026	0.010	NE	0.26	J		086943-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-MW7	Aluminum	0.354	0.005	0.015	NE	NE			086946-009	SW846 6020
06-Jan-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		086946-009	SW846 6020
	Arsenic	0.00249	0.0015	0.005	0.010	0.014	J		086946-009	SW846 6020
	Barium	0.102	0.0005	0.002	2.00	0.12			086946-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		086946-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		086946-009	SW846 6020
	Calcium	54.4	0.100	0.500	NE	NE	B		086946-009	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		086946-009	SW846 6020
	Cobalt	0.000255	0.0001	0.001	NE	0.0025	J		086946-009	SW846 6020
	Copper	0.00127	0.0003	0.001	NE	<0.05			086946-009	SW846 6020
	Iron	0.854	0.010	0.025	NE	NE	B		086946-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		086946-009	SW846 6020
	Magnesium	17.9	0.0052	0.015	NE	NE			086946-009	SW846 6020
	Manganese	0.0122	0.001	0.005	NE	NE			086946-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		086946-009	SW846 7470
	Nickel	0.0014	0.0005	0.002	NE	0.028	J	J+	086946-009	SW846 6020
	Potassium	5.26	0.080	0.300	NE	NE			086946-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		086946-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		086946-009	SW846 6020
	Sodium	43.9	0.080	0.250	NE	NE			086946-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		086946-009	SW846 6020
	Uranium	0.00841	0.00005	0.0002	0.030	0.0052	B		086946-009	SW846 6020
	Vanadium	0.00441	0.003	0.010	NE	0.013	J		086946-009	SW846 6020
	Zinc	0.0038	0.0026	0.010	NE	0.26	J		086946-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-MW8	Aluminum	0.760	0.005	0.015	NE	NE			086950-009	SW846 6020
07-Jan-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		086950-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		086950-009	SW846 6020
	Barium	0.123	0.005	0.020	2.00	0.12			086950-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		086950-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		086950-009	SW846 6020
	Calcium	54.4	0.200	1.00	NE	NE	B		086950-009	SW846 6020
	Chromium	0.00359	0.0015	0.003	0.100	0.043		0.011U	086950-009	SW846 6020
	Cobalt	0.000501	0.0001	0.001	NE	0.0025	J		086950-009	SW846 6020
	Copper	0.00192	0.0003	0.001	NE	<0.05		0.0049U	086950-009	SW846 6020
	Iron	0.718	0.010	0.025	NE	NE			086950-009	SW846 6020
	Lead	0.0005	0.0005	0.002	NE	0.01	J		086950-009	SW846 6020
	Magnesium	19.1	0.0052	0.015	NE	NE			086950-009	SW846 6020
	Manganese	0.0274	0.001	0.005	NE	NE			086950-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		086950-009	SW846 7470
	Nickel	0.00236	0.0005	0.002	NE	0.028			086950-009	SW846 6020
	Potassium	5.44	0.080	0.300	NE	NE			086950-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		086950-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		086950-009	SW846 6020
	Sodium	49.0	0.800	2.50	NE	NE			086950-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		086950-009	SW846 6020
	Uranium	0.00875	0.00005	0.0002	0.030	0.0052			086950-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		086950-009	SW846 6020
	Zinc	0.00384	0.0026	0.010	NE	0.26	J		086950-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-MW8 (Duplicate)	Aluminum	0.608	0.005	0.015	NE	NE			086951-009	SW846 6020
07-Jan-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		086951-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		086951-009	SW846 6020
	Barium	0.122	0.005	0.020	2.00	0.12			086951-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		086951-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		086951-009	SW846 6020
	Calcium	52.9	0.200	1.00	NE	NE	B		086951-009	SW846 6020
	Chromium	0.00373	0.0015	0.003	0.100	0.043		0.011U	086951-009	SW846 6020
	Cobalt	0.00046	0.0001	0.001	NE	0.0025	J		086951-009	SW846 6020
	Copper	0.00188	0.0003	0.001	NE	<0.05		0.0049U	086951-009	SW846 6020
	Iron	0.171	0.010	0.025	NE	NE			086951-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		086951-009	SW846 6020
	Magnesium	18.4	0.0052	0.015	NE	NE			086951-009	SW846 6020
	Manganese	0.0256	0.001	0.005	NE	NE			086951-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		086951-009	SW846 7470
	Nickel	0.00262	0.0005	0.002	NE	0.028			086951-009	SW846 6020
	Potassium	5.68	0.080	0.300	NE	NE			086951-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		086951-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		086951-009	SW846 6020
	Sodium	47.9	0.800	2.50	NE	NE			086951-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		086951-009	SW846 6020
	Uranium	0.00856	0.00005	0.0002	0.030	0.0052			086951-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		086951-009	SW846 6020
	Zinc	0.00383	0.0026	0.010	NE	0.26	J		086951-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-MW9	Aluminum	0.106	0.005	0.015	NE	NE			086953-009	SW846 6020
08-Jan-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		086953-009	SW846 6020
	Arsenic	0.00246	0.0015	0.005	0.010	0.014	J		086953-009	SW846 6020
	Barium	0.098	0.0005	0.002	2.00	0.12			086953-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		086953-009	SW846 6020
	Cadmium	0.000376	0.00011	0.001	0.005	0.00047	J		086953-009	SW846 6020
	Calcium	54.4	0.200	1.00	NE	NE	B		086953-009	SW846 6020
	Chromium	0.00202	0.0015	0.003	0.100	0.043	J		086953-009	SW846 6020
	Cobalt	0.000262	0.0001	0.001	NE	0.0025	J		086953-009	SW846 6020
	Copper	0.00106	0.0003	0.001	NE	<0.05			086953-009	SW846 6020
	Iron	0.288	0.010	0.025	NE	NE			086953-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		086953-009	SW846 6020
	Magnesium	19.8	0.0052	0.015	NE	NE			086953-009	SW846 6020
	Manganese	0.0141	0.001	0.005	NE	NE			086953-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		086953-009	SW846 7470
	Nickel	0.00194	0.0005	0.002	NE	0.028	J		086953-009	SW846 6020
	Potassium	4.93	0.080	0.300	NE	NE			086953-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		086953-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		086953-009	SW846 6020
	Sodium	48.4	0.800	2.50	NE	NE			086953-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		086953-009	SW846 6020
	Uranium	0.00934	0.00005	0.0002	0.030	0.0052			086953-009	SW846 6020
	Vanadium	0.00514	0.003	0.010	NE	0.013	J		086953-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.26	U		086953-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-BW2	Aluminum	0.0104	0.005	0.015	NE	NE	J	J+	087151-009	SW846 6020
01-Apr-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		087151-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		087151-009	SW846 6020
	Barium	0.0985	0.0005	0.002	2.00	0.12			087151-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087151-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087151-009	SW846 6020
	Calcium	69.3	0.100	0.500	NE	NE	B		087151-009	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		087151-009	SW846 6020
	Cobalt	0.00015	0.0001	0.001	NE	0.0025	J		087151-009	SW846 6020
	Copper	0.000777	0.0003	0.001	NE	<0.05	J		087151-009	SW846 6020
	Iron	0.218	0.010	0.025	NE	NE			087151-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087151-009	SW846 6020
	Magnesium	24.4	0.0052	0.015	NE	NE			087151-009	SW846 6020
	Manganese	0.00113	0.001	0.005	NE	NE	J		087151-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U	UJ	087151-009	SW846 7470
	Nickel	0.00151	0.0005	0.002	NE	0.028	J		087151-009	SW846 6020
	Potassium	3.82	0.080	0.300	NE	NE			087151-009	SW846 6020
	Selenium	0.00214	0.001	0.005	0.050	0.005	J		087151-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087151-009	SW846 6020
	Sodium	58.4	0.400	1.25	NE	NE			087151-009	SW846 6020
	Thallium	0.000512	0.0003	0.001	0.002	0.002	J	0.0024U	087151-009	SW846 6020
	Uranium	0.00754	0.00005	0.0002	0.030	0.0052	B		087151-009	SW846 6020
	Vanadium	0.00432	0.003	0.010	NE	0.013	J		087151-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.26	U		087151-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-MW4	Aluminum	0.00719	0.005	0.015	NE	NE	B, J	0.030U	087169-009	SW846 6020
13-Apr-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		087169-009	SW846 6020
	Arsenic	0.00171	0.0015	0.005	0.010	0.014	J		087169-009	SW846 6020
	Barium	0.109	0.0025	0.010	2.00	0.12			087169-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087169-009	SW846 6020
	Cadmium	0.00275	0.00011	0.001	0.005	0.00047			087169-009	SW846 6020
	Calcium	59.0	0.200	1.00	NE	NE	B		087169-009	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		087169-009	SW846 6020
	Cobalt	0.000265	0.0001	0.001	NE	0.0025	J		087169-009	SW846 6020
	Copper	0.00294	0.0003	0.001	NE	<0.05			087169-009	SW846 6020
	Iron	0.239	0.010	0.025	NE	NE			087169-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087169-009	SW846 6020
	Magnesium	19.2	0.052	0.150	NE	NE			087169-009	SW846 6020
	Manganese	0.00689	0.001	0.005	NE	NE			087169-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U	UJ	087169-009	SW846 7470
	Nickel	0.0291	0.0005	0.002	NE	0.028			087169-009	SW846 6020
	Potassium	4.76	0.080	0.300	NE	NE			087169-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087169-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087169-009	SW846 6020
	Sodium	53.2	0.800	2.50	NE	NE			087169-009	SW846 6020
	Thallium	0.00097	0.0003	0.001	0.002	0.002	J	0.0049U	087169-009	SW846 6020
	Uranium	0.0059	0.00005	0.0002	0.030	0.0052			087169-009	SW846 6020
	Vanadium	0.00344	0.003	0.010	NE	0.013	J		087169-009	SW846 6020
	Zinc	0.0799	0.0026	0.010	NE	0.26			087169-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-MW5	Aluminum	0.0073	0.005	0.015	NE	NE	J	J+	087153-009	SW846 6020
02-Apr-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		087153-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		087153-009	SW846 6020
	Barium	0.120	0.0005	0.002	2.00	0.12			087153-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087153-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087153-009	SW846 6020
	Calcium	83.4	0.100	0.500	NE	NE	B		087153-009	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		087153-009	SW846 6020
	Cobalt	0.000183	0.0001	0.001	NE	0.0025	J		087153-009	SW846 6020
	Copper	0.000809	0.0003	0.001	NE	<0.05	J		087153-009	SW846 6020
	Iron	0.307	0.010	0.025	NE	NE			087153-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087153-009	SW846 6020
	Magnesium	34.3	0.0052	0.015	NE	NE			087153-009	SW846 6020
	Manganese	0.00844	0.001	0.005	NE	NE			087153-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U	UJ	087153-009	SW846 7470
	Nickel	0.0018	0.0005	0.002	NE	0.028	J		087153-009	SW846 6020
	Potassium	5.41	0.080	0.300	NE	NE			087153-009	SW846 6020
	Selenium	0.00161	0.001	0.005	0.050	0.005	J		087153-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087153-009	SW846 6020
	Sodium	64.1	0.400	1.25	NE	NE			087153-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087153-009	SW846 6020
	Uranium	0.00991	0.00005	0.0002	0.030	0.0052	B		087153-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		087153-009	SW846 6020
	Zinc	0.00357	0.0026	0.010	NE	0.26	J		087153-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-MW6	Aluminum	0.00593	0.005	0.015	NE	NE	J		087158-009	SW846 6020
03-Apr-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		087158-009	SW846 6020
	Arsenic	0.00229	0.0015	0.005	0.010	0.014	B, J	0.010U	087158-009	SW846 6020
	Barium	0.120	0.0005	0.002	2.00	0.12			087158-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087158-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087158-009	SW846 6020
	Calcium	88.7	0.100	0.500	NE	NE	B		087158-009	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		087158-009	SW846 6020
	Cobalt	0.000219	0.0001	0.001	NE	0.0025	J		087158-009	SW846 6020
	Copper	0.00131	0.0003	0.001	NE	<0.05			087158-009	SW846 6020
	Iron	0.338	0.010	0.025	NE	NE			087158-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087158-009	SW846 6020
	Magnesium	27.6	0.0052	0.015	NE	NE			087158-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		087158-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		087158-009	SW846 7470
	Nickel	0.00186	0.0005	0.002	NE	0.028	J		087158-009	SW846 6020
	Potassium	5.82	0.080	0.300	NE	NE			087158-009	SW846 6020
	Selenium	0.00126	0.001	0.005	0.050	0.005	J		087158-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087158-009	SW846 6020
	Sodium	62.5	0.400	1.25	NE	NE			087158-009	SW846 6020
	Thallium	0.000376	0.0003	0.001	0.002	0.002	J		087158-009	SW846 6020
	Uranium	0.0101	0.00005	0.0002	0.030	0.0052			087158-009	SW846 6020
	Vanadium	0.00867	0.003	0.010	NE	0.013	J	0.023U	087158-009	SW846 6020
	Zinc	0.00489	0.0026	0.010	NE	0.26	B, J	0.013U	087158-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-MW6 (Duplicate)	Aluminum	0.0085	0.005	0.015	NE	NE	J		087159-009	SW846 6020
03-Apr-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		087159-009	SW846 6020
	Arsenic	0.00193	0.0015	0.005	0.010	0.014	B, J	0.010U	087159-009	SW846 6020
	Barium	0.120	0.0005	0.002	2.00	0.12			087159-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087159-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087159-009	SW846 6020
	Calcium	91.1	0.100	0.500	NE	NE	B		087159-009	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		087159-009	SW846 6020
	Cobalt	0.000223	0.0001	0.001	NE	0.0025	J		087159-009	SW846 6020
	Copper	0.00112	0.0003	0.001	NE	<0.05			087159-009	SW846 6020
	Iron	0.344	0.010	0.025	NE	NE			087159-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087159-009	SW846 6020
	Magnesium	29.2	0.0052	0.015	NE	NE			087159-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		087159-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		087159-009	SW846 7470
	Nickel	0.00199	0.0005	0.002	NE	0.028	J		087159-009	SW846 6020
	Potassium	6.39	0.080	0.300	NE	NE			087159-009	SW846 6020
	Selenium	0.00132	0.001	0.005	0.050	0.005	J		087159-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087159-009	SW846 6020
	Sodium	66.1	0.400	1.25	NE	NE			087159-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087159-009	SW846 6020
	Uranium	0.00975	0.00005	0.0002	0.030	0.0052			087159-009	SW846 6020
	Vanadium	0.00801	0.003	0.010	NE	0.013	J	0.023U	087159-009	SW846 6020
	Zinc	0.0032	0.0026	0.010	NE	0.26	B, J	0.013U	087159-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-MW7	Aluminum	0.014	0.005	0.015	NE	NE	J	0.052U	087165-009	SW846 6020
08-Apr-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		087165-009	SW846 6020
	Arsenic	0.00159	0.0015	0.005	0.010	0.014	B, J	0.010U	087165-009	SW846 6020
	Barium	0.104	0.0005	0.002	2.00	0.12			087165-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087165-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087165-009	SW846 6020
	Calcium	55.8	0.100	0.500	NE	NE	B		087165-009	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		087165-009	SW846 6020
	Cobalt	0.00016	0.0001	0.001	NE	0.0025	J		087165-009	SW846 6020
	Copper	0.000944	0.0003	0.001	NE	<0.05	J	0.0020U	087165-009	SW846 6020
	Iron	0.247	0.010	0.025	NE	NE			087165-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087165-009	SW846 6020
	Magnesium	19.2	0.0052	0.015	NE	NE			087165-009	SW846 6020
	Manganese	0.00151	0.001	0.005	NE	NE	J		087165-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		087165-009	SW846 7470
	Nickel	0.00138	0.0005	0.002	NE	0.028	J		087165-009	SW846 6020
	Potassium	4.94	0.080	0.300	NE	NE			087165-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087165-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087165-009	SW846 6020
	Sodium	45.3	0.080	0.250	NE	NE			087165-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087165-009	SW846 6020
	Uranium	0.00806	0.00005	0.0002	0.030	0.0052			087165-009	SW846 6020
	Vanadium	0.00703	0.003	0.010	NE	0.013	J		087165-009	SW846 6020
	Zinc	0.00373	0.0026	0.010	NE	0.26	B, J	0.013U	087165-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-MW8	Aluminum	0.0219	0.005	0.015	NE	NE			087161-009	SW846 6020
07-Apr-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		087161-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		087161-009	SW846 6020
	Barium	0.131	0.0005	0.002	2.00	0.12			087161-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087161-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087161-009	SW846 6020
	Calcium	61.1	0.100	0.500	NE	NE	B		087161-009	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		087161-009	SW846 6020
	Cobalt	0.000166	0.0001	0.001	NE	0.0025	J		087161-009	SW846 6020
	Copper	0.00128	0.0003	0.001	NE	<0.05			087161-009	SW846 6020
	Iron	0.244	0.010	0.025	NE	NE			087161-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087161-009	SW846 6020
	Magnesium	18.6	0.0052	0.015	NE	NE			087161-009	SW846 6020
	Manganese	0.00436	0.001	0.005	NE	NE	J		087161-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		087161-009	SW846 7470
	Nickel	0.00143	0.0005	0.002	NE	0.028	J		087161-009	SW846 6020
	Potassium	5.32	0.080	0.300	NE	NE			087161-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087161-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087161-009	SW846 6020
	Sodium	47.6	0.400	1.25	NE	NE			087161-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087161-009	SW846 6020
	Uranium	0.00847	0.00005	0.0002	0.030	0.0052			087161-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		087161-009	SW846 6020
	Zinc	0.00409	0.0026	0.010	NE	0.26	B, J	0.013U	087161-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-MW9	Aluminum	0.0812	0.005	0.015	NE	NE			087167-009	SW846 6020
09-Apr-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		087167-009	SW846 6020
	Arsenic	0.00237	0.0015	0.005	0.010	0.014	B, J	0.010U	087167-009	SW846 6020
	Barium	0.104	0.0005	0.002	2.00	0.12			087167-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087167-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087167-009	SW846 6020
	Calcium	59.1	0.100	0.500	NE	NE	B		087167-009	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		087167-009	SW846 6020
	Cobalt	0.000237	0.0001	0.001	NE	0.0025	J		087167-009	SW846 6020
	Copper	0.00108	0.0003	0.001	NE	<0.05			087167-009	SW846 6020
	Iron	0.368	0.010	0.025	NE	NE			087167-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087167-009	SW846 6020
	Magnesium	19.0	0.0052	0.015	NE	NE			087167-009	SW846 6020
	Manganese	0.00884	0.001	0.005	NE	NE			087167-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		087167-009	SW846 7470
	Nickel	0.00172	0.0005	0.002	NE	0.028	J		087167-009	SW846 6020
	Potassium	5.03	0.080	0.300	NE	NE			087167-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087167-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087167-009	SW846 6020
	Sodium	44.3	0.080	0.250	NE	NE			087167-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087167-009	SW846 6020
	Uranium	0.00963	0.00005	0.0002	0.030	0.0052			087167-009	SW846 6020
	Vanadium	0.0085	0.003	0.010	NE	0.013	J		087167-009	SW846 6020
	Zinc	0.00578	0.0026	0.010	NE	0.26	B, J	0.013U	087167-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-BW2	Aluminum	0.0381	0.010	0.030	NE	NE	B	0.134U	087489-009	SW846 6020
06-Jul-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087489-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		087489-009	SW846 6020
	Barium	0.0904	0.0005	0.002	2.00	0.12			087489-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087489-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087489-009	SW846 6020
	Calcium	66.0	0.100	1.00	NE	NE	B		087489-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087489-009	SW846 6020
	Cobalt	0.000186	0.0001	0.001	NE	0.0025	J		087489-009	SW846 6020
	Copper	0.000861	0.0003	0.001	NE	<0.05	J		087489-009	SW846 6020
	Iron	0.334	0.010	0.100	NE	NE			087489-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087489-009	SW846 6020
	Magnesium	21.9	0.005	0.015	NE	NE			087489-009	SW846 6020
	Manganese	0.00143	0.001	0.005	NE	NE	J		087489-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087489-009	SW846 7470
	Nickel	0.00168	0.0005	0.002	NE	0.028	J		087489-009	SW846 6020
	Potassium	3.82	0.080	0.300	NE	NE			087489-009	SW846 6020
	Selenium	0.00224	0.001	0.005	0.050	0.005	J		087489-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087489-009	SW846 6020
	Sodium	54.5	0.400	1.25	NE	NE			087489-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087489-009	SW846 6020
	Uranium	0.0081	0.00005	0.0002	0.030	0.0052			087489-009	SW846 6020
	Vanadium	0.00467	0.003	0.010	NE	0.013	J		087489-009	SW846 6020
	Zinc	0.00321	0.0026	0.010	NE	0.26	J		087489-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-MW7	Aluminum	0.0321	0.010	0.030	NE	NE	B	0.134U	087492-009	SW846 6020
07-Jul-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087492-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		087492-009	SW846 6020
	Barium	0.0985	0.0005	0.002	2.00	0.12			087492-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087492-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087492-009	SW846 6020
	Calcium	56.7	0.100	1.00	NE	NE	B		087492-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087492-009	SW846 6020
	Cobalt	0.000173	0.0001	0.001	NE	0.0025	J		087492-009	SW846 6020
	Copper	0.000908	0.0003	0.001	NE	<0.05	J		087492-009	SW846 6020
	Iron	0.283	0.010	0.100	NE	NE			087492-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087492-009	SW846 6020
	Magnesium	20.1	0.005	0.015	NE	NE			087492-009	SW846 6020
	Manganese	0.00168	0.001	0.005	NE	NE	J		087492-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087492-009	SW846 7470
	Nickel	0.00168	0.0005	0.002	NE	0.028	J		087492-009	SW846 6020
	Potassium	4.95	0.080	0.300	NE	NE			087492-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087492-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087492-009	SW846 6020
	Sodium	48.9	0.080	0.250	NE	NE			087492-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087492-009	SW846 6020
	Uranium	0.0093	0.00005	0.0002	0.030	0.0052			087492-009	SW846 6020
	Vanadium	0.00434	0.003	0.010	NE	0.013	J		087492-009	SW846 6020
	Zinc	0.0102	0.0026	0.010	NE	0.26			087492-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-MW8	Aluminum	0.201	0.010	0.030	NE	NE	B		087495-009	SW846 6020
08-Jul-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087495-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		087495-009	SW846 6020
	Barium	0.131	0.0005	0.002	2.00	0.12			087495-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087495-009	SW846 6020
	Cadmium	0.000193	0.00011	0.001	0.005	0.00047	J		087495-009	SW846 6020
	Calcium	56.5	0.100	1.00	NE	NE	B		087495-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087495-009	SW846 6020
	Cobalt	0.000227	0.0001	0.001	NE	0.0025	J		087495-009	SW846 6020
	Copper	0.00135	0.0003	0.001	NE	<0.05			087495-009	SW846 6020
	Iron	0.497	0.010	0.100	NE	NE			087495-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087495-009	SW846 6020
	Magnesium	20.4	0.005	0.015	NE	NE			087495-009	SW846 6020
	Manganese	0.00876	0.001	0.005	NE	NE			087495-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087495-009	SW846 7470
	Nickel	0.00196	0.0005	0.002	NE	0.028	J		087495-009	SW846 6020
	Potassium	5.25	0.080	0.300	NE	NE			087495-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087495-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087495-009	SW846 6020
	Sodium	46.8	0.400	1.25	NE	NE			087495-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087495-009	SW846 6020
	Uranium	0.00924	0.00005	0.0002	0.030	0.0052			087495-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		087495-009	SW846 6020
	Zinc	0.0557	0.0026	0.010	NE	0.26			087495-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-MW9	Aluminum	0.0858	0.010	0.030	NE	NE	B	0.134U	087500-009	SW846 6020
09-Jul-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087500-009	SW846 6020
	Arsenic	0.00268	0.0015	0.005	0.010	0.014	J		087500-009	SW846 6020
	Barium	0.096	0.0005	0.002	2.00	0.12			087500-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087500-009	SW846 6020
	Cadmium	0.000163	0.00011	0.001	0.005	0.00047	J		087500-009	SW846 6020
	Calcium	57.2	0.100	1.00	NE	NE	B		087500-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087500-009	SW846 6020
	Cobalt	0.000208	0.0001	0.001	NE	0.0025	J		087500-009	SW846 6020
	Copper	0.000906	0.0003	0.001	NE	<0.05	J	0.012UJ	087500-009	SW846 6020
	Iron	0.350	0.010	0.100	NE	NE			087500-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087500-009	SW846 6020
	Magnesium	21.1	0.005	0.015	NE	NE			087500-009	SW846 6020
	Manganese	0.00648	0.001	0.005	NE	NE			087500-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087500-009	SW846 7470
	Nickel	0.00178	0.0005	0.002	NE	0.028	J		087500-009	SW846 6020
	Potassium	5.00	0.080	0.300	NE	NE			087500-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087500-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087500-009	SW846 6020
	Sodium	44.2	0.400	1.25	NE	NE			087500-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087500-009	SW846 6020
	Uranium	0.0106	0.00005	0.0002	0.030	0.0052			087500-009	SW846 6020
	Vanadium	0.00918	0.003	0.010	NE	0.013	J		087500-009	SW846 6020
	Zinc	0.00398	0.0026	0.010	NE	0.26	J		087500-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-MW9 (Duplicate)	Aluminum	0.207	0.010	0.030	NE	NE	B		087501-009	SW846 6020
09-Jul-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087501-009	SW846 6020
	Arsenic	0.00368	0.0015	0.005	0.010	0.014	J		087501-009	SW846 6020
	Barium	0.0978	0.0005	0.002	2.00	0.12			087501-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087501-009	SW846 6020
	Cadmium	0.000167	0.00011	0.001	0.005	0.00047	J		087501-009	SW846 6020
	Calcium	59.1	0.100	1.00	NE	NE	B		087501-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087501-009	SW846 6020
	Cobalt	0.000249	0.0001	0.001	NE	0.0025	J		087501-009	SW846 6020
	Copper	0.0014	0.0003	0.001	NE	<0.05		0.012UJ	087501-009	SW846 6020
	Iron	0.525	0.010	0.100	NE	NE			087501-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087501-009	SW846 6020
	Magnesium	20.5	0.005	0.015	NE	NE			087501-009	SW846 6020
	Manganese	0.00918	0.001	0.005	NE	NE			087501-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087501-009	SW846 7470
	Nickel	0.00201	0.0005	0.002	NE	0.028			087501-009	SW846 6020
	Potassium	5.18	0.080	0.300	NE	NE			087501-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087501-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087501-009	SW846 6020
	Sodium	48.1	0.080	0.250	NE	NE			087501-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087501-009	SW846 6020
	Uranium	0.0107	0.00005	0.0002	0.030	0.0052			087501-009	SW846 6020
	Vanadium	0.00859	0.003	0.010	NE	0.013	J		087501-009	SW846 6020
	Zinc	0.00693	0.0026	0.010	NE	0.26	J		087501-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-BW2	Aluminum	ND	0.010	0.030	NE	NE	U		087769-009	SW846 6020
06-Oct-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087769-009	SW846 6020
	Arsenic	0.00274	0.0015	0.005	0.010	0.014	B, J	0.014U	087769-009	SW846 6020
	Barium	0.103	0.0005	0.002	2.00	0.12			087769-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087769-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087769-009	SW846 6020
	Calcium	65.4	0.200	2.00	NE	NE	B		087769-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087769-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		087769-009	SW846 6020
	Copper	0.000466	0.0003	0.001	NE	<0.05	J	0.012U	087769-009	SW846 6020
	Iron	0.169	0.010	0.100	NE	NE	B		087769-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087769-009	SW846 6020
	Magnesium	19.6	0.005	0.015	NE	NE		J	087769-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		087769-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087769-009	SW846 7470
	Nickel	0.001	0.0005	0.002	NE	0.028	J		087769-009	SW846 6020
	Potassium	4.01	0.080	0.300	NE	NE			087769-009	SW846 6020
	Selenium	0.00279	0.001	0.005	0.050	0.005	J		087769-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087769-009	SW846 6020
	Sodium	55.0	0.800	2.05	NE	NE		J	087769-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087769-009	SW846 6020
	Uranium	0.00734	0.00005	0.0002	0.030	0.0052			087769-009	SW846 6020
	Vanadium	0.0119	0.003	0.010	NE	0.013	B	0.041U	087769-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.26	U		087769-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-BW2 (Duplicate)	Aluminum	ND	0.010	0.030	NE	NE	U		087770-009	SW846 6020
06-Oct-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087770-009	SW846 6020
	Arsenic	0.00546	0.0015	0.005	0.010	0.014	B	0.014U	087770-009	SW846 6020
	Barium	0.104	0.0005	0.002	2.00	0.12			087770-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087770-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087770-009	SW846 6020
	Calcium	67.7	0.200	2.00	NE	NE	B		087770-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087770-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		087770-009	SW846 6020
	Copper	0.000427	0.0003	0.001	NE	<0.05	J	0.012U	087770-009	SW846 6020
	Iron	0.166	0.010	0.100	NE	NE	B		087770-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087770-009	SW846 6020
	Magnesium	20.6	0.005	0.015	NE	NE		J	087770-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		087770-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087770-009	SW846 7470
	Nickel	0.000888	0.0005	0.002	NE	0.028	J		087770-009	SW846 6020
	Potassium	4.14	0.080	0.300	NE	NE			087770-009	SW846 6020
	Selenium	0.00197	0.001	0.005	0.050	0.005	J		087770-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087770-009	SW846 6020
	Sodium	49.8	0.080	0.250	NE	NE		J	087770-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087770-009	SW846 6020
	Uranium	0.0073	0.00005	0.0002	0.030	0.0052			087770-009	SW846 6020
	Vanadium	0.0117	0.003	0.010	NE	0.013	B	0.041U	087770-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.26	U		087770-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-MW7	Aluminum	ND	0.010	0.030	NE	NE	U		087774-009	SW846 6020
08-Oct-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087774-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		087774-009	SW846 6020
	Barium	0.109	0.0005	0.002	2.00	0.12			087774-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087774-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087774-009	SW846 6020
	Calcium	49.3	0.020	0.200	NE	NE	B		087774-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087774-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		087774-009	SW846 6020
	Copper	0.000646	0.0003	0.001	NE	<0.05	J		087774-009	SW846 6020
	Iron	0.145	0.010	0.100	NE	NE	B		087774-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087774-009	SW846 6020
	Magnesium	16.9	0.005	0.015	NE	NE		J	087774-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		087774-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087774-009	SW846 7470
	Nickel	0.000731	0.0005	0.002	NE	0.028	J		087774-009	SW846 6020
	Potassium	5.12	0.080	0.300	NE	NE			087774-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087774-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087774-009	SW846 6020
	Sodium	43.0	0.080	0.250	NE	NE		J	087774-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087774-009	SW846 6020
	Uranium	0.00791	0.00005	0.0002	0.030	0.0052			087774-009	SW846 6020
	Vanadium	0.00863	0.003	0.010	NE	0.013	B, J	0.041U	087774-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.26	U		087774-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier [b]	Validation Qualifier [c]	Sample No.	Analytical Method [d]
MWL-MW8	Aluminum	0.231	0.010	0.030	NE	NE			087772-009	SW846 6020
07-Oct-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087772-009	SW846 6020
	Arsenic	0.00173	0.0015	0.005	0.010	0.014	B, J	0.014U	087772-009	SW846 6020
	Barium	0.153	0.0005	0.002	2.00	0.12			087772-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087772-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087772-009	SW846 6020
	Calcium	59.0	0.200	2.00	NE	NE	B		087772-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087772-009	SW846 6020
	Cobalt	0.0002	0.0001	0.001	NE	0.0025	J		087772-009	SW846 6020
	Copper	0.00116	0.0003	0.001	NE	<0.05			087772-009	SW846 6020
	Iron	0.526	0.010	0.100	NE	NE	B		087772-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087772-009	SW846 6020
	Magnesium	18.1	0.005	0.015	NE	NE		J	087772-009	SW846 6020
	Manganese	0.171	0.001	0.005	NE	NE			087772-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087772-009	SW846 7470
	Nickel	0.00168	0.0005	0.002	NE	0.028	J		087772-009	SW846 6020
	Potassium	5.78	0.080	0.300	NE	NE			087772-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087772-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087772-009	SW846 6020
	Sodium	45.0	0.080	0.250	NE	NE		J	087772-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087772-009	SW846 6020
	Uranium	0.00817	0.00005	0.0002	0.030	0.0052			087772-009	SW846 6020
	Vanadium	0.00377	0.003	0.010	NE	0.013	B, J	0.041U	087772-009	SW846 6020
	Zinc	0.0109	0.0026	0.010	NE	0.26			087772-009	SW846 6020

Refer to footnotes at end of table.

Table A-7 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L) [a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW9	Aluminum	0.029	0.010	0.030	NE	NE	J		087765-009	SW846 6020
05-Oct-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087765-009	SW846 6020
	Arsenic	0.00581	0.0015	0.005	0.010	0.014	B	0.014U	087765-009	SW846 6020
	Barium	0.103	0.0005	0.002	2.00	0.12			087765-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087765-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087765-009	SW846 6020
	Calcium	55.3	0.200	2.00	NE	NE	B		087765-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087765-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		087765-009	SW846 6020
	Copper	0.000557	0.0003	0.001	NE	<0.05	J		087765-009	SW846 6020
	Iron	0.185	0.010	0.100	NE	NE	B		087765-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087765-009	SW846 6020
	Magnesium	16.5	0.005	0.015	NE	NE		J	087765-009	SW846 6020
	Manganese	0.00505	0.001	0.005	NE	NE			087765-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087765-009	SW846 7470
	Nickel	0.00099	0.0005	0.002	NE	0.028	J		087765-009	SW846 6020
	Potassium	5.09	0.080	0.300	NE	NE			087765-009	SW846 6020
	Selenium	0.00103	0.001	0.005	0.050	0.005	J		087765-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087765-009	SW846 6020
	Sodium	38.9	0.080	0.250	NE	NE		J	087765-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087765-009	SW846 6020
	Uranium	0.00937	0.00005	0.0002	0.030	0.0052			087765-009	SW846 6020
	Vanadium	0.0179	0.003	0.010	NE	0.013	B	0.041U	087765-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.26	U		087765-009	SW846 6020

[a]Maximum background concentrations in groundwater (Dinwiddie, R.S. [New Mexico Environment Department], September 1997, Letter to M.J. Zamorski [U.S. Department of Energy], "Request for Supplemental Information: Background Concentrations Report, SNL/KAFB," September 27.).
[b]Laboratory Qualifier.
B = Analyte is detected in associated laboratory method blank.
J = Amount detected is below the PQL.
U = Analyte is absent or below the MDL.
[c]Validation Qualifier.
If cell is blank, then all quality control samples meet acceptance criteria with respect to submitted samples.
J = The associated value is an estimated quantity.
J+ = The associated numerical value is an estimated quantity with suspected positive bias.
U = The analyte was analyzed for but not detected. The associated numerical value is the sample quantitation limit.
UJ = The analyte was analyzed for but not detected. The associated value is an estimate and may be inaccurate or imprecise.
[d]EPA 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.

Table A-7 (Concluded)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

EPA = U.S. Environmental Protection Agency.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
ND = Not detected (at MDL).
NE = Not established.
PQL = Practical quantitation limit.
SW = Solid waste.

Table A-8
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-BW2	Aluminum	ND	0.005	0.015	NE	NE	U		086943-010	SW846 6020
05-Jan-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		086943-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		086943-010	SW846 6020
	Barium	0.0964	0.0005	0.002	2.00	0.12			086943-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		086943-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		086943-010	SW846 6020
	Calcium	68.5	0.100	0.500	NE	NE	B		086943-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		086943-010	SW846 6020
	Cobalt	0.00011	0.0001	0.001	NE	0.0025	J		086943-010	SW846 6020
	Copper	0.000645	0.0003	0.001	NE	<0.05	J		086943-010	SW846 6020
	Iron	0.180	0.010	0.025	NE	NE	B		086943-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		086943-010	SW846 6020
	Magnesium	22.7	0.0052	0.015	NE	NE			086943-010	SW846 6020
	Manganese	0.00112	0.001	0.005	NE	NE	J		086943-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		086943-010	SW846 7470
	Nickel	0.00122	0.0005	0.002	NE	0.028	J	J+	086943-010	SW846 6020
	Potassium	4.13	0.080	0.300	NE	NE			086943-010	SW846 6020
	Selenium	0.00146	0.001	0.005	0.050	0.005	J		086943-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		086943-010	SW846 6020
	Sodium	56.7	0.400	1.25	NE	NE			086943-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		086943-010	SW846 6020
	Uranium	0.00757	0.00005	0.0002	0.030	0.0052	B		086943-010	SW846 6020
	Vanadium	0.00429	0.003	0.010	NE	0.013	J		086943-010	SW846 6020
	Zinc	0.00358	0.0026	0.010	NE	0.26	J		086943-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW7	Aluminum	ND	0.005	0.015	NE	NE	U		086946-010	SW846 6020
06-Jan-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		086946-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		086946-010	SW846 6020
	Barium	0.102	0.0005	0.002	2.00	0.12			086946-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		086946-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		086946-010	SW846 6020
	Calcium	54.2	0.100	0.500	NE	NE	B		086946-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		086946-010	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		086946-010	SW846 6020
	Copper	0.0007	0.0003	0.001	NE	<0.05	J		086946-010	SW846 6020
	Iron	0.147	0.010	0.025	NE	NE	B		086946-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		086946-010	SW846 6020
	Magnesium	19.3	0.0052	0.015	NE	NE			086946-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		086946-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		086946-010	SW846 7470
	Nickel	0.000937	0.0005	0.002	NE	0.028	J	J+	086946-010	SW846 6020
	Potassium	5.14	0.080	0.300	NE	NE			086946-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		086946-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		086946-010	SW846 6020
	Sodium	44.5	0.080	0.250	NE	NE			086946-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		086946-010	SW846 6020
	Uranium	0.0085	0.00005	0.0002	0.030	0.0052	B		086946-010	SW846 6020
	Vanadium	0.00354	0.003	0.010	NE	0.013	J		086946-010	SW846 6020
	Zinc	0.00262	0.0026	0.010	NE	0.26	J		086946-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW8	Aluminum	0.0183	0.005	0.015	NE	NE			086950-010	SW846 6020
07-Jan-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		086950-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		086950-010	SW846 6020
	Barium	0.114	0.005	0.020	2.00	0.12			086950-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		086950-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		086950-010	SW846 6020
	Calcium	49.8	0.020	0.100	NE	NE	B		086950-010	SW846 6020
	Chromium	0.00225	0.0015	0.003	0.100	0.043	J	0.011U	086950-010	SW846 6020
	Cobalt	0.000166	0.0001	0.001	NE	0.0025	J		086950-010	SW846 6020
	Copper	0.00113	0.0003	0.001	NE	<0.05		0.0049U	086950-010	SW846 6020
	Iron	0.164	0.010	0.025	NE	NE			086950-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		086950-010	SW846 6020
	Magnesium	19.0	0.0052	0.015	NE	NE			086950-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		086950-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		086950-010	SW846 7470
	Nickel	0.00185	0.0005	0.002	NE	0.028	J		086950-010	SW846 6020
	Potassium	5.16	0.080	0.300	NE	NE			086950-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		086950-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		086950-010	SW846 6020
	Sodium	46.4	0.800	2.50	NE	NE			086950-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		086950-010	SW846 6020
	Uranium	0.00853	0.00005	0.0002	0.030	0.0052			086950-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		086950-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.26	U		086950-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW8 (Duplicate)	Aluminum	0.0104	0.005	0.015	NE	NE	J		086951-010	SW846 6020
07-Jan-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		086951-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		086951-010	SW846 6020
	Barium	0.100	0.005	0.020	2.00	0.12			086951-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		086951-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		086951-010	SW846 6020
	Calcium	43.5	0.020	0.100	NE	NE	B		086951-010	SW846 6020
	Chromium	0.00221	0.0015	0.003	0.100	0.043	J	0.011U	086951-010	SW846 6020
	Cobalt	0.000162	0.0001	0.001	NE	0.0025	J		086951-010	SW846 6020
	Copper	0.00102	0.0003	0.001	NE	<0.05		0.0049U	086951-010	SW846 6020
	Iron	0.977	0.010	0.025	NE	NE			086951-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		086951-010	SW846 6020
	Magnesium	15.3	0.0052	0.015	NE	NE			086951-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		086951-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		086951-010	SW846 7470
	Nickel	0.00167	0.0005	0.002	NE	0.028	J		086951-010	SW846 6020
	Potassium	4.51	0.080	0.300	NE	NE			086951-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		086951-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		086951-010	SW846 6020
	Sodium	39.8	0.800	2.50	NE	NE			086951-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		086951-010	SW846 6020
	Uranium	0.00719	0.00005	0.0002	0.030	0.0052			086951-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		086951-010	SW846 6020
	Zinc	0.00269	0.0026	0.010	NE	0.26	J		086951-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW9	Aluminum	0.014	0.005	0.015	NE	NE	J		086953-010	SW846 6020
08-Jan-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		086953-010	SW846 6020
	Arsenic	0.00231	0.0015	0.005	0.010	0.014	J		086953-010	SW846 6020
	Barium	0.097	0.0005	0.002	2.00	0.12			086953-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		086953-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		086953-010	SW846 6020
	Calcium	52.0	0.200	1.00	NE	NE	B		086953-010	SW846 6020
	Chromium	0.00311	0.0015	0.003	0.100	0.043			086953-010	SW846 6020
	Cobalt	0.000182	0.0001	0.001	NE	0.0025	J		086953-010	SW846 6020
	Copper	0.00082	0.0003	0.001	NE	<0.05	J		086953-010	SW846 6020
	Iron	0.170	0.010	0.025	NE	NE			086953-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		086953-010	SW846 6020
	Magnesium	18.8	0.0052	0.015	NE	NE			086953-010	SW846 6020
	Manganese	0.00938	0.001	0.005	NE	NE			086953-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		086953-010	SW846 7470
	Nickel	0.00195	0.0005	0.002	NE	0.028	J		086953-010	SW846 6020
	Potassium	4.54	0.080	0.300	NE	NE			086953-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		086953-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		086953-010	SW846 6020
	Sodium	49.2	0.800	2.50	NE	NE			086953-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		086953-010	SW846 6020
	Uranium	0.00952	0.00005	0.0002	0.030	0.0052			086953-010	SW846 6020
	Vanadium	0.00545	0.003	0.010	NE	0.013	J		086953-010	SW846 6020
	Zinc	0.00286	0.0026	0.010	NE	0.26	J		086953-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-BW2	Aluminum	ND	0.005	0.015	NE	NE	U		087151-010	SW846 6020
01-Apr-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		087151-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		087151-010	SW846 6020
	Barium	0.0966	0.0005	0.002	2.00	0.12			087151-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087151-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087151-010	SW846 6020
	Calcium	66.8	0.100	0.500	NE	NE	B		087151-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		087151-010	SW846 6020
	Cobalt	0.000127	0.0001	0.001	NE	0.0025	J		087151-010	SW846 6020
	Copper	0.000691	0.0003	0.001	NE	<0.05	J		087151-010	SW846 6020
	Iron	0.215	0.010	0.025	NE	NE			087151-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087151-010	SW846 6020
	Magnesium	28.0	0.0052	0.015	NE	NE			087151-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		087151-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U	UJ	087151-010	SW846 7470
	Nickel	0.00131	0.0005	0.002	NE	0.028	J		087151-010	SW846 6020
	Potassium	3.93	0.080	0.300	NE	NE			087151-010	SW846 6020
	Selenium	0.0019	0.001	0.005	0.050	0.005	J		087151-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087151-010	SW846 6020
	Sodium	56.7	0.400	1.25	NE	NE			087151-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087151-010	SW846 6020
	Uranium	0.00785	0.00005	0.0002	0.030	0.0052	B		087151-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		087151-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.26	U		087151-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW4	Aluminum	0.0347	0.005	0.015	NE	NE	B		087169-010	SW846 6020
13-Apr-09	Antimony	0.000713	0.0005	0.002	0.006	0.006	B, J	0.0043U	087169-010	SW846 6020
	Arsenic	0.00234	0.0015	0.005	0.010	0.014	J		087169-010	SW846 6020
	Barium	0.112	0.0025	0.010	2.00	0.12			087169-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087169-010	SW846 6020
	Cadmium	0.00277	0.00011	0.001	0.005	0.00047			087169-010	SW846 6020
	Calcium	59.4	0.200	1.00	NE	NE	B		087169-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		087169-010	SW846 6020
	Cobalt	0.000225	0.0001	0.001	NE	0.0025	J		087169-010	SW846 6020
	Copper	0.00252	0.0003	0.001	NE	<0.05			087169-010	SW846 6020
	Iron	0.210	0.010	0.025	NE	NE			087169-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087169-010	SW846 6020
	Magnesium	20.8	0.052	0.150	NE	NE			087169-010	SW846 6020
	Manganese	0.00118	0.001	0.005	NE	NE	J		087169-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U	UJ	087169-010	SW846 7470
	Nickel	0.0294	0.0005	0.002	NE	0.028			087169-010	SW846 6020
	Potassium	4.90	0.080	0.300	NE	NE			087169-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087169-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087169-010	SW846 6020
	Sodium	53.0	0.800	2.50	NE	NE			087169-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087169-010	SW846 6020
	Uranium	0.00624	0.00005	0.0002	0.030	0.0052			087169-010	SW846 6020
	Vanadium	0.00359	0.003	0.010	NE	0.013	J		087169-010	SW846 6020
	Zinc	0.080	0.0026	0.010	NE	0.26			087169-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW5	Aluminum	ND	0.005	0.015	NE	NE	U		087153-010	SW846 6020
02-Apr-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		087153-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		087153-010	SW846 6020
	Barium	0.120	0.0005	0.002	2.00	0.12			087153-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087153-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087153-010	SW846 6020
	Calcium	86.4	0.100	0.500	NE	NE	B		087153-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		087153-010	SW846 6020
	Cobalt	0.000175	0.0001	0.001	NE	0.0025	J		087153-010	SW846 6020
	Copper	0.000867	0.0003	0.001	NE	<0.05	J		087153-010	SW846 6020
	Iron	0.260	0.010	0.025	NE	NE			087153-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087153-010	SW846 6020
	Magnesium	36.4	0.0052	0.015	NE	NE			087153-010	SW846 6020
	Manganese	0.0038	0.001	0.005	NE	NE	J		087153-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U	UJ	087153-010	SW846 7470
	Nickel	0.00195	0.0005	0.002	NE	0.028	J		087153-010	SW846 6020
	Potassium	5.67	0.080	0.300	NE	NE			087153-010	SW846 6020
	Selenium	0.00195	0.001	0.005	0.050	0.005	J		087153-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087153-010	SW846 6020
	Sodium	69.4	0.400	1.25	NE	NE			087153-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087153-010	SW846 6020
	Uranium	0.00999	0.00005	0.0002	0.030	0.0052	B		087153-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		087153-010	SW846 6020
	Zinc	0.00309	0.0026	0.010	NE	0.26	J		087153-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW6	Aluminum	ND	0.005	0.015	NE	NE	U		087158-010	SW846 6020
03-Apr-09	Antimony	0.000708	0.0005	0.002	0.006	0.006	B, J	0.0040U	087158-010	SW846 6020
	Arsenic	0.00202	0.0015	0.005	0.010	0.014	B, J	0.010U	087158-010	SW846 6020
	Barium	0.120	0.0005	0.002	2.00	0.12			087158-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087158-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087158-010	SW846 6020
	Calcium	87.6	0.100	0.500	NE	NE	B		087158-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		087158-010	SW846 6020
	Cobalt	0.000242	0.0001	0.001	NE	0.0025	J		087158-010	SW846 6020
	Copper	0.00121	0.0003	0.001	NE	<0.05			087158-010	SW846 6020
	Iron	0.327	0.010	0.025	NE	NE			087158-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087158-010	SW846 6020
	Magnesium	28.6	0.0052	0.015	NE	NE			087158-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		087158-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		087158-010	SW846 7470
	Nickel	0.00172	0.0005	0.002	NE	0.028	J		087158-010	SW846 6020
	Potassium	5.74	0.080	0.300	NE	NE			087158-010	SW846 6020
	Selenium	0.00142	0.001	0.005	0.050	0.005	J		087158-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087158-010	SW846 6020
	Sodium	58.9	0.400	1.25	NE	NE			087158-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087158-010	SW846 6020
	Uranium	0.00964	0.00005	0.0002	0.030	0.0052			087158-010	SW846 6020
	Vanadium	0.00906	0.003	0.010	NE	0.013	J	0.023U	087158-010	SW846 6020
	Zinc	0.00358	0.0026	0.010	NE	0.26	B, J	0.013U	087158-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW6 (Duplicate)	Aluminum	0.00633	0.005	0.015	NE	NE	J		087159-010	SW846 6020
03-Apr-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		087159-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		087159-010	SW846 6020
	Barium	0.111	0.0005	0.002	2.00	0.12			087159-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087159-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087159-010	SW846 6020
	Calcium	88.6	0.100	0.500	NE	NE	B		087159-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		087159-010	SW846 6020
	Cobalt	0.000189	0.0001	0.001	NE	0.0025	J		087159-010	SW846 6020
	Copper	0.00117	0.0003	0.001	NE	<0.05			087159-010	SW846 6020
	Iron	0.293	0.010	0.025	NE	NE			087159-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087159-010	SW846 6020
	Magnesium	24.0	0.0052	0.015	NE	NE			087159-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		087159-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		087159-010	SW846 7470
	Nickel	0.00174	0.0005	0.002	NE	0.028	J		087159-010	SW846 6020
	Potassium	5.41	0.080	0.300	NE	NE			087159-010	SW846 6020
	Selenium	0.00162	0.001	0.005	0.050	0.005	J		087159-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087159-010	SW846 6020
	Sodium	61.3	0.400	1.25	NE	NE			087159-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087159-010	SW846 6020
	Uranium	0.00973	0.00005	0.0002	0.030	0.0052			087159-010	SW846 6020
	Vanadium	0.00704	0.003	0.010	NE	0.013	J	0.023U	087159-010	SW846 6020
	Zinc	0.00316	0.0026	0.010	NE	0.26	B, J	0.013U	087159-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW7	Aluminum	0.0231	0.005	0.015	NE	NE		0.052U	087165-010	SW846 6020
08-Apr-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		087165-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		087165-010	SW846 6020
	Barium	0.107	0.0005	0.002	2.00	0.12			087165-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087165-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087165-010	SW846 6020
	Calcium	58.5	0.100	0.500	NE	NE	B		087165-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		087165-010	SW846 6020
	Cobalt	0.000164	0.0001	0.001	NE	0.0025	J		087165-010	SW846 6020
	Copper	0.00117	0.0003	0.001	NE	<0.05		0.0020U	087165-010	SW846 6020
	Iron	0.240	0.010	0.025	NE	NE			087165-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087165-010	SW846 6020
	Magnesium	19.1	0.0052	0.015	NE	NE			087165-010	SW846 6020
	Manganese	0.00131	0.001	0.005	NE	NE	J		087165-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		087165-010	SW846 7470
	Nickel	0.00151	0.0005	0.002	NE	0.028	J		087165-010	SW846 6020
	Potassium	5.02	0.080	0.300	NE	NE			087165-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087165-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087165-010	SW846 6020
	Sodium	46.9	0.080	0.250	NE	NE			087165-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087165-010	SW846 6020
	Uranium	0.00812	0.00005	0.0002	0.030	0.0052			087165-010	SW846 6020
	Vanadium	0.00549	0.003	0.010	NE	0.013	J		087165-010	SW846 6020
	Zinc	0.00395	0.0026	0.010	NE	0.26	B, J	0.013U	087165-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW8	Aluminum	0.00534	0.005	0.015	NE	NE	J		087161-010	SW846 6020
07-Apr-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		087161-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		087161-010	SW846 6020
	Barium	0.129	0.0005	0.002	2.00	0.12			087161-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087161-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087161-010	SW846 6020
	Calcium	59.2	0.100	0.500	NE	NE	B		087161-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		087161-010	SW846 6020
	Cobalt	0.000162	0.0001	0.001	NE	0.0025	J		087161-010	SW846 6020
	Copper	0.00106	0.0003	0.001	NE	<0.05			087161-010	SW846 6020
	Iron	0.225	0.010	0.025	NE	NE			087161-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087161-010	SW846 6020
	Magnesium	18.8	0.0052	0.015	NE	NE			087161-010	SW846 6020
	Manganese	0.00194	0.001	0.005	NE	NE	J		087161-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		087161-010	SW846 7470
	Nickel	0.00152	0.0005	0.002	NE	0.028	J		087161-010	SW846 6020
	Potassium	5.84	0.080	0.300	NE	NE			087161-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087161-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087161-010	SW846 6020
	Sodium	49.5	0.080	0.250	NE	NE			087161-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087161-010	SW846 6020
	Uranium	0.00845	0.00005	0.0002	0.030	0.0052			087161-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		087161-010	SW846 6020
	Zinc	0.0041	0.0026	0.010	NE	0.26	B, J	0.013U	087161-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW9	Aluminum	0.0111	0.005	0.015	NE	NE	J		087167-010	SW846 6020
09-Apr-09	Antimony	ND	0.0005	0.002	0.006	0.006	U		087167-010	SW846 6020
	Arsenic	0.00244	0.0015	0.005	0.010	0.014	B, J	0.010U	087167-010	SW846 6020
	Barium	0.101	0.0005	0.002	2.00	0.12			087167-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087167-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087167-010	SW846 6020
	Calcium	58.5	0.100	0.500	NE	NE	B		087167-010	SW846 6020
	Chromium	ND	0.0015	0.003	0.100	0.043	U		087167-010	SW846 6020
	Cobalt	0.000181	0.0001	0.001	NE	0.0025	J		087167-010	SW846 6020
	Copper	0.00096	0.0003	0.001	NE	<0.05	J		087167-010	SW846 6020
	Iron	0.252	0.010	0.025	NE	NE			087167-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087167-010	SW846 6020
	Magnesium	19.8	0.0052	0.015	NE	NE			087167-010	SW846 6020
	Manganese	0.00418	0.001	0.005	NE	NE	J		087167-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	0.002	U		087167-010	SW846 7470
	Nickel	0.0016	0.0005	0.002	NE	0.028	J		087167-010	SW846 6020
	Potassium	5.17	0.080	0.300	NE	NE			087167-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087167-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087167-010	SW846 6020
	Sodium	45.8	0.080	0.250	NE	NE			087167-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087167-010	SW846 6020
	Uranium	0.00935	0.00005	0.0002	0.030	0.0052			087167-010	SW846 6020
	Vanadium	0.0085	0.003	0.010	NE	0.013	J		087167-010	SW846 6020
	Zinc	0.00451	0.0026	0.010	NE	0.26	B, J	0.013U	087167-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-BW2	Aluminum	0.0215	0.010	0.030	NE	NE	B, J	0.134U	087489-010	SW846 6020
06-Jul-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087489-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		087489-010	SW846 6020
	Barium	0.0935	0.0005	0.002	2.00	0.12			087489-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087489-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087489-010	SW846 6020
	Calcium	68.6	0.100	1.00	NE	NE	B		087489-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087489-010	SW846 6020
	Cobalt	0.000186	0.0001	0.001	NE	0.0025	J		087489-010	SW846 6020
	Copper	0.000806	0.0003	0.001	NE	<0.05	J		087489-010	SW846 6020
	Iron	0.320	0.010	0.100	NE	NE			087489-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087489-010	SW846 6020
	Magnesium	22.7	0.005	0.015	NE	NE			087489-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		087489-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087489-010	SW846 7470
	Nickel	0.00171	0.0005	0.002	NE	0.028	J		087489-010	SW846 6020
	Potassium	3.90	0.080	0.300	NE	NE			087489-010	SW846 6020
	Selenium	0.00169	0.001	0.005	0.050	0.005	J		087489-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087489-010	SW846 6020
	Sodium	53.9	0.400	1.25	NE	NE			087489-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087489-010	SW846 6020
	Uranium	0.00835	0.00005	0.0002	0.030	0.0052			087489-010	SW846 6020
	Vanadium	0.00614	0.003	0.010	NE	0.013	J		087489-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.26	U		087489-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW7	Aluminum	0.024	0.010	0.030	NE	NE	B, J	0.134U	087492-010	SW846 6020
07-Jul-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087492-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		087492-010	SW846 6020
	Barium	0.0981	0.0005	0.002	2.00	0.12			087492-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087492-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087492-010	SW846 6020
	Calcium	55.4	0.100	1.00	NE	NE	B		087492-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087492-010	SW846 6020
	Cobalt	0.000158	0.0001	0.001	NE	0.0025	J		087492-010	SW846 6020
	Copper	0.00095	0.0003	0.001	NE	<0.05	J		087492-010	SW846 6020
	Iron	0.262	0.010	0.100	NE	NE			087492-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087492-010	SW846 6020
	Magnesium	19.3	0.005	0.015	NE	NE			087492-010	SW846 6020
	Manganese	0.00153	0.001	0.005	NE	NE	J		087492-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087492-010	SW846 7470
	Nickel	0.00166	0.0005	0.002	NE	0.028	J		087492-010	SW846 6020
	Potassium	4.93	0.080	0.300	NE	NE			087492-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087492-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087492-010	SW846 6020
	Sodium	46.3	0.080	0.250	NE	NE			087492-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087492-010	SW846 6020
	Uranium	0.00923	0.00005	0.0002	0.030	0.0052			087492-010	SW846 6020
	Vanadium	0.00635	0.003	0.010	NE	0.013	J		087492-010	SW846 6020
	Zinc	0.0112	0.0026	0.010	NE	0.26			087492-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW8	Aluminum	0.0311	0.010	0.030	NE	NE	B	0.134U	087495-010	SW846 6020
08-Jul-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087495-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		087495-010	SW846 6020
	Barium	0.128	0.0005	0.002	2.00	0.12			087495-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087495-010	SW846 6020
	Cadmium	0.000133	0.00011	0.001	0.005	0.00047	J		087495-010	SW846 6020
	Calcium	56.1	0.100	1.00	NE	NE	B		087495-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087495-010	SW846 6020
	Cobalt	0.000165	0.0001	0.001	NE	0.0025	J		087495-010	SW846 6020
	Copper	0.00105	0.0003	0.001	NE	<0.05			087495-010	SW846 6020
	Iron	0.275	0.010	0.100	NE	NE			087495-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087495-010	SW846 6020
	Magnesium	20.1	0.005	0.015	NE	NE			087495-010	SW846 6020
	Manganese	0.00219	0.001	0.005	NE	NE	J		087495-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087495-010	SW846 7470
	Nickel	0.00186	0.0005	0.002	NE	0.028	J		087495-010	SW846 6020
	Potassium	5.20	0.080	0.300	NE	NE			087495-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087495-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087495-010	SW846 6020
	Sodium	47.8	0.080	0.250	NE	NE			087495-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087495-010	SW846 6020
	Uranium	0.00909	0.00005	0.0002	0.030	0.0052			087495-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		087495-010	SW846 6020
	Zinc	0.0473	0.0026	0.010	NE	0.26			087495-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW9	Aluminum	0.0267	0.010	0.030	NE	NE	B, J	0.134U	087500-010	SW846 6020
09-Jul-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087500-010	SW846 6020
	Arsenic	0.00259	0.0015	0.005	0.010	0.014	J		087500-010	SW846 6020
	Barium	0.0914	0.0005	0.002	2.00	0.12			087500-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087500-010	SW846 6020
	Cadmium	0.000183	0.00011	0.001	0.005	0.00047	J		087500-010	SW846 6020
	Calcium	54.9	0.100	1.00	NE	NE	B		087500-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087500-010	SW846 6020
	Cobalt	0.00016	0.0001	0.001	NE	0.0025	J		087500-010	SW846 6020
	Copper	0.00122	0.0003	0.001	NE	<0.05		0.002U	087500-010	SW846 6020
	Iron	0.264	0.010	0.100	NE	NE			087500-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087500-010	SW846 6020
	Magnesium	19.3	0.005	0.015	NE	NE			087500-010	SW846 6020
	Manganese	0.00342	0.001	0.005	NE	NE	J		087500-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087500-010	SW846 7470
	Nickel	0.00166	0.0005	0.002	NE	0.028	J		087500-010	SW846 6020
	Potassium	4.99	0.080	0.300	NE	NE			087500-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087500-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087500-010	SW846 6020
	Sodium	46.7	0.080	0.250	NE	NE			087500-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087500-010	SW846 6020
	Uranium	0.0102	0.00005	0.0002	0.030	0.0052			087500-010	SW846 6020
	Vanadium	0.00783	0.003	0.010	NE	0.013	J		087500-010	SW846 6020
	Zinc	0.00431	0.0026	0.010	NE	0.26	J		087500-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW9 (Duplicate)	Aluminum	0.0244	0.010	0.030	NE	NE	B, J	0.134U	087501-010	SW846 6020
09-Jul-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087501-010	SW846 6020
	Arsenic	0.0031	0.0015	0.005	0.010	0.014	J		087501-010	SW846 6020
	Barium	0.097	0.0005	0.002	2.00	0.12			087501-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087501-010	SW846 6020
	Cadmium	0.000221	0.00011	0.001	0.005	0.00047	J		087501-010	SW846 6020
	Calcium	59.2	0.100	1.00	NE	NE	B		087501-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087501-010	SW846 6020
	Cobalt	0.000173	0.0001	0.001	NE	0.0025	J		087501-010	SW846 6020
	Copper	0.0017	0.0003	0.001	NE	<0.05		0.002U	087501-010	SW846 6020
	Iron	0.269	0.010	0.100	NE	NE			087501-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087501-010	SW846 6020
	Magnesium	20.9	0.005	0.015	NE	NE			087501-010	SW846 6020
	Manganese	0.00384	0.001	0.005	NE	NE	J		087501-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087501-010	SW846 7470
	Nickel	0.00168	0.0005	0.002	NE	0.028	J		087501-010	SW846 6020
	Potassium	5.02	0.080	0.300	NE	NE			087501-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087501-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087501-010	SW846 6020
	Sodium	47.5	0.400	1.25	NE	NE			087501-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087501-010	SW846 6020
	Uranium	0.0107	0.00005	0.0002	0.030	0.0052			087501-010	SW846 6020
	Vanadium	0.00778	0.003	0.010	NE	0.013	J		087501-010	SW846 6020
	Zinc	0.00578	0.0026	0.010	NE	0.26	J		087501-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-BW2	Aluminum	ND	0.010	0.030	NE	NE	U		087769-010	SW846 6020
06-Oct-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087769-010	SW846 6020
	Arsenic	0.00376	0.0015	0.005	0.010	0.014	B, J	0.014U	087769-010	SW846 6020
	Barium	0.103	0.0005	0.002	2.00	0.12			087769-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087769-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087769-010	SW846 6020
	Calcium	68.4	0.200	2.00	NE	NE	B		087769-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087769-010	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		087769-010	SW846 6020
	Copper	0.000892	0.0003	0.001	NE	<0.05	J	0.012U	087769-010	SW846 6020
	Iron	0.153	0.010	0.100	NE	NE	B		087769-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087769-010	SW846 6020
	Magnesium	20.9	0.005	0.015	NE	NE		J	087769-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		087769-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087769-010	SW846 7470
	Nickel	0.000817	0.0005	0.002	NE	0.028	J		087769-010	SW846 6020
	Potassium	4.32	0.080	0.300	NE	NE			087769-010	SW846 6020
	Selenium	0.00216	0.001	0.005	0.050	0.005	J		087769-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087769-010	SW846 6020
	Sodium	51.5	0.800	2.50	NE	NE		J	087769-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087769-010	SW846 6020
	Uranium	0.00732	0.00005	0.0002	0.030	0.0052			087769-010	SW846 6020
	Vanadium	0.0116	0.003	0.010	NE	0.013	B	0.041U	087769-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.26	U		087769-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-BW2 (Duplicate)	Aluminum	ND	0.010	0.030	NE	NE	U		087770-010	SW846 6020
06-Oct-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087770-010	SW846 6020
	Arsenic	0.00178	0.0015	0.005	0.010	0.014	B, J	0.014U	087770-010	SW846 6020
	Barium	0.102	0.0005	0.002	2.00	0.12			087770-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087770-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087770-010	SW846 6020
	Calcium	67.4	0.200	2.00	NE	NE	B		087770-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087770-010	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		087770-010	SW846 6020
	Copper	0.00083	0.0003	0.001	NE	<0.05	J	0.012U	087770-010	SW846 6020
	Iron	0.158	0.010	0.100	NE	NE	B		087770-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087770-010	SW846 6020
	Magnesium	19.2	0.005	0.015	NE	NE		J	087770-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		087770-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087770-010	SW846 7470
	Nickel	0.000813	0.0005	0.002	NE	0.028	J		087770-010	SW846 6020
	Potassium	4.06	0.080	0.300	NE	NE			087770-010	SW846 6020
	Selenium	0.00224	0.001	0.005	0.050	0.005	J		087770-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087770-010	SW846 6020
	Sodium	49.1	0.080	0.250	NE	NE		J	087770-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087770-010	SW846 6020
	Uranium	0.00731	0.00005	0.0002	0.030	0.0052			087770-010	SW846 6020
	Vanadium	0.0103	0.003	0.010	NE	0.013	B	0.041U	087770-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.26	U		087770-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW7	Aluminum	ND	0.010	0.030	NE	NE	U		087774-010	SW846 6020
08-Oct-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087774-010	SW846 6020
	Arsenic	0.0017	0.0015	0.005	0.010	0.014	B, J	0.014U	087774-010	SW846 6020
	Barium	0.109	0.0005	0.002	2.00	0.12			087774-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087774-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087774-010	SW846 6020
	Calcium	48.7	0.020	0.200	NE	NE	B		087774-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087774-010	SW846 6020
	Cobalt	0.000275	0.0001	0.001	NE	0.0025	J		087774-010	SW846 6020
	Copper	0.000487	0.0003	0.001	NE	<0.05	J		087774-010	SW846 6020
	Iron	0.110	0.010	0.100	NE	NE	B	0.12U	087774-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087774-010	SW846 6020
	Magnesium	17.4	0.005	0.015	NE	NE		J	087774-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		087774-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087774-010	SW846 7470
	Nickel	0.000773	0.0005	0.002	NE	0.028	J		087774-010	SW846 6020
	Potassium	5.11	0.080	0.300	NE	NE			087774-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087774-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087774-010	SW846 6020
	Sodium	39.1	0.080	0.250	NE	NE		J	087774-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087774-010	SW846 6020
	Uranium	0.00789	0.00005	0.0002	0.030	0.0052			087774-010	SW846 6020
	Vanadium	0.00896	0.003	0.010	NE	0.013	B, J	0.041U	087774-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.26	U		087774-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW8	Aluminum	ND	0.010	0.030	NE	NE	U		087772-010	SW846 6020
07-Oct-09	Antimony	ND	0.0005	0.003	0.006	0.006	U		087772-010	SW846 6020
	Arsenic	0.00243	0.0015	0.005	0.010	0.014	B, J	0.014U	087772-010	SW846 6020
	Barium	0.150	0.0005	0.002	2.00	0.12			087772-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087772-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087772-010	SW846 6020
	Calcium	55.8	0.200	2.00	NE	NE	B		087772-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087772-010	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		087772-010	SW846 6020
	Copper	0.000661	0.0003	0.001	NE	<0.05	J		087772-010	SW846 6020
	Iron	0.125	0.010	0.100	NE	NE	B		087772-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087772-010	SW846 6020
	Magnesium	17.8	0.005	0.015	NE	NE		J	087772-010	SW846 6020
	Manganese	0.151	0.001	0.005	NE	NE			087772-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087772-010	SW846 7470
	Nickel	0.00113	0.0005	0.002	NE	0.028	J		087772-010	SW846 6020
	Potassium	5.51	0.080	0.300	NE	NE			087772-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		087772-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087772-010	SW846 6020
	Sodium	44.7	0.080	0.250	NE	NE		J	087772-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087772-010	SW846 6020
	Uranium	0.00801	0.00005	0.0002	0.030	0.0052			087772-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		087772-010	SW846 6020
	Zinc	0.00905	0.0026	0.010	NE	0.26	J		087772-010	SW846 6020

Refer to footnotes at end of table.

Table A-8 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Maximum Background (mg/L)[a]	Laboratory Qualifier[b]	Validation Qualifier[c]	Sample No.	Analytical Method[d]
MWL-MW9	Aluminum	0.113	0.010	0.030	NE	NE			087765-010	SW846 6020
05-Oct-09	Antimony	0.000561	0.0005	0.003	0.006	0.006	J		087765-010	SW846 6020
	Arsenic	0.0056	0.0015	0.005	0.010	0.014	B	0.014U	087765-010	SW846 6020
	Barium	0.099	0.0005	0.002	2.00	0.12			087765-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087765-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087765-010	SW846 6020
	Calcium	55.7	0.200	2.00	NE	NE	B		087765-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087765-010	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		087765-010	SW846 6020
	Copper	0.000471	0.0003	0.001	NE	<0.05	J		087765-010	SW846 6020
	Iron	0.146	0.010	0.100	NE	NE	B		087765-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.01	U		087765-010	SW846 6020
	Magnesium	17.3	0.005	0.015	NE	NE		J	087765-010	SW846 6020
	Manganese	0.00316	0.001	0.005	NE	NE	J		087765-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	087765-010	SW846 7470
	Nickel	0.00114	0.0005	0.002	NE	0.028	J		087765-010	SW846 6020
	Potassium	4.79	0.080	0.300	NE	NE			087765-010	SW846 6020
	Selenium	0.00146	0.001	0.005	0.050	0.005	J		087765-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	<0.01	U		087765-010	SW846 6020
	Sodium	38.8	0.080	0.250	NE	NE		J	087765-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087765-010	SW846 6020
	Uranium	0.00918	0.00005	0.0002	0.030	0.0052			087765-010	SW846 6020
	Vanadium	0.0142	0.003	0.010	NE	0.013	B	0.041U	087765-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.26	U		087765-010	SW846 6020

[a]Maximum background concentrations in groundwater (Dinwiddie , R.S. [New Mexico Environment Department], September 1997, Letter to M.J. Zamorski [U.S. Department of Energy], "Request for Supplemental Information: Background Concentrations Report, SNL/KAFB," September 27.).
[b]Laboratory Qualifier.
B = Analyte is detected in associated laboratory method blank.
J = Amount detected is below the practical quantitation limit (PQL).
U = Analyte is absent or below the method detection limit.
[c]Validation Qualifier.
If cell is blank, then all quality control samples meet acceptance criteria with respect to submitted samples.
J = The associated value is an estimated quantity.
J+ = The associated numerical value is an estimated quantity with suspected positive bias.
U = The analyte was analyzed for but not detected. The associated numerical value is the sample quantitation limit.
UJ = The analyte was analyzed for but not detected. The associated value is an estimate and may be inaccurate or imprecise.
[d]EPA 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.

Table A-8 (Concluded)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

EPA = U.S. Environmental Protection Agency.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
ND = Not detected (at MDL).
NE = Not established.
PQL = Practical quantitation limit.
SW = Solid waste.

Table A-9
Summary of Detected Volatile Organic Compounds and Semivolatile Organic Compounds
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (µg/L)	MDL (µg/L)	PQL (µg/L)	MCL (µg/L)	Laboratory Qualifier[a]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-BW2 05-Jan-09	Toluene	0.759	0.250	1.00	1000	J		086943-001	SW846-8260B
MWL-MW7	Acetone	3.74	3.50	10.0	NE	J		086946-001	SW846-8260B
06-Jan-09	Toluene	0.510	0.250	1.00	1000	J		086946-001	SW846-8260B
MWL-MW8	Acetone	4.42	3.50	10.0	NE	J	10.0U	086950-001	SW846-8260B
07-Jan-09	Toluene	0.496	0.250	1.00	1000	J		086950-001	SW846-8260B
MWL-MW8 (Duplicate)	Acetone	3.65	3.50	10.0	NE	J	10.0U	086951-001	SW846-8260B
07-Jan-09	Toluene	0.495	0.250	1.00	1000	J		086951-001	SW846-8260B
MWL-MW9 08-Jan-09	Toluene	0.852	0.250	1.00	1000	J		086953-001	SW846-8260B
MWL-MW6	2-Butanone	1.37	1.25	5.00	NE	J	J-	087158-001	SW846-8260B
03-Apr-09	2-Hexanone	8.25	1.25	5.00	NE	B	8.25U	087158-001	SW846-8260B
MWL-MW6 (Duplicate) 03-Apr-09	2-Hexanone	3.82	1.25	5.00	NE	B, J	5.00U	087159-001	SW846-8260B
MWL-MW7 08-Apr-09	Toluene	0.267	0.250	1.00	1000	J		087165-001	SW846-8260B
MWL-MW8	Toluene	0.457	0.250	1.00	1000	J		087161-001	SW846-8260B
07-Apr-09	bis(2-Ethylhexyl)phthalate	4.52	2.50	12.5	6.00	J		087161-002	SW846-8270C
MWL-MW9 09-Apr-09	Toluene	0.306	0.250	1.00	1000	J		087167-001	SW846-8260B
MWL-BW2 06-Jul-09	Toluene	0.366	0.250	1.00	1000	J		087489-001	SW846-8260B
MWL-MW7	Toluene	0.645	0.250	1.00	1000	J	J	087492-001	SW846-8260B
07-Jul-09	bis(2-Ethylhexyl)phthalate	9.82	2.13	10.6	6.00	J		087492-002	SW846-8270C
MWL-MW8	Toluene	0.475	0.250	1.00	1000	J		087495-001	SW846-8260B
08-Jul-09	bis(2-Ethylhexyl)phthalate	4.92	2.17	10.9	6.00	J		087495-002	SW846-8270C
MWL-MW9	Toluene	0.711	0.250	1.00	1000	J		087500-001	SW846-8260B
09-Jul-09	bis(2-Ethylhexyl)phthalate	2.35	2.22	11.1	6.00	J		087500-002	SW846-8270C

Refer to footnotes at end of table.

Table A-9 (Concluded)
Summary of Detected Volatile Organic Compounds and Semivolatile Organic Compounds
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Result (µg/L)	MDL (µg/L)	PQL (µg/L)	MCL (µg/L)	Laboratory Qualifier[a]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW9 (Duplicate)	Toluene	0.692	0.250	1.00	1000	J		087501-001	SW846-8260B
09-Jul-09	bis(2-Ethylhexyl)phthalate	2.37	2.30	11.5	6.00	J		087501-002	SW846-8270C
MWL-MW8 07-Oct-09	Toluene	0.253	0.250	1.00	1000	J	J+	087772-001	SW846-8260B
MWL-MW9	Toluene	0.513	0.250	1.00	1000	J		087765-001	SW846-8260B
05-Oct-09	bis(2-Ethylhexyl)phthalate	1.91	1.79	8.93	6.00	B, J	8.9U	087765-002	SW846-8270C

[a]Laboratory Qualifier
B = Analyte is detected in associated laboratory method blank.
J = Amount detected is below the practical quantitation limit (PQL).
[b]Validation Qualifier.
If cell is blank, then all quality control samples meet acceptance criteria with respect to submitted samples.
J = The associated value is an estimated quantity.
J+ = The associated numerical value is an estimated quantity with suspected positive bias.
J- = The associated numerical value is an estimated quantity with suspected negative bias.
U = The analyte was analyzed for but not detected. The associated numerical value is the sample quantitation limit.
[c]Analytical Method.
EPA 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.
EPA = U.S. Environmental Protection Agency.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
µg/L = Microgram(s) per liter.
NE = Not established.
PQL = Practical quantitation limit.
SW = Solid waste.

Table A-10
Method Detection Limits for Volatile and Semivolatile Organic Compounds
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Analyte	MDL (μg/L)	Analytical Method[a]	Analyte	MDL (μg/L)	Analytical Method[a]	Analyte	MDL (μg/L)	Analytical Method[a]
1,1,1-Trichloroethane	0.325	8260	1,2,4-Trichlorobenzene	1.79 - 2.50	8270	Di-n-butyl phthalate	1.79 - 2.50	8270
1,1,2,2-Tetrachloroethane	0.250	8260	1,2-Dichlorobenzene	1.79 - 2.50	8270	Di-n-octyl phthalate	2.68 - 3.75	8270
1,1,2-Trichloroethane	0.250	8260	1,3-Dichlorobenzene	1.79 - 2.50	8270	Dibenz[a,h]anthracene	0.179 - 0.250	8270
1,1-Dichloroethane	0.300	8260	1,4-Dichlorobenzene	1.79 - 2.50	8270	Dibenzofuran	1.79 - 2.50	8270
1,1-Dichloroethene	0.300	8260	2,4,5-Trichlorophenol	1.00 - 2.44	8270	Diethylphthalate	1.79 - 2.50	8270
1,2-Dichloroethane	0.250	8260	2,4,6-Trichlorophenol	1.79 - 2.50	8270	Dimethylphthalate	1.79 - 2.50	8270
1,2-Dichloropropane	0.250	8260	2,4-Dichlorophenol	1.79 - 2.50	8270	Dinitro-o-cresol	2.68 - 3.75	8270
2-Butanone	1.25	8260	2,4-Dimethylphenol	1.79 - 2.50	8270	Diphenyl amine	2.68 - 3.75	8270
2-Hexanone	1.25	8260	2,4-Dinitrophenol	4.46 - 12.5	8270	Fluoranthene	0.179 - 0.250	8270
4-methyl-, 2-Pentanone	1.25	8260	2,4-Dinitrotoluene	1.79 - 2.50	8270	Fluorene	0.179 - 0.250	8270
Acetone	3.50	8260	2,6-Dinitrotoluene	1.79 - 2.50	8270	Hexachlorobenzene	1.79 - 2.50	8270
Benzene	0.300	8260	2-Chloronaphthalene	0.268 - 0.438	8270	Hexachlorobutadiene	1.79 - 2.50	8270
Bromodichloromethane	0.250	8260	2-Chlorophenol	1.79 - 2.50	8270	Hexachlorocyclopentadiene	2.00 - 3.66	8270
Bromoform	0.250	8260	2-Methylnaphthalene	0.268 - 0.375	8270	Hexachloroethane	1.79 - 2.50	8270
Bromomethane	0.300 - 0.500	8260	2-Nitroaniline	1.79 - 2.50	8270	Indeno(1,2,3-c,d)pyrene	0.179 - 0.250	8270
Carbon disulfide	1.25	8260	2-Nitrophenol	1.79 - 2.50	8270	Isophorone	2.00 - 3.66	8270
Carbon tetrachloride	0.260 - 0.300	8260	3,3'-Dichlorobenzidine	1.00 - 2.44	8270	Naphthalene	0.268 - 0.375	8270
Chlorobenzene	0.250	8260	3-Nitroaniline	1.79 - 2.50	8270	Nitro-benzene	2.68 - 3.75	8270
Chloroethane	0.300	8260	4-Bromophenyl phenyl ether	1.79 - 2.50	8270	Pentachlorophenol	1.79 - 2.50	8270
Chloroform	0.250	8260	4-Chloro-3-methylphenol	1.79 - 2.50	8270	Phenanthrene	0.179 - 0.250	8270
Chloromethane	0.300	8260	4-Chlorobenzenamine	1.79 - 2.50	8270	Phenol	0.893 - 1.25	8270
Dibromochloromethane	0.260 - 0.300	8260	4-Chlorophenyl phenyl ether	1.79 - 2.50	8270	Pyrene	0.268 - 0.375	8270
Ethyl benzene	0.250	8260	4-Nitroaniline	2.68 - 3.75	8270	bis(2-Chloroethoxy)methane	2.68 - 3.75	8270
Methylene chloride	3.00	8260	4-Nitrophenol	1.79 - 2.50	8270	bis(2-Chloroethyl)ether	1.79 - 2.50	8270
Styrene	0.250	8260	Acenaphthene	0.277 - 0.388	8270	bis(2-Ethylhexyl)phthalate	1.79 - 2.50	8270
Tetrachloroethene	0.300 - 0.450	8260	Acenaphthylene	0.179 - 0.250	8270	bis-Chloroisopropyl ether	1.79 - 2.50	8270
Toluene	0.250	8260	Anthracene	0.179 - 0.250	8270	m,p-Cresol	2.68 - 3.75	8270
Trichloroethene	0.250	8260	Benzo(a)anthracene	0.179 - 0.250	8270	n-Nitrosodipropylamine	1.79 - 2.50	8270
Vinyl acetate	1.50	8260	Benzo(a)pyrene	0.179 - 0.250	8270	o-Cresol	1.79 - 2.50	8270
Vinyl chloride	0.500	8260	Benzo(b)fluoranthene	0.179 - 0.250	8270			
Xylene	0.300 - 0.600	8260	Benzo(ghi)perylene	0.179 - 0.250	8270			
cis-1,2-Dichloroethene	0.300	8260	Benzo(k)fluoranthene	0.179 - 0.250	8270			
cis-1,3-Dichloropropene	0.250	8260	Butylbenzyl phthalate	1.79 - 2.50	8270			
trans-1,2-Dichloroethene	0.300	8260	Carbazole	0.179 - 0.250	8270			
trans-1,3-Dichloropropene	0.250	8260	Chrysene	0.179 - 0.250	8270			

[a]EPA 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.
EPA = U.S. Environmental Protection Agency.
MDL = Method detection limit.
μg/L = Microgram(s) per liter.

Table A-11
Summary of Perchlorate Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Perchlorate Result (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[a]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-BW2 05-Jan-09	ND	0.004	0.012	NE	U		086943-020	EPA 314.0
MWL-MW7 06-Jan-09	ND	0.004	0.012	NE	U		086946-020	EPA 314.0
MWL-MW8 07-Jan-09	ND	0.004	0.012	NE	U		086950-020	EPA 314.0
MWL-MW8 (Duplicate) 07-Jan-09	ND	0.004	0.012	NE	U		086951-020	EPA 314.0
MWL-MW9 08-Jan-09	ND	0.004	0.012	NE	U		086953-020	EPA 314.0
MWL-MW7 08-Apr-09	ND	0.004	0.012	NE	U		087165-020	EPA 314.0
MWL-MW8 07-Apr-09	ND	0.004	0.012	NE	U		087161-020	EPA 314.0
MWL-MW9 09-Apr-09	ND	0.004	0.012	NE	U		087167-020	EPA 314.0

[a]Laboratory Qualifier.
U = Analyte is absent or below the method detection limit.
[b]Validation Qualifier.
If cell is blank, then all quality control samples meet acceptance criteria with respect to submitted samples.
[c]EPA 1999, "Perchlorate in Drinking Water Using Ion Chromatography," EPA 815/R-00-014, U.S. Environmental Protection Agency, Washington, D.C.
EPA = U.S. Environmental Protection Agency.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
ND = Not detected (at MDL).
NE = Not established.
PQL = Practical quantitation limit.
SW = Solid waste.

Table A-12
Summary of Tritium, Gross Alpha, Gross Beta, and Gamma Spectroscopy Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL (pCi/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-BW2	Americium-241	1.92 ± 7.66	11.5	5.75	NE	U	BD	086943-033	EPA 901.1
05-Jan-09	Cesium-137	0.672 ± 1.91	3.21	1.60	NE	U	BD	086943-033	EPA 901.1
	Cobalt-60	-0.353 ± 2.02	3.33	1.67	NE	U	BD	086943-033	EPA 901.1
	Potassium-40	-36.1 ± 37.4	42.0	21.0	NE	U	BD	086943-033	EPA 901.1
	Gross Alpha	4.81[g]	6.36	2.50	15		J+	086943-034	EPA 900.0
	Gross Beta	7.48 ± 2.16	2.69	1.31	4mrem/yr		J	086943-034	EPA 900.0
	Tritium	55.7 ± 102	172	83.0	NE	U	BD	086943-036	EPA 906.0 M
MWL-MW7	Americium-241	-27.6 ± 12.7	20.4	10.2	NE	U	BD	086946-033	EPA 901.1
06-Jan-09	Cesium-137	0.248 ± 2.15	3.57	1.78	NE	U	BD	086946-033	EPA 901.1
	Cobalt-60	0.821 ± 2.24	3.82	1.91	NE	U	BD	086946-033	EPA 901.1
	Potassium-40	17.1 ± 59.3	30.5	15.3	NE	U	BD	086946-033	EPA 901.1
	Gross Alpha	6.07[g]	3.50	1.14	15		J+	086946-034	EPA 900.0
	Gross Beta	5.81 ± 1.61	1.94	0.948	4mrem/yr		J	086946-034	EPA 900.0
	Tritium	-62 ± 96.1	171	82.5	NE	U	BD	086946-036	EPA 906.0 M
MWL-MW8	Americium-241	-3.18 ± 9.09	13.4	6.69	NE	U	BD	086950-033	EPA 901.1
07-Jan-09	Cesium-137	0.262 ± 1.84	3.10	1.55	NE	U	BD	086950-033	EPA 901.1
	Cobalt-60	-0.0527 ± 1.97	3.27	1.63	NE	U	BD	086950-033	EPA 901.1
	Potassium-40	-9.95 ± 40.6	43.6	21.8	NE	U	BD	086950-033	EPA 901.1
	Gross Alpha	4.24[g]	1.06	0.457	15			086950-034	EPA 900.0
	Gross Beta	8.89 ± 2.02	1.96	0.952	4mrem/yr			086950-034	EPA 900.0
	Tritium	0.00 ± 98.7	171	82.8	NE	U	BD	086950-036	EPA 906.0 M
MWL-MW8 (Duplicate)	Americium-241	-3.7 ± 11.6	19.6	9.83	NE	U	BD	086951-033	EPA 901.1
07-Jan-09	Cesium-137	0.379 ± 2.05	3.50	1.75	NE	U	BD	086951-033	EPA 901.1
	Cobalt-60	-3.27 ± 4.36	3.52	1.76	NE	U	BD	086951-033	EPA 901.1
	Potassium-40	48.3 ± 57.2	32.5	16.3	NE	X	R	086951-033	EPA 901.1
	Gross Alpha	4.76[g]	1.35	0.602	15			086951-034	EPA 900.0
	Gross Beta	7.44 ± 1.76	1.81	0.880	4mrem/yr			086951-034	EPA 900.0
	Tritium	-4.47 ± 99.2	172	83.4	NE	U	BD	086951-036	EPA 906.0 M

Refer to footnotes at end of table.

Table A-12 (Continued)
Summary of Tritium, Gross Alpha, Gross Beta, and Gamma Spectroscopy Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL (pCi/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW9	Americium-241	-8.34 ± 11.4	19.1	9.54	NE	U	BD	086953-033	EPA 901.1
08-Jan-09	Cesium-137	0.276 ± 2.05	3.50	1.75	NE	U	BD	086953-033	EPA 901.1
	Cobalt-60	-1.96 ± 4.40	3.85	1.92	NE	U	BD	086953-033	EPA 901.1
	Potassium-40	15.7 ± 56.8	31.9	15.9	NE	U	BD	086953-033	EPA 901.1
	Gross Alpha	4.54 [g]	1.83	0.845	15			086953-034	EPA 900.0
	Gross Beta	6.84 ± 1.71	1.85	0.897	4mrem/yr			086953-034	EPA 900.0
	Tritium	76.8 ± 104	174	84.2	NE	U	BD	086953-036	EPA 906.0 M
MWL-BW2	Americium-241	1.79 ± 8.72	13.5	6.74	NE	U	BD	087151-033	EPA 901.1
01-Apr-09	Cesium-137	-2.19 ± 2.60	2.95	1.47	NE	U	BD	087151-033	EPA 901.1
	Cobalt-60	-0.749 ± 1.96	3.22	1.61	NE	U	BD	087151-033	EPA 901.1
	Potassium-40	-44.1 ± 34.8	39.4	19.7	NE	U	BD	087151-033	EPA 901.1
	Gross Alpha	7.25 [g]	2.74	1.27	15			087151-034	EPA 900.0
	Gross Beta	7.77 ± 2.46	3.26	1.60	4mrem/yr		J	087151-034	EPA 900.0
	Tritium	28.2 ± 95.0	163	78.7	NE	U	BD	087151-036	EPA 906.0 M
MWL-MW4	Americium-241	0.611 ± 3.95	5.82	2.91	NE	U	BD	087169-033	EPA 901.1
13-Apr-09	Cesium-137	2.93 ± 2.58	4.56	2.28	NE	U	BD	087169-033	EPA 901.1
	Cobalt-60	-1.68 ± 3.10	4.82	2.41	NE	U	BD	087169-033	EPA 901.1
	Potassium-40	-13.5 ± 44.7	56.4	28.2	NE	U	BD	087169-033	EPA 901.1
	Gross Alpha	2.67 [g]	0.903	0.375	15			087169-034	EPA 900.0
	Gross Beta	5.04 ± 1.49	1.89	0.921	4mrem/yr		J	087169-034	EPA 900.0
	Tritium	-44.1 ± 91.1	176	80.4	NE	U	BD	087169-036	EPA 906.0 M
MWL-MW5	Americium-241	-15.1 ± 7.54	12.0	6.01	NE	U	BD	087153-033	EPA 901.1
02-Apr-09	Cesium-137	0.375 ± 1.84	3.08	1.54	NE	U	BD	087153-033	EPA 901.1
	Cobalt-60	0.874 ± 1.99	3.42	1.71	NE	U	BD	087153-033	EPA 901.1
	Potassium-40	-36.6 ± 40.1	40.3	20.1	NE	U	BD	087153-033	EPA 901.1
	Gross Alpha	9.26 [g]	1.76	0.753	15			087153-034	EPA 900.0
	Gross Beta	8.18 ± 2.81	3.82	1.86	4mrem/yr		J	087153-034	EPA 900.0
	Tritium	78.1 ± 97.8	163	78.7	NE	U	BD	087153-036	EPA 906.0 M

Refer to footnotes at end of table.

Table A-12 (Continued)
Summary of Tritium, Gross Alpha, Gross Beta, and Gamma Spectroscopy Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL (pCi/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW6	Americium-241	0.125 ± 13.1	19.8	9.91	NE	U	BD	087158-033	EPA 901.1
03-Apr-09	Cesium-137	0.157 ± 2.18	3.61	1.81	NE	U	BD	087158-033	EPA 901.1
	Cobalt-60	-0.798 ± 3.29	3.69	1.85	NE	U	BD	087158-033	EPA 901.1
	Potassium-40	93.8 ± 43.5	36.3	18.2	NE		J	087158-033	EPA 901.1
	Gross Alpha	6.63 [g]	1.37	0.604	15			087158-034	EPA 900.0
	Gross Beta	8.27 ± 1.78	1.34	0.637	4mrem/yr			087158-034	EPA 900.0
	Tritium	54.3 ± 96.5	163	78.8	NE	U	BD	087158-036	EPA 906.0 M
MWL-MW6 (Duplicate)	Americium-241	-3.47 ± 11.0	18.7	9.38	NE	U	BD	087159-033	EPA 901.1
03-Apr-09	Cesium-137	0.939 ± 1.97	3.40	1.70	NE	U	BD	087159-033	EPA 901.1
	Cobalt-60	-0.234 ± 2.08	3.46	1.73	NE	U	BD	087159-033	EPA 901.1
	Potassium-40	-9.76 ± 43.8	49.7	24.9	NE	U	BD	087159-033	EPA 901.1
	Gross Alpha	7.37 [g]	1.44	0.637	15			087159-034	EPA 900.0
	Gross Beta	7.89 ± 1.95	1.89	0.910	4mrem/yr			087159-034	EPA 900.0
	Tritium	28.1 ± 94.5	162	78.3	NE	U	BD	087159-036	EPA 906.0 M
MWL-MW7	Americium-241	-6.93 ± 5.09	8.19	4.10	NE	U	BD	087165-033	EPA 901.1
08-Apr-09	Cesium-137	-1.13 ± 1.83	3.00	1.50	NE	U	BD	087165-033	EPA 901.1
	Cobalt-60	1.63 ± 1.87	3.33	1.67	NE	U	BD	087165-033	EPA 901.1
	Potassium-40	-2.78 ± 33.0	42.7	21.4	NE	U	BD	087165-033	EPA 901.1
	Gross Alpha	3.04 [g]	1.28	0.576	15			087165-034	EPA 900.0
	Gross Beta	6.22 ± 1.36	1.15	0.551	4mrem/yr			087165-034	EPA 900.0
	Tritium	10.9 ± 94.6	164	79.1	NE	U	BD	087165-036	EPA 906.0 M
MWL-MW8	Americium-241	11.7 ± 12.5	19.4	9.71	NE	U	BD	087161-033	EPA 901.1
07-Apr-09	Cesium-137	0.838 ± 2.05	3.46	1.73	NE	U	BD	087161-033	EPA 901.1
	Cobalt-60	0.904 ± 2.16	3.69	1.85	NE	U	BD	087161-033	EPA 901.1
	Potassium-40	68.3 ± 36.6	34.7	17.4	NE		J	087161-033	EPA 901.1
	Gross Alpha	3.93 [g]	1.16	0.516	15			087161-034	EPA 900.0
	Gross Beta	7.49 ± 1.51	1.01	0.480	4mrem/yr			087161-034	EPA 900.0
	Tritium	21.7 ± 94.7	163	78.7	NE	U	BD	087161-036	EPA 906.0 M

Refer to footnotes at end of table.

Table A-12 (Continued)
Summary of Tritium, Gross Alpha, Gross Beta, and Gamma Spectroscopy Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL (pCi/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW9	Americium-241	2.82 ± 3.77	6.15	3.08	NE	U	BD	087167-033	EPA 901.1
09-Apr-09	Cesium-137	0.440 ± 2.92	4.85	2.43	NE	U	BD	087167-033	EPA 901.1
	Cobalt-60	-3.16 ± 4.29	4.85	2.43	NE	U	BD	087167-033	EPA 901.1
	Potassium-40	63.0 ± 32.3	63.0	31.3	NE	U	BD	087167-033	EPA 901.1
	Gross Alpha	4.85 [g]	0.815	0.348	15			087167-034	EPA 900.0
	Gross Beta	5.27 ± 1.16	0.949	0.452	4mrem/yr			087167-034	EPA 900.0
	Tritium	17.4 ± 94.6	163	78.8	NE	U	BD	087167-036	EPA 906.0 M
MWL-BW2	Americium-241	3.48 ± 6.04	9.26	4.63	NE	U	BD	087489-033	EPA 901.1
06-Jul-09	Cesium-137	0.118 ± 1.53	2.64	1.32	NE	U	BD	087489-033	EPA 901.1
	Cobalt-60	1.51 ± 1.66	2.91	1.46	NE	U	BD	087489-033	EPA 901.1
	Potassium-40	8.12 ± 43.8	25.2	12.6	NE	U	BD	087489-033	EPA 901.1
	Gross Alpha	4.77 [g]	2.04	0.901	15			087489-034	EPA 900.0
	Gross Beta	8.67 ± 4.30	5.60	2.45	4mrem/yr		J	087489-034	EPA 900.0
	Tritium	-66.1 ± 91.6	163	78.9	NE	U	BD	087489-036	EPA 906.0 M
MWL-MW7	Americium-241	-10.8 ± 12.8	19.2	9.59	NE	U	BD	087492-033	EPA 901.1
07-Jul-09	Cesium-137	1.91 ± 4.46	3.07	1.54	NE	U	BD	087492-033	EPA 901.1
	Cobalt-60	-0.00746 ± 1.95	3.32	1.66	NE	U	BD	087492-033	EPA 901.1
	Potassium-40	2.11 ± 42.1	43.4	21.7	NE	U	BD	087492-033	EPA 901.1
	Gross Alpha	3.61 [g]	1.85	0.819	15			087492-034	EPA 900.0
	Gross Beta	5.81 ± 2.38	3.48	1.70	4mrem/yr		J	087492-034	EPA 900.0
	Tritium	-128 ± 89.4	163	78.9	NE	U	BD	087492-036	EPA 906.0 M
MWL-MW8	Americium-241	-1.01 ± 5.53	8.25	4.13	NE	U	BD	087495-033	EPA 901.1
08-Jul-09	Cesium-137	0.105 ± 1.83	3.09	1.55	NE	U	BD	087495-033	EPA 901.1
	Cobalt-60	0.712 ± 1.83	3.16	1.58	NE	U	BD	087495-033	EPA 901.1
	Potassium-40	17.0 ± 47.3	31.0	15.5	NE	U	BD	087495-033	EPA 901.1
	Gross Alpha	6.71 [g]	1.86	0.826	15			087495-034	EPA 900.0
	Gross Beta	6.10 ± 3.79	5.32	2.31	4mrem/yr		J	087495-034	EPA 900.0
	Tritium	-82.8 ± 91.2	163	79.0	NE	U	BD	087495-036	EPA 906.0 M

Refer to footnotes at end of table.

Table A-12 (Continued)
Summary of Tritium, Gross Alpha, Gross Beta, and Gamma Spectroscopy Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL (pCi/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW9	Americium-241	19.9 ± 15.5	24.3	12.2	NE	U	BD	087500-033	EPA 901.1
09-Jul-09	Cesium-137	-1.5 ± 1.80	2.94	1.47	NE	U	BD	087500-033	EPA 901.1
	Cobalt-60	0.210 ± 2.03	3.46	1.73	NE	U	BD	087500-033	EPA 901.1
	Potassium-40	45.7 ± 44.1	29.8	14.9	NE	X	R	087500-033	EPA 901.1
	Gross Alpha	3.50 [g]	2.32	1.05	15			087500-034	EPA 900.0
	Gross Beta	8.18 ± 2.28	2.72	1.32	4mrem/yr			087500-034	EPA 900.0
	Tritium	-82.5 ± 90.9	163	78.8	NE	U	BD	087500-036	EPA 906.0 M
MWL-MW9 (Duplicate)	Americium-241	2.48 ± 7.82	13.6	6.82	NE	U	BD	087501-033	EPA 901.1
09-Jul-09	Cesium-137	-3.56 ± 2.89	3.10	1.55	NE	U	BD	087501-033	EPA 901.1
	Cobalt-60	0.070 ± 1.89	3.16	1.58	NE	U	BD	087501-033	EPA 901.1
	Potassium-40	5.11 ± 52.8	28.6	14.3	NE	U	BD	087501-033	EPA 901.1
	Gross Alpha	3.73 [g]	1.27	0.526	15			087501-034	EPA 900.0
	Gross Beta	4.78 ± 3.10	4.16	1.72	4mrem/yr		J	087501-034	EPA 900.0
	Tritium	-47.6 ± 92.3	163	78.9	NE	U	BD	087501-036	EPA 906.0 M
MWL-BW2	Americium-241	5.72 ± 6.12	9.47	4.74	NE	U	BD	087769-033	EPA 901.1
06-Oct-09	Cesium-137	-0.584 ± 1.52	2.56	1.28	NE	U	BD	087769-033	EPA 901.1
	Cobalt-60	0.374 ± 1.54	2.57	1.29	NE	U	BD	087769-033	EPA 901.1
	Potassium-40	18.7 ± 32.4	28.3	14.2	NE	U	BD	087769-033	EPA 901.1
	Gross Alpha	4.62 [g]	1.86	0.836	15			087769-034	EPA 900.0
	Gross Beta	3.17 ± 1.76	2.73	1.33	4mrem/yr		J	087769-034	EPA 900.0
	Tritium	-11.6 ± 90.9	158	76.6	NE	U	BD	087769-036	EPA 906.0 M
MWL-BW2 (Duplicate)	Americium-241	2.73 ± 2.69	4.18	2.09	NE	U	BD	087770-033	EPA 901.1
06-Oct-09	Cesium-137	-3.96 ± 5.30	5.42	2.71	NE	U	BD	087770-033	EPA 901.1
	Cobalt-60	1.28 ± 2.22	3.86	1.93	NE	U	BD	087770-033	EPA 901.1
	Potassium-40	20.3 ± 48.1	34.7	17.4	NE	U	BD	087770-033	EPA 901.1
	Gross Alpha	2.54 [g]	6.27	2.36	15		J	087770-034	EPA 900.0
	Gross Beta	6.30 ± 2.13	2.88	1.40	4mrem/yr		J	087770-034	EPA 900.0
	Tritium	-78.9 ± 88.1	157	76.2	NE	U	BD	087770-036	EPA 906.0 M

Refer to footnotes at end of table.

Table A-12 (Concluded)
Summary of Tritium, Gross Alpha, Gross Beta, and Gamma Spectroscopy Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2009

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL (pCi/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample No.	Analytical Method[f]
MWL-MW7	Americium-241	-1.03 ± 4.56	5.00	2.50	NE	U	BD	087774-033	EPA 901.1
08-Oct-09	Cesium-137	-3.52 ± 3.64	3.85	1.92	NE	U	BD	087774-033	EPA 901.1
	Cobalt-60	1.71 ± 2.47	4.29	2.15	NE	U	BD	087774-033	EPA 901.1
	Potassium-40	40.5 ± 23.2	34.8	17.4	NE	X	R	087774-033	EPA 901.1
	Gross Alpha	3.69 [g]	1.82	0.819	15			087774-034	EPA 900.0
	Gross Beta	8.92 ± 4.15	5.23	2.31	4mrem/yr		J	087774-034	EPA 900.0
	Tritium	9.69 ± 91.9	158	76.8	NE	U	BD	087774-036	EPA 906.0 M
MWL-MW8	Americium-241	-0.0692 ± 7.92	11.8	5.90	NE	U	BD	087772-033	EPA 901.1
07-Oct-09	Cesium-137	0.322 ± 1.92	3.21	1.61	NE	U	BD	087772-033	EPA 901.1
	Cobalt-60	-0.195 ± 1.85	3.07	1.54	NE	U	BD	087772-033	EPA 901.1
	Potassium-40	3.48 ± 40.7	33.3	16.7	NE	U	BD	087772-033	EPA 901.1
	Gross Alpha	3.51 [g]	6.54	2.55	15		J	087772-034	EPA 900.0
	Gross Beta	5.19 ± 3.17	4.34	1.86	4mrem/yr		J	087772-034	EPA 900.0
	Tritium	-48.5 ± 89.8	158	76.8	NE	U	BD	087772-036	EPA 906.0 M
MWL-MW9	Americium-241	2.94 ± 11.4	17.2	8.59	NE	U	BD	087765-033	EPA 901.1
05-Oct-09	Cesium-137	-2.78 ± 1.95	3.06	1.53	NE	U	BD	087765-033	EPA 901.1
	Cobalt-60	-0.124 ± 2.10	3.55	1.78	NE	U	BD	087765-033	EPA 901.1
	Potassium-40	-37.9 ± 40.9	47.7	23.9	NE	U	BD	087765-033	EPA 901.1
	Gross Alpha	4.72 [g]	1.70	0.759	15			087765-034	EPA 900.0
	Gross Beta	5.75 ± 3.61	5.14	2.25	4mrem/yr		J	087765-034	EPA 900.0
	Tritium	9.66 ± 91.6	158	76.6	NE	U	BD	087765-036	EPA 906.0 M

[a]Activity levels of zero or less are considered to be not detected.
[b]MDA is the minimal detectable activity in a sample required to ensure a 95% probability that the measured activity is accurately quantified above the critical level.
[c]Critical level is the minimum activity that can be measured and reported with 99% confidence that the analyte is greater than zero, analyte is matrix specific.
[d]Laboratory Qualifier.
U = Analyte is absent or below the method detection limit.
X = Used in radiochemistry to identify data rejected due to interference, low abundance, peak not meeting identification criteria, or uncertain identification for gamma spectroscopy.
[e]Validation Qualifier
If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.
BD = Used in radiochemistry to identify results that are not statistically different from zero.
J = The associated value is an estimated quantity.
R = The data are unusable for their intended purpose. The analyte may or may not be present.
[f]EPA 1980, "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032, U.S. Environmental Protection Agency, Cincinnati, Ohio.
[g]Excluding uranium (40 CFR Parts 9, 141, and 142, Table I-4)

EPA = U.S. Environmental Protection Agency.
ID = Identification.
MCL = Maximum contaminant level.
MDA = Minimum detectable activity.
mrem/yr = Millirem per year.
NE = Not established.
pCi/L = Picocurie(s) per liter.

Table A-13
Duplicate Sample Analytical Results for Chemical Analyses
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
January 2009

Sample Location	MWL-MW8 Environmental	MWL-MW8 Duplicate	
	Result (R_1)	Result (R_2)	
Parameter[a]	All results in mg/L (unless noted)		RPD[b]
Toluene (μg/L)	0.496	0.495	<1
Nitrate plus nitrite as N	1.11	1.12	1
Alkalinity, total as CaCO3	222	222	<1
Bromide	0.302	0.328	8
Chloride	44.7	44.4	1
Fluoride	1.05	1.02	3
Sulfate	34.9	34.7	1
Aluminum (unfiltered)	0.760	0.608	22
Barium (unfiltered)	0.123	0.122	1
Calcium (unfiltered)	54.4	52.9	3
Chromium (unfiltered)	0.00359	0.00373	4
Cobalt (unfiltered)	0.000501	0.000460	9
Copper (unfiltered)	0.00192	0.00188	2
Iron (unfiltered)	0.718	0.171	123
Lead (unfiltered)	0.0005	ND	NC
Magnesium (unfiltered)	19.1	18.4	4
Manganese (unfiltered)	0.0274	0.0256	7
Nickel (unfiltered)	0.00236	0.00262	10
Potassium (unfiltered)	5.44	5.68	4
Sodium (unfiltered)	49.0	47.9	2
Uranium (unfiltered)	0.00875	0.00856	2
Zinc (unfiltered)	0.00384	0.00383	<1
Aluminum (filtered)	0.0183	0.0104	55
Barium (filtered)	0.114	0.100	13
Calcium (filtered)	49.8	43.5	14
Chromium (filtered)	0.00225	0.00221	2
Cobalt (filtered)	0.000166	0.000162	2
Copper (filtered)	0.00113	0.00102	10
Iron (filtered)	0.164	0.977	143
Magnesium (filtered)	19.0	15.3	22
Nickel (filtered)	0.00185	0.00167	10
Potassium (filtered)	5.16	4.51	13
Sodium (filtered)	46.4	39.8	15

Refer to footnotes at end of table.

Table A-13 (Continued)
Duplicate Sample Analytical Results for Chemical Analyses
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
April 2009

Sample Location	MWL-MW6 Environmental	MWL-MW6 Duplicate	
	Result (R_1)	Result (R_2)	
Parameter[a]	All results in mg/L (unless noted)		RPD[b]
2-Butanone (μg/L)	1.37	ND	NC
Nitrate plus nitrite as N	1.52	1.72	12
Alkalinity, total as CaCO3	298	298	< 1
Bromide	0.457	0.435	5
Chloride	76.1	75.9	< 1
Fluoride	0.726	0.746	3
Sulfate	51.9	51.8	< 1
Aluminum (unfiltered)	0.00593	0.0085	36
Barium (unfiltered)	0.120	0.120	< 1
Calcium (unfiltered)	88.7	91.1	3
Cobalt (unfiltered)	0.000219	0.000223	2
Copper (unfiltered)	0.00131	0.00112	16
Iron (unfiltered)	0.338	0.344	2
Magnesium (unfiltered)	27.6	29.2	6
Nickel (unfiltered)	0.00186	0.00199	7
Potassium (unfiltered)	5.82	6.39	9
Selenium (unfiltered)	0.00126	0.00132	5
Sodium (unfiltered)	62.5	66.1	6
Thallium (unfiltered)	0.000376	ND	NC
Uranium (unfiltered)	0.0101	0.00975	4
Aluminum (filtered)	ND	0.00633	NC
Barium (filtered)	0.120	0.111	8
Calcium (filtered)	87.6	88.6	1
Cobalt (filtered)	0.000242	0.000189	25
Copper (filtered)	0.00121	0.00117	3
Iron (filtered)	0.327	0.293	11
Magnesium (filtered)	28.6	24.0	17
Nickel (filtered)	0.00172	0.00174	1
Potassium (filtered)	5.74	5.41	6
Selenium (filtered)	0.00142	0.00162	13
Sodium (filtered)	58.9	61.3	4
Uranium (filtered)	0.00964	0.00973	1
2-Butanone (μg/L)	1.37	ND	NC
Nitrate plus nitrite as N	1.52	1.72	12

Refer to footnotes at end of table.

Table A-13 (Continued)
Duplicate Sample Analytical Results for Chemical Analyses
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
July 2009

Sample Location	MWL-MW9 Environmental Result (R_1)	MWL-MW9 Duplicate Result (R_2)	
Parameter[a]	All results in mg/L (unless noted)		RPD[b]
Toluene (μg/L)	0.711	0.692	3
bis(2-Ethylhexyl) phthalate (μg/L)	2.35	2.37	1
Nitrate plus nitrite as N	2.03	1.96	4
Alkalinity, total as CaCO3	217	220	1
Bromide	0.267	0.291	9
Chloride	39.5	38.1	4
Fluoride	1.020	0.996	2
Sulfate	37.7	37.8	< 1
Aluminum (unfiltered)	ND (0.134)	0.207	NC
Arsenic (unfiltered)	0.00268	0.00368	31
Barium (unfiltered)	0.096	0.0978	2
Cadmium (unfiltered)	0.000163	0.000167	2
Calcium (unfiltered)	57.2	59.1	3
Cobalt (unfiltered)	0.000208	0.000249	18
Iron (unfiltered)	0.350	0.525	40
Magnesium (unfiltered)	21.1	20.5	3
Manganese (unfiltered)	0.00648	0.00918	34
Nickel (unfiltered)	0.00178	0.00201	12
Potassium (unfiltered)	5.00	5.18	4
Sodium (unfiltered)	44.2	48.1	8
Uranium (unfiltered)	0.0106	0.0107	1
Vanadium (unfiltered)	0.00918	0.00859	7
Zinc (unfiltered)	0.00398	0.00693	54
Arsenic (unfiltered)	0.00259	0.0031	18
Barium (filtered)	0.0914	0.097	6
Cadmium (filtered)	0.000183	0.000221	19
Calcium (filtered)	54.9	59.2	8
Cobalt (filtered)	0.00016	0.000173	8
Iron (filtered)	0.264	0.269	2
Magnesium (filtered)	19.3	20.9	8
Manganese (filtered)	0.00342	0.00384	12
Nickel (filtered)	0.00166	0.00168	1
Potassium (filtered)	4.99	5.02	1

Refer to footnotes at end of table.

Table A-13 (Concluded)
Duplicate Sample Analytical Results for Chemical Analyses
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
October 2009

Sample Location	MWL-BW2 Environmental Result (R_1)	MWL-BW2 Duplicate Result (R_2)	RPD[b]
Parameter[a]	All results in mg/L (unless noted)		
Nitrate plus nitrite as N	2.04	1.98	3
Alkalinity, total as CaCO3	252	248	2
Bromide	0.374	0.365	2
Chloride	61.4	61.3	<1
Fluoride	0.700	0.716	2
Sulfate	43.0	42.8	<1
Barium (unfiltered)	0.103	0.104	1
Calcium (unfiltered)	65.4	67.7	3
Iron (unfiltered)	0.169	0.166	2
Magnesium (unfiltered)	19.6	20.6	5
Nickel (unfiltered)	0.001	0.000888	12
Potassium (unfiltered)	4.01	4.14	3
Selenium (unfiltered)	0.00279	0.00197	34
Sodium (unfiltered)	55.0	49.8000	10
Uranium (unfiltered)	0.00734	0.00730	1
Vanadium (unfiltered)	0.0119	0.01170	2
Barium (filtered)	0.1030	0.102	1
Calcium (filtered)	68.4	67.4	1
Iron (filtered)	0.153	0.158	3
Magnesium (filtered)	20.9	19.2	8
Nickel (filtered)	0.000817	0.000813	<1
Potassium (filtered)	4.32	4.06	6
Selenium (filtered)	0.00216	0.00224	4
Sodium (filtered)	51.5	49.1	5
Uranium (filtered)	0.0073	0.00731	<1
Nitrate plus nitrite as N	2.04	1.98	3
Alkalinity, total as CaCO3	252	248	2
Bromide	0.374	0.365	2
Chloride	61.4	61.3	<1
Fluoride	0.700	0.716	2
Sulfate	43.0	42.8	<1
Barium (unfiltered)	0.103	0.104	1
Calcium (unfiltered)	65.4	67.7	3

[a]Parameters not detected in both samples are not listed.
[b]RPD is not calculated for estimated values.
CaCO3 = Calcium carbonate.
J = Analyte detected below practical quantitation limit or reported as an estimated concentration.
µg/L = Microgram(s) per liter.
mg/L = Milligram(s) per liter.
N = Nitrogen.
NC = Not calculated.
RPD = Relative percent difference is calculated with the following equation and rounded to nearest whole number:

$$RPD = \frac{|R_1 - R_2|}{[(R_1 + R_2)/2]} \times 100$$

where:
R_1 = analysis result
R_2 = duplicate analysis result

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APPENDIX B
Generalized Conceptual Hydrogeologic Model Explaining the Lower Groundwater Elevations Measured in MWL-MW7 through MWL-MW9 at the Mixed Waste Landfill

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MIXED WASTE LANDFILL
GENERALIZED HYDROGEOLOGIC CONCEPTUAL MODEL EXPLAINING THE LOWER GROUNDWATER ELEVATIONS MEASURED IN MWL-MW7 THROUGH MWL-MW9
SUMMARY

A generalized hydrogeologic conceptual model for the aquifer system beneath the Mixed Waste Landfill (MWL) that explains lower groundwater elevations measured in MWL-MW7 through MWL-MW9 relative to the groundwater monitoring wells they replaced (MWL-MW1 through MWL-MW3) is presented in this appendix. This information augments the comprehensive conceptual model presented in the "Mixed Waste Landfill Groundwater Report, 1990 through 2001" (Goering et al. December 2002) and the Phase 2 RCRA Facility Investigation Report (Peace et al. September 2002). In general, the groundwater elevation (i.e., top of the regional aquifer or water table) along the west side of the MWL is approximately 20 feet lower in the new monitoring wells than it was in the older monitoring wells. A summary is provided, followed by a map and two hydrogeologic cross sections depicting the wells, simplified subsurface hydrogeology, groundwater levels, and hydraulic conductivity data (Figures B-1 through B-3). Although this conceptual model is simplified, it is based on actual water level and hydraulic conductivity measurements and is consistent with the geologic interpretation of monitoring well lithologic and geophysical logging information. It is intended to provide a general framework for understanding the groundwater system with respect to the groundwater elevations measured in MWL-MW7 through MWL-MW9 since they were installed in 2008. Following the map and profiles, additional supporting information and a regional perspective are presented in the section titled, "Supporting Observations and a Regional Perspective". This information is illustrated in three additional "time-phased" conceptual figures (Figures B-4 through B-6).

The lower groundwater elevations in MWL-MW7 through MWL-MW9 appear to be related to two major factors. First, the geology of the upper part of the regional groundwater system, which is in general a stratified system, varies with depth from a low hydraulic conductivity layer (in which MWL-MW2 and MWL-MW3 were screened) to a medium conductivity layer (in which the lower parts of the screens of MWL-MW7, MWL-MW8, and MWL-MW9 reside) to a high conductivity layer corresponding to the Ancestral Rio Grande sediments (in which at least part of the screen interval of MWL-MW4 [lower screen], MWL-MW5, and MWL-MW6 are located). Second, the regional aquifer continues to decline as a result of historic and ongoing large-scale removal of water by the City of Albuquerque (COA) and Kirtland Air Force Base (KAFB). The overall effect at the MWL is that groundwater flow is predominantly vertically downward in the lower conductivity and medium conductivity layers in response to this regional drawdown from pumping (i.e., a draining system).

Because the screen intervals of the new wells (MWL-MW7, MWL-MW8, and MWL-MW9) extend across the medium hydraulic conductivity layer and the screens in the wells they replaced (MWL-MW1, MWL-MW2, and MWL-MW3) were completely within the lower conductivity layer above the medium hydraulic conductivity layer, the vertical gradient has a larger impact on the groundwater elevation in the new wells. The end result is that the top of the regional water table is significantly lower in MWL-MW7, MWL-MW8, and MWL-MW9.

The profile figures (B-2 and B-3) presented in this summary are focused on depicting the hydrogeologic regime. In order to depict the hydrogeologic regime at a practical scale and because the depth to groundwater is approximately 500 ft at the MWL, the upper 400 ft of the vadose zone is not shown.

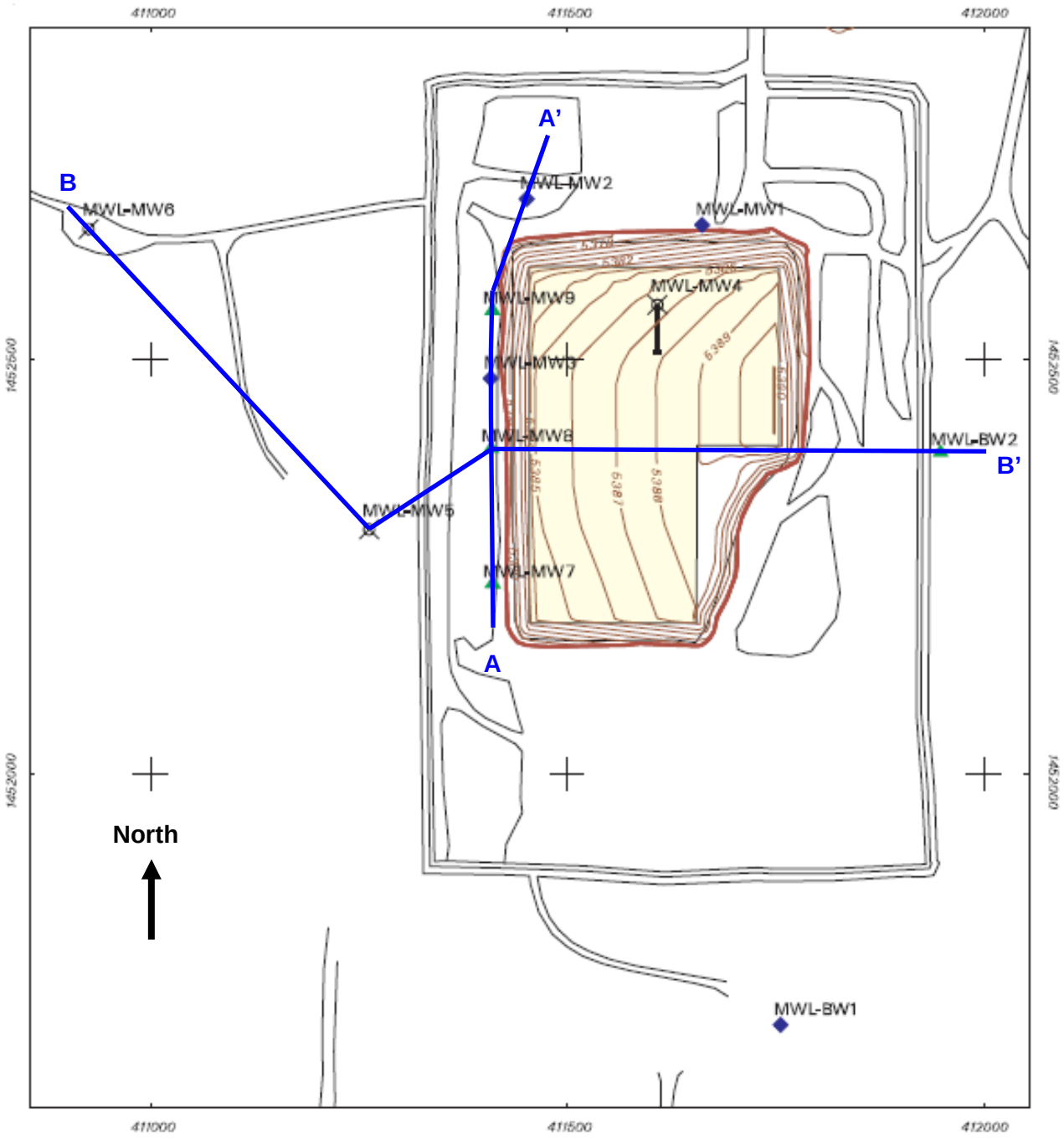

Figure B-1
Location of MWL North-South Profile A – A'
and
MWL East-West Profile B – B'

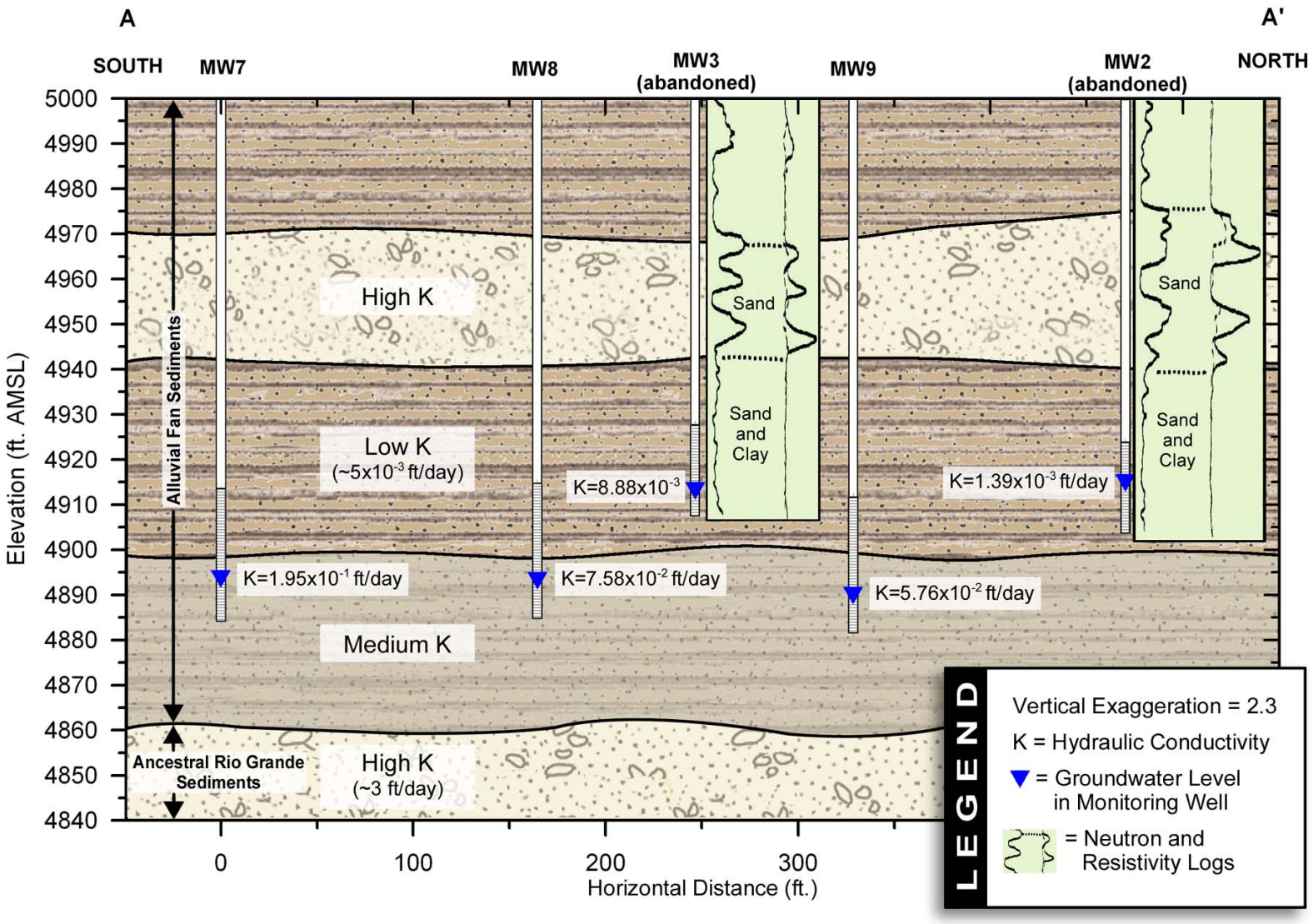

Figure B-2
MWL North–South Profile 2009

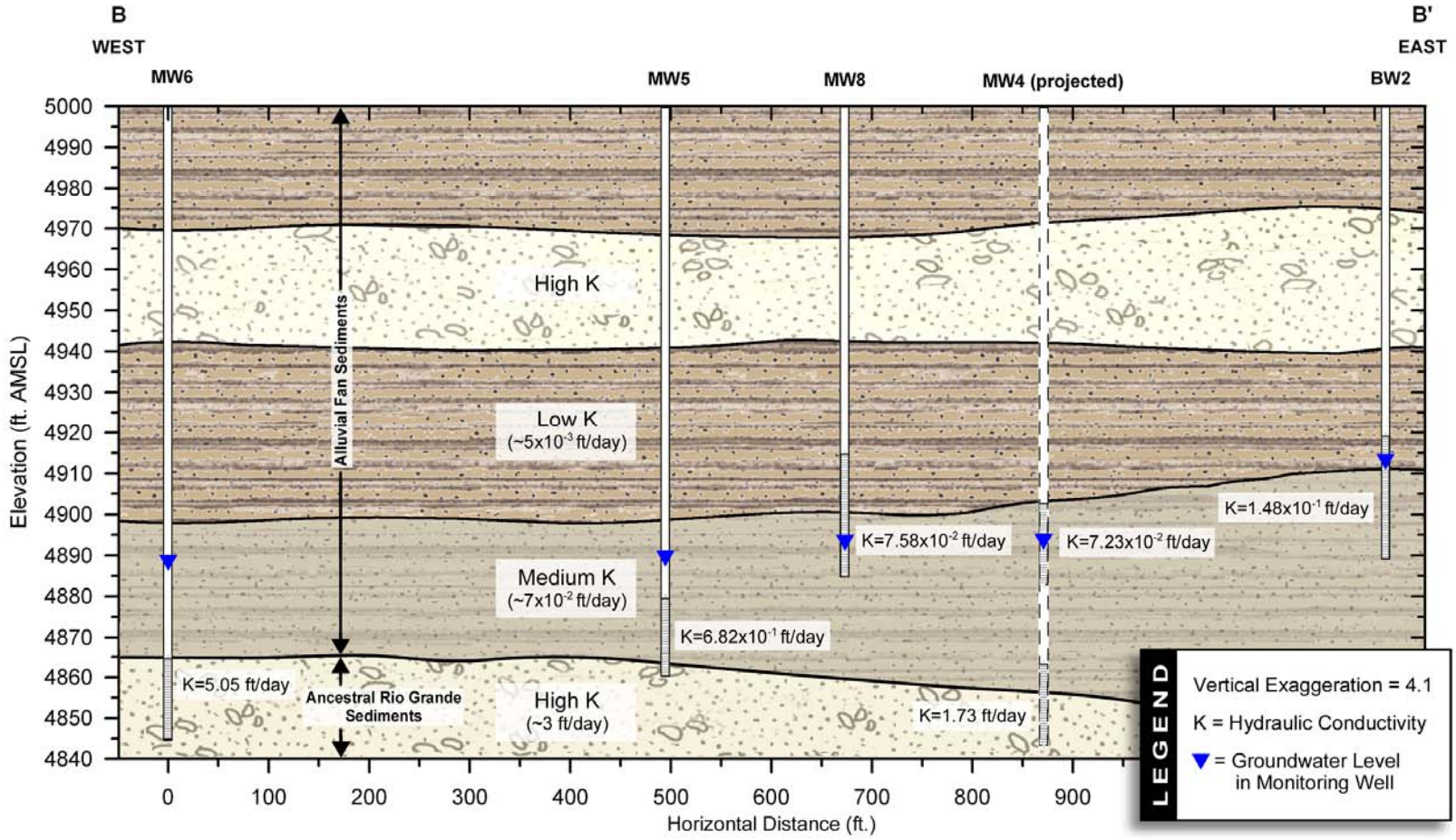

Figure B-3
MWL East–West Profile 2009

Water level data presented in the Figures B-2 and B-3 reflect 2009 conditions. All hydraulic conductivity data for the older wells is taken the "Mixed Waste Landfill Groundwater Report, 1990 through 2001" (Goering et al. December 2002). For the newer 2008 wells the hydraulic conductivity values are from slug testing performed in 2009 (Skelly et al. August 2009). All references to the hydraulic conductivity of various layers are relative and are not meant to represent a precise hydraulic conductivity value or range.

The overall elements of the hydrogeology of the site are summarized below.

- The relatively flat ground surface at the MWL slopes slightly to the west.

- Overall, the conceptual model is a stratified system that varies with depth from a low hydraulic conductivity layer (in which groundwater monitoring wells MWL-MW2 and MWL-MW3 are screened), to a medium conductivity layer (in which the lower parts of the screens of MWL-MW7, MWL-MW8, and MWL-MW9 reside), to a high conductivity layer corresponding to the Ancestral Rio Grande sediments (in which at least part of the screen interval of MWL-MW4 [lower screen], MWL-MW5, and MWL-MW6 are located). Groundwater flow is predominantly vertically downward in the low conductivity and medium conductivity layers in response to regional drawdown from pumping.

- The difference in water levels in wells MWL-MW2 and MWL-MW3 (higher), and the water levels in wells MWL-MW7, MWL-MW8, and MWL-MW9 (approximately 20 ft lower) is a result of the strong downward vertical gradient in hydraulic head associated with the downward vertical drainage of the lower conductivity units overlying the Ancestral Rio Grande sediments.

- The declining heads in the regional aquifer (i.e., regional drawdown) result from groundwater removal at KAFB and across the COA (i.e., production wells for drinking water).

- The nearest KAFB and COA production wells are located more than 3 miles north of the MWL.

Supporting Observations and a Regional Perspective

- Wells MWL-MW2 and MWL-MW3 are screened in low hydraulic conductivity material (i.e., fine-grained Alluvial Fan sediments). Hydraulic testing indicates a conductivity of about 1.39×10^{-3} to 8.88×10^{-3} ft/day. Resistivity and neutron geophysical logs also indicate that the wells are screened in fine-grained sediments.

- Wells MWL-MW7, MWL-MW8, and MWL-MW9 have well screens that straddle the low hydraulic conductivity layer described above and the underlying medium conductivity layer, also in the Alluvial Fan sediments. Hydraulic testing (i.e., aquifer pump testing) for the upper screen in MWL-MW4 in the medium conductivity layer resulted in a conductivity of approximately 7.23×10^{-2} ft/day. The hydraulic conductivity for wells MWL-MW7, MWL-MW8, and MWL-MW9 were 1.95×10^{-1}, 7.58×10^{-2}, and 5.76×10^{-2} ft/day, respectively, based on slug testing results.

- The lower screen in well MWL-MW4 and the screens in MWL-MW5 and MWL-MW6 reside in a higher conductivity material, interpreted to be the coarser Ancestral Rio Grande sediments. The well screen for MWL-MW5 straddles the contact between the Ancestral Rio Grande sediments and the Alluvial Fan sediments, whereas the lower screen of MWL-MW4 and the screen of MWL-MW6 are completely within the Ancestral Rio Grande sediments. Hydraulic testing in the lower screen of MWL-MW4 yielded a conductivity of about 1.5 ft/day, and MWL-MW6 had a conductivity of about 5.0 ft/day. The conductivity of MWL-MW5 was slightly lower at 6.83×10^{-1} ft/day.

- Based on the geologic and geophysical logging results as well as hydraulic conductivity testing results, the wells MWL-MW7, MWL-MW8, and MWL-MW9 are screened in the Alluvial Fan sediments that generally occur above the Ancestral Rio Grande sediments. However, in places the Alluvial Fan and Ancestral Rio Grande sediments appear to be inter-layered. The high hydraulic conductivity layer above the low hydraulic conductivity layer shown in Figures B-2 and B-3 is interpreted as an inter-fingering layer of the coarse-grained Ancestral Rio Grande sediments within the predominantly fine-grained Alluvial Fan sediments (Goering et al. December 2002).

- Significant drawdown has occurred in the Ancestral Rio Grande sediments over the last two to three decades. Water levels in the Ancestral Rio Grande sediments in the vicinity of the MWL were decreasing at a rate of about 2 ft/year in the mid-1990s (Peace et al. September 2002). Water levels in well MWL-MW6 decreased at a lower rate of about 0.4 ft/year from 2004 to 2007 (Goering et al. December 2002). Projecting backward in time to the mid 1990's, it is possible that the water table prior to pumping was at least 40 to 60 ft higher than current water levels. This time-dependent regional trend is shown schematically in Figures B-4 through B-6. The wells are not intended to be actual MWL monitoring wells; they are included to show the impact of the regional groundwater decline on the water levels in wells located in the different hydrogeologic units, similar to the MWL groundwater monitoring wells.

- The Alluvial Fan sediments continue to undergo significant dewatering. Groundwater movement in the low hydraulic conductivity layer and the medium conductivity layer above the Ancestral Rio Grande sediments is dominated by downward vertical drainage in

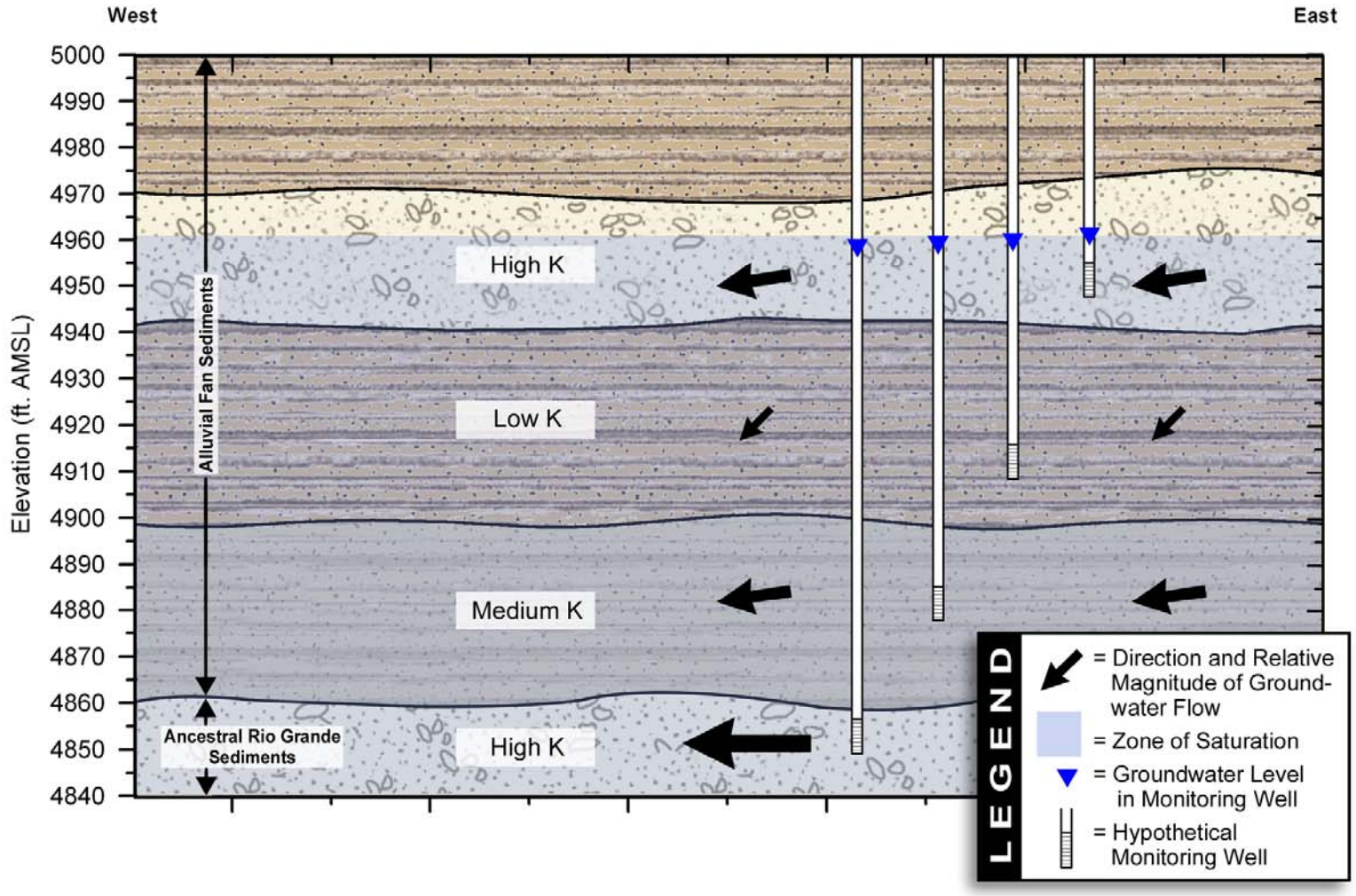

Figure B-4
Mixed Waste Landfill Conceptual Model
Water Table Conditions – Pre-Pumping Early 1900s

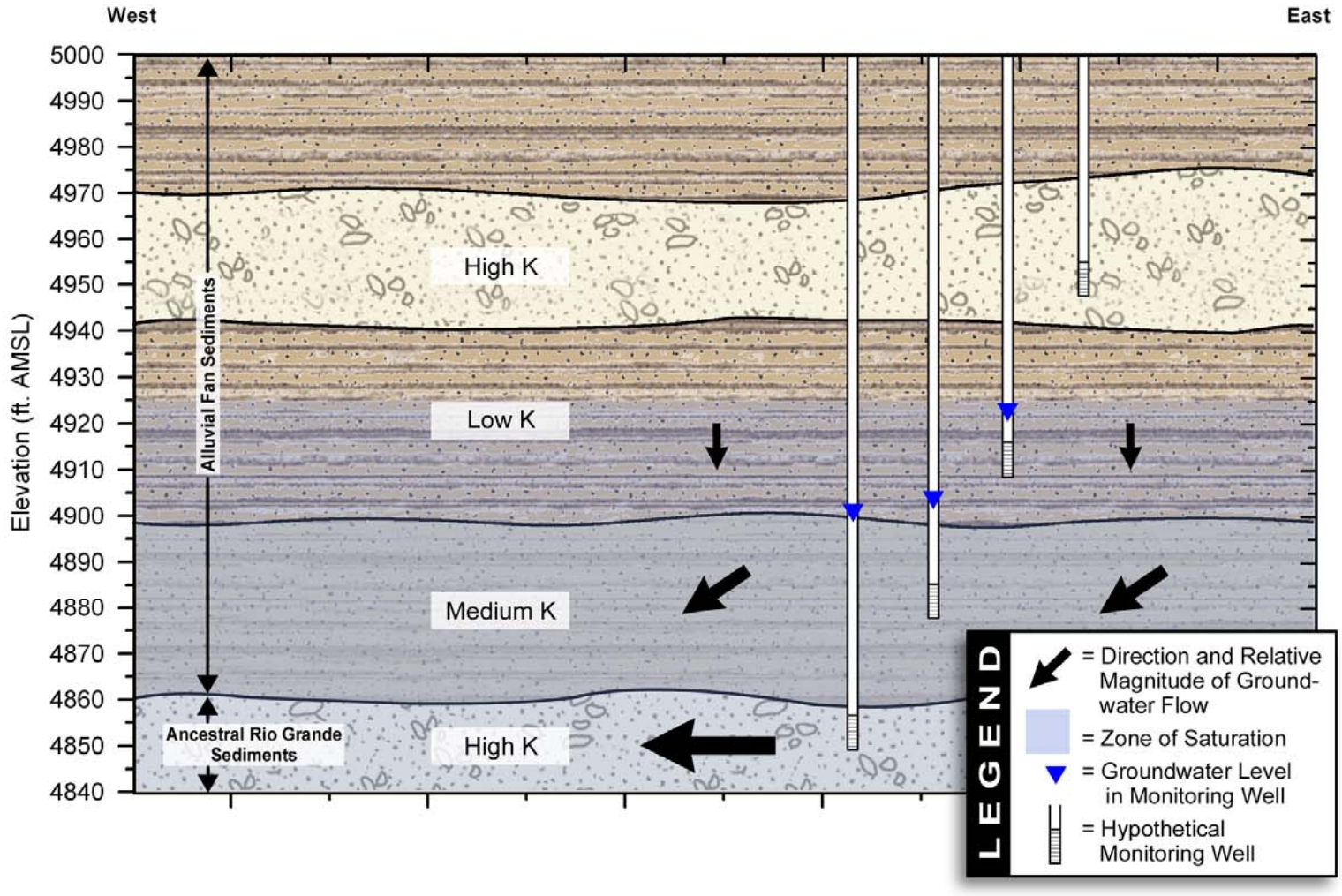

Figure B-5
Mixed Waste Landfill Conceptual Model
Water Table Conditions – Early 1990s KAFB and COA Pumping of the Regional Aquifer

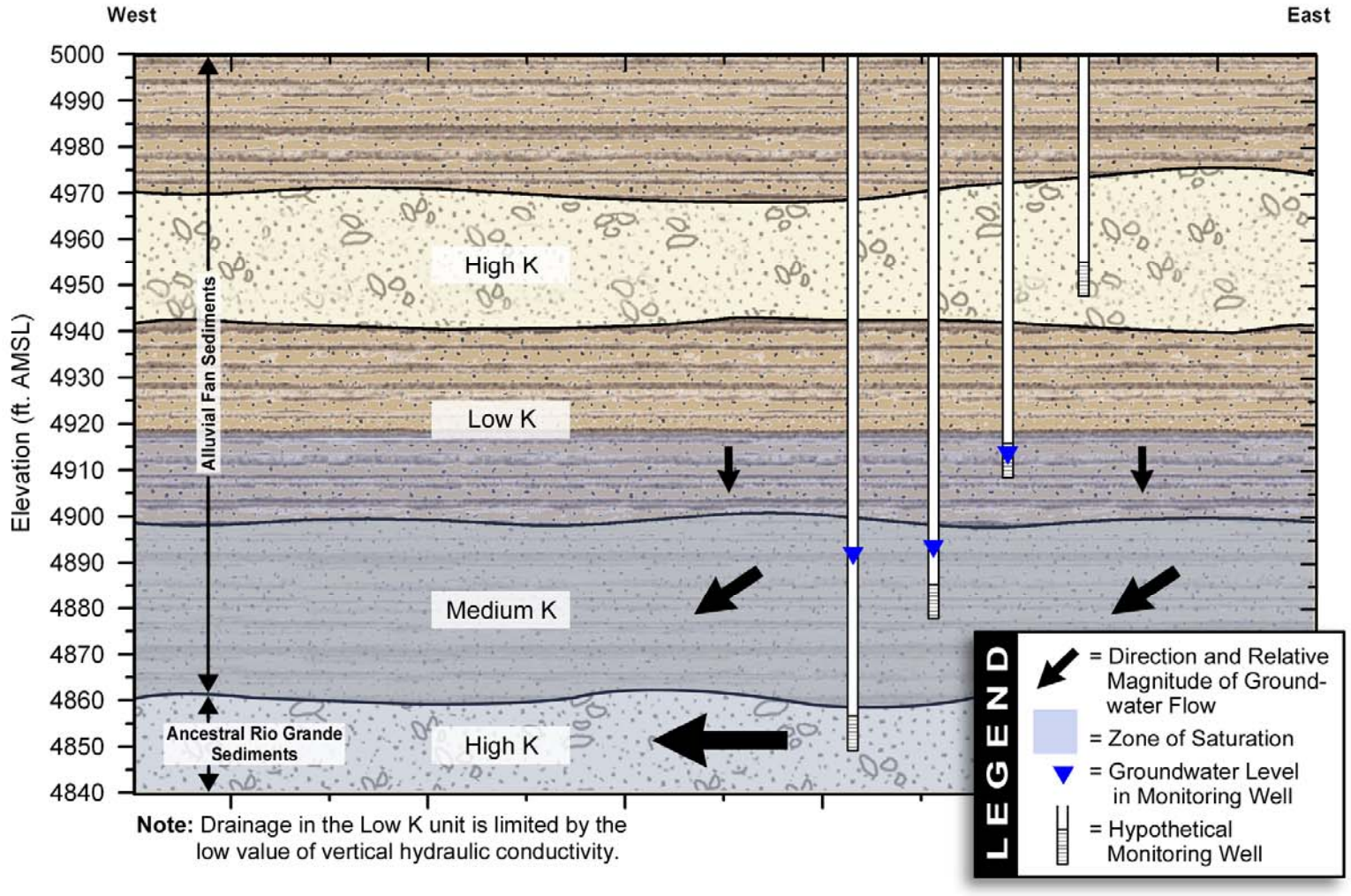

Figure B-6
Mixed Waste Landfill Conceptual Model
Water Table Conditions – Late 2000s Continued KAFB and COA Pumping of the Regional Aquifer

response to regional drawdown in the underlying Ancestral Rio Grande sediments. For example, the average vertical hydraulic gradient using the water levels in wells MWL-MW3 and MWL-MW8 is 0.93 downward. The vertical hydraulic gradient between the upper and lower screens in MWL-MW4 is downward at 0.11 (Peace et al. September 2002 and Goering et al. December 2002).

- The horizontal gradient between MWL-BW2 and MWL-MW8 was approximately 0.03 in October 2009.

- Values of vertical hydraulic gradient approaching or equal to 1.0 and the stratified nature of the Alluvial Fan sediments suggest possible variably saturated conditions between locally saturated media in the low hydraulic conductivity layer. Transient stranded water may exist in this low conductivity material as the system drains vertically downward.

- Water level measurements in monitoring wells are composite values of hydraulic head over the screened interval, with the observed water level being strongly weighted toward the head in the material with the highest hydraulic conductivity. This means that the water level measurements in MWL-MW7, MWL-MW8, and MWL-MW9 are dominated by the head in the medium hydraulic conductivity layer in the lower part of the screens.

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Goering, T.J., G.M. Haggerty, D. Van Hart, and J.L. Peace, December 2002. "Mixed Waste Landfill Groundwater Report, 1990 through 2001, Sandia National Laboratories, Albuquerque, New Mexico," SAND Report SAND2002-4098, prepared by Sandia National Laboratories, Albuquerque, New Mexico, for the U.S. Department of Energy under Contract DE-AC04-94AL85000.

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Volume VII

TAB 8

Notice of Approval: Responses to NOD Issued for
Mixed Waste Landfill Groundwater Monitoring Report
Calendar Year 2008

From: NMED/Bearzi
To: SNL/Wagner

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BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

NEW MEXICO ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

RON CURRY
Secretary

SARAH COTTRELL
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

June 7, 2010

Patty Wagner
Manager
U. S. Department of Energy
NNSA/Sandia Site Office
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Dr. Marianne C. Walck
Director
Nuclear Energy & Global Security Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185-0701

RE: NOTICE OF APPROVAL: RESPONSES TO NOTICE OF DISAPPROVAL ISSUED FOR MIXED WASTE LANDFILL GROUNDWATER MONITORING REPORT, CALENDAR YEAR 2008, MAY 2009 SANDIA NATIONAL LABORATORIES, EPA # NM5890110518 HWB-09-012

Dear Ms. Wagner and Dr. Walck:

The New Mexico Environment Department (NMED) has reviewed the subject responses dated December 23, 2009, to NMED's Notice of Disapproval issued for the *Mixed Waste Landfill Groundwater Monitoring Report Calendar Year 2008.* The responses were submitted by the U. S. Department of Energy (DOE) on behalf of DOE and Sandia Corporation (collectively the Permittees). The subject report, as amended by the responses, is hereby approved.

If you have any questions regarding this matter, please contact Sid Brandwein of my staff at (505) 222-9504.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
S. Brandwein, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
J. Cochran, SNL, MS 0719
J. Gould, SNL, MS 0184
File: SNL 2010 and Reading
HWB-09-012

Volume VII

TAB 9

Notice of Approval: Mixed Waste Landfill
Groundwater Monitoring Report Calendar Year 2009

From: NMED/Bearzi
To: SNL/Wagner

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NEW MEXICO ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

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DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

SARAH COTTRELL
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

November 9, 2010

rec-d
NOV 15 2010

Ms. Patty Wagner
Manager
U.S. Department of Energy
NNSA / Sandia Site Office
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Albuquerque, NM 87185-5400

Dr. Marianne Walck
Director
Nuclear Energy & Global Security Technologies Center
Sandia National Laboratories/New Mexico
P.O. Box 5800, MS 0701
Albuquerque, NM 87185-0701

RE: NOTICE OF APPROVAL: MIXED WASTE LANDFILL GROUNDWATER MONITORING REPORT CALENDAR YEAR 2009, JUNE 2010
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
SNL-10-008

Dear Ms. Wagner and Dr. Walck:

The New Mexico Environment Department (NMED) has reviewed the *Mixed Waste Landfill Groundwater Report, Calendar Year 2009*, dated June 2010, with cover letter dated June 7, 2010 (hereinafter referred to as the "Report"). The Report was submitted by the U. S. Department of Energy (DOE) and documents the results of groundwater sampling and analysis conducted at the Mixed Waste Landfill during 2009. The Report is hereby approved.

If you have any questions regarding this matter, please contact Mr. Brian L. Salem of my staff at (505) 222-9576.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc Mullen
Cochran
Mitchell
Daniel
Records

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
B. Salem, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
J. Cochran, SNL, MS-0719
J. Gould, SNL, MS-0184
File: SNL-10-008 and Reading

Volume VII

TAB 10

Mixed Waste Landfill Chapter 4 Excerpted from the
Annual Groundwater Monitoring Report, Calendar Year 2011

From: SNL/Wagner
To: NMED/Kieling

Back of Tab 10

National Nuclear Security Administration
Sandia Site Office
P. O. Box 5400
Albuquerque, NM 87185

ENTERED

SEP 30 2011

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

John E. Kieling, Acting Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Bldg. 1
Santa Fe, NM 87505

Subject: Mixed Waste Landfill Groundwater Monitoring Report Calendar Year 2010

Dear Mr. Kieling:

On behalf of the United States Department of Energy/National Nuclear Security Administration (DOE/NNSA) and Sandia Corporation (Sandia), DOE/NNSA is submitting the *Mixed Waste Landfill Groundwater Monitoring Report Calendar Year 2010.* The report presents groundwater monitoring data from sampling events conducted at the Mixed Waste Landfill (MWL) in 2010. The results of the groundwater monitoring showed constituent concentrations within historical ranges for the MWL and no constituents exceeded their respective regulatory standards.

This is the last, separate Sandia National Laboratories/New Mexico (SNL/NM) Environmental Restoration (ER) Project MWL groundwater monitoring report. Currently, MWL groundwater monitoring results are provided to the New Mexico Environment Department (NMED) in two regulatory submittals: the SNL/NM Annual Groundwater Monitoring Report and the ER Project MWL Annual Groundwater Monitoring Report. The two reports contain the same information at the same level of detail. The Compliance Order on Consent (NMED April 2004) does not require a separate ER Project MWL report; therefore, future MWL groundwater monitoring results (Calendar Year 2011 and beyond) will only be submitted to NMED as part of the SNL/NM Annual Groundwater Monitoring Report.

If you have any questions regarding this annual report, please contact me at (505) 845-4392, or Carolyn Holloway of my staff at (505) 845-5248.

Sincerely,

Kimberly A. Davis for

Patty Wagner
Manager

Enclosure

cc:
See Page 2

cc w/enclosure:
William Moats, NMED-HWB (via Certified Mail)
Laurie King, EPA, Region 6 (via Certified Mail)
Thomas Skibitski, NMED-OB, MS-1396
Barry Birch, NMED-OB, MS-1396
Mike Mitchell, SNL/NM, MS-0718
Zimmerman Library, UNM
SNL ES&H Records Center, SNL/NM, MS-0718
Carolyn Holloway, NNSA/SSO, MS-0184

cc w/o enclosure:
Thomas Longo, HQ/GTN, NA-56
John Lehr, HQ/FORS
Robert Fleming, HQ/GTN, NA-173
Joanna Serra, HQ/FORS NA-173
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Shirley Mondy, SSO/MO, MS-0184
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Amy Blumberg, SNL/NM, MS-0141
Andrew Orrell, SNL/NM, MS-0771
David Miller, SNL/NM, MS-0718
John Cochran, SNL/NM, MS-0719
Carolyn Daniel, SNL/NM, MS-0718

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Mixed Waste Landfill Groundwater Monitoring Report Calendar Year 2010**

Document author: **Michael Sanders, Department 06234**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 9/20/11
Date

S. Andrew Orrell, Director
Nuclear Energy & Fuel Cycle Programs
Center 6200
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ for 9/30/11
Date

Ms. Patty Wagner, Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Sandia National Laboratories

Sandia National Laboratories/New Mexico Environmental Restoration Project

MIXED WASTE LANDFILL GROUNDWATER MONITORING REPORT CALENDAR YEAR 2010

SEPTEMBER 2011

United States Department of Energy
Sandia Site Office

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

EXECUTIVE SUMMARY

Groundwater monitoring was conducted at a total of seven groundwater monitoring wells at the Mixed Waste Landfill (MWL), Sandia National Laboratories, New Mexico, in January, April, and July 2010. During 2008, four new monitoring wells (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) were installed and subsequently sampled for eight consecutive quarters, in accordance with requirements specified in the Compliance Order on Consent (Consent Order; NMED April 2004) between the U.S. Department of Energy, Sandia Corporation, and the New Mexico Environment Department. The eighth quarter of sampling for MWL-BW2 was completed in January 2010 and for MWL-MW7, MWL-MW8, and MWL-MW9 in April 2010. In addition, sampling for perchlorate was required at the new wells for at least four consecutive quarters. The fourth and final quarter of perchlorate sampling was completed for the four new wells in April 2009. No detections of perchlorate at or above the screening level of 4 micrograms per liter were reported in any of the perchlorate samples collected from these wells. Perchlorate sampling was accordingly discontinued after April 2009. All MWL monitoring wells are now being sampled annually as required by the Consent Order.

The field activities and analytical results for the Calendar Year (CY) 2010 groundwater sampling events are presented in this report. The MWL groundwater monitoring wells were sampled in accordance with appropriate Field Operating Procedures for groundwater sampling activities and Mini-Sampling and Analysis Plans. The groundwater monitoring results for the CY 2010 sampling events are consistent with data for previous sampling events, within the range of historical MWL groundwater data, and indicate the MWL has not impacted groundwater beneath the site. Based upon the field and laboratory quality control sample and data validation results, the CY 2010 groundwater monitoring data are defensible and representative.

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A Summary Tables of Field Measurements and Analytical Results, Calendar Year 2010

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ACRONYMS AND ABBREVIATIONS

AOP	Administrative Operating Procedure
ARG	Ancestral Rio Grande
CY	Calendar Year
DOE	U.S. Department of Energy
EB	equipment blank
EPA	U.S. Environmental Protection Agency
FB	field blank
FOP	Field Operating Procedure
GEL	GEL Laboratories, Inc.
HWB	Hazardous Waste Bureau
LTES	Long-Term Environmental Stewardship
MCL	maximum contaminant level
MDA	minimum detectable activity
MDL	method detection limit
µg/L	microgram(s) per liter
mg/L	milligram(s) per liter
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
NPN	nitrate plus nitrite
pCi/L	picocurie(s) per liter
PQL	practical quantitation limit
QC	quality control
RCRA	Resource Conservation and Recovery Act
RPD	relative percent difference
Sandia	Sandia Corporation
SAP	Sampling and Analysis Plan
SC	specific conductance
SNL/NM	Sandia National Laboratories, New Mexico
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TAL	target analyte list
TB	trip blank
VOC	volatile organic compound

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1.0 INTRODUCTION

Groundwater monitoring of seven wells was conducted at the Mixed Waste Landfill (MWL), Sandia National Laboratories, New Mexico (SNL/NM) during the first three quarters of Calendar Year (CY) 2010. This report describes the field activities conducted during the sampling events and presents the analytical results. Appendix A presents summary tables of the field measurements and sampling results.

The MWL is located on Kirtland Air Force Base, 4 miles south of the SNL/NM Technical Area I facilities and 5 miles southeast of Albuquerque International Sunport. The MWL is a 2.6-acre site in the north-central portion of Technical Area III (Figure 1-1). The MWL was established in 1959 as a disposal area for low-level radioactive and mixed waste generated by SNL/NM research facilities and accepted low-level radioactive and minor amounts of mixed waste from March 1959 through December 1988. Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies (at the time of disposal) of activity were disposed of in the MWL.

The MWL consists of two distinct disposal areas: the classified area (occupying 0.6 acres) and the unclassified area (occupying 2.0 acres). Low-level radioactive and mixed waste was disposed of in each of these areas. Classified wastes were buried in cylindrical pits in the classified area. Unclassified wastes were buried in shallow trenches in the unclassified area. An evapotranspirative cover that includes a biointrusion barrier was installed during Fiscal Year 2009 (SNL/NM January 2010a) in accordance with the New Mexico Environment Department (NMED)-approved “MWL Corrective Measures Implementation Plan” (SNL/NM November 2005).

Groundwater at the MWL has been extensively characterized since 1990 for major ion chemistry, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), nitrate plus nitrite (NPN), metals, radionuclides, and perchlorate. Twenty-one years of quarterly, semiannual, and annual data indicate that groundwater has not been contaminated by releases from the MWL (Goering et al. 2002; Lyon and Goering January 2006; SNL/NM December 2001, January 2002, March 2002, July 2002, August 2002, October 2002, June 2003, September 2003, July 2004, November 2006, January 2008, May 2009, and June 2010).

The MWL groundwater monitoring well network was modified in 2008 (SNL/NM May 2009). Due to declining water levels, four monitoring wells (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) were plugged and abandoned, and four new monitoring wells (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) were installed. Figure 1-2 shows the current groundwater monitoring well network at the MWL. The well network consists of seven wells completed within the interfingering, fine-grained, alluvial fan deposits and coarse-grained, Ancestral Rio Grande (ARG) deposits. The monitoring well network currently consists of one background well (MWL-BW2), one on-site monitoring well (MWL-MW4), and five downgradient wells (MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9).

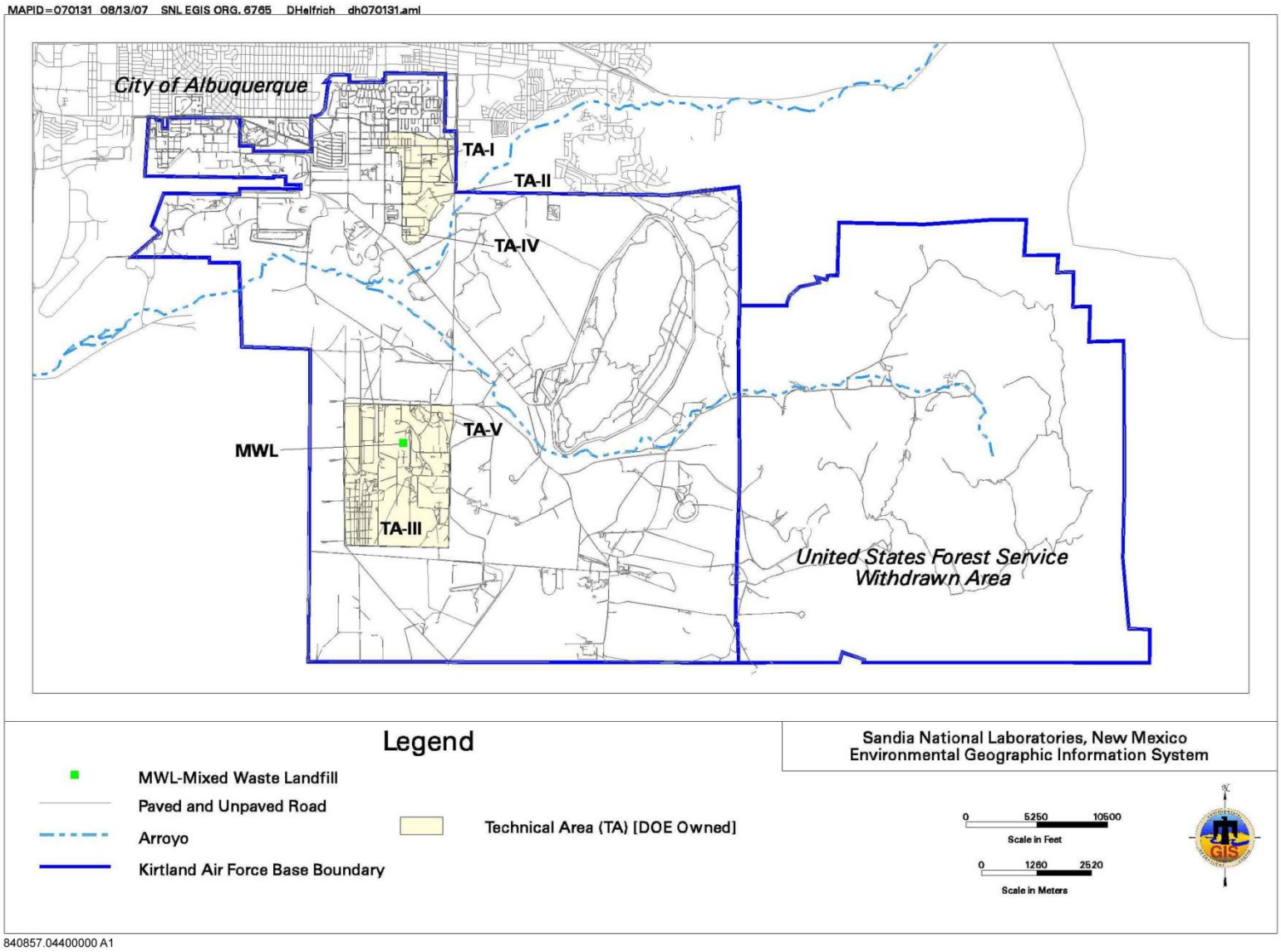

Figure 1-1
Location of the Mixed Waste Landfill, Sandia National Laboratories, and Kirtland Air Force Base

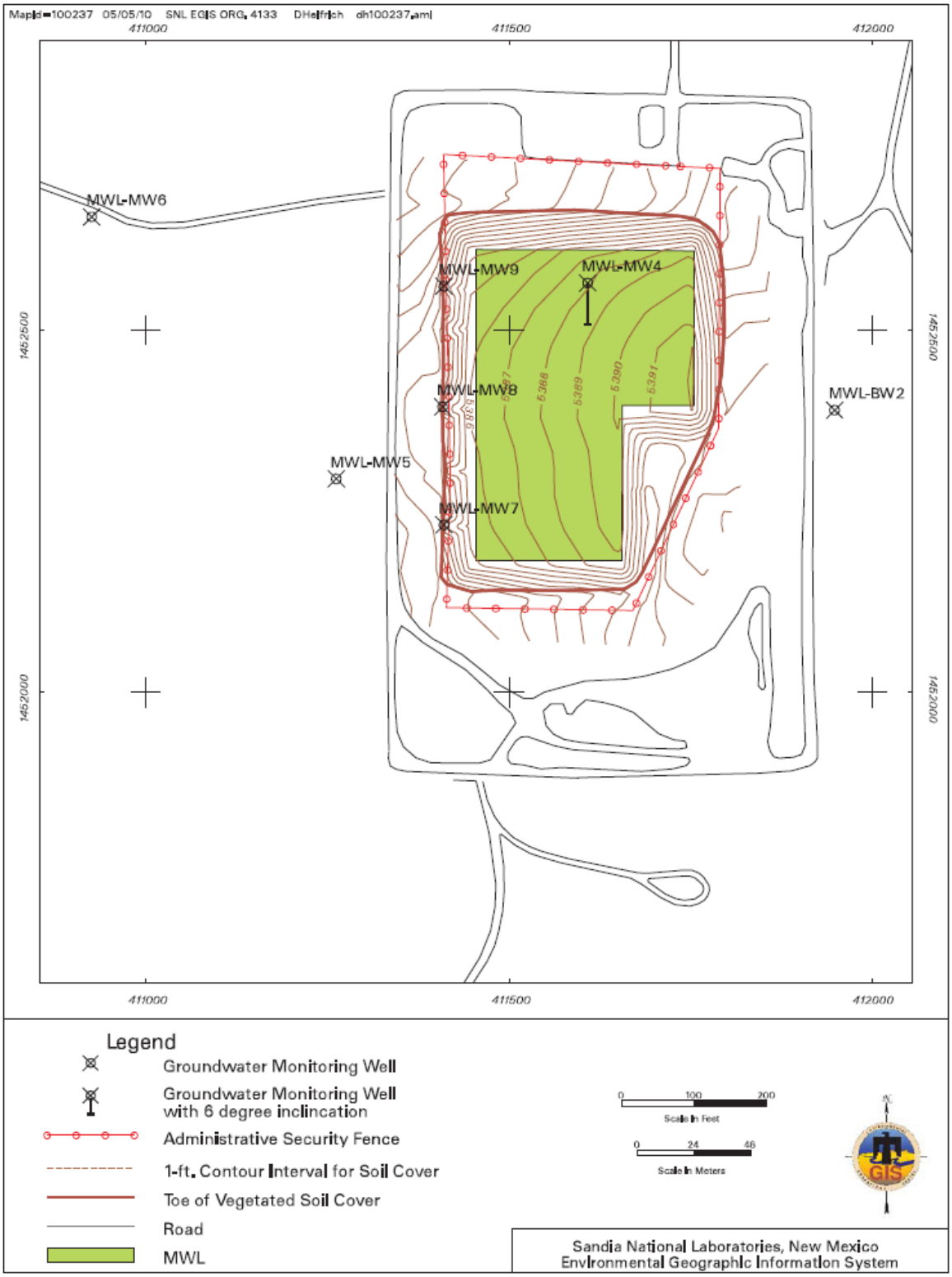

Figure 1-2
Location of Groundwater Monitoring Wells at the Mixed Waste Landfill, Calendar Year 2010

During construction of the evapotranspirative cover on May 27, 2009, the packer in the dual-screen well MWL-MW4 was removed to allow the well casing to be extended. The packer was serviced and reinstalled on March 4, 2010. References in this report to groundwater samples and water levels from MWL-MW4 refer to groundwater withdrawn or measured from the upper screened interval, and references made to the bottom of this well refer to the depth to the top of the packer.

In April 2010, the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia) received a letter from the NMED entitled "Toluene Detections in Groundwater, Sandia National Laboratories Mixed Waste Landfill," which required further investigation to determine the source of very low toluene concentrations in some MWL groundwater samples collected in 2008 through early 2010, including conducting a purging/sampling study of the groundwater along with any other studies necessary to determine the source (Bearzi April 2010). The results of the toluene investigation indicate that the MWL is not the source of the very low toluene concentrations detected in MWL groundwater samples. The DOE/Sandia submitted the "Mixed Waste Landfill Toluene Investigation Report" in August 2010 and received a Notice of Disapproval with two comments from the NMED in September 2010 (Bearzi September 2010). The DOE/Sandia response (Wagner October 2010) that included a revised version of the report (SNL/NM October 2010) was submitted to the NMED in October 2010. The NMED approved the revised "MWL Toluene Investigation Report" in January 2011 (Bearzi January 2011).

2.0 REGULATORY CRITERIA

Historically, the NMED Hazardous Waste Bureau (HWB) has provided regulatory oversight of the MWL as Solid Waste Management Unit (SWMU) 76 under the Hazardous and Solid Waste Amendments module of the facility Resource Conservation and Recovery Act (RCRA) Permit. The NMED confirmed that the MWL is properly designated as a SWMU (Dinwiddie June 1998) and, as such, must comply with the corrective action program defined in Title 20, New Mexico Administrative Code, Section 4.1.500, incorporating Title 40, Code of Federal Regulations, Section 264.101. The requirements for corrective action at the MWL (SWMU 76), including those for groundwater monitoring, are established through the corrective measures process.

The Compliance Order on Consent (Consent Order), effective in April 2004, transferred the regulatory requirements for groundwater sampling at the MWL from the facility RCRA Permit to the Consent Order (NMED April 2004). This report has been formatted to address the content criteria set forth in the Consent Order for Periodic Monitoring Reports. Table 2-1 provides a "crosswalk" that lists the required elements from the Consent Order and the corresponding section(s) in which these elements are addressed in this report.

Table 2-1
Monitoring Report Crosswalk for Mixed Waste Landfill
Annual Groundwater Monitoring Report

Required Elements of the Consent Order (NMED April 2004)	MWL Groundwater Monitoring Report Calendar Year 2010
1. Title Page and Signature Block (for the name, title, and organization of the preparer and the responsible DOE and Sandia representative)	Title Page Signatures for full Sandia and DOE chain of command on the transmittal paperwork that accompanies the report from Sandia to the DOE to the NMED
2. Executive Summary (Abstract)	Executive Summary and Section 9.0
3. Table of Contents	Table of Contents
4. Introduction	Section 1.0 Introduction
5. Scope of Activities	Section 3.0 Scope of Activities
6. Regulatory Criteria	Section 2.0 Regulatory Criteria
7. Monitoring Results	Section 6.0 Summary of Analytical Results
8. Conclusions	Section 9.0 Summary and Conclusions
9. Tables	Appendix A
10. Figures	Section 1.0 Introduction; Section 4.0 Field Methods and Measurements
11. Appendices	Appendix A (Summary Tables)

DOE = U.S. Department of Energy.
MWL = Mixed Waste Landfill.
NMED = New Mexico Environment Department.
Sandia = Sandia Corporation.

Although radionuclides are being monitored at the MWL, the information related to radionuclides is provided voluntarily by Sandia. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements of the Consent Order, as specified in Section III.A (NMED April 2004).

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3.0 SCOPE OF ACTIVITIES

Groundwater sampling was conducted during CY 2010 at the MWL in accordance with the appropriate Field Operating Procedures (FOPs) (SNL/NM November 2009a, November 2009b, and November 2009c) and Mini-Sampling and Analysis Plans (SAPs) (SNL/NM January 2010b, April 2010, and July 2010). Seven monitoring wells at the MWL were sampled, including one background well (MWL-BW2), one on-site monitoring well (MWL-MW4), and five downgradient monitoring wells (MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9).

3.1 Analytical Parameters

The analytical parameters selected for monitoring at the MWL groundwater wells during CY 2010 include target analyte list (TAL) metals, total uranium, VOCs, SVOCs, NPN, and major anions. Alkalinity titrations were performed in the field on groundwater collected from each well. Radiochemical analysis included tritium, gross alpha/beta radioactivity, gamma-emitting radionuclides, isotopic uranium, and radon-222. The analytical results are presented in Section 6.0.

The MWL groundwater samples were submitted for analysis to GEL Laboratories, Inc. (GEL) in Charleston, South Carolina. All groundwater samples were collected using a Bennett™ pump.

Field quality control (QC) samples submitted to GEL included field duplicate, equipment blank (EB), and field blank (FB) samples. In addition, trip blank (TB) samples were submitted with the samples for VOC analysis. Section 7.0 discusses the QC sample results.

3.2 Monitoring History

The groundwater monitoring well network at the MWL was originally installed in 1989. The wells have been sampled at various intervals since that time. During CY 2008, four monitoring wells (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) were plugged and abandoned, and four new monitoring wells (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) were installed (Bearzi January 2009).

In 1993, MWL-MW4 was completed at an angle of 6 degrees from vertical and is screened at two discrete intervals 20 feet apart (Peace et al. September 2002) to evaluate vertical anisotropy, vertical potentiometric gradients, and changes in aquifer parameters with depth. An inflatable packer separates the screened intervals, and pressure is maintained in the packer to isolate the two screened intervals. Although monitoring well MWL-MW4 is screened in two discrete intervals, only the upper interval was sampled during CY 2010, as this is the uppermost water-bearing interval beneath the MWL. References in this report to groundwater samples from MWL-MW4 refer to groundwater withdrawn from the upper interval.

3.3 Monitoring Network

The MWL wells were sampled either quarterly or annually in CY 2010. The established wells (MWL-MW4, MWL-MW5, and MWL-MW6) are required to undergo only annual sampling and

analysis. Wells MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9 are considered new wells and, as required by the Consent Order (NMED April 2004), were to be sampled for eight consecutive quarters for a defined suite of parameters in addition to sampling for perchlorate for at least four consecutive quarters. The required four quarters of perchlorate sampling were completed in April 2009, and the eighth required quarterly sampling event was completed for the new wells in January or April 2010 (Table 3.3-1). Quarterly sampling was extended through July 2010 for the new wells to support the MWL Toluene Investigation (SNL/NM October 2010). All MWL groundwater monitoring wells are now on an annual sampling schedule in accordance with the Consent Order. Figure 1-2 shows the current groundwater monitoring network consisting of seven wells completed within the interfingering, fine-grained, alluvial fan deposits and coarse-grained ARG alluvial deposits. All seven MWL wells are constructed of 5-inch-diameter, Schedule 80 polyvinyl chloride casing and screen.

Three sampling events occurred at the MWL during CY 2010 on the following dates: January 4 to January 7, April 19 to April 28, and July 6 to July 13. Table 3.3-1 summarizes the groundwater sampling events conducted at the MWL during CY 2010.

Table 3.3-1
Calendar Year 2010 Groundwater Sampling Events at the Mixed Waste Landfill

Well ID	January 2010	April 2010	July 2010
MWL-BW2	8th quarter sampling	9th quarter sampling	10th quarter sampling
MWL-MW4	–	Annual sampling	–
MWL-MW5	–	Annual sampling	–
MWL-MW6	–	Annual sampling	–
MWL-MW7	7th quarter sampling	8th quarter sampling	9th quarter sampling
MWL-MW8	7th quarter sampling	8th quarter sampling	9th quarter sampling
MWL-MW9	7th quarter sampling	8th quarter sampling	9th quarter sampling

BW = Background well.
ID = Identification.
MW = Monitoring well.
MWL = Mixed Waste Landfill.

4.0 FIELD METHODS AND MEASUREMENTS

Field measurements performed during groundwater sampling activities included groundwater elevations and water quality parameters. The following sections present detailed discussions of field activities and methods.

4.1 Groundwater Elevation Measurements

Depth-to-groundwater measurements to support groundwater sampling activities were obtained using a Solinst™ water level meter prior to purging activities. Depth-to-groundwater measurements were performed in accordance with FOP 05-01, "Long-Term Environmental Stewardship (LTES) Groundwater Monitoring Well Sampling and Field Analytical Measurements" (SNL/NM November 2009a). Measurements were obtained from all sampled monitoring wells. Table A-1 (Appendix A) presents depth-to-water measurements and groundwater elevations.

Separate groundwater elevation measurements that are used to map the potentiometric surface at the MWL are collected in accordance with FOP 03-02, Revision 3, "LTES Groundwater Level Acquisition and Management" (SNL/NM November 2009d). The October 2010 groundwater elevation data for the MWL monitoring well network are summarized in Table 4.1-1 and Figure 4.1-1.

Table 4.1-1
Mixed Waste Landfill Groundwater Elevation Data, October 2010

Well ID	Groundwater Elevation[a]	Comments
MWL-BW2	4912.74	Used to contour top of water table
MWL-MW4	4893.52	Upper screened interval above packer; used to contour top of water table
MWL-MW5	4889.28	Not used; well screened below water table
MWL-MW6	4888.09	Not used; well screened below water table
MWL-MW7	4894.00	Used to contour top of water table
MWL-MW8	4893.75	Used to contour top of water table
MWL-MW9	4890.36	Used to contour top of water table

[a]All elevation data in this table are 1988 North American Vertical Datum elevations.
BW = Background well.
ID = Identification.
MW = Monitoring well.
MWL = Mixed Waste Landfill.

Groundwater occurs at approximately 500 feet below ground surface within Santa Fe Group deposits (basin fill) in either fine-grained, alluvial fan deposits or coarse-grained, ARG deposits.

Figure 4.1-1 shows the localized potentiometric surface of the regional aquifer at the MWL in October 2010. Only MWL wells screened across the water table (MWL-BW2, MWL-MW7, MWL-MW8, MWL-MW9, and the upper screened interval of MWL-MW4) were used to contour the MWL potentiometric surface. Based upon the potentiometric surface contours, groundwater flows to the west-northwest.

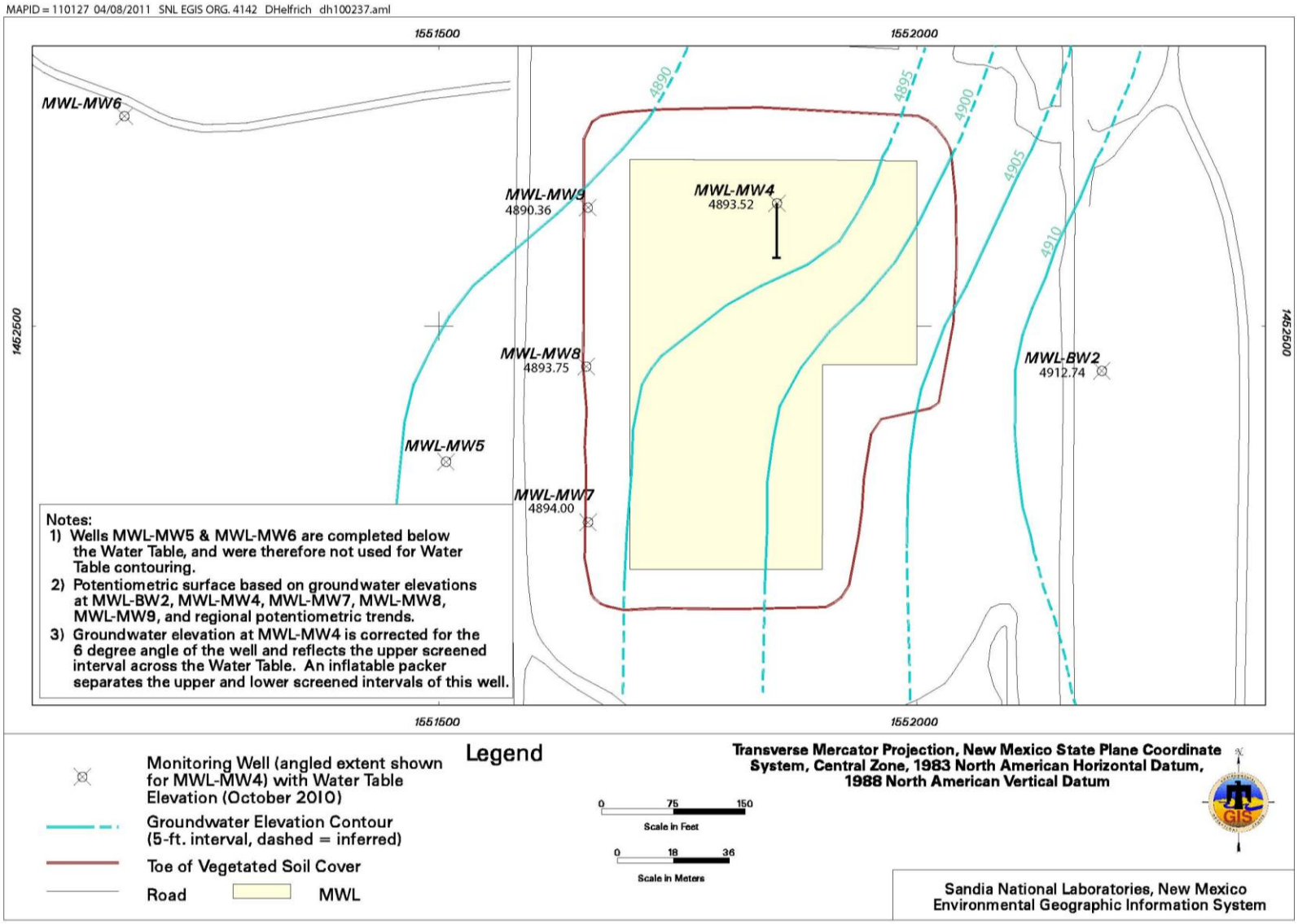

Figure 4.1-1
Potentiometric Surface of the Regional Aquifer at the Mixed Waste Landfill, October 2010

A hydrograph showing water level data for all MWL monitoring wells from January 2007 through December 2010 is provided as Figure 4.1-2. During CY 2010, groundwater elevations on the west side of the MWL decreased from 0.23 feet (MWL-MW5) to 0.03 feet (MWL-MW8). The greatest decrease in groundwater elevation was observed at MWL-BW2 on the east side of the MWL, which declined 0.35 feet. From 2005 through 2008, water levels in the two deeper wells MWL-MW5 and MWL-MW6 declined an average of 0.39 feet per year. The decline in these two wells was less between 2009 and 2010, averaging 0.15 feet per year.

During CY 2010, groundwater elevations in the four wells installed in 2008 (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) decreased from 0.35 feet (MWL-BW2) to 0.04 feet (MWL-MW8). From January 2009 through December 2010, water level declines in these four wells ranged from 0.85 feet (MWL-BW2) to 0.26 feet (MWL-MW7). No seasonal fluctuations are evident.

A generalized conceptual model integrating new information from the installation and monitoring of the four wells installed in 2008 is presented in the MWL Annual Groundwater Monitoring Report for CY 2009 (SNL/NM June 2010). In summary, the geology of the upper portion of the regional groundwater system in general is a stratified system. The geology varies with depth from a low hydraulic conductivity layer (in which the now plugged and abandoned wells MWL-MW2 and MWL-MW3 were screened) to a medium conductivity layer (in which the lower parts of the screens of MWL-MW7, MWL-MW8, and MWL-MW9 reside) to a high conductivity layer corresponding to the ARG sediments (in which at least part of the screened intervals of MWL-MW4 [lower screen], MWL-MW5, and MWL-MW6 are located).

The uppermost surface of the regional aquifer continues to decline as a result of historic and ongoing large-scale removal of water by the City of Albuquerque and Kirtland Air Force Base drinking water production wells. The overall effect at the MWL is that groundwater flow is predominantly vertically downward in the lower and medium hydraulic conductivity layers in response to regional drawdown from pumping (i.e., a draining system).

4.2 Well Purging and Water Quality Measurements

Prior to sample collection, each monitoring well was purged to remove stagnant water from the well so that a representative groundwater sample could be obtained. In accordance with procedures described in FOP 05-01 (SNL/NM November 2009a), all wells were purged a minimum of one saturated casing volume (the volume of the saturated screen plus the annulus). Purging continued until four stable measurements for turbidity, pH, temperature, and specific conductance (SC) were obtained prior to the collection of groundwater samples. Groundwater stability is considered acceptable when the following parameters have been achieved:

- Turbidity measurements are within 10% or are less than or equal to 5 nephelometric turbidity units
- pH is within 0.1 standard units
- Temperature is within 1.0 degrees Celsius
- SC is within 5%

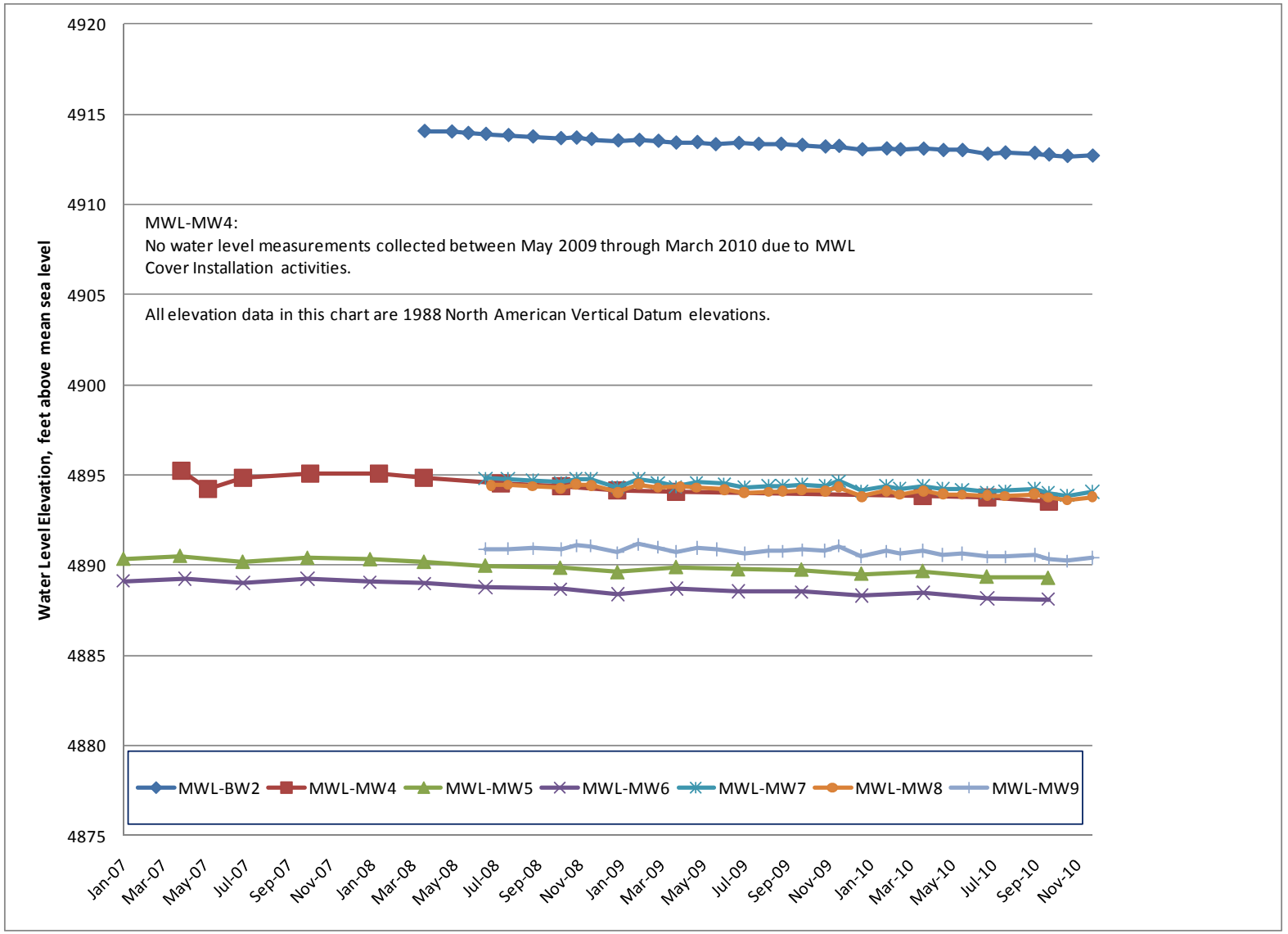

Figure 4.1-2
Hydrographs for MWL Monitoring Wells, January 2007 through December 2010

Purge volumes and indicator parameter measurements prior to sampling are shown in Table A-2 (Appendix A). The monitoring wells that have low yield were purged to dryness (Table A-2), allowed to recover, and then sampled to collect representative groundwater samples.

Field analytical measurements of stabilization parameters were collected in accordance with FOP 05-01 (SNL/NM November 2009a). Groundwater temperature, SC, pH, oxidation-reduction potential, and dissolved oxygen were measured using a YSI™ Model 620 Water Quality Meter. Turbidity was measured with a Hach™ Model 2100P portable turbidity meter. Field alkalinity was measured by field personnel using HACH Method 8203. Field water quality results are presented in Appendix A, Table A-2.

4.3 Pump Decontamination

The Bennett™ pump and tubing bundle used to collect groundwater samples were decontaminated prior to installation in MWL monitoring wells according to FOP 05-03, "LTES Groundwater Sampling Equipment Decontamination" (SNL/NM November 2009b). The EB samples for the CY 2010 groundwater sampling events were collected after decontamination to verify the effectiveness of the decontamination procedure and are discussed in Section 7.1.2.

4.4 Sample Collection

A Bennett™ sampling system was used to collect the groundwater samples from all MWL monitoring wells. The pump intake was set near or at the bottom of each screen interval (Appendix A, Table A-1). The minimum flow rate, given limitations of equipment and well characteristics, was used for all purging and sampling activities. All groundwater samples were collected directly from the pump discharge tubing into laboratory-provided sample containers.

Two groundwater samples were collected from each monitoring well for metal analyses. One unfiltered sample was collected for total metal analyses. The other sample was filtered through a 0.45-micron filter for dissolved metal analyses. Where appropriate for the requested analysis, chemical preservatives were added to the sample containers at the laboratory prior to shipment.

4.5 Sample Handling and Shipment

Immediately after collection, all sample containers were custody-taped, sealed in plastic bags, and placed on cold packs in shipping containers. Analysis Request/Chain-of-Custody forms were completed at the time of collection. The samples for chemical and radiological analyses were shipped via the SNL/NM Sample Management Office to the contracted analytical laboratory. Sample management activities followed SNL/NM Administrative Operating Procedure (AOP) 95-16, "Sample Management and Custody" (SNL/NM March 2007).

4.6 Waste Management

All purge and decontamination water was managed according to FOP 05-04, “LTES Groundwater Monitoring Waste Management” (SNL/NM November 2009c), and containerized on site pending the results of the analyses. All waste was managed as “nonregulated” waste, based upon historical sampling results and process knowledge of monitoring well locations. Results for the associated environmental samples provide supplemental data for approval to discharge water to the City of Albuquerque sanitary sewer system.

5.0 ANALYTICAL METHODS

Groundwater samples were submitted to GEL for chemical and radiological analyses. Analyses were performed in accordance with U.S. Environmental Protection Agency (EPA) test methods (EPA 1979, 1980, and 1986; Clesceri et al. 1998) and specified performance criteria (SNL/NM March 2003). Table A-3 (Appendix A) specifies the analytical parameters, appropriate test methods, and target analyte quantitation limits for sample analyses.

Analytical reports including certificates of analyses, analytical methods, method detection limits (MDLs), practical quantitation limits (PQLs), dates of analyses, results of QC analyses, and data validation findings are filed in the SNL/NM Customer Funded Records Center.

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6.0 SUMMARY OF ANALYTICAL RESULTS

Tables summarizing field measurements and analytical results are provided in Appendix A. Complete field documentation and laboratory analytical reports are filed in the SNL/NM Customer Funded Records Center.

The results for chemical and radiological constituent analysis are compared with established EPA Safe Drinking Water Act maximum contaminant levels (MCLs) (EPA 2009) and NMED HWB-approved background concentrations (NMED November 1998), where applicable.

The QC samples associated with each sampling event are included in the analysis of results and are discussed in Section 7.0. Data qualifiers resulting from QC samples or data validation results are presented with the related data in the respective data tables in Appendix A.

6.1 General Chemistry Parameters

The general chemistry analytical results are presented in Tables A-4 and A-5 (Appendix A). No general chemistry parameters exceed established MCLs in the groundwater samples. The only two parameters that have established MCLs are NPN (as nitrogen) and fluoride (10 and 4 milligrams per liter [mg/L], respectively. Concentrations of NPN (as nitrogen) range from 0.900 mg/L in the July MWL-MW8 sample to 3.59 mg/L in the April MWL-MW7 sample. Fluoride was detected at concentrations ranging from 0.642 mg/L in the January MWL-BW2 sample to 1.05 mg/L in the April MWL-MW9 sample.

6.2 Target Analyte List Metals

The TAL metal analysis includes two sets of analyses and results, filtered and unfiltered. Groundwater samples obtained for total metal analyses are collected without filtering, and dissolved metal samples are collected by filtering the sample prior to analysis (SNL/NM November 2009a). The difference in concentrations between the total and dissolved fraction may be attributed to the original metallic ion content of the particles and any sorption of ions to the suspended particles.

Table A-6 (Appendix A) summarizes the metal results, including total uranium, from all unfiltered groundwater samples collected during the CY 2010 groundwater monitoring events at the MWL. Samples were analyzed for TAL metals according to EPA Methods 6020 and 7470 (EPA 1986). No metals were detected in the unfiltered samples at concentrations that exceed the established MCLs, and the results are consistent with data from previous sampling events at the MWL. Barium results exceed the NMED HWB-approved background concentration of 0.120 mg/L in the groundwater samples from MWL-MW5 and MWL-MW8. Barium was reported in the environmental and duplicate samples from MWL-MW5 at concentrations of 0.126 and 0.127 mg/L, respectively. Barium was reported in all CY 2010 samples from MWL-MW8 at concentrations ranging from 0.141 to 0.145 mg/L. Uranium exceeds the NMED HWB-approved background concentration of 0.0052 mg/L in all CY 2010 MWL samples at concentrations ranging from 0.00573 mg/L in the April sample from MWL-MW4 to 0.00994 mg/L in the April sample from MWL-MW5.

Table A-7 (Appendix A) summarizes the metal results, including total uranium, for the filtered samples collected during the CY 2010 groundwater monitoring events. No detections of any metals in the filtered samples exceed the respective MCLs, and the results are consistent with data from previous sampling events at the MWL. Barium results exceed the NMED HWB-approved background concentration of 0.120 mg/L in the samples from MWL-MW5 and MWL-MW8 at concentrations ranging from 0.129 to 0.144 mg/L. Uranium exceeds the NMED HWB-approved background concentration of 0.0052 mg/L in all CY 2010 MWL samples at concentrations ranging from 0.0058 mg/L in the April sample from MWL-MW4 to 0.0102 mg/L in the April sample from MWL-MW5.

Barium and total uranium results for unfiltered and filtered samples reflect site-specific variations in background concentrations that are well below the established MCLs and are consistent with historical MWL monitoring results. They are not indicative of groundwater contamination.

6.3 Volatile and Semivolatile Organic Compounds

Detected VOCs and SVOCs are presented in Table A-8 (Appendix A). No VOCs or SVOCs were detected in any sample except for the VOCs toluene, chloromethane, and acetone. Toluene was detected in five January samples (one of which was a duplicate sample) including the sample from the background well MWL-BW2. Toluene concentrations ranged from 0.285 to 1.45 micrograms per liter (µg/L). All detections were very low concentrations and, of the five sampling results, three are below the PQL of 1.00 µg/L. No toluene detections were reported for the April and July samples, including the April purging/sampling study samples (34 samples and 14 field QC samples [SNL/NM October 2010]). Chloromethane was detected in two samples below the PQL of 1.00 µg/L, and acetone was detected below the PQL of 10.0 µg/L. Neither constituent has an established MCL.

During the April groundwater sampling event, two detections of methylene chloride (MWL-MW5 environmental and duplicate samples) and one detection of toluene were qualified as not detected during data validation due to associated laboratory method blank contamination (Section 7.2). Laboratory MDLs for VOCs and SVOCs are presented in Table A-9 (Appendix A).

The sporadic, very low-concentration detections of various VOCs are consistent with historic monitoring results and most likely reflect incidental sample contamination during the sampling, shipping, and/or laboratory analysis process. The results are not indicative of groundwater contamination.

6.4 Radiological Parameters

Groundwater samples from the MWL monitoring wells were screened for gamma-emitting radionuclides, gross alpha/beta activity, and tritium. The results for tritium, gross alpha/beta, gamma spectroscopy, and low-level tritium (April only) analyses are presented in Table A-10 (Appendix A) and are compared with the established EPA MCLs for gross alpha/beta activity and the NMED HWB background activity for cesium-137.

Gamma spectroscopy activity levels for short-list radionuclides are less than the associated minimum detectable activity (MDA). The potassium-40 results for the January environmental sample from MWL-MW7 and the April environmental sample from MWL-MW8 were rejected by the laboratory due to the peak not meeting identification criteria; however, these results were

qualified as not detected during data validation (i.e., results are not statistically different from zero). The potassium-40 activity result in the MWL-MW7 duplicate sample was not rejected by the laboratory and is less than the associated MDA.

Radioisotopic analyses included gross alpha/beta activity and tritium analyses (all sampling events) and istotopic uranium and radon-222 (July). The gross alpha measurements were corrected for naturally occurring uranium activity according to Title 40, Code of Federal Regulations, Parts 9, 141, and 142, Table I-4. No gross alpha activity results exceed the MCL of 15 picocuries per liter (pCi/L), and gross beta activity screening results do not exceed established limits. Isotopic uranium activity results are below NMED HWB background concentrations. Radon-222 was reported below the NMED HWB background level of 300 pCi/L in all groundwater samples, except the July sample from MWL-BW2 that had an activity of 494 ± 132 pCi/L. This result for the MWL-BW2 sample reflects site-specific variation in the radon-222 background concentration and is not indicative of groundwater contamination. Tritium activity levels are below laboratory MDAs in all groundwater samples (i.e., tritium was not detected). However, because it is a constituent of concern at the MWL, the results are presented in Table A-10 (Appendix A).

All April low-level tritium results were reported as nondetections except for the MWL-MW6 sample result (1.22 pCi/L). This result is slightly higher than the PQL of 1.18 pCi/L, but was qualified as estimated during data validation and is not indicative of groundwater contamination. Only detections are shown in Table A-10 for the April low-level tritium results.

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7.0 QUALITY CONTROL SAMPLE RESULTS

Field and laboratory QC samples were prepared to determine the accuracy of the methods used and to detect inadvertent sample contamination that may have occurred during the sampling and analysis process. All data were reviewed in accordance with AOP 00-03 “Data Validation Procedure for Chemical and Radiochemical Data” (SNL/NM July 2007). The results for each QC analysis and the impact on data quality are discussed in the following sections.

7.1 Field Quality Control Samples

The QC samples collected in the field included TB, EB, FB, and field duplicate samples. TB samples are submitted whenever samples are collected for VOC analysis to assess whether contamination of the samples occurred during shipment and storage. EB samples are collected to verify the effectiveness of the sampling equipment decontamination process, and duplicate samples are collected immediately after the environmental sample to provide information about sampling variability. FB samples provide a check for potential ambient sources of sample contamination during the sampling process and/or sampling error. The following sections discuss the analytical results for each QC sample type.

7.1.1 Trip Blank Samples

TB samples were submitted whenever samples were collected for VOC analysis to assess whether contamination of the samples had occurred during shipment and storage. TB samples consist of laboratory reagent-grade water with hydrochloric acid preservative contained in 40-milliliter volatile organic analysis vials prepared by the analytical laboratory, which accompany the empty sample containers supplied by the laboratory. TBs were brought to the field and accompanied each sample shipment. TB sample results are summarized as follows by sampling event.

January 2010. A total of seven TB samples were submitted with the January samples. No VOCs were detected above associated laboratory MDLs, except chloromethane. Chloromethane was detected in TBs associated with three EB samples and the MWL-BW2 environmental sample. No corrective action was required, as chloromethane was not detected in the associated EB samples or the MWL-BW2 environmental sample.

April 2010. A total of 10 TB samples were submitted with the April samples. No VOCs were detected above associated laboratory MDLs. Methylene chloride and toluene were qualified as not detected in TB samples associated with MWL-MW5, MWL-MW8, and both EB samples during data validation due to associated laboratory method blank contamination.

July 2010. A total of five TB samples were submitted with the July 2010 samples. No VOCs were detected above associated laboratory MDLs.

7.1.2 Equipment Blank Samples

A total of seven EB samples were collected during the CY 2010 sampling events at the MWL to verify the equipment decontamination process. The EB samples are collected prior to sampling various wells and submitted for all analytical parameters. The EB sampling results are summarized as follows by sampling event.

January 2010. A total of four EB samples were collected prior to sampling each monitoring well. The EB collected prior to sampling MWL-MW7 was submitted for all analytical parameters. EB samples associated with MWL-BW2, MWL-MW8, and MWL-MW9 were submitted for a limited set of parameters including VOCs, SVOCs, and metals. Various organic and inorganic parameters were detected in the EB samples. No corrective action was required except for metals. Detected metals included aluminum, arsenic, barium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium, and zinc. Metals in associated environmental samples detected at concentrations less than five times the EB result were qualified as not detected during data validation. The number of metals detected in the EB samples may be attributed to new stainless steel water lines installed inside the sampling truck prior to this sampling event as part of the toluene investigation (Section 1.0), deionized water quality, sampling equipment, and/or the analytical laboratory.

April 2010. A total of two EB samples were collected prior to sampling monitoring wells MWL-BW2 and MWL-MW5 and submitted for all analyses. Various VOCs, chloride, alkalinity, calcium, chromium, cobalt, copper, iron, magnesium, manganese, sodium, and vanadium were detected in the EB samples. No corrective action was required for detected organic compounds as these compounds were not detected in associated environmental samples. No corrective action was required for chloride, alkalinity, calcium, chromium, iron, magnesium, manganese, or sodium, as these parameters were either not detected in the associated environmental samples or detected at concentrations greater than five times the EB result. Filtered fractions of cobalt, copper, and vanadium and unfiltered fractions of copper in associated environmental samples were detected at concentrations less than five times the EB result and were qualified as not detected during data validation.

July 2010. One EB sample was collected prior to sampling monitoring well MWL-MW7 and submitted for all analyses. Bromodichloromethane, chloroform, cadmium, calcium, cobalt, copper, iron, magnesium, zinc, and gross alpha were detected in the EB sample. No corrective action was required for bromodichloromethane, chloroform, cadmium, or zinc, as these analytes were not detected in the associated environmental sample. No corrective action was required for calcium, cobalt, or magnesium, as these parameters were detected in the environmental sample at concentrations greater than five times the EB result. The environmental sample results for copper, iron, and gross alpha were qualified as not detected during data validation because the results are less than five times the EB result.

7.1.3 Field Blank Samples

FB samples were collected at the various sampling locations, stored with the associated environmental samples throughout the sampling process, and returned to the laboratory for VOC analyses with the associated environmental samples to assess whether contamination of the samples resulted from ambient field conditions. The FB samples are prepared by pouring deionized water into sample containers at the sampling point (i.e., in the sampling truck at the well location) to simulate the transfer of environmental samples from the sampling system to the

sample container. Based upon a recommendation presented in the MWL Toluene Investigation Report (SNL/NM October 2010), an FB sample was collected for each MWL sampling location starting with the July sampling event.

January, April, and July 2010. In January and April, one FB sample was collected at MWL-MW9, and in July, four FB samples were collected at MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9. Bromodichloromethane, chloroform, and dibromochloromethane were detected in the FB samples. No corrective action was required as these compounds were not detected in the associated environmental samples.

7.1.4 Field Duplicate Samples

Duplicate environmental samples were collected to estimate the overall reproducibility of the sampling and analytical processes. The duplicate samples were collected immediately after the original environmental sample in order to reduce variability caused by time and/or sampling mechanics. Duplicate samples were analyzed for all analytical parameters.

Relative percent difference (RPD) calculations between duplicate samples were performed for detected analytes. Table A-11 (Appendix A) summarizes the results for the CY 2010 duplicate sample analyses and presents calculated RPD values.

January, April, and July 2010. The MWL Mini-SAPs do not specify QC acceptance criteria for duplicate sample data; however, duplicate sample results show good correlation (low RPD values less than or equal to 20) for all calculated parameters, except aluminum, nickel, vanadium, and zinc. The RPD values for aluminum and vanadium were calculated at 58 and 90, respectively, for the unfiltered MWL-BW2 sample in April; the RPD for zinc was calculated at 44 in the filtered MWL-MW5 sample in April; and the RPD values for nickel and vanadium were calculated at 97 and 23, respectively, for the filtered MWL-MW7 sample in July. The RPD values for these metal parameters are considered estimated values, as reported concentrations are below associated PQLs.

7.2 Laboratory Quality Control Samples

Internal laboratory QC samples, including method blanks and duplicate laboratory control samples, were analyzed concurrently with all groundwater samples. Additionally, batch matrix spike, matrix spike duplicate, and surrogate spike analyses were analyzed by GEL. The chemical data were reviewed and qualified in accordance with AOP 00-03 (SNL/NM July 2007). Although some analytical results were qualified as not detected or as estimated values during the data validation process, no significant data quality problems were noted for any CY 2010 MWL groundwater monitoring samples.

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8.0 VARIANCES AND NONCONFORMANCES

All analytical and field methods were performed according to the requirements specified in the MWL groundwater monitoring Mini-SAPs for CY 2010 (SNL/NM January 2010b, April 2010, and July 2010), and no variances from the plans occurred.

As addressed in Section 7.1, various constituents have been detected in field QC samples since SNL/NM personnel changed suppliers for deionized water. In particular, various metals and the VOCs bromodichloromethane, chloroform, and dibromochloromethane continue to be detected in the FB samples. The DOE and Sandia continue to test and investigate the quality of deionized water currently in use and will make adjustments as necessary.

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9.0 SUMMARY AND CONCLUSIONS

Groundwater sampling and analysis were conducted at the MWL during three quarters in CY 2010 according to the Mini-SAPs generated for each sampling event (SNL/NM January 2010b, April 2010, and July 2010). No organic, inorganic, general chemistry, or radiological constituents were detected at concentrations or activity levels that exceed the respective established MCLs (where applicable) in the groundwater samples. The metals barium and uranium and radon-222 exceed the NMED HWB-approved background concentrations (NMED November 1998). Barium exceeds the NMED HWB-approved background concentration of 0.120 mg/L in unfiltered and filtered samples from MWL-MW5 and MWL-MW8 at concentrations ranging from 0.126 to 0.145 mg/L. Uranium exceeds the NMED HWB-approved background concentration of 0.0052 mg/L in all MWL unfiltered and filtered samples at concentrations ranging from 0.00573 to 0.0102 mg/L. Radon-222 was reported above the NMED HWB-approved background activity of 300 pCi/L in the July sample from MWL-BW2 at an activity of 494 ± 132 pCi/L. These results reflect site-specific variations in background concentrations or activity levels that are consistent with historical MWL monitoring results. They are not indicative of groundwater contamination.

The groundwater monitoring results for the CY 2010 sampling events are consistent with data for previous sampling events, within the range of historical MWL groundwater data, and indicate the MWL has not impacted groundwater beneath the site. Based upon the field and laboratory QC sample and data validation results, the CY 2010 groundwater monitoring data are defensible and representative.

Toluene was detected at very low concentrations in all the groundwater samples collected in January but was not detected in any of the samples collected in April or July. The toluene concentrations detected in the April groundwater and field QC samples, including some of the samples associated with the toluene investigation purging/sampling study, were related to contamination introduced into the samples during the analytical process at the off-site laboratory. The sporadic, very low-concentration detections of various VOCs including toluene are consistent with historical monitoring results and most likely reflect incidental sample contamination introduced during the sampling, shipping, and/or laboratory analytical process. The results are not indicative of groundwater contamination, as conclusively demonstrated in the “Mixed Waste Landfill Toluene Investigation Report” (SNL/NM October 2010).

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APPENDIX A
Summary Tables of Field Measurements and Analytical Results, Calendar Year 2010

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Table A-1
Groundwater Elevations, Pump Setting Depths, and Static Water Level Information
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Date of Measurement	Measurement Point Elevation[a] (FAMSL)	Depth to Water (FBTOC)	Groundwater Elevation (FAMSL)	Elevation of Bottom of Well (FAMSL)	Static Water Height (feet)	Pump Setting Depth (FBTOC)
MWL-MW4	04/28/10	5391.70	498.09[b]	4893.61	4881.26[c]	12.35	509.5
MWL-MW5	04/20/10	5382.56	493.10	4889.46	4858.82	30.64	517
MWL-MW6	04/19/10	5375.31	486.97	4888.34	4842.13	46.21	527
MWL-MW7	01/05/10	5383.30	489.29	4894.01	4881.63	12.38	493
	04/22/10		488.72	4894.58		12.95	493
	07/07/10		489.15	4894.15		12.52	493
MWL-MW8	01/06/10	5384.67	490.80	4893.87	4882.74	11.13	497
	04/26/10		490.63	4894.04		11.30	497
	07/12/10		490.70	4893.97		11.23	497
MWL-MW9	01/07/10	5381.91	491.36	4890.55	4879.3	11.25	497
	04/21/10		491.04	4890.87		11.57	497
	07/13/10		491.32	4890.59		11.29	497
MWL-BW2	01/04/10	5391.02	478.16	4912.86	4886.67	26.50	497.5
	04/27/10		478.03	4912.99		26.32	497.5
	07/06/10		478.15	4912.87		26.20	497.5

[a]Measurement point is the top of well casing. All elevations in this table are 1988 North American Vertical Datum elevations.
[b]MWL-MW4 orientation is 6 degrees from vertical. Depth of water measurement was 500.83 feet in the well, corrected to 498.09 feet vertically below the measurement point.
[c]Bottom of well MWL-MW4 assumed to be the top of the packer, which is set at the approximate bottom of the upper well screen.
BW = Background Well.
FAMSL = Feet above mean sea level.
FBTOC = Feet below top of casing.
ID = Identification.
MW = Monitoring Well.
MWL = Mixed Waste Landfill.

Table A-2
Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	Temp (°C)	Specific Conductivity (μmhos/cm)	ORP (mV)	pH (at 25°C)	Turbidity (NTU)	DO (% Sat)
MWL-MW7 Date purge began: 1/5/2010 Date sampled: 1/5/2010	Before Sampling	5	16.43	576	202.1	7.25	0.88	39.2
		6	16.53	576	200.0	7.24	0.66	39.7
		7	16.70	579	196.5	7.24	0.64	40.7
		8	16.74	579	196.9	7.24	0.62	41.7
MWL-MW8[a] Date purge began: 1/6/2010 Date sampled: 1/6/2010	Before Sampling	7	16.33	578	193.6	7.21	1.21	38.1
		8	17.10	582	189.1	7.22	1.29	35.1
		9	17.13	584	187.6	7.21	0.99	32.2
		10	17.35	586	184.4	7.20	1.00	26.9
MWL-MW9[a] Date purge began: 1/7/2010 Date sampled: 1/7/2010	Before Sampling	4	14.78	564	219.3	7.25	0.29	30.0
		5	15.68	565	214.1	7.26	0.77	27.1
		6	16.13	567	210.3	7.26	1.15	25.9
		7	16.49	569	207.0	7.24	1.10	20.9
MWL-BW2 Date purge began: 1/4/2010 Date sampled: 1/4/2010	Before Sampling	34	17.30	700	100.8	7.07	0.26	7.5
		36	17.78	702	100.5	7.07	0.20	7.0
		38	18.02	7.04	100.3	7.07	0.15	6.8
		39	18.14	7.04	100.3	7.07	0.18	6.7
MWL-MW4[a] Date purge began: 4/28/2009 Date sampled: 4/29/2009	Before Sampling	13	20.01	579	96.4	7.41	0.82	27.0
		14	19.39	592	256.4	7.37	0.48	37.6
		15	19.73	592	255.5	7.33	0.53	29.8
		16	19.80	592	257.4	7.33	0.26	27.6
MWL-MW5 Date purge began: 4/20/2010 Date sampled: 4/20/2010	Before Sampling	30	20.72	860	174.2	7.03	0.26	28.2
		35	20.88	861	170.0	7.05	0.23	28.5
		40	21.04	863	166.6	7.03	0.23	28.8
		41	21.00	863	166.5	7.03	0.24	28.9

Refer to footnotes at end of table.

Table A-2 (Continued)
Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	Temp (°C)	Specific Conductivity (μmhos/cm)	ORP (mV)	pH (at 25°C)	Turbidity (NTU)	DO (% Sat)
MWL-MW6 Date purge began: 4/19/2010 Date sampled: 4/19/2010	Before Sampling	37	20.47	822	179.2	7.16	0.10	33.0
		39	20.62	822	177.2	7.16	0.10	33.1
		40	20.65	821	176.3	7.16	0.09	32.9
		41	20.72	822	175.0	7.16	0.11	33.3
MWL-MW7 Date purge began: 4/22/2010 Date sampled: 4/22/2010	Before Sampling	8	16.53	565	248.2	7.28	0.89	44.8
		9	16.61	565	245.8	7.29	0.69	45.2
		10	16.79	565	243.3	7.30	0.71	44.7
		11	16.67	565	242.3	7.30	0.42	44.2
MWL-MW8[a] Date purge began: 4/26/2010 Date sampled: 4/26/2010	Before Sampling	7	20.34	565	208.5	7.26	1.60	47.8
		8	20.37	568	205.1	7.26	1.58	43.5
		9	21.97	585	155.7	7.20	0.59	30.4
		10	22.14	586	153.3	7.21	0.53	30.1
MWL-MW9[a] Date purge began: 4/21/2010 Date sampled: 4/21/2010	Before Sampling	5	20.34	562	240.9	7.25	1.14	35.6
		6	20.48	562	236.8	7.27	2.22	37.8
		6.5	21.30	570	135.1	7.19	1.60	29.7
		7.5	21.44	571	134.5	7.20	1.50	30.8
MWL-BW2 Date purge began: 4/27/2010 Date sampled: 4/27/2010	Before Sampling	34	19.91	687	159.6	7.13	0.22	7.1
		36	19.91	687	157.1	7.12	0.22	7.0
		38	19.89	6.88	154.8	7.12	0.28	7.1
		40	20.02	688	152.4	7.12	0.25	8.0
MWL-MW7 Date purge began: 7/7/2010 Date sampled: 7/7/2010	Before Sampling	5	22.99	568	243.1	7.55	0.42	49.1
		6	23.47	568	243.7	7.55	0.31	51.6
		7	23.60	569	243.4	7.55	0.25	52.1
		8	23.69	568	243.1	7.55	0.28	52.6

Refer to footnotes at end of table.

Table A-2 (Concluded)
Summary of Purge Volumes and Purge Indicator Measurements
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Sample Attributes	Measurement Relative to Sampling	Purge Volume (gallons)	Temp (°C)	Specific Conductivity (µmhos/cm)	ORP (mV)	pH (at 25°C)	Turbidity (NTU)	DO (% Sat)
MWL-MW8[a] Date purge began: 7/12/2010 Date sampled: 7/12/2010	Before Sampling	8	22.70	574	200.5	7.47	0.94	47.9
		9	22.79	578	200.0	7.46	0.90	42.6
		10	25.84	595	173.0	7.45	0.74	30.5
		11	25.54	595	167.5	7.45	0.83	27.9
MWL-MW9[a] Date purge began: 7/13/2010 Date sampled: 7/13/2010	Before Sampling	3	23.69	554	208.4	7.54	0.66	46.1
		4	23.94	556	213.5	7.55	1.07	49.6
		4.75	23.84	559	21.41	7.54	1.47	41.3
		5.25	25.66	577	223.5	7.47	1.65	47.9
MWL-BW2 Date purge began: 7/6/2010 Date sampled: 7/6/2010	Before Sampling	34	21.32	681	138.4	7.32	0.63	10.1
		36	21.44	680	138.1	7.32	0.65	9.6
		38	21.62	684	140.0	7.32	0.67	11.7
		40	21.70	683	143.6	7.32	0.58	12.8

[a]Wells were purged to dryness. Purge volumes show total gallons removed prior to sampling.

°C = Degree(s) Celsius.
%sat = Percent saturation.
BW = Background Well.
DO = Dissolved oxygen.
µmhos/cm = Micromhos per centimeter.
mV = Millivolt(s).
MW = Monitoring Well.
MWL = Mixed Waste Landfill.
NTU = Nephelometric turbidity units.
ORP = Oxidation-reduction potential.
pH = Potential of hydrogen.
Temp = Temperature.

Table A-3
Analytical Parameters, Test Methods, and Target Quantitation Limits
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Analytical Parameter	Test Method[a]	Target Quantitation Limit[b]
Total Metals TAL and Uranium	SW846-6020 SW846-7470A	0.0002 – 2.50 mg/L
Volatile Organic Compounds	SW846-8260B	1.00 – 10.0 µg/L
Semivolatile Organic Compounds	SW846-8270C	1.00 – 23.8 µg/L
Nitrate plus Nitrite (as nitrogen)	EPA 353.2	0.250 – 0.500 mg/L
Major Anions Bromide, Fluoride, Chloride, and Sulfate	SW846-9056	0.100 – 4.0 mg/L
Total Alkalinity as Calcium Carbonate	SM 2320B	1.00 mg/L
Radionuclides Gamma-Emitting Radionuclides Gross Beta Activity Tritium	 EPA 901.1 EPA 900.0 EPA 906.0 HASL-300	 MDA is isotope-specific 0.969 – 3.51 pCi/L 1.18 – 183 pCi/L

[a]Methods are from EPA, 1979, "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, U.S. Environmental Protection Agency, Cincinnati, Ohio; EPA, 1980, "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032, U.S. Environmental Protection Agency, Cincinnati, Ohio; EPA, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C., or Clesceri, L.S., A.E. Greenburg, and A.D. Eaton, 1998, "Standard Methods for the Examination of Water and Wastewater," 20th ed., Method 2320B; DOE Environmental Measurements Laboratory, 1990, "EML Procedures Manual," 27th ed., Vol. 1, Rev. 1992, HASL-300.
[b]For target compounds only. Reporting limits may be elevated if an interfering component is present or if sample dilution is required.
DOE = U.S. Department of Energy.
EPA = U.S. Environmental Protection Agency.
HASL = Health and Safety Laboratory.
MDA = Minimum detectable activity.
µg/L = Microgram(s) per liter.
mg/L = Milligram(s) per liter.
pCi/L = Picocurie(s) per liter.
SM = Standard Method.
SW = Solid waste.
TAL = Target analyte list.

Table A-4
Summary of Nitrate plus Nitrite Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	NMED HWB[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample Number	Analytical Method[g]
MWL-BW2 04-Jan-10	Nitrate plus nitrite as N	2.20	0.100	0.500	10.0	4.0			087998-018	EPA 353.2
MWL-MW7 05-Jan-10	Nitrate plus nitrite as N	3.41	0.100	0.500	10.0	4.0			088002-018	EPA 353.2
MWL-MW7 (Duplicate) 05-Jan-10	Nitrate plus nitrite as N	3.29	0.100	0.500	10.0	4.0			088003-018	EPA 353.2
MWL-MW8 06-Jan-10	Nitrate plus nitrite as N	1.07	0.050	0.250	10.0	4.0			088007-018	EPA 353.2
MWL-MW9 07-Jan-10	Nitrate plus nitrite as N	2.12	0.100	0.500	10.0	4.0			088011-018	EPA 353.2
MWL-BW2 27-Apr-10	Nitrate plus nitrite as N	2.38	0.100	0.500	10.0	4.0	B		088942-018	EPA 353.2
MWL-BW2 (Duplicate) 27-Apr-10	Nitrate plus nitrite as N	2.30	0.050	0.250	10.0	4.0	B		088943-018	EPA 353.2
MWL-MW4 29-Apr-10	Nitrate plus nitrite as N	2.43	0.100	0.500	10.0	4.0	B		088949-018	EPA 353.2
MWL-MW5 20-Apr-10	Nitrate plus nitrite as N	1.45	0.050	0.250	10.0	4.0	B		088918-018	EPA 353.2
MWL-MW5 (Duplicate) 20-Apr-10	Nitrate plus nitrite as N	1.55	0.050	0.250	10.0	4.0	B		088919-018	EPA 353.2
MWL-MW6 19-Apr-10	Nitrate plus nitrite as N	1.89	0.100	0.500	10.0	4.0	B		088909-018	EPA 353.2
MWL-MW7 22-Apr-10	Nitrate plus nitrite as N	3.59	0.100	0.500	10.0	4.0	B		088929-018	EPA 353.2
MWL-MW8 26-Apr-10	Nitrate plus nitrite as N	1.32	0.050	0.250	10.0	4.0	B		088934-018	EPA 353.2
MWL-MW9 21-Apr-10	Nitrate plus nitrite as N	2.33	0.100	0.500	10.0	4.0	B		088924-018	EPA 353.2
MWL-BW2 06-Jul-10	Nitrate plus nitrite as N	2.03	0.100	0.500	10.0	4.0			089402-018	EPA 353.2
MWL-MW7 07-Jul-10	Nitrate plus nitrite as N	3.11	0.100	0.500	10.0	4.0			089407-018	EPA 353.2
MWL-MW7 (Duplicate) 07-Jul-10	Nitrate plus nitrite as N	3.11	0.050	0.250	10.0	4.0			089408-018	EPA 353.2

Refer to footnotes at end of table.

Table A-4 (Concluded)
Summary of Nitrate plus Nitrite Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	NMED HWB[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample Number	Analytical Method[g]
MWL-MW8 12-Jul-10	Nitrate plus nitrite as N	0.900	0.050	0.250	10.0	4.0	B		089411-018	EPA 353.2
MWL-MW9 13-Jul-10	Nitrate plus nitrite as N	2.41	0.100	0.500	10.0	4.0	B		089414-018	EPA 353.2

[a]The MDL is the minimum concentration or activity that can be measured and reported with 99% confidence that the analyte is greater than zero.
[b]The PQL is the lowest concentration of analyte in a sample that can be reliably determined within specified limits of precision and accuracy by the indicated method under routine laboratory operating conditions.
[c]The MCL is established by the EPA Primary Water Regulations (40 CFR 141.11[b]), and subsequent amendments.
[d]NMED, November 1998, Letter from B. Garcia to M. Zamorski (U.S. Department of Energy) and J.B. Woodward (Sandia Corporation), Re: "Approval, SNL Background Study," New Mexico Environment Department, Santa Fe, New Mexico, November 25, 1998.
[e]B = Analyte is detected in associated laboratory method blank.
[f]If cell is blank, then all quality control samples meet acceptance criteria with respect to submitted samples.
[g]EPA 1979, "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, U.S. Environmental Protection Agency, Cincinnati, Ohio.

BW = Background Well.
CFR = Code of Federal Regulations.
EPA = U.S. Environmental Protection Agency.
HWB = Hazardous Waste Bureau.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
MW = Monitoring Well.
MWL = Mixed Waste Landfill.
N = Nitrogen.
NMED = New Mexico Environment Department.
PQL = Practical quantitation limit.

Table A-5
Summary of Alkalinity and Anion Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample Number	Analytical Method[f]
MWL-BW2	Alkalinity, total as CaCO3	236	0.725	1.00	NE			087998-016	SM 2320B
04-Jan-10	Bromide	0.361	0.066	0.200	NE			087998-016	SW846 9056
	Chloride	67.3	0.660	2.00	NE			087998-016	SW846 9056
	Fluoride	0.642	0.033	0.100	4.0			087998-016	SW846 9056
	Sulfate	46.5	1.00	4.00	NE			087998-016	SW846 9056
MWL-MW7	Alkalinity, total as CaCO3	207	0.725	1.00	NE			088002-016	SM 2320B
05-Jan-10	Bromide	0.294	0.066	0.200	NE			088002-016	SW846 9056
	Chloride	40.2	0.660	2.00	NE			088002-016	SW846 9056
	Fluoride	0.903	0.033	0.100	4.0			088002-016	SW846 9056
	Sulfate	36.8	0.100	0.400	NE			088002-016	SW846 9056
MWL-MW7 (Duplicate)	Alkalinity, total as CaCO3	206	0.725	1.00	NE			088003-016	SM 2320B
05-Jan-10	Bromide	0.278	0.066	0.200	NE			088003-016	SW846 9056
	Chloride	40.4	0.660	2.00	NE			088003-016	SW846 9056
	Fluoride	0.971	0.033	0.100	4.0			088003-016	SW846 9056
	Sulfate	36.8	0.100	0.400	NE			088003-016	SW846 9056
MWL-MW8	Alkalinity, total as CaCO3	217	0.725	1.00	NE			088007-016	SM 2320B
06-Jan-10	Bromide	0.325	0.066	0.200	NE			088007-016	SW846 9056
	Chloride	48.7	0.660	2.00	NE			088007-016	SW846 9056
	Fluoride	0.970	0.033	0.100	4.0			088007-016	SW846 9056
	Sulfate	36.0	0.100	0.400	NE			088007-016	SW846 9056
MWL-MW9	Alkalinity, total as CaCO3	209	0.725	1.00	NE	B		088011-016	SM 2320B
07-Jan-10	Bromide	0.279	0.066	0.200	NE			088011-016	SW846 9056
	Chloride	38.9	0.660	2.00	NE			088011-016	SW846 9056
	Fluoride	1.02	0.033	0.100	4.0			088011-016	SW846 9056
	Sulfate	38.0	0.100	0.400	NE			088011-016	SW846 9056
MWL-BW2	Alkalinity, total as CaCO3	238	0.725	1.00	NE	B		088942-016	SM 2320B
27-Apr-10	Bromide	0.399	0.066	0.200	NE			088942-016	SW846 9056
	Chloride	58.4	0.660	2.00	NE			088942-016	SW846 9056
	Fluoride	0.667	0.033	0.100	4.0			088942-016	SW846 9056
	Sulfate	43.7	1.00	4.00	NE			088942-016	SW846 9056
MWL-BW2 (Duplicate)	Alkalinity, total as CaCO3	235	0.725	1.00	NE	B		088943-016	SM 2320B
27-Apr-10	Bromide	0.399	0.066	0.200	NE			088943-016	SW846 9056
	Chloride	59.3	0.660	2.00	NE			088943-016	SW846 9056
	Fluoride	0.675	0.033	0.100	4.0			088943-016	SW846 9056
	Sulfate	44.6	1.00	4.00	NE			088943-016	SW846 9056

Refer to footnotes at end of table.

Table A-5 (Continued)
Summary of Alkalinity and Anion Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample Number	Analytical Method[f]
MWL-MW4	Alkalinity, total as CaCO3	208	0.725	1.00	NE	B		088949-016	SM 2320B
29-Apr-10	Bromide	0.375	0.066	0.200	NE			088949-016	SW846 9056
	Chloride	47.6	0.660	2.00	NE			088949-016	SW846 9056
	Fluoride	0.982	0.033	0.100	4.0			088949-016	SW846 9056
	Sulfate	38.0	0.100	0.400	NE			088949-016	SW846 9056
MWL-MW5	Alkalinity, total as CaCO3	307	0.725	1.00	NE	B		088918-016	SM 2320B
20-Apr-10	Bromide	0.464	0.066	0.200	NE			088918-016	SW846 9056
	Chloride	84.5	0.660	2.00	NE			088918-016	SW846 9056
	Fluoride	0.861	0.033	0.100	4.0			088918-016	SW846 9056
	Sulfate	53.6	1.00	4.00	NE			088918-016	SW846 9056
MWL-MW5 (Duplicate)	Alkalinity, total as CaCO3	310	0.725	1.00	NE	B		088919-016	SM 2320B
20-Apr-10	Bromide	0.467	0.066	0.200	NE			088919-016	SW846 9056
	Chloride	84.7	0.660	2.00	NE			088919-016	SW846 9056
	Fluoride	0.885	0.033	0.100	4.0			088919-016	SW846 9056
	Sulfate	53.9	1.00	4.00	NE			088919-016	SW846 9056
MWL-MW6	Alkalinity, total as CaCO3	289	0.725	1.00	NE	B		088909-016	SM 2320B
19-Apr-10	Bromide	0.530	0.066	0.200	NE			088909-016	SW846 9056
	Chloride	74.4	0.660	2.00	NE			088909-016	SW846 9056
	Fluoride	0.734	0.033	0.100	4.0			088909-016	SW846 9056
	Sulfate	50.2	1.00	4.00	NE			088909-016	SW846 9056
MWL-MW7	Alkalinity, total as CaCO3	209	0.725	1.00	NE	B		088929-016	SM 2320B
22-Apr-10	Bromide	0.298	0.066	0.200	NE			088929-016	SW846 9056
	Chloride	40.4	0.660	2.00	NE			088929-016	SW846 9056
	Fluoride	1.02	0.033	0.100	4.0			088929-016	SW846 9056
	Sulfate	37.1	0.100	0.400	NE			088929-016	SW846 9056
MWL-MW8	Alkalinity, total as CaCO3	220	0.725	1.00	NE	B		088934-016	SM 2320B
26-Apr-10	Bromide	0.349	0.066	0.200	NE			088934-016	SW846 9056
	Chloride	44.8	0.660	2.00	NE			088934-016	SW846 9056
	Fluoride	0.947	0.033	0.100	4.0			088934-016	SW846 9056
	Sulfate	37.1	0.100	0.400	NE			088934-016	SW846 9056
MWL-MW9	Alkalinity, total as CaCO3	316	0.725	1.00	NE	B		088924-016	SM 2320B
21-Apr-10	Bromide	0.298	0.066	0.200	NE			088924-016	SW846 9056
	Chloride	39.9	0.660	2.00	NE			088924-016	SW846 9056
	Fluoride	1.05	0.033	0.100	4.0			088924-016	SW846 9056
	Sulfate	38.5	0.100	0.400	NE			088924-016	SW846 9056

Refer to footnotes at end of table.

Table A-5 (Concluded)
Summary of Alkalinity and Anion Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result (mg/L)	MDL[a] (mg/L)	PQL[b] (mg/L)	MCL[c] (mg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample Number	Analytical Method[f]
MWL-BW2	Alkalinity, total as CaCO3	250	0.725	1.00	NE	B		089402-016	SM 2320B
06-Jul-10	Bromide	0.388	0.066	0.200	NE			089402-016	SW846 9056
	Chloride	60.1	0.660	2.00	NE	B		089402-016	SW846 9056
	Fluoride	0.690	0.033	0.100	4.0			089402-016	SW846 9056
	Sulfate	45.0	1.00	4.00	NE			089402-016	SW846 9056
MWL-MW7	Alkalinity, total as CaCO3	217	0.725	1.00	NE	B		089407-016	SM 2320B
07-Jul-10	Bromide	0.328	0.066	0.200	NE			089407-016	SW846 9056
	Chloride	37.9	0.660	2.00	NE	B		089407-016	SW846 9056
	Fluoride	0.919	0.033	0.100	4.0			089407-016	SW846 9056
	Sulfate	37.6	0.100	0.400	NE			089407-016	SW846 9056
MWL-MW7 (Duplicate)	Alkalinity, total as CaCO3	219	0.725	1.00	NE	B		089408-016	SM 2320B
07-Jul-10	Bromide	0.317	0.066	0.200	NE			089408-016	SW846 9056
	Chloride	39.0	0.660	2.00	NE	B		089408-016	SW846 9056
	Fluoride	0.948	0.033	0.100	4.0			089408-016	SW846 9056
	Sulfate	37.5	0.100	0.400	NE			089408-016	SW846 9056
MWL-MW8	Alkalinity, total as CaCO3	231	0.725	1.00	NE	B		089411-016	SM 2320B
12-Jul-10	Bromide	0.361	0.066	0.200	NE			089411-016	SW846 9056
	Chloride	50.5	0.660	2.00	NE			089411-016	SW846 9056
	Fluoride	1.01	0.033	0.100	4.0			089411-016	SW846 9056
	Sulfate	35.5	0.100	0.400	NE			089411-016	SW846 9056
MWL-MW9	Alkalinity, total as CaCO3	227	0.725	1.00	NE	B		089414-016	SM 2320B
13-Jul-10	Bromide	0.333	0.066	0.200	NE			089414-016	SW846 9056
	Chloride	39.3	0.660	2.00	NE			089414-016	SW846 9056
	Fluoride	1.04	0.033	0.100	4.0			089414-016	SW846 9056
	Sulfate	38.2	0.100	0.400	NE			089414-016	SW846 9056

[a]The MDL is the minimum concentration or activity that can be measured and reported with 99% confidence that the analyte is greater than zero.
[b]The PQL is the lowest concentration of analyte in a sample that can be reliably determined within specified limits of precision and accuracy by the indicated method under routine laboratory operating conditions.
[c]The MCL is established by the EPA Primary Water Regulations (40 CFR 141.11[b]), and subsequent amendments.
[d]B = Analyte is detected in associated laboratory method blank.
[e]If cell is blank, then all quality control samples meet acceptance criteria with respect to submitted samples.
[f]EPA 1986,"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.
Clesceri, L.S., A.E. Greenburg, and A.D. Eaton, 1998, *Standard Methods for the Examination of Water and Wastewater*, 20th ed., Method 2320B.

BW = Background Well.
CaCO3 = Calcium carbonate.
CFR = Code of Federal Regulations
EPA = U.S. Environmental Protection Agency.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
MW = Monitoring Well.
MWL = Mixed Waste Landfill.
NE = Not established.
PQL = Practical quantitation limit.
SM = Standard Method.
SW = Solid waste.

Table A-6
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-BW2	Aluminum	ND	0.010	0.030	NE	NE	U		087998-009	SW846 6020
04-Jan-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		087998-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		087998-009	SW846 6020
	Barium	0.0909	0.0005	0.002	2.00	0.120			087998-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087998-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087998-009	SW846 6020
	Calcium	72.3	0.100	1.00	NE	NE			087998-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087998-009	SW846 6020
	Cobalt	0.000132	0.0001	0.001	NE	0.0025	J		087998-009	SW846 6020
	Copper	0.000569	0.0003	0.001	NE	< 0.050	J	0.0039U	087998-009	SW846 6020
	Iron	0.192	0.010	0.100	NE	NE			087998-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		087998-009	SW846 6020
	Magnesium	23.0	0.005	0.015	NE	NE			087998-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		087998-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		087998-009	SW846 7470
	Nickel	0.00277	0.0005	0.002	NE	0.028			087998-009	SW846 6020
	Potassium	3.86	0.080	0.300	NE	NE			087998-009	SW846 6020
	Selenium	0.00172	0.001	0.005	0.050	0.005	J		087998-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		087998-009	SW846 6020
	Sodium	60.6	0.400	1.25	NE	NE			087998-009	SW846 6020
	Thallium	0.000375	0.0003	0.001	0.002	0.002	J	0.0017U	087998-009	SW846 6020
	Uranium	**0.00686**	0.00005	0.0002	0.030	0.0052			087998-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		087998-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		087998-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW7	Aluminum	ND	0.010	0.030	NE	NE	U		088002-009	SW846 6020
05-Jan-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088002-009	SW846 6020
	Arsenic	0.00184	0.0015	0.005	0.010	0.014	B, J	0.012U	088002-009	SW846 6020
	Barium	0.0974	0.0005	0.002	2.00	0.120			088002-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088002-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088002-009	SW846 6020
	Calcium	58.6	0.100	1.00	NE	NE			088002-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088002-009	SW846 6020
	Cobalt	0.000105	0.0001	0.001	NE	0.0025	J		088002-009	SW846 6020
	Copper	0.000757	0.0003	0.001	NE	< 0.050	J	0.0045U	088002-009	SW846 6020
	Iron	0.168	0.010	0.100	NE	NE			088002-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088002-009	SW846 6020
	Magnesium	20.3	0.005	0.015	NE	NE			088002-009	SW846 6020
	Manganese	0.00139	0.001	0.005	NE	NE	J		088002-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		088002-009	SW846 7470
	Nickel	0.00226	0.0005	0.002	NE	0.028			088002-009	SW846 6020
	Potassium	5.10	0.080	0.300	NE	NE			088002-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		088002-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088002-009	SW846 6020
	Sodium	50.8	0.400	1.25	NE	NE			088002-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088002-009	SW846 6020
	Uranium	**0.00781**	0.00005	0.0002	0.030	0.0052			088002-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		088002-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		088002-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW7 (Duplicate) 05-Jan-10	Aluminum	ND	0.010	0.030	NE	NE	U		088003-009	SW846 6020
	Antimony	ND	0.0005	0.003	0.006	0.006	U		088003-009	SW846 6020
	Arsenic	0.0019	0.0015	0.005	0.010	0.014	B, J	0.012U	088003-009	SW846 6020
	Barium	0.104	0.0005	0.002	2.00	0.120			088003-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088003-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088003-009	SW846 6020
	Calcium	61.0	0.100	1.00	NE	NE			088003-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088003-009	SW846 6020
	Cobalt	0.000113	0.0001	0.001	NE	0.0025	J		088003-009	SW846 6020
	Copper	0.000695	0.0003	0.001	NE	< 0.050	J	0.0045U	088003-009	SW846 6020
	Iron	0.187	0.010	0.100	NE	NE			088003-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088003-009	SW846 6020
	Magnesium	22.1	0.005	0.015	NE	NE			088003-009	SW846 6020
	Manganese	0.00137	0.001	0.005	NE	NE	J		088003-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		088003-009	SW846 7470
	Nickel	0.00244	0.0005	0.002	NE	0.028			088003-009	SW846 6020
	Potassium	5.37	0.080	0.300	NE	NE			088003-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		088003-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088003-009	SW846 6020
	Sodium	53.2	0.400	1.25	NE	NE			088003-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088003-009	SW846 6020
	Uranium	**0.00833**	0.00005	0.0002	0.030	0.0052			088003-009	SW846 6020
	Vanadium	0.0041	0.003	0.010	NE	0.013	J	0.024U	088003-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		088003-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW8	Aluminum	0.077	0.010	0.030	NE	NE		0.18U	088007-009	SW846 6020
06-Jan-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088007-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		088007-009	SW846 6020
	Barium	**0.143**	0.0005	0.002	2.00	0.120			088007-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088007-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088007-009	SW846 6020
	Calcium	60.9	0.100	1.00	NE	NE			088007-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088007-009	SW846 6020
	Cobalt	0.000161	0.0001	0.001	NE	0.0025	J		088007-009	SW846 6020
	Copper	0.000838	0.0003	0.001	NE	< 0.050	J	0.0043U	088007-009	SW846 6020
	Iron	0.275	0.010	0.100	NE	NE			088007-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088007-009	SW846 6020
	Magnesium	22.1	0.005	0.015	NE	NE			088007-009	SW846 6020
	Manganese	0.227	0.001	0.005	NE	NE			088007-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		088007-009	SW846 7470
	Nickel	0.00279	0.0005	0.002	NE	0.028			088007-009	SW846 6020
	Potassium	5.61	0.080	0.300	NE	NE			088007-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		088007-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088007-009	SW846 6020
	Sodium	51.0	0.400	1.25	NE	NE			088007-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088007-009	SW846 6020
	Uranium	**0.00789**	0.00005	0.0002	0.030	0.0052			088007-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		088007-009	SW846 6020
	Zinc	0.00496	0.0026	0.010	NE	0.260	J		088007-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW9	Aluminum	0.0371	0.010	0.030	NE	NE			088011-009	SW846 6020
07-Jan-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088011-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		088011-009	SW846 6020
	Barium	0.095	0.0005	0.002	2.00	0.120			088011-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088011-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088011-009	SW846 6020
	Calcium	57.4	0.100	1.00	NE	NE	B		088011-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088011-009	SW846 6020
	Cobalt	0.000256	0.0001	0.001	NE	0.0025	J		088011-009	SW846 6020
	Copper	0.00104	0.0003	0.001	NE	< 0.050		0.0048U	088011-009	SW846 6020
	Iron	0.233	0.010	0.100	NE	NE			088011-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088011-009	SW846 6020
	Magnesium	19.9	0.005	0.015	NE	NE			088011-009	SW846 6020
	Manganese	0.0195	0.001	0.005	NE	NE			088011-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		088011-009	SW846 7470
	Nickel	0.00186	0.0005	0.002	NE	0.028	J		088011-009	SW846 6020
	Potassium	4.96	0.080	0.300	NE	NE			088011-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		088011-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088011-009	SW846 6020
	Sodium	45.2	0.080	0.250	NE	NE			088011-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088011-009	SW846 6020
	Uranium	**0.00942**	0.00005	0.0002	0.030	0.0052			088011-009	SW846 6020
	Vanadium	0.00317	0.003	0.010	NE	0.013	J		088011-009	SW846 6020
	Zinc	0.00317	0.0026	0.010	NE	0.260	J		088011-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-BW2	Aluminum	0.0109	0.010	0.030	NE	NE	J		088942-009	SW846 6020
27-Apr-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088942-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		088942-009	SW846 6020
	Barium	0.0938	0.0005	0.002	2.00	0.120			088942-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088942-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088942-009	SW846 6020
	Calcium	67.2	0.200	2.00	NE	NE	B		088942-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088942-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		088942-009	SW846 6020
	Copper	0.000382	0.0003	0.001	NE	< 0.050	J	0.019UJ	088942-009	SW846 6020
	Iron	0.0703	0.010	0.100	NE	NE	J		088942-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088942-009	SW846 6020
	Magnesium	20.9	0.005	0.015	NE	NE			088942-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		088942-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		088942-009	SW846 7470
	Nickel	0.00103	0.0005	0.002	NE	0.028	J		088942-009	SW846 6020
	Potassium	4.14	0.080	0.300	NE	NE			088942-009	SW846 6020
	Selenium	0.00241	0.001	0.005	0.050	0.005	J		088942-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088942-009	SW846 6020
	Sodium	50.2	0.800	2.50	NE	NE			088942-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088942-009	SW846 6020
	Uranium	**0.00652**	0.00005	0.0002	0.030	0.0052			088942-009	SW846 6020
	Vanadium	0.010	0.003	0.010	NE	0.013			088942-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		088942-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
WL-BW2 (Duplicate) 27-Apr-10	Aluminum	0.0197	0.010	0.030	NE	NE	J		088943-009	SW846 6020
	Antimony	ND	0.0005	0.003	0.006	0.006	U		088943-009	SW846 6020
	Arsenic	0.00517	0.0015	0.005	0.010	0.014	B	0.014U	088943-009	SW846 6020
	Barium	0.0943	0.0005	0.002	2.00	0.120			088943-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088943-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088943-009	SW846 6020
	Calcium	67.8	0.200	2.00	NE	NE	B		088943-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088943-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		088943-009	SW846 6020
	Copper	0.000393	0.0003	0.001	NE	< 0.050	J	0.019UJ	088943-009	SW846 6020
	Iron	0.070	0.010	0.100	NE	NE	J		088943-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088943-009	SW846 6020
	Magnesium	20.5	0.005	0.015	NE	NE			088943-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		088943-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		088943-009	SW846 7470
	Nickel	0.00104	0.0005	0.002	NE	0.028	J		088943-009	SW846 6020
	Potassium	4.02	0.080	0.300	NE	NE			088943-009	SW846 6020
	Selenium	0.00214	0.001	0.005	0.050	0.005	J		088943-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088943-009	SW846 6020
	Sodium	49.8	0.800	2.50	NE	NE			088943-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088943-009	SW846 6020
	Uranium	**0.00636**	0.00005	0.0002	0.030	0.0052			088943-009	SW846 6020
	Vanadium	0.00378	0.003	0.010	NE	0.013	J		088943-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		088943-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW4	Aluminum	0.0106	0.010	0.030	NE	NE	J		088949-009	SW846 6020
29-Apr-10	Antimony	0.00372	0.0005	0.003	0.006	0.006			088949-009	SW846 6020
	Arsenic	0.00913	0.0015	0.005	0.010	0.014	B	0.014U	088949-009	SW846 6020
	Barium	0.0974	0.0005	0.002	2.00	0.120			088949-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088949-009	SW846 6020
	Cadmium	0.000233	0.00011	0.001	0.005	0.00047	J		088949-009	SW846 6020
	Calcium	61.0	0.200	2.00	NE	NE	B		088949-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088949-009	SW846 6020
	Cobalt	0.000166	0.0001	0.001	NE	0.0025	J		088949-009	SW846 6020
	Copper	0.00305	0.0003	0.001	NE	< 0.050			088949-009	SW846 6020
	Iron	0.0607	0.010	0.100	NE	NE	J		088949-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088949-009	SW846 6020
	Magnesium	18.5	0.005	0.015	NE	NE			088949-009	SW846 6020
	Manganese	0.00925	0.001	0.005	NE	NE			088949-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		088949-009	SW846 7470
	Nickel	0.0106	0.0005	0.002	NE	0.028			088949-009	SW846 6020
	Potassium	5.29	0.080	0.300	NE	NE			088949-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		088949-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088949-009	SW846 6020
	Sodium	44.5	0.800	2.50	NE	NE			088949-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088949-009	SW846 6020
	Uranium	**0.00573**	0.00005	0.0002	0.030	0.0052			088949-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		088949-009	SW846 6020
	Zinc	0.117	0.0026	0.010	NE	0.260			088949-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW5	Aluminum	ND	0.010	0.030	NE	NE	U		088918-009	SW846 6020
20-Apr-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088918-009	SW846 6020
	Arsenic	0.00326	0.0015	0.005	0.010	0.014	B, J	0.012U	088918-009	SW846 6020
	Barium	**0.126**	0.0005	0.002	2.00	0.120			088918-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088918-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088918-009	SW846 6020
	Calcium	94.5	0.100	1.00	NE	NE	B		088918-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088918-009	SW846 6020
	Cobalt	0.000141	0.0001	0.001	NE	0.0025	J		088918-009	SW846 6020
	Copper	0.000877	0.0003	0.001	NE	< 0.050	J	0.0092U	088918-009	SW846 6020
	Iron	0.197	0.010	0.100	NE	NE	B		088918-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088918-009	SW846 6020
	Magnesium	31.1	0.005	0.015	NE	NE			088918-009	SW846 6020
	Manganese	0.00759	0.001	0.005	NE	NE			088918-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	088918-009	SW846 7470
	Nickel	0.00177	0.0005	0.002	NE	0.028	J		088918-009	SW846 6020
	Potassium	6.39	0.400	1.50	NE	NE			088918-009	SW846 6020
	Selenium	0.00123	0.001	0.005	0.050	0.005	J	NJ-	088918-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088918-009	SW846 6020
	Sodium	68.6	0.400	1.25	NE	NE			088918-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088918-009	SW846 6020
	Uranium	**0.00994**	0.00005	0.0002	0.030	0.0052			088918-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U	UJ	088918-009	SW846 6020
	Zinc	0.00307	0.0026	0.010	NE	0.260			088918-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW5 (Duplicate) 20-Apr-10	Aluminum	ND	0.010	0.030	NE	NE	U		088919-009	SW846 6020
	Antimony	ND	0.0005	0.003	0.006	0.006	U		088919-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		088919-009	SW846 6020
	Barium	**0.127**	0.0005	0.002	2.00	0.120			088919-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088919-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088919-009	SW846 6020
	Calcium	90.7	0.100	1.00	NE	NE	B		088919-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088919-009	SW846 6020
	Cobalt	0.000122	0.0001	0.001	NE	0.0025	J		088919-009	SW846 6020
	Copper	0.000822	0.0003	0.001	NE	< 0.050	J	0.0092U	088919-009	SW846 6020
	Iron	0.236	0.010	0.100	NE	NE	B		088919-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088919-009	SW846 6020
	Magnesium	30.9	0.005	0.015	NE	NE			088919-009	SW846 6020
	Manganese	0.0081	0.001	0.005	NE	NE			088919-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	088919-009	SW846 7470
	Nickel	0.00178	0.0005	0.002	NE	0.028	J		088919-009	SW846 6020
	Potassium	6.43	0.400	1.50	NE	NE			088919-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U	UJ	088919-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088919-009	SW846 6020
	Sodium	60.9	0.400	1.25	NE	NE			088919-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088919-009	SW846 6020
	Uranium	**0.0099**	0.00005	0.0002	0.030	0.0052			088919-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U	UJ	088919-009	SW846 6020
	Zinc	0.00293	0.0026	0.010	NE	0.260	J		088919-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW6	Aluminum	ND	0.010	0.030	NE	NE	U		088909-009	SW846 6020
19-Apr-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088909-009	SW846 6020
	Arsenic	0.00288	0.0015	0.005	0.010	0.014	B, J	0.012U	088909-009	SW846 6020
	Barium	0.110	0.0005	0.002	2.00	0.120			088909-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088909-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088909-009	SW846 6020
	Calcium	90.0	0.100	1.00	NE	NE	B		088909-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088909-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		088909-009	SW846 6020
	Copper	0.000556	0.0003	0.001	NE	< 0.050	J		088909-009	SW846 6020
	Iron	0.0705	0.010	0.100	NE	NE	B, J		088909-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088909-009	SW846 6020
	Magnesium	28.7	0.005	0.015	NE	NE			088909-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		088909-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	088909-009	SW846 7470
	Nickel	0.0012	0.0005	0.002	NE	0.028	J		088909-009	SW846 6020
	Potassium	6.08	0.400	1.50	NE	NE			088909-009	SW846 6020
	Selenium	0.0016	0.001	0.005	0.050	0.005	J	NJ-	088909-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088909-009	SW846 6020
	Sodium	63.7	0.400	1.25	NE	NE			088909-009	SW846 6020
	Thallium	0.000771	0.0003	0.001	0.002	0.002	J		088909-009	SW846 6020
	Uranium	**0.00947**	0.00005	0.0002	0.030	0.0052		J+	088909-009	SW846 6020
	Vanadium	0.00674	0.003	0.010	NE	0.013	B, J	0.022U	088909-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		088909-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW7	Aluminum	ND	0.010	0.030	NE	NE	U		088929-009	SW846 6020
22-Apr-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088929-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		088929-009	SW846 6020
	Barium	0.0995	0.0005	0.002	2.00	0.120			088929-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088929-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088929-009	SW846 6020
	Calcium	54.5	0.100	1.00	NE	NE	B		088929-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088929-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		088929-009	SW846 6020
	Copper	0.000703	0.0003	0.001	NE	< 0.050	J		088929-009	SW846 6020
	Iron	0.128	0.010	0.100	NE	NE	B		088929-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088929-009	SW846 6020
	Magnesium	19.1	0.005	0.015	NE	NE			088929-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		088929-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	088929-009	SW846 7470
	Nickel	0.00123	0.0005	0.002	NE	0.028	J		088929-009	SW846 6020
	Potassium	4.84	0.400	1.50	NE	NE			088929-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U	UJ	088929-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088929-009	SW846 6020
	Sodium	43.9	0.400	1.25	NE	NE			088929-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088929-009	SW846 6020
	Uranium	**0.00819**	0.00005	0.0002	0.030	0.0052			088929-009	SW846 6020
	Vanadium	0.00648	0.003	0.010	NE	0.013	B, J	0.022UJ	088929-009	SW846 6020
	Zinc	0.00342	0.0026	0.010	NE	0.260	J		088929-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW8	Aluminum	0.0355	0.010	0.030	NE	NE			088934-009	SW846 6020
26-Apr-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088934-009	SW846 6020
	Arsenic	0.00304	0.0015	0.005	0.010	0.014	B, J	0.014U	088934-009	SW846 6020
	Barium	**0.141**	0.0005	0.002	2.00	0.120			088934-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088934-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088934-009	SW846 6020
	Calcium	57.2	0.200	2.00	NE	NE	B		088934-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088934-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		088934-009	SW846 6020
	Copper	0.000671	0.0003	0.001	NE	< 0.050	J		088934-009	SW846 6020
	Iron	0.149	0.010	0.100	NE	NE			088934-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088934-009	SW846 6020
	Magnesium	20.3	0.005	0.015	NE	NE			088934-009	SW846 6020
	Manganese	0.00703	0.001	0.005	NE	NE			088934-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		088934-009	SW846 7470
	Nickel	0.00109	0.0005	0.002	NE	0.028	J		088934-009	SW846 6020
	Potassium	5.29	0.080	0.300	NE	NE			088934-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		088934-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088934-009	SW846 6020
	Sodium	42.5	0.080	0.250	NE	NE			088934-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088934-009	SW846 6020
	Uranium	**0.00694**	0.00005	0.0002	0.030	0.0052			088934-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		088934-009	SW846 6020
	Zinc	0.00359	0.0026	0.010	NE	0.260	J		088934-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW9	Aluminum	0.0386	0.010	0.030	NE	NE			088924-009	SW846 6020
21-Apr-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088924-009	SW846 6020
	Arsenic	0.00344	0.0015	0.005	0.010	0.014	B, J	0.012U	088924-009	SW846 6020
	Barium	0.102	0.0005	0.002	2.00	0.120			088924-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088924-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088924-009	SW846 6020
	Calcium	58.3	0.100	1.00	NE	NE	B		088924-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088924-009	SW846 6020
	Cobalt	0.000139	0.0001	0.001	NE	0.0025	J		088924-009	SW846 6020
	Copper	0.000816	0.0003	0.001	NE	< 0.050	J		088924-009	SW846 6020
	Iron	0.144	0.010	0.100	NE	NE	B		088924-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088924-009	SW846 6020
	Magnesium	19.7	0.005	0.015	NE	NE			088924-009	SW846 6020
	Manganese	0.00676	0.001	0.005	NE	NE			088924-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	088924-009	SW846 7470
	Nickel	0.00122	0.0005	0.002	NE	0.028	J		088924-009	SW846 6020
	Potassium	4.90	0.400	1.50	NE	NE			088924-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U	UJ	088924-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088924-009	SW846 6020
	Sodium	44.8	0.400	1.25	NE	NE			088924-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088924-009	SW846 6020
	Uranium	**0.00982**	0.00005	0.0002	0.030	0.0052			088924-009	SW846 6020
	Vanadium	0.0149	0.003	0.010	NE	0.013	B	0.022UJ	088924-009	SW846 6020
	Zinc	0.00441	0.0026	0.010	NE	0.260	J		088924-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-BW2	Aluminum	ND	0.010	0.030	NE	NE	U		089402-009	SW846 6020
06-Jul-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		089402-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		089402-009	SW846 6020
	Barium	0.0961	0.0005	0.002	2.00	0.120			089402-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		089402-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		089402-009	SW846 6020
	Calcium	69.2	0.100	1.00	NE	NE	B		089402-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		089402-009	SW846 6020
	Cobalt	0.0001	0.0001	0.001	NE	0.0025	J		089402-009	SW846 6020
	Copper	0.000576	0.0003	0.001	NE	< 0.050	J		089402-009	SW846 6020
	Iron	0.224	0.010	0.100	NE	NE			089402-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		089402-009	SW846 6020
	Magnesium	25.2	0.005	0.015	NE	NE			089402-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		089402-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		089402-009	SW846 7470
	Nickel	0.00173	0.0005	0.002	NE	0.028	J		089402-009	SW846 6020
	Potassium	3.93	0.080	0.300	NE	NE			089402-009	SW846 6020
	Selenium	0.00226	0.001	0.005	0.050	0.005	J		089402-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		089402-009	SW846 6020
	Sodium	51.8	0.400	1.25	NE	NE			089402-009	SW846 6020
	Thallium	0.000504	0.0003	0.001	0.002	0.002	J	0.0029U	089402-009	SW846 6020
	Uranium	**0.00729**	0.00005	0.0002	0.030	0.0052			089402-009	SW846 6020
	Vanadium	0.0057	0.003	0.010	NE	0.013	J		089402-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		089402-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW7	Aluminum	ND	0.010	0.030	NE	NE	U		089407-009	SW846 6020
07-Jul-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		089407-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		089407-009	SW846 6020
	Barium	0.0977	0.0005	0.002	2.00	0.120			089407-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		089407-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		089407-009	SW846 6020
	Calcium	55.8	0.100	1.00	NE	NE	B		089407-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		089407-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		089407-009	SW846 6020
	Copper	0.000736	0.0003	0.001	NE	< 0.050	J	0.013UJ	089407-009	SW846 6020
	Iron	0.183	0.010	0.100	NE	NE			089407-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		089407-009	SW846 6020
	Magnesium	18.0	0.005	0.015	NE	NE			089407-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		089407-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		089407-009	SW846 7470
	Nickel	0.00157	0.0005	0.002	NE	0.028	J		089407-009	SW846 6020
	Potassium	4.86	0.080	0.300	NE	NE			089407-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		089407-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		089407-009	SW846 6020
	Sodium	44.8	0.080	0.250	NE	NE			089407-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		089407-009	SW846 6020
	Uranium	**0.00798**	0.00005	0.0002	0.030	0.0052			089407-009	SW846 6020
	Vanadium	0.00783	0.003	0.010	NE	0.013	J		089407-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		089407-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW7 (Duplicate) 07-Jul-10	Aluminum	ND	0.010	0.030	NE	NE	U		089408-009	SW846 6020
	Antimony	ND	0.0005	0.003	0.006	0.006	U		089408-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		089408-009	SW846 6020
	Barium	0.0947	0.0005	0.002	2.00	0.120			089408-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		089408-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		089408-009	SW846 6020
	Calcium	54.9	0.100	1.00	NE	NE	B		089408-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		089408-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		089408-009	SW846 6020
	Copper	0.000721	0.0003	0.001	NE	< 0.050	J	0.013UJ	089408-009	SW846 6020
	Iron	0.181	0.010	0.100	NE	NE			089408-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		089408-009	SW846 6020
	Magnesium	17.2	0.005	0.015	NE	NE			089408-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		089408-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		089408-009	SW846 7470
	Nickel	0.00139	0.0005	0.002	NE	0.028	J		089408-009	SW846 6020
	Potassium	4.52	0.080	0.300	NE	NE			089408-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		089408-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		089408-009	SW846 6020
	Sodium	45.9	0.080	0.250	NE	NE			089408-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		089408-009	SW846 6020
	Uranium	**0.00796**	0.00005	0.0002	0.030	0.0052			089408-009	SW846 6020
	Vanadium	0.00828	0.003	0.010	NE	0.013	J		089408-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		089408-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW8	Aluminum	0.079	0.010	0.030	NE	NE			089411-009	SW846 6020
12-Jul-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		089411-009	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		089411-009	SW846 6020
	Barium	**0.145**	0.0005	0.002	2.00	0.120			089411-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		089411-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		089411-009	SW846 6020
	Calcium	61.2	0.100	1.00	NE	NE			089411-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		089411-009	SW846 6020
	Cobalt	0.000101	0.0001	0.001	NE	0.0025	J		089411-009	SW846 6020
	Copper	0.000687	0.0003	0.001	NE	< 0.050	J		089411-009	SW846 6020
	Iron	0.237	0.010	0.100	NE	NE			089411-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		089411-009	SW846 6020
	Magnesium	21.4	0.005	0.015	NE	NE			089411-009	SW846 6020
	Manganese	0.0111	0.001	0.005	NE	NE			089411-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		089411-009	SW846 7470
	Nickel	0.0013	0.0005	0.002	NE	0.028	J		089411-009	SW846 6020
	Potassium	5.34	0.080	0.300	NE	NE			089411-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		089411-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		089411-009	SW846 6020
	Sodium	46.5	0.080	0.250	NE	NE			089411-009	SW846 6020
	Thallium	0.000508	0.0003	0.001	0.002	0.002	J		089411-009	SW846 6020
	Uranium	**0.00745**	0.00005	0.0002	0.030	0.0052	B		089411-009	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		089411-009	SW846 6020
	Zinc	0.0034	0.0026	0.010	NE	0.260	J		089411-009	SW846 6020

Refer to footnotes at the end of table

Table A-6 (Continued)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW9	Aluminum	0.0124	0.010	0.030	NE	NE	J		089414-009	SW846 6020
13-Jul-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		089414-009	SW846 6020
	Arsenic	0.00316	0.0015	0.005	0.010	0.014	J		089414-009	SW846 6020
	Barium	0.0959	0.0005	0.002	2.00	0.120			089414-009	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		089414-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		089414-009	SW846 6020
	Calcium	58.4	0.100	1.00	NE	NE			089414-009	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		089414-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		089414-009	SW846 6020
	Copper	0.00102	0.0003	0.001	NE	< 0.050			089414-009	SW846 6020
	Iron	0.165	0.010	0.100	NE	NE			089414-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		089414-009	SW846 6020
	Magnesium	21.5	0.005	0.015	NE	NE			089414-009	SW846 6020
	Manganese	0.00364	0.001	0.005	NE	NE	J		089414-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		089414-009	SW846 7470
	Nickel	0.00134	0.0005	0.002	NE	0.028	J		089414-009	SW846 6020
	Potassium	4.81	0.080	0.300	NE	NE			089414-009	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		089414-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		089414-009	SW846 6020
	Sodium	42.4	0.080	0.250	NE	NE			089414-009	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		089414-009	SW846 6020
	Uranium	**0.00881**	0.00005	0.0002	0.030	0.0052	B		089414-009	SW846 6020
	Vanadium	0.00697	0.003	0.010	NE	0.013	J		089414-009	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		089414-009	SW846 6020

[a]Values in **bold** exceed the established MCL and/or the NMED HWB-approved background level.
[b]The MDL is the minimum concentration or activity that can be measured and reported with 99% confidence that the analyte is greater than zero.
[c]The PQL is the lowest concentration of analyte in a sample that can be reliably determined within specified limits of precision and accuracy by the indicated method under routine laboratory operating conditions.
[d]The MCL is established by the EPA Primary Water Regulations (40 CFR 141.11[b]), and subsequent amendments.
[e]NMED November 1998, Letter from B. Garcia to M. Zamorski (U.S. Department of Energy) and J.B. Woodward (Sandia Corporation), Re: "Approval, SNL Background Study," New Mexico Environment Department, Santa Fe, New Mexico, November 25, 1998.
[f]Laboratory Qualifier.
B = Analyte is detected in associated laboratory method blank.
J = Amount detected is below the PQL.
U = Analyte is absent or below the MDL.

Table A-6 (Concluded)
Summary of Unfiltered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

[g]Validation Qualifier.
If cell is blank, then all quality control samples meet acceptance criteria with respect to submitted samples.
J+ = The associated numerical value is an estimated quantity with suspected positive bias.
NJ- = Presumptive evidence of the presence of the material at an estimated quantity with a suspected negative bias.
U = The analyte was analyzed for but not detected. The associated numerical value is the sample quantitation limit.
UJ = The analyte was analyzed for but not detected. The associated value is an estimate and may be inaccurate or imprecise.
[h]EPA 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.
BW = Background Well.
CFR = Code of Federal Regulations.
EPA = U.S. Environmental Protection Agency.
HWB = Hazardous Waste Bureau.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
MW = Monitoring Well.
MWL = Mixed Waste Landfill.
ND = Not detected.
NE = Not established.
NMED = New Mexico Environment Department.
PQL = Practical quantitation limit.
SW = Solid Waste

Table A-7
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result [a] (mg/L)	MDL [b] (mg/L)	PQL [c] (mg/L)	MCL [d] (mg/L)	NMED HWB (mg/L)	Laboratory Qualifier [f]	Validation Qualifier [g]	Sample Number	Analytical Method [h]
MWL-BW2	Aluminum	ND	0.010	0.030	NE	NE	U		087998-010	SW846 6020
04-Jan-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		087998-010	SW846 6020
	Arsenic	0.0024	0.0015	0.005	0.010	0.014	B, J	0.012U	087998-010	SW846 6020
	Barium	0.0949	0.0005	0.002	2.00	0.120			087998-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		087998-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		087998-010	SW846 6020
	Calcium	75.6	0.100	1.00	NE	NE			087998-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		087998-010	SW846 6020
	Cobalt	0.000154	0.0001	0.001	NE	0.0025	J	0.00087U	087998-010	SW846 6020
	Copper	0.000552	0.0003	0.001	NE	< 0.050	J	0.011U	087998-010	SW846 6020
	Iron	0.203	0.010	0.100	NE	NE			087998-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		087998-010	SW846 6020
	Magnesium	25.2	0.005	0.015	NE	NE			087998-010	SW846 6020
	Manganese	0.00101	0.001	0.005	NE	NE	J	0.063U	087998-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		087998-010	SW846 7470
	Nickel	0.00279	0.0005	0.002	NE	0.028		0.038U	087998-010	SW846 6020
	Potassium	4.27	0.080	0.300	NE	NE			087998-010	SW846 6020
	Selenium	0.00165	0.001	0.005	0.050	0.005	J		087998-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		087998-010	SW846 6020
	Sodium	66.3	0.400	1.25	NE	NE			087998-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		087998-010	SW846 6020
	Uranium	**0.00706**	0.00005	0.0002	0.030	0.0052			087998-010	SW846 6020
	Vanadium	0.00455	0.003	0.010	NE	0.013	J	0.024U	087998-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		087998-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW7	Aluminum	ND	0.010	0.030	NE	NE	U		088002-010	SW846 6020
05-Jan-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088002-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		088002-010	SW846 6020
	Barium	0.0938	0.0005	0.002	2.00	0.120			088002-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088002-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088002-010	SW846 6020
	Calcium	59.5	0.100	1.00	NE	NE			088002-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088002-010	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		088002-010	SW846 6020
	Copper	0.000825	0.0003	0.001	NE	< 0.050	J	0.012U	088002-010	SW846 6020
	Iron	0.155	0.010	0.100	NE	NE			088002-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088002-010	SW846 6020
	Magnesium	21.3	0.005	0.015	NE	NE			088002-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		088002-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		088002-010	SW846 7470
	Nickel	0.00218	0.0005	0.002	NE	0.028			088002-010	SW846 6020
	Potassium	5.15	0.080	0.300	NE	NE			088002-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		088002-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088002-010	SW846 6020
	Sodium	49.3	0.400	1.25	NE	NE			088002-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088002-010	SW846 6020
	Uranium	**0.00774**	0.00005	0.0002	0.030	0.0052			088002-010	SW846 6020
	Vanadium	0.00528	0.003	0.010	NE	0.013	J	0.024U	088002-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		088002-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW7 (Duplicate) 05-Jan-10	Aluminum	ND	0.010	0.030	NE	NE	U		088003-010	SW846 6020
	Antimony	ND	0.0005	0.003	0.006	0.006	U		088003-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		088003-010	SW846 6020
	Barium	0.0961	0.0005	0.002	2.00	0.120			088003-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088003-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088003-010	SW846 6020
	Calcium	60.7	0.100	1.00	NE	NE			088003-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088003-010	SW846 6020
	Cobalt	0.000105	0.0001	0.001	NE	0.0025	J		088003-010	SW846 6020
	Copper	0.000672	0.0003	0.001	NE	< 0.050	J	0.012U	088003-010	SW846 6020
	Iron	0.161	0.010	0.100	NE	NE			088003-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088003-010	SW846 6020
	Magnesium	22.7	0.005	0.015	NE	NE			088003-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		088003-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		088003-010	SW846 7470
	Nickel	0.0023	0.0005	0.002	NE	0.028			088003-010	SW846 6020
	Potassium	5.71	0.080	0.300	NE	NE			088003-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		088003-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088003-010	SW846 6020
	Sodium	53.1	0.400	1.25	NE	NE			088003-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088003-010	SW846 6020
	Uranium	**0.00792**	0.00005	0.0002	0.030	0.0052			088003-010	SW846 6020
	Vanadium	0.00403	0.003	0.010	NE	0.013	J	0.024U	088003-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		088003-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW8	Aluminum	ND	0.010	0.030	NE	NE	U		088007-010	SW846 6020
06-Jan-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088007-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		088007-010	SW846 6020
	Barium	**0.142**	0.0005	0.002	2.00	0.120			088007-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088007-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088007-010	SW846 6020
	Calcium	62.3	0.100	1.00	NE	NE			088007-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088007-010	SW846 6020
	Cobalt	0.000119	0.0001	0.001	NE	0.0025	J		088007-010	SW846 6020
	Copper	0.000651	0.0003	0.001	NE	< 0.050	J	0.0021U	088007-010	SW846 6020
	Iron	0.179	0.010	0.100	NE	NE			088007-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088007-010	SW846 6020
	Magnesium	22.2	0.005	0.015	NE	NE			088007-010	SW846 6020
	Manganese	0.224	0.001	0.005	NE	NE			088007-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		088007-010	SW846 7470
	Nickel	0.00269	0.0005	0.002	NE	0.028			088007-010	SW846 6020
	Potassium	5.84	0.080	0.300	NE	NE			088007-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		088007-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088007-010	SW846 6020
	Sodium	53.7	0.400	1.25	NE	NE			088007-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088007-010	SW846 6020
	Uranium	**0.00779**	0.00005	0.0002	0.030	0.0052			088007-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		088007-010	SW846 6020
	Zinc	0.00492	0.0026	0.010	NE	0.260	J		088007-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW9	Aluminum	ND	0.010	0.030	NE	NE	U		088011-010	SW846 6020
07-Jan-10	Antimony	0.000782	0.0005	0.003	0.006	0.006	J		088011-010	SW846 6020
	Arsenic	0.00175	0.0015	0.005	0.010	0.014	J		088011-010	SW846 6020
	Barium	0.0945	0.0005	0.002	2.00	0.120			088011-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088011-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088011-010	SW846 6020
	Calcium	60.3	0.100	1.00	NE	NE	B		088011-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088011-010	SW846 6020
	Cobalt	0.000181	0.0001	0.001	NE	0.0025	J		088011-010	SW846 6020
	Copper	0.00081	0.0003	0.001	NE	< 0.050	J	0.0025U	088011-010	SW846 6020
	Iron	0.180	0.010	0.100	NE	NE			088011-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088011-010	SW846 6020
	Magnesium	20.3	0.005	0.015	NE	NE			088011-010	SW846 6020
	Manganese	0.00407	0.001	0.005	NE	NE	J		088011-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		088011-010	SW846 7470
	Nickel	0.00164	0.0005	0.002	NE	0.028	J		088011-010	SW846 6020
	Potassium	4.95	0.080	0.300	NE	NE			088011-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		088011-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088011-010	SW846 6020
	Sodium	47.8	0.080	0.250	NE	NE			088011-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088011-010	SW846 6020
	Uranium	**0.00971**	0.00005	0.0002	0.030	0.0052			088011-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		088011-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		088011-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-BW2	Aluminum	0.0118	0.010	0.030	NE	NE	J		088942-010	SW846 6020
27-Apr-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088942-010	SW846 6020
	Arsenic	0.00331	0.0015	0.005	0.010	0.014	B, J	0.014U	088942-010	SW846 6020
	Barium	0.0935	0.0005	0.002	2.00	0.120			088942-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088942-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088942-010	SW846 6020
	Calcium	64.1	0.200	2.00	NE	NE	B		088942-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088942-010	SW846 6020
	Cobalt	0.000305	0.0001	0.001	NE	0.0025	J	0.0034U	088942-010	SW846 6020
	Copper	0.00044	0.0003	0.001	NE	< 0.050	J	0.0036U	088942-010	SW846 6020
	Iron	0.0625	0.010	0.100	NE	NE	J		088942-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088942-010	SW846 6020
	Magnesium	20.1	0.005	0.015	NE	NE			088942-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		088942-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		088942-010	SW846 7470
	Nickel	0.00108	0.0005	0.002	NE	0.028	J		088942-010	SW846 6020
	Potassium	3.95	0.080	0.300	NE	NE			088942-010	SW846 6020
	Selenium	0.002	0.001	0.005	0.050	0.005	J		088942-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088942-010	SW846 6020
	Sodium	48.0	0.800	2.50	NE	NE			088942-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088942-010	SW846 6020
	Uranium	**0.00638**	0.00005	0.0002	0.030	0.0052			088942-010	SW846 6020
	Vanadium	0.00856	0.003	0.010	NE	0.013	J	0.074UJ	088942-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		088942-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-BW2 (Duplicate) 27-Apr-10	Aluminum	ND	0.010	0.030	NE	NE	U		088943-010	SW846 6020
	Antimony	ND	0.0005	0.003	0.006	0.006	U		088943-010	SW846 6020
	Arsenic	0.00518	0.0015	0.005	0.010	0.014	B	0.014U	088943-010	SW846 6020
	Barium	0.095	0.0005	0.002	2.00	0.120			088943-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088943-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088943-010	SW846 6020
	Calcium	71.7	0.200	2.00	NE	NE	B		088943-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088943-010	SW846 6020
	Cobalt	0.000139	0.0001	0.001	NE	0.0025	J	0.0034U	088943-010	SW846 6020
	Copper	0.00043	0.0003	0.001	NE	< 0.050	J	0.0036U	088943-010	SW846 6020
	Iron	0.0648	0.010	0.100	NE	NE	J		088943-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088943-010	SW846 6020
	Magnesium	21.9	0.005	0.015	NE	NE			088943-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		088943-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		088943-010	SW846 7470
	Nickel	0.00113	0.0005	0.002	NE	0.028	J		088943-010	SW846 6020
	Potassium	4.20	0.080	0.300	NE	NE			088943-010	SW846 6020
	Selenium	0.00206	0.001	0.005	0.050	0.005	J		088943-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088943-010	SW846 6020
	Sodium	53.1	0.800	2.50	NE	NE			088943-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088943-010	SW846 6020
	Uranium	**0.00642**	0.00005	0.0002	0.030	0.0052			088943-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U	0.074UJ	088943-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		088943-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW4	Aluminum	0.0172	0.010	0.030	NE	NE	J		088949-010	SW846 6020
29-Apr-10	Antimony	0.00288	0.0005	0.003	0.006	0.006	J		088949-010	SW846 6020
	Arsenic	0.007	0.0015	0.005	0.010	0.014	B	0.014U	088949-010	SW846 6020
	Barium	0.0969	0.0005	0.002	2.00	0.120			088949-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088949-010	SW846 6020
	Cadmium	0.000237	0.00011	0.001	0.005	0.00047	J		088949-010	SW846 6020
	Calcium	59.5	0.200	2.00	NE	NE	B		088949-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088949-010	SW846 6020
	Cobalt	0.000137	0.0001	0.001	NE	0.0025	J		088949-010	SW846 6020
	Copper	0.00163	0.0003	0.001	NE	< 0.050			088949-010	SW846 6020
	Iron	0.045	0.010	0.100	NE	NE	J	NJ-	088949-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088949-010	SW846 6020
	Magnesium	18.6	0.005	0.015	NE	NE			088949-010	SW846 6020
	Manganese	0.004	0.001	0.005	NE	NE	J		088949-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		088949-010	SW846 7470
	Nickel	0.00976	0.0005	0.002	NE	0.028			088949-010	SW846 6020
	Potassium	5.11	0.080	0.300	NE	NE			088949-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		088949-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088949-010	SW846 6020
	Sodium	44.5	0.800	2.50	NE	NE			088949-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088949-010	SW846 6020
	Uranium	**0.0058**	0.00005	0.0002	0.030	0.0052			088949-010	SW846 6020
	Vanadium	0.0111	0.003	0.010	NE	0.013			088949-010	SW846 6020
	Zinc	0.106	0.0026	0.010	NE	0.260			088949-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW5	Aluminum	ND	0.010	0.030	NE	NE	U		088918-010	SW846 6020
20-Apr-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088918-010	SW846 6020
	Arsenic	0.004	0.0015	0.005	0.010	0.014	B, J	0.012U	088918-010	SW846 6020
	Barium	**0.129**	0.0005	0.002	2.00	0.120			088918-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088918-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088918-010	SW846 6020
	Calcium	88.8	0.100	1.00	NE	NE	B		088918-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088918-010	SW846 6020
	Cobalt	0.000134	0.0001	0.001	NE	0.0025	J	0.00086U	088918-010	SW846 6020
	Copper	0.000791	0.0003	0.001	NE	< 0.050	J	0.0081U	088918-010	SW846 6020
	Iron	0.165	0.010	0.100	NE	NE	B		088918-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088918-010	SW846 6020
	Magnesium	28.7	0.005	0.015	NE	NE			088918-010	SW846 6020
	Manganese	0.00296	0.001	0.005	NE	NE	J		088918-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	088918-010	SW846 7470
	Nickel	0.00203	0.0005	0.002	NE	0.028			088918-010	SW846 6020
	Potassium	5.62	0.400	1.50	NE	NE			088918-010	SW846 6020
	Selenium	0.00135	0.001	0.005	0.050	0.005	J	NJ-	088918-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088918-010	SW846 6020
	Sodium	60.6	0.400	1.25	NE	NE			088918-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088918-010	SW846 6020
	Uranium	**0.0102**	0.00005	0.0002	0.030	0.0052			088918-010	SW846 6020
	Vanadium	0.00933	0.003	0.010	NE	0.013	B, J	0.022UJ	088918-010	SW846 6020
	Zinc	0.00443	0.0026	0.010	NE	0.260	J		088918-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW5 (Duplicate)	Aluminum	ND	0.010	0.030	NE	NE	U		088919-010	SW846 6020
20-Apr-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088919-010	SW846 6020
	Arsenic	0.00234	0.0015	0.005	0.010	0.014	B, J	0.012U	088919-010	SW846 6020
	Barium	**0.138**	0.0005	0.002	2.00	0.120			088919-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088919-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088919-010	SW846 6020
	Calcium	95.5	0.100	1.00	NE	NE	B		088919-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088919-010	SW846 6020
	Cobalt	0.000126	0.0001	0.001	NE	0.0025	J	0.00086U	088919-010	SW846 6020
	Copper	0.000843	0.0003	0.001	NE	< 0.050	J	0.0081U	088919-010	SW846 6020
	Iron	0.198	0.010	0.100	NE	NE	B		088919-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088919-010	SW846 6020
	Magnesium	31.2	0.005	0.015	NE	NE			088919-010	SW846 6020
	Manganese	0.00323	0.001	0.005	NE	NE	J		088919-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	088919-010	SW846 7470
	Nickel	0.00169	0.0005	0.002	NE	0.028	J		088919-010	SW846 6020
	Potassium	5.92	0.400	1.50	NE	NE			088919-010	SW846 6020
	Selenium	0.00155	0.001	0.005	0.050	0.005	J	NJ-	088919-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088919-010	SW846 6020
	Sodium	65.5	0.400	1.25	NE	NE			088919-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088919-010	SW846 6020
	Uranium	**0.0102**	0.00005	0.0002	0.030	0.0052			088919-010	SW846 6020
	Vanadium	0.00358	0.003	0.010	NE	0.013	B, J	0.022UJ	088919-010	SW846 6020
	Zinc	0.00282	0.0026	0.010	NE	0.260	J		088919-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW6	Aluminum	ND	0.010	0.030	NE	NE	U		088909-010	SW846 6020
19-Apr-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088909-010	SW846 6020
	Arsenic	0.00474	0.0015	0.005	0.010	0.014	B, J	0.012U	088909-010	SW846 6020
	Barium	0.109	0.0005	0.002	2.00	0.120			088909-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088909-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088909-010	SW846 6020
	Calcium	86.6	0.100	1.00	NE	NE	B		088909-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088909-010	SW846 6020
	Cobalt	0.000196	0.0001	0.001	NE	0.0025	J		088909-010	SW846 6020
	Copper	0.00102	0.0003	0.001	NE	< 0.050			088909-010	SW846 6020
	Iron	0.184	0.010	0.100	NE	NE	B		088909-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088909-010	SW846 6020
	Magnesium	28.1	0.005	0.015	NE	NE			088909-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		088909-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	088909-010	SW846 7470
	Nickel	0.00156	0.0005	0.002	NE	0.028	J		088909-010	SW846 6020
	Potassium	5.94	0.400	1.50	NE	NE			088909-010	SW846 6020
	Selenium	0.00158	0.001	0.005	0.050	0.005	J	NJ-	088909-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088909-010	SW846 6020
	Sodium	62.8	0.400	1.25	NE	NE			088909-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088909-010	SW846 6020
	Uranium	**0.00989**	0.00005	0.0002	0.030	0.0052			088909-010	SW846 6020
	Vanadium	0.00826	0.003	0.010	NE	0.013	B, J	0.022UJ	088909-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		088909-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW7	Aluminum	ND	0.010	0.030	NE	NE	U		088929-010	SW846 6020
22-Apr-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088929-010	SW846 6020
	Arsenic	0.00242	0.0015	0.005	0.010	0.014	B, J	0.012U	088929-010	SW846 6020
	Barium	0.108	0.0005	0.002	2.00	0.120			088929-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088929-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088929-010	SW846 6020
	Calcium	58.5	0.100	1.00	NE	NE	B		088929-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088929-010	SW846 6020
	Cobalt	0.000128	0.0001	0.001	NE	0.0025	J		088929-010	SW846 6020
	Copper	0.000799	0.0003	0.001	NE	< 0.050	J		088929-010	SW846 6020
	Iron	0.159	0.010	0.100	NE	NE	B		088929-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088929-010	SW846 6020
	Magnesium	19.2	0.005	0.015	NE	NE			088929-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		088929-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	088929-010	SW846 7470
	Nickel	0.00127	0.0005	0.002	NE	0.028	J		088929-010	SW846 6020
	Potassium	5.45	0.400	1.50	NE	NE			088929-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U	UJ	088929-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088929-010	SW846 6020
	Sodium	49.8	0.400	1.25	NE	NE			088929-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088929-010	SW846 6020
	Uranium	**0.00842**	0.00005	0.0002	0.030	0.0052			088929-010	SW846 6020
	Vanadium	0.00828	0.003	0.010	NE	0.013	B, J	0.022UJ	088929-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		088929-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW8	Aluminum	ND	0.010	0.030	NE	NE	U		088934-010	SW846 6020
26-Apr-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088934-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		088934-010	SW846 6020
	Barium	**0.142**	0.0005	0.002	2.00	0.120			088934-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088934-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088934-010	SW846 6020
	Calcium	56.6	0.200	2.00	NE	NE	B		088934-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088934-010	SW846 6020
	Cobalt	0.000266	0.0001	0.001	NE	0.0025	J		088934-010	SW846 6020
	Copper	0.000555	0.0003	0.001	NE	< 0.050	J		088934-010	SW846 6020
	Iron	0.087	0.010	0.100	NE	NE	J		088934-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088934-010	SW846 6020
	Magnesium	19.2	0.005	0.015	NE	NE			088934-010	SW846 6020
	Manganese	0.00265	0.001	0.005	NE	NE	J		088934-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		088934-010	SW846 7470
	Nickel	0.00104	0.0005	0.002	NE	0.028	J		088934-010	SW846 6020
	Potassium	5.25	0.080	0.300	NE	NE			088934-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		088934-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088934-010	SW846 6020
	Sodium	43.0	0.080	0.250	NE	NE			088934-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088934-010	SW846 6020
	Uranium	**0.00679**	0.00005	0.0002	0.030	0.0052			088934-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		088934-010	SW846 6020
	Zinc	0.0032	0.0026	0.010	NE	0.260	J		088934-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW9	Aluminum	ND	0.010	0.030	NE	NE	U		088924-010	SW846 6020
21-Apr-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		088924-010	SW846 6020
	Arsenic	0.0044	0.0015	0.005	0.010	0.014	B, J	0.012U	088924-010	SW846 6020
	Barium	0.098	0.0005	0.002	2.00	0.120			088924-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		088924-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		088924-010	SW846 6020
	Calcium	58.6	0.100	1.00	NE	NE	B		088924-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		088924-010	SW846 6020
	Cobalt	0.000158	0.0001	0.001	NE	0.0025	J		088924-010	SW846 6020
	Copper	0.000725	0.0003	0.001	NE	< 0.050	J		088924-010	SW846 6020
	Iron	0.127	0.010	0.100	NE	NE	B		088924-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		088924-010	SW846 6020
	Magnesium	18.5	0.005	0.015	NE	NE			088924-010	SW846 6020
	Manganese	0.00168	0.001	0.005	NE	NE	J		088924-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U	UJ	088924-010	SW846 7470
	Nickel	0.00129	0.0005	0.002	NE	0.028	J		088924-010	SW846 6020
	Potassium	5.44	0.400	1.50	NE	NE			088924-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U	UJ	088924-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		088924-010	SW846 6020
	Sodium	49.3	0.400	1.25	NE	NE			088924-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		088924-010	SW846 6020
	Uranium	**0.00959**	0.00005	0.0002	0.030	0.0052			088924-010	SW846 6020
	Vanadium	0.012	0.003	0.010	NE	0.013	B	0.022UJ	088924-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		088924-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-BW2	Aluminum	ND	0.010	0.030	NE	NE	U		089402-010	SW846 6020
06-Jul-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		089402-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		089402-010	SW846 6020
	Barium	0.0948	0.0005	0.002	2.00	0.120			089402-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		089402-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		089402-010	SW846 6020
	Calcium	70.4	0.100	1.00	NE	NE	B		089402-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		089402-010	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		089402-010	SW846 6020
	Copper	0.000786	0.0003	0.001	NE	< 0.050	J		089402-010	SW846 6020
	Iron	0.226	0.010	0.100	NE	NE			089402-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		089402-010	SW846 6020
	Magnesium	25.1	0.005	0.015	NE	NE			089402-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		089402-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		089402-010	SW846 7470
	Nickel	0.00172	0.0005	0.002	NE	0.028	J		089402-010	SW846 6020
	Potassium	4.00	0.080	0.300	NE	NE			089402-010	SW846 6020
	Selenium	0.00228	0.001	0.005	0.050	0.005	J		089402-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		089402-010	SW846 6020
	Sodium	54.4	0.400	1.25	NE	NE			089402-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		089402-010	SW846 6020
	Uranium	**0.0074**	0.00005	0.0002	0.030	0.0052			089402-010	SW846 6020
	Vanadium	0.00687	0.003	0.010	NE	0.013	J		089402-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		089402-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW7	Aluminum	ND	0.010	0.030	NE	NE	U		089407-010	SW846 6020
07-Jul-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		089407-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		089407-010	SW846 6020
	Barium	0.0982	0.0005	0.002	2.00	0.120			089407-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		089407-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		089407-010	SW846 6020
	Calcium	55.6	0.100	1.00	NE	NE	B		089407-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		089407-010	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	0.0025	U		089407-010	SW846 6020
	Copper	0.00246	0.0003	0.001	NE	< 0.050		0.0032U	089407-010	SW846 6020
	Iron	0.184	0.010	0.100	NE	NE		0.29U	089407-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		089407-010	SW846 6020
	Magnesium	17.4	0.005	0.015	NE	NE			089407-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		089407-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		089407-010	SW846 7470
	Nickel	0.00445	0.0005	0.002	NE	0.028			089407-010	SW846 6020
	Potassium	4.91	0.080	0.300	NE	NE			089407-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		089407-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		089407-010	SW846 6020
	Sodium	45.3	0.080	0.250	NE	NE			089407-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		089407-010	SW846 6020
	Uranium	**0.00816**	0.00005	0.0002	0.030	0.0052			089407-010	SW846 6020
	Vanadium	0.0081	0.003	0.010	NE	0.013	J		089407-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		089407-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW7 (Duplicate) 07-Jul-10	Aluminum	ND	0.010	0.030	NE	NE	U		089408-010	SW846 6020
	Antimony	ND	0.0005	0.003	0.006	0.006	U		089408-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		089408-010	SW846 6020
	Barium	0.0971	0.0005	0.002	2.00	0.120			089408-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		089408-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		089408-010	SW846 6020
	Calcium	54.8	0.100	1.00	NE	NE	B		089408-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		089408-010	SW846 6020
	Cobalt	0.000171	0.0001	0.001	NE	0.0025	J	0.00088U	089408-010	SW846 6020
	Copper	0.000873	0.0003	0.001	NE	< 0.050	J	0.0032U	089408-010	SW846 6020
	Iron	0.198	0.010	0.100	NE	NE		0.29U	089408-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		089408-010	SW846 6020
	Magnesium	17.4	0.005	0.015	NE	NE			089408-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	NE	U		089408-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		089408-010	SW846 7470
	Nickel	0.00155	0.0005	0.002	NE	0.028	J		089408-010	SW846 6020
	Potassium	4.58	0.080	0.300	NE	NE			089408-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		089408-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		089408-010	SW846 6020
	Sodium	46.0	0.080	0.250	NE	NE			089408-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		089408-010	SW846 6020
	Uranium	**0.008**	0.00005	0.0002	0.030	0.0052			089408-010	SW846 6020
	Vanadium	0.00646	0.003	0.010	NE	0.013	J		089408-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		089408-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW8	Aluminum	ND	0.010	0.030	NE	NE	U		089411-010	SW846 6020
12-Jul-10	Antimony	0.000927	0.0005	0.003	0.006	0.006	J		089411-010	SW846 6020
	Arsenic	ND	0.0015	0.005	0.010	0.014	U		089411-010	SW846 6020
	Barium	**0.144**	0.0005	0.002	2.00	0.120			089411-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		089411-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		089411-010	SW846 6020
	Calcium	61.7	0.100	1.00	NE	NE			089411-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		089411-010	SW846 6020
	Cobalt	0.000251	0.0001	0.001	NE	0.0025	J		089411-010	SW846 6020
	Copper	0.00058	0.0003	0.001	NE	< 0.050	J		089411-010	SW846 6020
	Iron	0.140	0.010	0.100	NE	NE			089411-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		089411-010	SW846 6020
	Magnesium	21.4	0.005	0.015	NE	NE			089411-010	SW846 6020
	Manganese	0.00325	0.001	0.005	NE	NE	J		089411-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		089411-010	SW846 7470
	Nickel	0.00133	0.0005	0.002	NE	0.028	J		089411-010	SW846 6020
	Potassium	5.06	0.080	0.300	NE	NE			089411-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		089411-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		089411-010	SW846 6020
	Sodium	44.4	0.080	0.250	NE	NE			089411-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		089411-010	SW846 6020
	Uranium	**0.00739**	0.00005	0.0002	0.030	0.0052	B		089411-010	SW846 6020
	Vanadium	ND	0.003	0.010	NE	0.013	U		089411-010	SW846 6020
	Zinc	0.00364	0.0026	0.010	NE	0.260	J		089411-010	SW846 6020

Refer to footnotes at the end of table.

Table A-7 (Continued)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	NMED HWB[e] (mg/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW9	Aluminum	ND	0.010	0.030	NE	NE	U		089414-010	SW846 6020
13-Jul-10	Antimony	ND	0.0005	0.003	0.006	0.006	U		089414-010	SW846 6020
	Arsenic	0.00316	0.0015	0.005	0.010	0.014	J		089414-010	SW846 6020
	Barium	0.0971	0.0005	0.002	2.00	0.120			089414-010	SW846 6020
	Beryllium	ND	0.0001	0.0005	0.004	0.004	U		089414-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	0.00047	U		089414-010	SW846 6020
	Calcium	57.3	0.100	1.00	NE	NE			089414-010	SW846 6020
	Chromium	ND	0.0025	0.010	0.100	0.043	U		089414-010	SW846 6020
	Cobalt	0.00017	0.0001	0.001	NE	0.0025	J		089414-010	SW846 6020
	Copper	0.000471	0.0003	0.001	NE	< 0.050	J		089414-010	SW846 6020
	Iron	0.138	0.010	0.100	NE	NE			089414-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	0.010	U		089414-010	SW846 6020
	Magnesium	20.3	0.005	0.015	NE	NE			089414-010	SW846 6020
	Manganese	0.00153	0.001	0.005	NE	NE	J		089414-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	0.002	U		089414-010	SW846 7470
	Nickel	0.0013	0.0005	0.002	NE	0.028	J		089414-010	SW846 6020
	Potassium	5.03	0.080	0.300	NE	NE			089414-010	SW846 6020
	Selenium	ND	0.001	0.005	0.050	0.005	U		089414-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	< 0.010	U		089414-010	SW846 6020
	Sodium	46.4	0.080	0.250	NE	NE			089414-010	SW846 6020
	Thallium	ND	0.0003	0.001	0.002	0.002	U		089414-010	SW846 6020
	Uranium	**0.00883**	0.00005	0.0002	0.030	0.0052	B		089414-010	SW846 6020
	Vanadium	0.00767	0.003	0.010	NE	0.013	J		089414-010	SW846 6020
	Zinc	ND	0.0026	0.010	NE	0.260	U		089414-010	SW846 6020

[a]Values in **bold** exceed the established MCL and/or the NMED HWB-approved background level.
[b]The MDL is the minimum concentration or activity that can be measured and reported with 99% confidence that the analyte is greater than zero.
[c]The PQL is the lowest concentration of analyte in a sample that can be reliably determined within specified limits of precision and accuracy by the indicated method under routine laboratory operating conditions.
[d]The MCL is established by the EPA Primary Water Regulations (40 CFR 141.11[b]), and subsequent amendments.
[e]NMED November 1998, Letter from B. Garcia to M. Zamorski (U.S. Department of Energy) and J.B. Woodward (Sandia Corporation), Re: "Approval, SNL Background Study," New Mexico Environment Department, Santa Fe, New Mexico, November 25, 1998.
[f]Laboratory Qualifier
B = Analyte is detected in associated laboratory method blank.
J = Amount detected is below the PQL.
U = Analyte is absent or below the MDL.
[g]Validation Qualifier.
If cell is blank, then all quality control samples meet acceptance criteria with respect to submitted samples.
NJ- = Presumptive evidence of the presence of the material at an estimated quantity with a suspected negative bias.
U = The analyte was analyzed for but not detected. The associated numerical value is the sample quantitation limit.
UJ = The analyte was analyzed for but not detected. The associated value is an estimate and may be inaccurate or imprecise.

Table A-7 (Concluded)
Summary of Filtered Total Metal Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

[h]EPA 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.
BW = Background Well.
CFR = Code of Federal Regulations.
EPA = U.S. Environmental Protection Agency.
HWB = Hazardous Waste Bureau.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
MW = Monitoring Well.
MWL = Mixed Waste Landfill.
ND = Not detected.
NE = Not established.
NMED = New Mexico Environment Department.
PQL = Practical quantitation limit.
SW = Solid Waste

Table A-8
Summary of Detected Volatile and Semivolatile Organic Compounds
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Result (µg/L)	MDL[a] (µg/L)	PQL[b] (µg/L)	MCL[c] (µg/L)	Laboratory Qualifier[d]	Validation Qualifier[e]	Sample Number	Analytical Method[f]
MWL-BW2 04-Jan-10	Toluene	0.438	0.250	1.00	1,000	J		087998-001	SW846-8260B
MWL-MW7 05-Jan-10	Toluene	0.320	0.250	1.00	1,000	J		088002-001	SW846-8260B
MWL-MW7 (Duplicate) 05-Jan-10	Toluene	0.285	0.250	1.00	1,000	J		088003-001	SW846-8260B
MWL-MW8 06-Jan-10	Chloromethane	0.338	0.300	1.00	NE	J		088007-001	SW846-8260B
	Toluene	1.45	0.250	1.00	1,000			088007-001	SW846-8260B
MWL-MW9 07-Jan-10	Toluene	1.10	0.250	1.00	1,000			088011-001	SW846-8260B
MWL-MW5 20-Apr-10	Methylene Chloride	3.95	3.00	10.0	5.00	B, J	10.0U	088918-001	SW846-8260B
MWL-MW5 (Duplicate) 20-Apr-10	Methylene Chloride	3.95	3.00	10.0	5.00	B, J	10.0U	088919-001	SW846-8260B
MWL-MW6 19-Apr-10	Acetone	7.91	3.50	10.0	NE	J		088909-001	SW846-8260B
MWL-MW8 26-Apr-10	Toluene	0.260	0.250	1.00	1,000	B, J	1.0U	088934-001	SW846-8260B
MWL-MW8 12-Jul-10	Chloromethane	0.370	0.300	1.00	NE	J		089411-001	SW846-8260B

[a]The MDL is the minimum concentration or activity that can be measured and reported with 99% confidence that the analyte is greater than zero.
[b]The PQL is the lowest concentration of analyte in a sample that can be reliably determined within specified limits of precision and accuracy by the indicated method under routine laboratory operating conditions.
[c]The MCL is established by the EPA Primary Water Regulations (40 CFR 141.11[b]), and subsequent amendments.
[d]Laboratory Qualifier.
B = Analyte is detected in associated laboratory method blank.
J = Amount detected is below the PQL.
[e]Validation Qualifier.
If cell is blank, then all quality control samples meet acceptance criteria with respect to submitted samples.
U = The analyte was analyzed for but not detected. The associated numerical value is the sample quantitation limit.
[f]EPA 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.

BW = Background Well.
CFR = Code of Federal Regulations.
EPA = U.S. Environmental Protection Agency.
ID = Identification.
MCL = Maximum contaminant level.
MDL = Method detection limit.
µg/L = Microgram(s) per liter.
MW = Monitoring Well.
MWL = Mixed Waste Landfill.
NE = Not established.
PQL = Practical quantitation limit.
SW = Solid Waste.

Table A-9
Method Detection Limits for Volatile and Semivolatile Organic Compounds
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Analyte	MDL[a] (μg/L)	Analytical Method[b]	Analyte	MDL[a] (μg/L)	Analytical Method[b]	Analyte	MDL[a] (μg/L)	Analytical Method[b]
1,1,1-Trichloroethane	0.325	8260	1,2,4-Trichlorobenzene	2.00 - 2.38	8270	Di-n-butyl phthalate	2.00 - 2.38	8270
1,1,2,2-Tetrachloroethane	0.250	8260	1,2-Dichlorobenzene	2.00 - 2.38	8270	Di-n-octyl phthalate	3.00 - 3.57	8270
1,1,2-Trichloroethane	0.250	8260	1,3-Dichlorobenzene	2.00 - 2.38	8270	Dibenz[a,h]anthracene	0.200 - 0.238	8270
1,1-Dichloroethane	0.300	8260	1,4-Dichlorobenzene	2.00 - 2.38	8270	Dibenzofuran	2.00 - 2.38	8270
1,1-Dichloroethene	0.300	8260	2,4,5-Trichlorophenol	2.00 - 2.38	8270	Diethylphthalate	2.00 - 2.38	8270
1,2-Dichloroethane	0.250	8260	2,4,6-Trichlorophenol	2.00 - 2.38	8270	Dimethylphthalate	2.00 - 2.38	8270
1,2-Dichloropropane	0.250	8260	2,4-Dichlorophenol	2.00 - 2.38	8270	Dinitro-o-cresol	3.00 - 3.57	8270
2-Butanone	1.25	8260	2,4-Dimethylphenol	2.00 - 2.38	8270	Diphenyl amine	3.00 - 3.57	8270
2-Hexanone	1.25	8260	2,4-Dinitrophenol	5.00 - 5.95	8270	Fluoranthene	0.200 - 0.238	8270
4-methyl-, 2-Pentanone	1.25	8260	2,4-Dinitrotoluene	2.00 - 2.38	8270	Fluorene	0.200 - 0.238	8270
Acetone	3.50	8260	2,6-Dinitrotoluene	2.00 - 2.38	8270	Hexachlorobenzene	2.00 - 2.38	8270
Benzene	0.300	8260	2-Chloronaphthalene	0.300 - 0.357	8270	Hexachlorobutadiene	2.00 - 2.38	8270
Bromodichloromethane	0.250	8260	2-Chlorophenol	2.00 - 2.38	8270	Hexachlorocyclopentadiene	3.00 - 3.57	8270
Bromoform	0.250	8260	2-Methylnaphthalene	0.300 - 0.357	8270	Hexachloroethane	2.00 - 2.38	8270
Bromomethane	0.300	8260	2-Nitroaniline	2.00 - 2.38	8270	Indeno(1,2,3-c,d)pyrene	0.200 - 0.238	8270
Carbon disulfide	1.25	8260	2-Nitrophenol	2.00 - 2.38	8270	Isophorone	3.00 - 3.57	8270
Carbon tetrachloride	0.300	8260	3,3'-Dichlorobenzidine	2.00 - 2.38	8270	Naphthalene	0.300 - 0.357	8270
Chlorobenzene	0.250	8260	3-Nitroaniline	2.00 - 2.38	8270	Nitro-benzene	3.00 - 3.57	8270
Chloroethane	0.300	8260	4-Bromophenyl phenyl ether	2.00 - 2.38	8270	Pentachlorophenol	2.00 - 2.38	8270
Chloroform	0.250	8260	4-Chloro-3-methylphenol	2.00 - 2.38	8270	Phenanthrene	0.200 - 0.238	8270
Chloromethane	0.300	8260	4-Chlorobenzenamine	2.00 - 2.38	8270	Phenol	1.00 - 1.19	8270
Dibromochloromethane	0.300	8260	4-Chlorophenyl phenyl ether	2.00 - 2.38	8270	Pyrene	0.300 - 0.357	8270
Ethyl benzene	0.250	8260	4-Nitroaniline	3.00 - 3.57	8270	bis(2-Chloroethoxy)methane	3.00 - 3.57	8270
Methylene chloride	3.00	8260	4-Nitrophenol	2.00 - 2.38	8270	bis(2-Chloroethyl)ether	2.00 - 2.38	8270
Styrene	0.250	8260	Acenaphthene	0.310 - 0.369	8270	bis(2-Ethylhexyl)phthalate	2.00 - 2.38	8270
Tetrachloroethene	0.300	8260	Acenaphthylene	0.200 - 0.238	8270	bis-Chloroisopropyl ether	2.00 - 2.38	8270
Toluene	0.250	8260	Anthracene	0.200 - 0.238	8270	m,p-Cresol	3.00 - 3.57	8270
Trichloroethene	0.250	8260	Benzo(a)anthracene	0.200 - 0.238	8270	n-Nitrosodipropylamine	2.00 - 2.38	8270
Vinyl acetate	1.50	8260	Benzo(a)pyrene	0.200 - 0.238	8270	o-Cresol	2.00 - 2.38	8270
Vinyl chloride	0.500	8260	Benzo(b)fluoranthene	0.200 - 0.238	8270			
Xylene	0.300	8260	Benzo(ghi)perylene	0.200 - 0.238	8270			
cis-1,2-Dichloroethene	0.300	8260	Benzo(k)fluoranthene	0.200 - 0.238	8270			
cis-1,3-Dichloropropene	0.250	8260	Butylbenzyl phthalate	2.00 - 2.38	8270			
trans-1,2-Dichloroethene	0.300	8260	Carbazole	0.200 - 0.238	8270			
trans-1,3-Dichloropropene	0.250	8260	Chrysene	0.200 - 0.238	8270			

[a]The MDL is the minimum concentration or activity that can be measured and reported with 99% confidence that the analyte is greater than zero.
[b]EPA 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., Rev. 1, U.S. Environmental Protection Agency, Washington, D.C.
EPA = U.S. Environmental Protection Agency.
MDL = Method detection limit.
µg/L = Microgram(s) per liter.

Table A-10
Summary of Tritium, Gross Alpha, Gross Beta, Gamma Spectroscopy, Isotopic Uranium, and Radon-222 Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d] (pCi/L)	NMED HWB[e] (pCi/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-BW2	Americium-241	-4.38 ± 18.4	21.9	11.0	NE	NE	U	BD	087998-033	EPA 901.1
04-Jan-10	Cesium-137	-3.32 ± 2.28	3.60	1.80	NE	9.3	U	BD	087998-033	EPA 901.1
	Cobalt-60	0.698 ± 2.22	3.85	1.93	NE	NE	U	BD	087998-033	EPA 901.1
	Potassium-40	11.7 ± 50.3	39.1	19.6	NE	NE	U	BD	087998-033	EPA 901.1
	Gross Alpha	1.97	NA	NA	15	NE	NA		087998-034	EPA 900.0
	Gross Beta	4.74 ± 1.23	1.33	0.637	4mrem/yr	NE			087998-034	EPA 900.0
	Tritium	11.4 ± 87.7	151	73.2	NE	NE	U	BD	087998-036	EPA 906.0 M
MWL-MW7	Americium-241	1.95 ± 12.1	21.0	10.5	NE	NE	U	BD	088002-033	EPA 901.1
05-Jan-10	Cesium-137	-3.4 ± 3.87	3.97	1.99	NE	9.3	U	BD	088002-033	EPA 901.1
	Cobalt-60	-5.06 ± 4.14	3.42	1.71	NE	NE	U	BD	088002-033	EPA 901.1
	Potassium-40	73.4 ± 28.7	33.5	16.8	NE	NE	X	R	088002-033	EPA 901.1
	Gross Alpha	7.07	NA	NA	15	NE	NA	None	088002-034	EPA 900.0
	Gross Beta	3.98 ± 1.04	1.07	0.513	4mrem/yr	NE			088002-034	EPA 900.0
	Tritium	43.6 ± 90.1	153	74.0	NE	NE	U	BD	088002-036	EPA 906.0 M
MWL-MW7 (Duplicate)	Americium-241	-18.2 ± 12.6	20.7	10.4	NE	NE	U	BD	088003-033	EPA 901.1
05-Jan-10	Cesium-137	0.400 ± 2.27	3.78	1.89	NE	9.3	U	BD	088003-033	EPA 901.1
	Cobalt-60	0.487 ± 2.25	3.79	1.90	NE	NE	U	BD	088003-033	EPA 901.1
	Potassium-40	-14.6 ± 42.5	46.6	23.3	NE	NE	U	BD	088003-033	EPA 901.1
	Gross Alpha	5.02	NA	NA	15	NE	NA	None	088003-034	EPA 900.0
	Gross Beta	4.94 ± 1.19	1.17	0.564	4mrem/yr	NE			088003-034	EPA 900.0
	Tritium	-34.2 ± 87.1	153	74.1	NE	NE	U	BD	088003-036	EPA 906.0 M
MWL-MW8	Americium-241	-4.21 ± 5.90	9.77	4.89	NE	NE	U	BD	088007-033	EPA 901.1
06-Jan-10	Cesium-137	-2.37 ± 2.65	3.08	1.54	NE	9.3	U	BD	088007-033	EPA 901.1
	Cobalt-60	2.37 ± 1.95	3.55	1.77	NE	NE	U	BD	088007-033	EPA 901.1
	Potassium-40	25.2 ± 46.4	30.7	15.4	NE	NE	U	BD	088007-033	EPA 901.1
	Gross Alpha	4.91	NA	NA	15	NE	NA	None	088007-034	EPA 900.0
	Gross Beta	6.81 ± 1.53	1.41	0.687	4mrem/yr	NE			088007-034	EPA 900.0
	Tritium	-38 ± 87.2	153	74.3	NE	NE	U	BD	088007-036	EPA 906.0 M
MWL-MW9	Americium-241	-1.52 ± 8.81	13.6	6.82	NE	NE	U	BD	088011-033	EPA 901.1
07-Jan-10	Cesium-137	1.92 ± 1.84	3.26	1.63	NE	9.3	U	BD	088011-033	EPA 901.1
	Cobalt-60	0.306 ± 1.84	3.11	1.56	NE	NE	U	BD	088011-033	EPA 901.1
	Potassium-40	16.8 ± 41.2	31.1	15.6	NE	NE	U	BD	088011-033	EPA 901.1
	Gross Alpha	9.89	NA	NA	15	NE	NA	None	088011-034	EPA 900.0
	Gross Beta	10.4 ± 2.11	1.67	0.813	4mrem/yr	NE			088011-034	EPA 900.0
	Tritium	27.9 ± 91.3	157	75.6	NE	NE	U	BD	088011-036	EPA 906.0 M

Refer to footnotes at end of table.

Table A-10 (Continued)
Summary of Tritium, Gross Alpha, Gross Beta, Gamma Spectroscopy, Isotopic Uranium, and Radon-222 Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d] (pCi/L)	NMED HWB[e] (pCi/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-BW2	Americium-241	-0.0373 ± 5.88	9.55	4.78	NE	NE	U	BD	088942-033	EPA 901.1
27-Apr-10	Cesium-137	0.751 ± 1.60	2.72	1.36	NE	9.3	U	BD	088942-033	EPA 901.1
	Cobalt-60	-1.43 ± 2.86	2.87	1.44	NE	NE	U	BD	088942-033	EPA 901.1
	Potassium-40	17.2 ± 31.1	40.6	20.3	NE	NE	U	BD	088942-033	EPA 901.1
	Gross Alpha	7.73	NA	NA	15	NE	NA	None	088942-034	EPA 900.0
	Gross Beta	3.63 ± 1.09	1.20	0.572	4mrem/yr	NE		BD	088942-034	EPA 900.0
	Tritium	34.7 ± 101	183	80.9	NE	NE	U	BD	088942-036	EPA 906.0 M
MWL-BW2 (Duplicate)	Americium-241	-1.16 ± 7.62	12.8	6.42	NE	NE	U	BD	088943-033	EPA 901.1
27-Apr-10	Cesium-137	-0.495 ± 2.82	3.30	1.65	NE	9.3	U	BD	088943-033	EPA 901.1
	Cobalt-60	0.546 ± 1.86	3.18	1.59	NE	NE	U	BD	088943-033	EPA 901.1
	Potassium-40	-1.01 ± 35.8	42.4	21.2	NE	NE	U	BD	088943-033	EPA 901.1
	Gross Alpha	6.24	NA	NA	15	NE	NA	None	088943-034	EPA 900.0
	Gross Beta	3.19 ± 1.06	1.23	0.586	4mrem/yr	NE		J	088943-034	EPA 900.0
	Tritium	34.5 ± 101	182	80.4	NE	NE	U	BD	088943-036	EPA 906.0 M
MWL-MW4	Americium-241	-0.689 ± 7.49	11.9	5.94	NE	NE	U	BD	088949-033	EPA 901.1
29-Apr-10	Cesium-137	1.87 ± 1.65	2.87	1.44	NE	9.3	U	BD	088949-033	EPA 901.1
	Cobalt-60	-0.705 ± 1.69	2.69	1.35	NE	NE	U	BD	088949-033	EPA 901.1
	Potassium-40	-9.08 ± 34.3	43.3	21.7	NE	NE	U	BD	088949-033	EPA 901.1
	Gross Alpha	6.56	NA	NA	15	NE	NA	None	088949-034	EPA 900.0
	Gross Beta	4.68 ± 1.21	1.20	0.569	4mrem/yr	NE			088949-034	EPA 900.0
	Tritium	-36.9 ± 89.2	180	79.4	NE	NE	U	BD	088949-036	EPA 906.0 M
MWL-MW5	Americium-241	-36.5 ± 11.6	17.5	8.77	NE	NE	U	BD	088918-033	EPA 901.1
20-Apr-10	Cesium-137	0.0424 ± 1.92	3.28	1.64	NE	9.3	U	BD	088918-033	EPA 901.1
	Cobalt-60	-1.93 ± 2.83	3.20	1.60	NE	NE	U	BD	088918-033	EPA 901.1
	Potassium-40	5.62 ± 42.1	45.2	22.6	NE	NE	U	BD	088918-033	EPA 901.1
	Gross Alpha	6.74	NA	NA	15	NE	NA	None	088918-034	EPA 900.0
	Gross Beta	4.55 ± 1.46	1.86	0.894	4mrem/yr	NE		J	088918-034	EPA 900.0
	Tritium	-21 ± 90.0	157	76.1	NE	NE	U	BD	088918-036	EPA 906.0 M
MWL-MW5 (Duplicate)	Americium-241	-26.5 ± 11.6	18.7	9.33	NE	NE	U	BD	088919-033	EPA 901.1
20-Apr-10	Cesium-137	-0.343 ± 1.91	3.21	1.61	NE	9.3	U	BD	088919-033	EPA 901.1
	Cobalt-60	1.07 ± 1.93	3.35	1.68	NE	NE	U	BD	088919-033	EPA 901.1
	Potassium-40	4.85 ± 53.3	52.6	26.3	NE	NE	U	BD	088919-033	EPA 901.1
	Gross Alpha	8.57	NA	NA	15	NE	NA	None	088919-034	EPA 900.0
	Gross Beta	5.50 ± 1.39	1.33	0.633	4mrem/yr	NE			088919-034	EPA 900.0
	Tritium	-24.8 ± 89.7	157	76.0	NE	NE	U	BD	088919-036	EPA 906.0 M

Refer to footnotes at end of table.

Table A-10 (Continued)
Summary of Tritium, Gross Alpha, Gross Beta, Gamma Spectroscopy, Isotopic Uranium, and Radon-222 Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d] (pCi/L)	NMED HWB[e] (pCi/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW6	Americium-241	-18 ± 12.1	19.1	9.57	NE	NE	U	BD	088909-033	EPA 901.1
19-Apr-10	Cesium-137	-0.304 ± 1.79	2.97	1.49	NE	9.3	U	BD	088909-033	EPA 901.1
	Cobalt-60	0.169 ± 1.88	3.17	1.58	NE	NE	U	BD	088909-033	EPA 901.1
	Potassium-40	-19.9 ± 37.2	45.3	22.6	NE	NE	U	BD	088909-033	EPA 901.1
	Gross Alpha	5.26	NA	NA	15	NE	NA	None	088909-034	EPA 900.0
	Gross Beta	3.20 ± 1.08	1.32	0.627	4mrem/yr	NE		J	088909-034	EPA 900.0
	Tritium	41.7 ± 91.6	156	75.4	NE	NE	U	BD	088909-036	EPA 906.0 M
	Low Level Tritium	1.22 ± 0.744	1.18	0.554	NE	NE		J	088909-037	HASL 300
MWL-MW7	Americium-241	1.28 ± 5.88	9.61	4.81	NE	NE	U	BD	088929-033	EPA 901.1
22-Apr-10	Cesium-137	0.658 ± 1.66	2.81	1.41	NE	9.3	U	BD	088929-033	EPA 901.1
	Cobalt-60	1.77 ± 1.71	3.04	1.52	NE	NE	U	BD	088929-033	EPA 901.1
	Potassium-40	-5.69 ± 36.1	36.5	18.2	NE	NE	U	BD	088929-033	EPA 901.1
	Gross Alpha	3.52	NA	NA	15	NE	NA	None	088929-034	EPA 900.0
	Gross Beta	5.63 ± 1.24	0.969	0.459	4mrem/yr	NE			088929-034	EPA 900.0
	Tritium	-21 ± 89.8	157	76.0	NE	NE	U	BD	088929-036	EPA 906.0 M
MWL-MW8	Americium-241	-8.24 ± 5.47	8.80	4.40	NE	NE	U	BD	088934-033	EPA 901.1
26-Apr-10	Cesium-137	1.65 ± 1.77	3.12	1.56	NE	9.3	U	BD	088934-033	EPA 901.1
	Cobalt-60	-2.01 ± 2.70	3.21	1.61	NE	NE	U	BD	088934-033	EPA 901.1
	Potassium-40	49.5 ± 43.8	29.3	14.7	NE	NE	X	BD	088934-033	EPA 901.1
	Gross Alpha	3.52	NA	NA	15	NE	NA	None	088934-034	EPA 900.0
	Gross Beta	4.29 ± 1.12	1.12	0.529	4mrem/yr	NE			088934-034	EPA 900.0
	Tritium	108 ± 112	181	79.8	NE	NE	U	BD	088934-036	EPA 906.0 M
MWL-MW9	Americium-241	-2.93 ± 13.3	22.5	11.3	NE	NE	U	BD	088924-033	EPA 901.1
21-Apr-10	Cesium-137	0.313 ± 1.86	3.19	1.60	NE	9.3	U	BD	088924-033	EPA 901.1
	Cobalt-60	0.497 ± 1.94	3.35	1.67	NE	NE	U	BD	088924-033	EPA 901.1
	Potassium-40	-36.3 ± 44.5	49.3	24.7	NE	NE	U	BD	088924-033	EPA 901.1
	Gross Alpha	1.63	NA	NA	15	NE	NA	None	088924-034	EPA 900.0
	Gross Beta	5.65 ± 1.37	1.31	0.632	4mrem/yr	NE			088924-034	EPA 900.0
	Tritium	-115 ± 86.7	157	76.1	NE	NE	U	BD	088924-036	EPA 906.0 M

Refer to footnotes at end of table.

Table A-10 (Continued)
Summary of Tritium, Gross Alpha, Gross Beta, Gamma Spectroscopy, Isotopic Uranium, and Radon-222 Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d] (pCi/L)	NMED HWB[e] (pCi/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-BW2	Americium-241	2.09 ± 7.82	11.7	5.84	NE	NE	U	BD	089402-033	EPA 901.1
06-Jul-10	Cesium-137	0.0535 ± 1.91	3.17	1.59	NE	9.3	U	BD	089402-033	EPA 901.1
	Cobalt-60	1.65 ± 2.02	3.57	1.79	NE	NE	U	BD	089402-033	EPA 901.1
	Potassium-40	-44.9 ± 38.0	42.0	21.0	NE	NE	U	BD	089402-033	EPA 901.1
	Gross Alpha	1.31	NA	NA	15	NE	NA	None	089402-034	EPA 900.0
	Gross Beta	5.56 ± 1.61	1.94	0.935	4mrem/yr	NE		J	089402-034	EPA 900.0
	Uranium-233/234	6.13 ± 0.909	0.122	0.0544	NE	7.0			089402-035	HASL-300
	Uranium-235/236	0.199 ± 0.0724	0.0735	0.0288	NE	0.41		J	089402-035	HASL-300
	Uranium-238	2.12 ± 0.353	0.0845	0.0358	NE	3.0			089402-035	HASL-300
	Tritium	37.6 ± 91.4	156	75.3	NE	NE	U	BD	089402-036	EPA 906.0 M
	Radon-222	**494 ± 132**	92.4	43.9	NE	300			089402-038	SM 7500 Rn B
MWL-MW7	Americium-241	0.165 ± 3.95	5.01	2.51	NE	NE	U	BD	089407-033	EPA 901.1
07-Jul-10	Cesium-137	0.155 ± 3.51	3.96	1.98	NE	9.3	U	BD	089407-033	EPA 901.1
	Cobalt-60	-2.63 ± 3.37	4.03	2.02	NE	NE	U	BD	089407-033	EPA 901.1
	Potassium-40	58.5 ± 25.5	58.5	24.7	NE	NE	U	BD	089407-033	EPA 901.1
	Gross Alpha	-2.23	NA	NA	15	NE	NA	None	089407-034	EPA 900.0
	Gross Beta	5.39 ± 1.57	1.95	0.948	4mrem/yr	NE		J	089407-034	EPA 900.0
	Uranium-233/234	5.38 ± 0.818	0.132	0.059	NE	7.0			089407-035	HASL-300
	Uranium-235/236	0.286 ± 0.0926	0.0797	0.0312	NE	0.41			089407-035	HASL-300
	Uranium-238	2.38 ± 0.396	0.0916	0.0388	NE	3.0			089407-035	HASL-300
	Tritium	61.8 ± 93.4	157	75.9	NE	NE	U	BD	089407-036	EPA 906.0 M
	Radon-222	289 ± 85.8	77.9	37.0	NE	300			089407-038	SM 7500 Rn B
MWL-MW7 (Duplicate)	Americium-241	-40.3 ± 11.7	17.4	8.68	NE	NE	U	BD	089408-033	EPA 901.1
07-Jul-10	Cesium-137	-0.51 ± 1.86	3.14	1.57	NE	9.3	U	BD	089408-033	EPA 901.1
	Cobalt-60	2.81 ± 2.08	3.77	1.89	NE	NE	U	BD	089408-033	EPA 901.1
	Potassium-40	6.90 ± 35.9	46.5	23.3	NE	NE	U	BD	089408-033	EPA 901.1
	Gross Alpha	-2.41	NA	NA	15	NE	NA	None	089408-034	EPA 900.0
	Gross Beta	4.28 ± 1.13	1.23	0.592	4mrem/yr	NE			089408-034	EPA 900.0
	Uranium-233/234	5.27 ± 0.794	0.125	0.0559	NE	7.0			089408-035	HASL-300
	Uranium-235/236	0.187 ± 0.0707	0.0756	0.0296	NE	0.41		J	089408-035	HASL-300
	Uranium-238	2.71 ± 0.438	0.0868	0.0368	NE	3.0			089408-035	HASL-300
	Tritium	41.5 ± 91.5	156	75.3	NE	NE	U	BD	089408-036	EPA 906.0 M
	Radon-222	231 ± 75.3	78.1	37.1	NE	300		J	089408-038	SM 7500 Rn B

Refer to footnotes at end of table.

Table A-10 (Continued)
Summary of Tritium, Gross Alpha, Gross Beta, Gamma Spectroscopy, Isotopic Uranium, and Radon-222 Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d] (pCi/L)	NMED HWB[e] (pCi/L)	Laboratory Qualifier[f]	Validation Qualifier[g]	Sample Number	Analytical Method[h]
MWL-MW8	Americium-241	1.48 ± 4.05	6.68	3.34	NE	NE	U	BD	089411-033	EPA 901.1
12-Jul-10	Cesium-137	-9.95 ± 5.84	8.40	4.20	NE	9.3	U	BD	089411-033	EPA 901.1
	Cobalt-60	-0.248 ± 3.33	5.58	2.79	NE	NE	U	BD	089411-033	EPA 901.1
	Potassium-40	-0.685 ± 59.6	76.8	38.4	NE	NE	U	BD	089411-033	EPA 901.1
	Gross Alpha	-4.99	NA	NA	15	NE	NA	None	089411-034	EPA 900.0
	Gross Beta	9.90 ± 2.90	3.51	1.69	4mrem/yr	NE		J	089411-034	EPA 900.0
	Uranium-233/234	5.24 ± 0.813	0.149	0.0667	NE	7.0			089411-035	HASL-300
	Uranium-235/236	0.223 ± 0.0844	0.0901	0.0353	NE	0.41		J	089411-035	HASL-300
	Uranium-238	2.33 ± 0.400	0.103	0.0439	NE	3.0			089411-035	HASL-300
	Tritium	59.4 ± 92.5	156	75.3	NE	NE	U	BD	089411-036	EPA 906.0 M
	Radon-222	183 ± 61.4	67.0	31.9	NE	300		J	089411-038	SM 7500 Rn B
MWL-MW9	Americium-241	5.51 ± 8.50	13.2	6.59	NE	NE	U	BD	089414-033	EPA 901.1
13-Jul-10	Cesium-137	2.66 ± 1.79	3.21	1.61	NE	9.3	U	BD	089414-033	EPA 901.1
	Cobalt-60	0.205 ± 1.83	3.08	1.54	NE	NE	U	BD	089414-033	EPA 901.1
	Potassium-40	-10.1 ± 39.7	42.5	21.2	NE	NE	U	BD	089414-033	EPA 901.1
	Gross Alpha	-0.42	NA	NA	15	NE	NA	None	089414-034	EPA 900.0
	Gross Beta	6.44 ± 2.04	2.44	1.16	4mrem/yr	NE		J	089414-034	EPA 900.0
	Uranium-233/234	5.43 ± 0.832	0.140	0.0624	NE	7.0			089414-035	HASL-300
	Uranium-235/236	0.148 ± 0.0652	0.0843	0.0331	NE	0.41		J	089414-035	HASL-300
	Uranium-238	2.78 ± 0.458	0.0969	0.0411	NE	3.0			089414-035	HASL-300
	Tritium	-21.9 ± 89.5	157	75.8	NE	NE	U	BD	089414-036	EPA 906.0 M
	Radon-222	294 ± 83.4	70.5	33.6	NE	300			089414-038	SM 7500 Rn B

[a]Values in **bold** exceed the established MCL and/or the NMED HWB-approved background level. Activity levels of zero or less are considered to be not detected.
[b]MDA is the minimal detectable activity in a sample required to ensure a 95% probability that the measured activity is accurately quantified above the critical level.
[c]Critical level is the minimum activity that can be measured and reported with 99% confidence that the analyte is greater than zero, analyte is matrix-specific.
NA = Not applicable for gross alpha activities. The critical level could not be calculated as the gross alpha activity was corrected by subtracting out the total uranium activity.
[d]The MCL is established by the EPA Primary Water Regulations (40 CFR 141.11[b]), and subsequent amendments.
[e]NMED November 1998, Letter from B. Garcia to M. Zamorski (U.S. Department of Energy) and J.B. Woodward (Sandia Corporation), Re: "Approval, SNL Background Study," New Mexico Environment Department, Santa Fe, New Mexico, November 25, 1998.
[f]Laboratory Qualifier.
NA = Not applicable for gross alpha activities. The MDA could not be calculated as the gross alpha activity was corrected by subtracting out the total uranium activity.
U = Analyte is absent or below the method detection limit.
X = Used in radiochemistry to identify data rejected due to interference, low abundance, peak not meeting identification criteria, or uncertain identification for gamma spectroscopy.

Table A-10 (Concluded)
Summary of Tritium, Gross Alpha, Gross Beta, Gamma Spectroscopy, Isotopic Uranium, and Radon-222 Results
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

[g]Validation Qualifier.
If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.
BD = Used in radiochemistry to identify results that are not statistically different from zero.
J = The associated value is an estimated quantity.
[h]EPA 1980, "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032, U.S. Environmental Protection Agency, Cincinnati, Ohio; DOE Environmental Measurements Laboratory, 1990, "EML Procedures Manual," 27th ed., Vol. 1, Rev. 1992, HASL-300.
BW = Background Well.
CFR = Code of Federal Regulations.
DOE = U.S. Department of Energy.
EPA = U.S. Environmental Protection Agency.
HASL = Health and Safety Laboratory.
HWB = Hazardous Waste Bureau.
ID = Identification.
MCL = Maximum contaminant level.
MDA = Minimum detectable activity.
mrem/yr = Millirem per year.
MW = Monitoring Well.
MWL = Mixed Waste Landfill.
NE = Not established.
NMED = New Mexico Environment Department.
pCi/L = Picocurie(s) per liter.
SM = Standard Method.

Table A-11
Duplicate Sample Analytical Results for Chemical Analyses
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Sample Location	MWL-MW7 Environmental Result (R_1) January 5, 2010	MWL-MW7 Duplicate Result (R_2) January 5, 2010	
Parameter[a]	All results in mg/L (unless noted)		RPD[b]
Toluene (μg/L)	0.320	0.285	12
Nitrate plus nitrite as N	3.41	3.29	4
Alkalinity, total as CaCO3	207	206	< 1
Bromide	0.294	0.278	6
Chloride	40.2	40.4	< 1
Fluoride	0.903	0.971	7
Sulfate	36.8	36.8	< 1
Barium (unfiltered)	0.0974	0.104	7
Calcium (unfiltered)	58.6	61.0	4
Cobalt (unfiltered)	0.000105	0.000113	7
Iron (unfiltered)	0.168	0.187	11
Magnesium (unfiltered)	20.3	22.1	8
Manganese (unfiltered)	0.00139	0.00137	1
Nickel (unfiltered)	0.00226	0.00244	8
Potassium (unfiltered)	5.10	5.37	5
Sodium (unfiltered)	50.8	53.2	5
Uranium (unfiltered)	0.00781	0.00833	6
Barium (filtered)	0.0938	0.0961	2
Calcium (filtered)	59.5	60.7	2
Iron (filtered)	0.155	0.161	4
Magnesium (filtered)	21.3	22.7	6
Nickel (filtered)	0.00218	0.0023	5
Potassium (filtered)	5.15	5.71	10
Sodium (filtered)	49.3	53.1	7
Uranium (filtered)	0.00774	0.00792	2

Refer to footnotes at end of table.

Table A-11 (Continued)
Duplicate Sample Analytical Results for Chemical Analyses
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Sample Location	MWL-BW2 Environmental Result (R_1) April 27, 2010	MWL-BW2 Duplicate Result (R_2) April 27, 2010	
Parameter[a]	All results in mg/L (unless noted)		RPD[b]
Nitrate plus nitrite as N	2.38	2.30	3
Alkalinity, total as CaCO3	238	235	1
Bromide	0.399	0.399	<1
Chloride	58.4	59.3	2
Fluoride	0.667	0.675	1
Sulfate	43.7	44.6	2
Aluminum (unfiltered)	0.0109	0.0197	58
Barium (unfiltered)	0.0938	0.0943	1
Calcium (unfiltered)	67.2	67.8	1
Iron (unfiltered)	0.0703	0.0700	<1
Magnesium (unfiltered)	20.9	20.5	2
Nickel (unfiltered)	0.00103	0.00104	1
Potassium (unfiltered)	4.14	4.02	3
Selenium (unfiltered)	0.00241	0.00214	12
Sodium (unfiltered)	50.2	49.8	1
Uranium (unfiltered)	0.00652	0.00636	2
Vanadium (unfiltered)	0.010	0.00378	90
Barium (filtered)	0.0935	0.095	2
Calcium (filtered)	64.1	71.7	11
Iron (filtered)	0.0625	0.0648	4
Magnesium (filtered)	20.1	21.9	9
Nickel (filtered)	0.00108	0.00113	5
Potassium (filtered)	3.95	4.20	6
Selenium (filtered)	0.002	0.00206	3
Sodium (filtered)	48.0	53.1	10
Uranium (filtered)	0.00638	0.00642	1

Refer to footnotes at end of table.

Table A-11 (Continued)
Duplicate Sample Analytical Results for Chemical Analyses
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Sample Location	MWL-MW5 Environmental Result (R_1) April 20, 2010	MWL-MW5 Duplicate Result (R_2) April 20, 2010	
Parameter[a]	All results in mg/L (unless noted)		RPD[b]
Nitrate plus nitrite as N	1.45	1.55	7
Alkalinity, total as CaCO3	307	310	1
Bromide	0.464	0.467	1
Chloride	84.5	84.7	<1
Fluoride	0.861	0.885	3
Sulfate	53.6	53.9	1
Barium (unfiltered)	0.126	0.127	1
Calcium (unfiltered)	94.5	90.7	4
Cobalt (unfiltered)	0.000141	0.000122	14
Iron (unfiltered)	0.197	0.236	18
Magnesium (unfiltered)	31.1	30.9	1
Manganese (unfiltered)	0.00759	0.0081	7
Nickel (unfiltered)	0.00177	0.00178	1
Potassium (unfiltered)	6.39	6.43	1
Sodium (unfiltered)	68.6	60.9	12
Uranium (unfiltered)	0.00994	0.00990	<1
Zinc (unfiltered)	0.00307	0.00293	5
Barium (filtered)	0.129	0.138	7
Calcium (filtered)	88.8	95.5	7
Iron (filtered)	0.165	0.198	18
Magnesium (filtered)	28.7	31.2	8
Manganese (filtered)	0.00296	0.00323	9
Nickel (filtered)	0.00203	0.00169	18
Potassium (filtered)	5.62	5.92	5
Selenium (filtered)	0.00135	0.00155	14
Sodium (filtered)	60.6	65.5	8
Uranium (filtered)	0.0102	0.0102	<1
Zinc (filtered)	0.00443	0.00282	44

Refer to footnotes at end of table.

Table A-11 (Concluded)
Duplicate Sample Analytical Results for Chemical Analyses
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico
Calendar Year 2010

Sample Location	MWL-MW7 Environmental Result (R_1) July 7, 2010	MWL-MW7 Duplicate Result (R_2) July 7, 2010	
Parameter[a]	All results in mg/L (unless noted)		RPD[b]
Nitrate plus nitrite as N	3.11	3.11	< 1
Alkalinity, total as CaCO3	217	219	1
Bromide	0.328	0.317	3
Chloride	37.9	39.0	3
Fluoride	0.919	0.948	3
Sulfate	37.6	37.5	< 1
Barium (unfiltered)	0.0977	0.0947	3
Calcium (unfiltered)	55.8	54.9	2
Iron (unfiltered)	0.183	0.181	1
Magnesium (unfiltered)	18.0	17.2	5
Nickel (unfiltered)	0.00157	0.00139	12
Potassium (unfiltered)	4.86	4.52	7
Sodium (unfiltered)	44.8	45.9	2
Uranium (unfiltered)	0.00798	0.00796	< 1
Vanadium (unfiltered)	0.00783	0.00828	6
Barium (filtered)	0.0982	0.0971	1
Calcium (filtered)	55.6	54.8	1
Magnesium (filtered)	17.4	17.4	< 1
Nickel (filtered)	0.00445	0.00155	97
Potassium (filtered)	4.91	4.58	7
Sodium (filtered)	45.3	46.0	2
Uranium (filtered)	0.00816	0.008	2
Vanadium (filtered)	0.0081	0.00646	23

[a]Parameters not detected in both samples are not listed.
[b]RPD is not calculated for estimated values.
BW = Background Well.
CaCO3 = Calcium carbonate.
µg/L = Microgram(s) per liter.
mg/L = Milligram(s) per liter.
MW = Monitoring Well.
MWL = Mixed Waste Landfill.
N = Nitrogen.
RPD = Relative percent difference is calculated with the following equation and rounded to nearest whole number:

$$RPD = \frac{|R_1 - R_2|}{[(R_1 + R_2)/2]} \times 100$$

where:
R_1 = analysis result
R_2 = duplicate analysis result

Volume VII

TAB 11

Mixed Waste Landfill Chapter 4 Excerpted from the
Annual Groundwater Monitoring Report, Calendar Year 2011

From: SNL/ Beausoleil
To: NMED/Kieling

Back of Tab 11

National Nuclear Security Administration
Sandia Site Office
P. O. Box 5400
Albuquerque, NM 87185

AUG 16 2012

CERTIFIED MAIL

Mr. John E. Kieling
Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505

Subject: Calendar Year 2011 Annual Groundwater Monitoring Report for Sandia National Laboratories/New Mexico

Dear Mr. Kieling:

The Department of Energy/National Nuclear Security Administration/Sandia Site Office (DOE/NNSA/SSO) is submitting the enclosed Calendar Year 2011 Annual Groundwater Monitoring Report for DOE/NNSA/SSO and Sandia Corporation (Sandia). This report is submitted in compliance with periodic reporting requirements for groundwater monitoring discussed in Section X.D of the Compliance Order on Consent between the New Mexico Environment Department, DOE/NNSA/SSO, and Sandia. Specifically, the report meets the annual reporting requirement for the Tijeras Arroyo Groundwater, the Technical Area V Groundwater, and the Burn Site Groundwater study areas.

If you have questions please contact John Weckerle of my staff at (505) 845-6026.

Sincerely,

Geoffrey L. Beausoleil
Manager

Enclosure
See Page 2

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Annual Groundwater Monitoring Report
Calendar Year 2011

Groundwater Protection Program
Sandia National Laboratories, New Mexico
June 2012

Prepared by:
Long-Term Stewardship and Disassembly and Sanitization Operations (4142)
and Environmental Programs (4143)
Groundwater Protection Program in coordination with
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Abstract

Sandia National Laboratories, New Mexico (SNL/NM) is a government-owned/contractor-operated laboratory. Sandia Corporation (Sandia), a wholly-owned subsidiary of Lockheed Martin Corporation, manages and operates SNL/NM for the U.S. Department of Energy (DOE), National Nuclear Security Administration (NNSA). The DOE/NNSA Sandia Site Office administers the contract and oversees contractor operations at the site. Sandia conducts two types of groundwater surveillance monitoring at SNL/NM: (1) on a site-wide basis as part of the SNL/NM Groundwater Protection Program (GWPP) and (2) as site-specific groundwater monitoring at Long-Term Stewardship (LTS)/Environmental Restoration (ER) Operations sites with ongoing groundwater investigations. This Annual Groundwater Monitoring Report summarizes GWPP, LTS, and ER Operations data collected during groundwater monitoring events conducted at the following SNL/NM sites through December 31, 2011: Burn Site Groundwater study area; Chemical Waste Landfill; Mixed Waste Landfill; Solid Waste Management Units 8/58, 49, 68, 116, 149, and 154; Technical Area V study area; and the Tijeras Arroyo Groundwater study area. Environmental monitoring and surveillance programs are required by DOE Order 436.1, *Departmental Sustainability,* and DOE Order 231.1B, *Environmental, Safety, and Health Reporting*.

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Table

1 Inventory of Groundwater Monitoring Wells Located at SNL/NM and Surrounding Areas

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1 SNL/NM Monitoring Well Locations and Base-Wide Potentiometric Surface Map for the Kirtland Air Force Base Vicinity, October 2011

Abbreviations and Acronyms

ABCWUA	Albuquerque Bernalillo County Water Utility Authority
Airport	Albuquerque International Sunport
amsl	above mean sea level
AOC	area of concern
AOP	Administrative Operating Procedure
ARG	Ancestral Rio Grande
bgs	below ground surface
BSG	Burn Site Groundwater
BW	background well
CAC	Corrective Action Complete
CCBA	Coyote Canyon Blast Area
CFR	Code of Federal Regulations
CME	Corrective Measures Evaluation
CMI	Corrective Measures Implementation
CMIP	Corrective Measures Implementation Plan
CMS	Corrective Measures Study
COA	City of Albuquerque
COC	constituent of concern
CTF	Coyote Test Field
CWL	Chemical Waste Landfill
CY	Calendar Year
DCG	Derived Concentration Guide
DI	deionized
DO	dissolved oxygen
DOE	U.S. Department of Energy
DRO	diesel range organics
DSS	Drain and Septic System
EB	equipment blank
EDMS	Environmental Data Management System
EMS	Environmental Management System
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ET	evapotranspirative
FB	field blank
FIP	Field Implementation Plan
FOP	Field Operating Procedure
FSO	Field Support Operations
FY	Fiscal Year
GEL	GEL Laboratories LLC
GRO	gasoline range organics
GWPP	Groundwater Protection Program
HE	high explosive
HPT	High Performing Team
HSWA	Hazardous and Solid Waste Amendments

Abbreviations and Acronyms (continued)

ID	identification
IMWP	Interim Measures Work Plan
IRP	Installation Restoration Program (U.S. Air Force)
KAFB	Kirtland Air Force Base
LCS	laboratory control sample
LE	Landfill Excavation
LRRI	Lovelace Respiratory Research Institute
LTMMP	Long-Term Monitoring and Maintenance Plan
LWDS	Liquid Waste Disposal System
MAC	maximum allowable concentration (established by the NMED)
MCL	maximum contaminant level
MDA	minimum detectable activity
MDL	method detection limit
MNA	monitored natural attenuation
MS	matrix spike
MSD	matrix spike duplicate
MW	monitoring well
MWL	Mixed Waste Landfill
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NFA	No Further Action
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
NNSA	National Nuclear Security Administration
NOD	Notice of Disapproval
NPN	nitrate plus nitrite
NTU	nephelometric turbidity units
OB	Oversight Bureau
ORP	oxidation-reduction potential
OU	Operable Unit
PCCP	Post-Closure Care Permit
PCE	tetrachloroethene
PGWS	perched groundwater system
PQL	practical quantitation limit
PVC	polyvinyl chloride
QC	quality control
QED™	QED Environmental Systems MicroPurge® low-flow sampling method
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-trinitro-triazine
RFI	RCRA Facility Investigation
RPD	relative percent difference

Abbreviations and Acronyms (concluded)

RSI	Request for Supplemental Information
Sandia	Sandia Corporation
SAP	Sampling and Analysis Plan
SC	specific conductance
SDWA	Safe Drinking Water Act
SMO	Sample Management Office
SNL/NM	Sandia National Laboratories, New Mexico
SVOC	semivolatile organic compound
SW	Solid Waste
SWMU	Solid Waste Management Unit
TA	Technical Area
TAG	Tijeras Arroyo Groundwater (Investigation)
TAL	Target Analyte List
TB	trip blank
TCE	trichloroethene (equivalent to trichlorethylene)
tetryl	methyl 2,4,6-trinitrophenylnitramine
TOC	total organic carbon
TOX	total organic halogens
TPH	total petroleum hydrocarbons
UCS	Underground Conduit System
USAF	U.S. Air Force
USGS	U.S. Geological Survey
VA	Veterans Administration
VCA	voluntary corrective action
VCM	voluntary corrective measure
VE	Vapor Extraction
VOC	volatile organic compound
WL	water level
WQ	water quality

Units

°C	degree Celsius
µg/L	microgram(s) per liter
µmhos/cm	micromho(s) per centimeter (unit of specific conductance)
ac-ft	acre feet
ft	foot (feet)
ft^3	cubic feet
ft^3/yr	cubic feet per year
ft/ft	feet per foot
ft/yr	feet per year
gal.	gallon(s)
gpm	gallons per minute
in./yr	inches per year
Ma	Mega Annum
mg/L	milligram(s) per liter
mL	milliliter(s)
mrem/yr	millirem per year
mV	millivolt(s)
NTU	nephelometric turbidity units
pCi/g	picocuries per gram
pCi/L	picocuries per liter
pH	potential of hydrogen
ppb	part(s) per billion, equivalent to µg/L in water
ppbv	part(s) per billion by volume
sq mi	square mile(s)
yr	year(s)

Monitoring Well Location Descriptions

AVN-#	Area V (North)
CCBA-#	Coyote Canyon Blast Area
CTF-#	Coyote Test Field
CWL-#	Chemical Waste Landfill
CYN-#	Lurance Canyon
EOD	Explosive Ordnance Disposal
HERTF	High Energy Research Test Facility
IP	Isleta Pueblo
ITRI	Inhalation Toxicology Research Institute
LMF	Large Melt Facility
LWDS-#	Liquid Waste Disposal System
MP-#	Montessa Park
MRN-#	Magazine Road North
MVMW#	Mountain View Monitoring Well
MWL-#	Mixed Waste Landfill
NMED-#	New Mexico Environment Department
NWTA3-#	Northwest Technical Area III
OBS-#	Old Burn Site
PGS-#	Parade Ground South
PL-#	Power Line Road, west
SFR-#	South Fence Road
STW-#	Solar Tower (West)
SWTA-#	Southwest Technical Area III
TA1-W-#	Technical Area I (Well)
TA2-NW-#	Technical Area II (Northwest)
TA2-SW-#	Technical Area II (Southwest)
TA2-W-#	Technical Area II (Well)
TAV-#	Technical Area V
TJA-#	Tijeras Arroyo
TRE-#	Thunder Road East
TRN-#	Target Road North
TRS-#	Target Road South
TSA-#	Transportation Safeguards Academy
WYO-#	Wyoming
12AUP-#	ER Site 12A Underflow Piezometer

**** Meteorological Towers***

* SC1	School House
* A-21	TA-I
* A-36	TA-III and TA-V

Annual Groundwater Monitoring Report

Executive Summary

Sandia Corporation (Sandia) conducts groundwater surveillance monitoring for the U.S. Department of Energy (DOE), National Nuclear Security Administration (NNSA) at Sandia National Laboratories, New Mexico (SNL/NM) on a site-wide basis as part of the SNL/NM Groundwater Protection Program (GWPP) and on a site-specific basis at Long-Term Stewardship (LTS)/Environmental Restoration (ER) Operations (formerly ER Project) sites with ongoing groundwater investigations. The SNL/NM facility is located on Kirtland Air Force Base (KAFB) in central New Mexico.

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia, a wholly owned subsidiary of Lockheed Martin Corporation, for the DOE NNSA under Contract DE-AC04-94AL85000.

This Annual Groundwater Monitoring Report documents the results of the groundwater monitoring activities at SNL/NM for Calendar Year (CY) 2011. This report has been prepared to meet the environmental reporting requirements for the CY 2011 Annual Site Environmental Report, providing an annual update of groundwater data to regulators, stakeholders, and outside agencies. In addition, it serves as a valuable tool to inform the public about the groundwater quality at SNL/NM. This report includes both water quality sampling results and water level measurements. Separate chapters focus on the investigation activities at each of the following monitoring networks maintained at SNL/NM: GWPP site-wide surveillance (Chapter 2.0); Chemical Waste Landfill (CWL) (Chapter 3.0); Mixed Waste Landfill (MWL) (Chapter 4.0); Technical Area (TA)-V (Chapter 5.0); Tijeras Arroyo Groundwater (TAG) (Chapter 6.0); Burn Site Groundwater (BSG) (Chapter 7.0); Solid Waste Management Units (SWMUs) 8/58 (Chapter 8.0); SWMU 49 (Chapter 9.0); SWMU 68 (Chapter 10.0); SWMU 116 (Chapter 11.0); SWMU 149 (Chapter 12.0); and SWMU 154 (Chapter 13.0).

Chapter 1.0 provides the general site description for the SNL/NM facility and describes the regulatory criteria for SNL/NM groundwater monitoring tasks. The regional aquifer supplying the Albuquerque Bernalillo County Water Utility Authority (ABCWUA) and KAFB production wells is located within the Albuquerque Basin. The regional aquifer is mostly contained within the upper unit and, to some extent, the middle unit of the Santa Fe Group. The edge of the basin on the east side is defined by the Sandia, Manzanita, and Manzano Mountains, which have uplifted along normal faults. KAFB straddles the east side of the basin and is divided approximately in half by basin-bounding faults. On KAFB, the basin is primarily defined by the north-south–trending Sandia fault and the Hubbell Springs fault. The Tijeras fault, a strike-slip fault that trends northeast-southwest, intersects the Sandia and Hubbell Springs faults forming a system of faults collectively referred to as the Tijeras fault complex. The faults form a distinct hydrogeological boundary between the regional aquifer within the basin (approximately 500 feet [ft] below ground surface [bgs]) and the more shallow bedrock aquifer systems within the uplifted areas (generally between 50 to 325 ft bgs).

Currently, SNL/NM LTS and ER Operations maintain 11 groundwater monitoring networks that consist of the following:

- CWL
- MWL
- TA-V
- TAG
- BSG
- SWMUs 8/58
- SWMU 49
- SWMU 68
- SWMU 116
- SWMU 149
- SWMU 154

At SNL/NM, SWMUs are regulated under the Hazardous and Solid Waste Amendment (HSWA) module of the SNL/NM Resource Conservation and Recovery Permit. In the HSWA module, a SWMU is defined as "any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste." Monitoring and/or corrective action requirements generally are determined on a SWMU-specific basis following a site investigation. A Compliance Order on Consent (the Order) between the New Mexico Environment Department (NMED), the DOE, and Sandia governs corrective actions for these sites and, accordingly, monitoring performed at the MWL, the TA-V, TAG, and BSG study areas, and SWMUs 8/58, 49, 68, 116, 149, and 154. The CWL has undergone closure in accordance with 20.4.1.600 New Mexico Administrative Code, incorporating Title 40, Code of Federal Regulations, Section 265, Subpart G, and the CWL Closure Plan and is regulated under a Post-Closure Care Permit.

Groundwater Quality Monitoring Activities and Results

During CY 2011, groundwater samples were collected from monitoring wells for the 12 investigations (GWPP and 11 LTS/ER Operations sites). The analytical results for samples from all monitoring wells were compared with maximum contaminant levels (MCLs) established by the U.S. Environmental Protection Agency (EPA). The results for GWPP monitoring wells were also compared with NMED maximum allowable concentrations (MACs) promulgated for groundwater by the State of New Mexico Water Quality Control Commission (NMWQCC). The results are summarized in the following sections, and the data are presented in the attachments following each chapter.

In this report groundwater monitoring data are presented for both hazardous and radioactive constituents; however, the monitoring data for radionuclides (gamma spectroscopy, gross alpha/beta activity, and tritium) are provided voluntarily by the DOE/Sandia. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements of the Order, as specified in Section III.A of the Order.

Groundwater Protection Program

Chapter 2.0 documents the results of the CY 2011 groundwater surveillance monitoring activities conducted as part of the SNL/NM GWPP. Water levels were measured at 102 monitoring wells. Water level measurements were obtained either monthly or quarterly depending on the response characteristics of the groundwater system at each well location to pumping or other stresses. The surveillance activities include the annual collection and analysis of groundwater samples from 14 monitoring wells and 1 surface water sample from a spring. Annual sampling of groundwater was conducted during March 2011. Samples collected from all locations were analyzed for Safe Drinking Water Act list volatile organic compounds (VOCs); total organic halogens; total phenols; total alkalinity; nitrate plus nitrite (NPN); total cyanide; major anions; Target Analyte List (TAL) metals plus uranium; mercury; radionuclides by gamma spectroscopy; gross alpha/beta activity; radium-226; and radium-228. Additional samples were collected at selected monitoring wells for analysis of high explosive (HE) compounds and isotopic uranium.

No analytical parameters exceed established MCLs or MACs, except for arsenic, beryllium, fluoride, uranium, and combined radium-226 and radium-228 activity. The concentrations of these analytes that exceed MCLs or MACs in groundwater samples are similar to the results reported for previous years, with the exception of uranium.

No VOCs or HE compounds were detected above established MCLs or MACs. The HE compound RDX [hexahydro-trinitro-triazine] was detected in the groundwater sample from monitoring well CTF-MW2 at a concentration of 0.391 micrograms per liter (μg/L).

Fluoride was detected above the NMWQCC groundwater protection MAC of 1.6 milligrams per liter (mg/L) at four sampling locations. The concentrations range from 1.66 to 2.41 mg/L. The EPA MCL for fluoride is 4.0 mg/L. Arsenic was detected above the MCL of 0.01 mg/L in the groundwater sample from CTF-MW2 at a concentration of 0.0501 mg/L. Beryllium was detected in the surface water sample from Coyote Springs at a concentration of 0.00654 mg/L. The MCL for beryllium is 0.004 mg/L. Beryllium has been consistently detected in the surface water samples from the springs and is considered to be of natural origin. Uranium was detected above the MCL of 0.030 mg/L in the sample from CTF-MW2 at a concentration of 0.0351 mg/L. The uranium result for CTF-MW2 is anomalously high compared to prior and subsequent monitoring data.

Combined radium-226 and radium-228 activity levels in the CTF-MW2 sample exceed the MCL of 5.0 picocuries per liter (pCi/L). Activity for radium-226 was reported in the sample from CTF-MW2 at 3.00 ± 1.12 pCi/L and for radium-228 at 6.78 ± 1.80 pCi/L.

Groundwater elevation measurements were obtained throughout CY 2011 at 102 locations on a monthly or quarterly basis. Groundwater elevation measurements obtained from representative monitoring wells were used to construct contours of the potentiometric surface. The contours display a pattern that reflects the impact of the groundwater withdrawal by water supply wells located in the northwestern portion of KAFB and ABCWUA wells located north of the base.

Groundwater elevations were also obtained from wells completed in the perched groundwater system (PGWS) to construct a groundwater elevation contour map. The contours indicate groundwater flow in the PGWS is toward the southeast. Water levels are declining in the northwest and increasing slightly in the east presumably due to the drainage of the system to the east and perhaps some additional recharge from the Tijeras Arroyo.

Chemical Waste Landfill

Chapter 3.0 discusses the CWL semiannual groundwater monitoring activities performed during July to August 2011. Groundwater samples were collected from four monitoring wells (CWL-BW5, CWL-MW9, CWL-MW10, and CWL-MW11) and analyzed for the three analytes (trichloroethene [TCE], chromium, and nickel), as specified in the Post-Closure Care Permit. No analytes were detected at concentrations exceeding the associated EPA MCLs in any of the CWL groundwater samples. The analytical results are comparable to historical values.

Mixed Waste Landfill

Chapter 4.0 discusses the MWL annual groundwater sampling activities conducted in June 2011. Groundwater samples were collected from seven monitoring wells (MWL-BW2, MWL-MW4, MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9) and analyzed for VOCs, TAL metals plus uranium, anions (as bromide, chloride, fluoride, and sulfate), total alkalinity, NPN, radionuclides by gamma spectroscopy, gross alpha/beta activity, and tritium as specified in the Order. No analytes were detected at concentrations exceeding the associated EPA MCLs in any of the MWL groundwater samples. The analytical results are comparable to historical values.

Technical Area V Groundwater Study Area

Chapter 5.0 discusses the TA-V groundwater monitoring activities conducted during CY 2011. Both TCE and nitrate have been identified as constituents of concern (COCs) in groundwater at the TA-V study area based on detections above the EPA MCL in samples collected from monitoring wells. Currently 16 wells in the TA-V study area are monitored for water quality and water levels. Table XI-1 of the Order specifies that the sampling frequency for groundwater monitoring at TA-V is quarterly. Unique features of the TA-V study area include low concentrations of TCE and nitrate in a deep alluvial aquifer.

The conceptual site model of contaminant transport at TA-V includes release from the source term, migration through the vadose zone, and movement in groundwater. The potential sources of TCE and/or nitrate in the TA-V study area include wastewater disposal systems and seepage pits. Based on the historical use and disposal of chlorinated solvents, the extent of TCE in groundwater is probably associated with multiple aqueous releases of solvents and subsequent vapor-phase transport through the vadose zone. The slow rate of groundwater flow (4 to 20 feet per year) is responsible for the present distribution of TCE in the aquifer.

Only NPN and TCE were detected above the MCLs in groundwater samples from TA-V study area wells. NPN concentrations exceed the MCL of 10 mg/L in samples from AVN-1, LWDS-MW1, TAV-MW6, and TAV-MW10, with a maximum concentration of 14.5 mg/L in the sample collected from LWDS-MW1 in November 2011.

During CY 2011, TCE exceeded the MCL of 5 µg/L in samples from five wells (LWDS-MW1, TAV-MW6, TAV-MW10, TAV-MW12, and TAV-MW14). The maximum concentration of TCE detected during this reporting period is 17.1 µg/L in the sample from TAV-MW6 collected in July 2011.

The analytical results for this reporting period are consistent with historical concentrations. The current conceptual site model for the TA-V study area does not require modification based on the sampling results for CY 2011.

The following activities took place for the TA-V study area during CY 2011:

- Monthly or quarterly water level measurements were obtained for all TA-V study area wells.
- Semiannual and quarterly groundwater sampling events were conducted at 16 wells in January, April, July, and November 2011.
- Quarterly perchlorate screening groundwater sampling and reporting were performed for TAV-MW11, TAV-MW12, TAV-MW13, and TAV-MW14.
- Soil-vapor monitoring wells TAV-SV01, TAV-SV02, and TAV-SV03 were installed.
- Quarterly soil-vapor sampling events were conducted at these three wells in April and May, July, and November 2011.

Tijeras Arroyo Groundwater Study Area

Chapter 6.0 addresses groundwater monitoring activities conducted during CY 2011 at the TAG study area. Currently, 21 wells in the TAG study area are monitored for water quality, and 30 wells are monitored for water levels. Two groundwater systems are present in the TAG study area: the PGWS at approximately 220 to 330 ft bgs and the regional aquifer groundwater system at approximately 440 to 570 ft bgs. Groundwater monitoring wells are completed within either the PGWS or regional aquifer. Unique features of the TAG study area include low concentrations of TCE at scattered locations in the PGWS and low concentrations of nitrate at scattered locations in the PGWS and regional aquifer.

For CY 2011, wells were sampled in February/March, May, August/September, and December. The samples were analyzed for VOCs, NPN, anions, TAL metals (plus uranium), gross alpha/beta activity, tritium, and radionuclides by gamma spectroscopy. Depending on their locations and historical concentrations of COCs, wells were sampled quarterly, semiannually, or annually during this reporting period.

Both TCE and nitrate have been identified as COCs in groundwater at the TAG study area based on historical groundwater monitoring results. Only NPN and TCE were detected above MCLs in samples from TAG study area wells. In CY 2011, NPN concentrations exceeded the MCL of 10 mg/L in samples from TA2-SW1-320, TA2-W-19, TJA-2, TJA-4, and TJA-7, with a maximum concentration of 31.1 mg/L in the sample from TJA-4 collected during the December 2011 sampling event. NPN concentrations in wells TA2-SW1-320, TJA-4, and TJA-7 have generally exceeded the MCL for the life of the wells, whereas NPN concentrations occasionally have exceeded the MCL in samples from TJA-2 and TA2-W-19.

During CY 2011, TCE exceeded the MCL of 5 µg/L in the groundwater sample form one PGWS well, WYO-4. The maximum concentration of TCE detected during this reporting period is 8.17 µg/L in the sample from WYO-4 collected during the May 2011 sampling event. TCE concentrations in samples from WYO-4 slightly exceed the MCL, and trends are level to slightly increasing over time.

The analytical results for this reporting period are consistent with historical concentrations. The current conceptual site model for the TAG study area does not require modification based on the sampling results for CY 2011.

The following activities took place for the TAG study area during CY 2011:

- Monthly, quarterly, or annual water level measurements were obtained from TAG monitoring wells.
- Quarterly groundwater sampling events were conducted at seven wells (TA2-SW1-320, TA2-W-19, TA2-W-26, TJA-2, TJA-4, TJA-7, and WYO-4) in February/March, May, August/September, and December 2011.
- Semiannual groundwater sampling was conducted at four wells (TA2-W-01, TA2-W-27, TJA-3, and TJA-6) in February/March and August/September 2011.
- Annual groundwater sampling was conducted at 10 wells (PGS-2, TA1-W-01, TA1-W-02, TA1-W-03, TA1-W-04, TA1-W-05, TA1-W-06, TA1-W-08, TA2-NW1-595, and WYO-3) in August/September 2011.

Burn Site Groundwater Study Area

Chapter 7.0 discusses the groundwater monitoring activities conducted during CY 2011 at the BSG study area, which is located around the active Lurance Canyon Burn Site facility. Groundwater investigations were initiated in 1997 at the request of the NMED after elevated nitrate levels were discovered in the Burn Site Well (a nonpotable production well used for fire suppression). The study area consists of 10 monitoring wells, and samples were collected and analyzed for VOCs, semivolatile organic compounds (SVOCs), HE compounds, total petroleum hydrocarbons (TPH)-diesel range organics, TPH-gasoline range organics, anions, alkalinity, NPN, TAL metals (plus uranium), gross alpha/beta activity, tritium, and radionuclides by gamma spectroscopy. As required by the NMED, semiannual sampling for perchlorate was conducted at CYN-MW6, and quarterly sampling for perchlorate was conducted at CYN-MW9, CYN-MW10, CYN-MW11, and CYN-MW12.

Only NPN was detected above the MCL in samples from BSG study area wells. NPN results exceed the MCL of 10 mg/L in samples from CYN-MW1D, CYN-MW3, CYN-MW6, CYN-MW9, CYN-MW11, and CYN-MW12, with a maximum concentration of 34.5 mg/L in the sample from CYN-MW9 collected during the October 2011 sampling event.

Perchlorate was detected slightly above the screening level/method detection limit (MDL) of 4 µg/L only in samples collected from CYN-MW6. Perchlorate concentrations range from 6.26 J to 7.06 J µg/L, where "J" represents an estimated concentration. Currently, no MCL is established for perchlorate.

The analytical results for this reporting period are consistent with historical concentrations. The current conceptual site model does not require modification based on the sampling results for CY 2011.

The following activities took place for the BSG study area during CY 2011:

- Quarterly groundwater sampling events were conducted at four wells (CYN-MW9, CYN-MW10, CYN-MW11, and CYN-MW12) in February, May, August, and October 2011.
- Semiannual groundwater sampling was conducted at six wells (CYN-MW1D, CYN-MW3, CYN-MW4, CYN-MW6, CYN-MW7, and CYN-MW8) in February, August, and October 2011.
- Quarterly perchlorate screening groundwater sampling and reporting were performed for CYN-MW9, CYN-MW10, CYN-MW11, and CYN-MW12; semiannual perchlorate screening groundwater sampling and reporting were performed for CYN-MW6.

Solid Waste Management Units 8/58

Chapter 8.0 discusses the groundwater monitoring activities conducted during CY 2011 at SWMUs 8/58, which are located in the Arroyo del Coyote watershed that captures runoff from the western flank of the Manzanita Mountains. Monitoring wells CCBA-MW1 and CCBA-MW2 were installed in August 2011, and the first quarter of sampling for these two wells occurred in October and November 2011. The groundwater samples from each well were analyzed for VOCs; SVOCs; HE compounds; NPN; major anions (as bromide, chloride, fluoride, and sulfate); major cations (as calcium, magnesium, potassium, and sodium); alkalinity; TAL metals plus uranium; perchlorate; total cyanide; radionuclides by gamma spectroscopy; gross alpha/beta activity; and isotopic uranium.

No parameters were detected above established MCLs, except for fluoride. Fluoride exceeds the established MCL of 4.0 mg/L in the CCBA-MW1 sample at a concentration of 5.36 mg/L.

The following activities took place for SWMUs 8/58 during CY 2011:

- The Groundwater Characterization Work Plan for SWMUs 8/58 was approved by the NMED.
- Adjustments to the well locations for SWMUs 8/58 were proposed by DOE/Sandia and approved by the NMED.
- Two groundwater monitoring wells (CCBA-MW1 and CCBA-MW2) were installed at SWMUs 8/58 in August 2011.
- A report describing the well installation field activities was prepared and submitted to the NMED.

- Quarterly groundwater sampling was conducted at the newly installed wells in October and November 2011.

- Quarterly and annual reporting of chemical analyses for groundwater samples from CCBA-MW1 and CCBA-MW2 was initiated.

Solid Waste Management Unit 49

Chapter 9.0 discusses the SWMU 49 annual groundwater monitoring activities performed during CY 2011. SWMU 49 is located in Lurance Canyon and consists of a surface discharge area associated with a former trailer used as a darkroom and the area around a drainpipe outfall from Building 9820. The DOE/Sandia received a letter from the NMED on April 14, 2010, that lists SWMU 49 under the heading of "SWMUs/AOCs to be Subject to Groundwater Monitoring Controls" and further states that SWMU 49 requires long-term monitoring of groundwater on an annual basis as a site control. Annual sampling was completed in March 2011, and samples were analyzed for general chemistry, VOCs, HE compounds, perchlorate, metals, cyanide, NPN, gross alpha/beta activity, and radionuclides by gamma spectroscopy. No analytes were detected above their respective MCLs.

The following activities took place for SWMU 49 during CY 2011:

- Annual groundwater sampling was conducted at CYN-MW5 in March 2011.

- Periodic groundwater elevation data were obtained from CYN-MW5.

Solid Waste Management Unit 68

Chapter 10.0 discusses the quarterly groundwater monitoring activities performed during CY 2011 at SWMU 68, which is located in Coyote Test Field. Monitoring wells OBS-MW1, OBS-MW2, and OBS-MW3 were installed in August 2011, and the first quarter of sampling for these wells occurred in October 2011. The groundwater samples from each well were analyzed for VOCs; SVOCs; HE compounds; NPN; major anions (as bromide, chloride, fluoride, and sulfate); major cations (as calcium, magnesium, potassium, and sodium); alkalinity; TAL metals plus uranium; perchlorate; total cyanide; hexavalent chromium; gross alpha/beta activity; radionuclides by gamma spectroscopy; and isotopic uranium. No parameters were detected above established MCLs.

The following activities took place for SWMU 68 during CY 2011:

- The SWMU 68 Groundwater Characterization Work Plan was approved by the NMED.

- Three groundwater monitoring wells (OBS-MW1, OBS-MW2, and OBS-MW3) were installed at SWMU 68 in August 2011.

- A report describing the well installation field activities was prepared and submitted to the NMED.

- Quarterly groundwater sampling was conducted at the newly installed wells in October 2011.

- Quarterly and annual reporting of chemical analyses for groundwater samples from OBS-MW1, OBS-MW2, and OBS-MW3 was initiated.

Solid Waste Management Unit 116
Chapter 11.0 discusses the SWMU 116 annual groundwater monitoring activities performed during CY 2011. SWMU 116 is located on the western margin of the Manzanita Mountain foothills and includes the immediate area surrounding the five seepage pits and septic tank located south of Building 9990. The DOE/Sandia received a letter from the NMED on April 14, 2010, that lists SWMU 116 under the heading of "SWMUs/AOCs to be Subject to Groundwater Monitoring Controls" and further states that SWMU 116 requires long-term monitoring of groundwater on an annual basis as a site control. Annual sampling was completed in March 2011, and samples were analyzed for general chemistry, VOCs, HE compounds, perchlorate, TAL metals plus uranium, cyanide, and NPN. No analytes were detected above their respective MCLs.

The following activities took place for SWMU 116 during CY 2011:

- Annual groundwater sampling was conducted at CTF-MW1 in March 2011.
- Periodic groundwater elevation data were obtained from CTF-MW1.

Solid Waste Management Unit 149
Chapter 12.0 discusses the quarterly groundwater monitoring activities performed during CY 2011 at SWMU 149, which is located in the Coyote Test Field. Monitoring well CTF-MW3 was sampled in March, June, September, and December 2011. The samples were analyzed for VOCs, TAL metals (including selenium), general chemistry parameters, perchlorate, and NPN. No analytical results for the CTF-MW3 groundwater samples exceed the corresponding MCLs.

The following activities took place for monitoring well CTF-MW3 near SWMU 149 during CY 2011:

- Quarterly groundwater sampling was conducted at CTF-MW3 in March, June, September, and December 2011.
- Quarterly reporting of analytical results for CTF-MW3 was conducted.

Solid Waste Management Unit 154
Chapter 13.0 discusses the quarterly groundwater monitoring activities performed during CY 2011 at SWMU 154, which is located in Coyote Test Field. Monitoring well CTF-MW2 was sampled in March, May, September, and December 2011. Analytical parameters included VOCs, SVOCs, HE compounds, NPN, major anions, alkalinity, TAL total metals plus uranium, perchlorate, radionuclides by gamma spectroscopy, gross alpha/beta activity, and isotopic uranium.

For all four quarters, arsenic was detected above the established MCL. For the March 2011 sampling event, thallium was detected above the MCL in the unfiltered environmental sample but not in the associated duplicate environmental sample or dissolved sample fractions. For the May 2011 sampling event, gross alpha activity was reported above the MCL, but the result reported for the reanalysis was below the MCL.

The following activities took place for monitoring well CTF-MW2 near SWMU 154 during CY 2011:

- Quarterly groundwater sampling was conducted at CTF-MW2 in March, May, September, and December 2011.
- Quarterly reporting of analytical results for groundwater samples from CTF-MW2 was conducted.

Future Groundwater Monitoring Events

The groundwater monitoring events conducted on a site-wide basis as part of the SNL/NM GWPP and at site-specific LTS/ER Operations sites will continue on a quarterly, semiannual, annual, and biennial basis during CY 2012, as specified by regulatory guidance. The results for these monitoring events will be presented in the Annual Groundwater Monitoring Report for CY 2012.

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4.0 Mixed Waste Landfill

4.1 Introduction

The Mixed Waste Landfill (MWL) is a 2.6-acre site in the north-central portion of Technical Area III at Sandia National Laboratories, New Mexico (SNL/NM) (Figure 4-1). The MWL consists of two distinct disposal areas: the classified area (occupying 0.6 acres) and the unclassified area (occupying 2.0 acres). Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies (at the time of disposal) of activity were disposed of in the MWL from March 1959 through December 1988. Classified wastes were buried in cylindrical pits in the classified area and unclassified wastes were buried in shallow trenches in the unclassified area.

The Phase 1 Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) was conducted in 1989 and 1990 to determine whether a release of RCRA contaminants had occurred at the MWL (SNL September 1990). The Phase 1 RFI indicated that tritium had been released to the environment. A Phase 2 RFI was conducted from 1992 to 1995 to determine the contaminant source, define the nature and extent of contamination, identify potential contaminant transport pathways, evaluate potential risks, and provide remedial action alternatives for the MWL (Peace et al. 2002).

The Phase 2 RFI confirmed tritium as the constituent of concern (COC) in soil at the MWL. Tritium occurs in surface and near-surface soil in and around the classified area. Tritium levels range from 1,100 picocuries per gram (pCi/g) in surface soil to 206 pCi/g in subsurface soil. The highest tritium levels have been found within 30 feet (ft) below ground surface (bgs) in soil adjacent to and directly below the classified area disposal pits. At depths greater than 30 ft bgs, tritium levels decrease rapidly. At approximately 100 ft bgs, the highest tritium level detected has been 0.074 pCi/g, and at 120 to 140 ft bgs, maximum tritium levels have been 0.029 pCi/g.

On October 11, 2001, the New Mexico Environment Department (NMED) directed the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia) to conduct a Corrective Measures Study (CMS) for the MWL (SNL December 2001a). The MWL CMS Report (SNL May 2003) was submitted to the NMED on May 21, 2003, for technical review and comment and recommended that an alternative vegetative soil cover (i.e., evapotranspirative [ET] cover) be deployed as the preferred corrective measure for the MWL. The NMED held a public comment period on the MWL CMS from August 11 to December 9, 2004, and a public hearing was held from December 2 to December 3 and December 8 to December 9, 2004. On May 26, 2005, the Secretary of the NMED selected a vegetative ET cover with a biointrusion barrier as the final remedy for the MWL. The selection was documented in the NMED *Final Order, State of New Mexico Before the Secretary of the Environment in the Matter of Request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill* (NMED May 2005), which also required a Corrective Measures Implementation Plan (CMIP). The MWL CMIP (SNL November 2005) was submitted to the NMED in November 2005. The NMED conditionally approved the CMIP in December 2008 after resolution of two Notices of Disapproval (NODs) (Bearzi December 2008). The MWL ET cover construction was completed from May through September 2009.

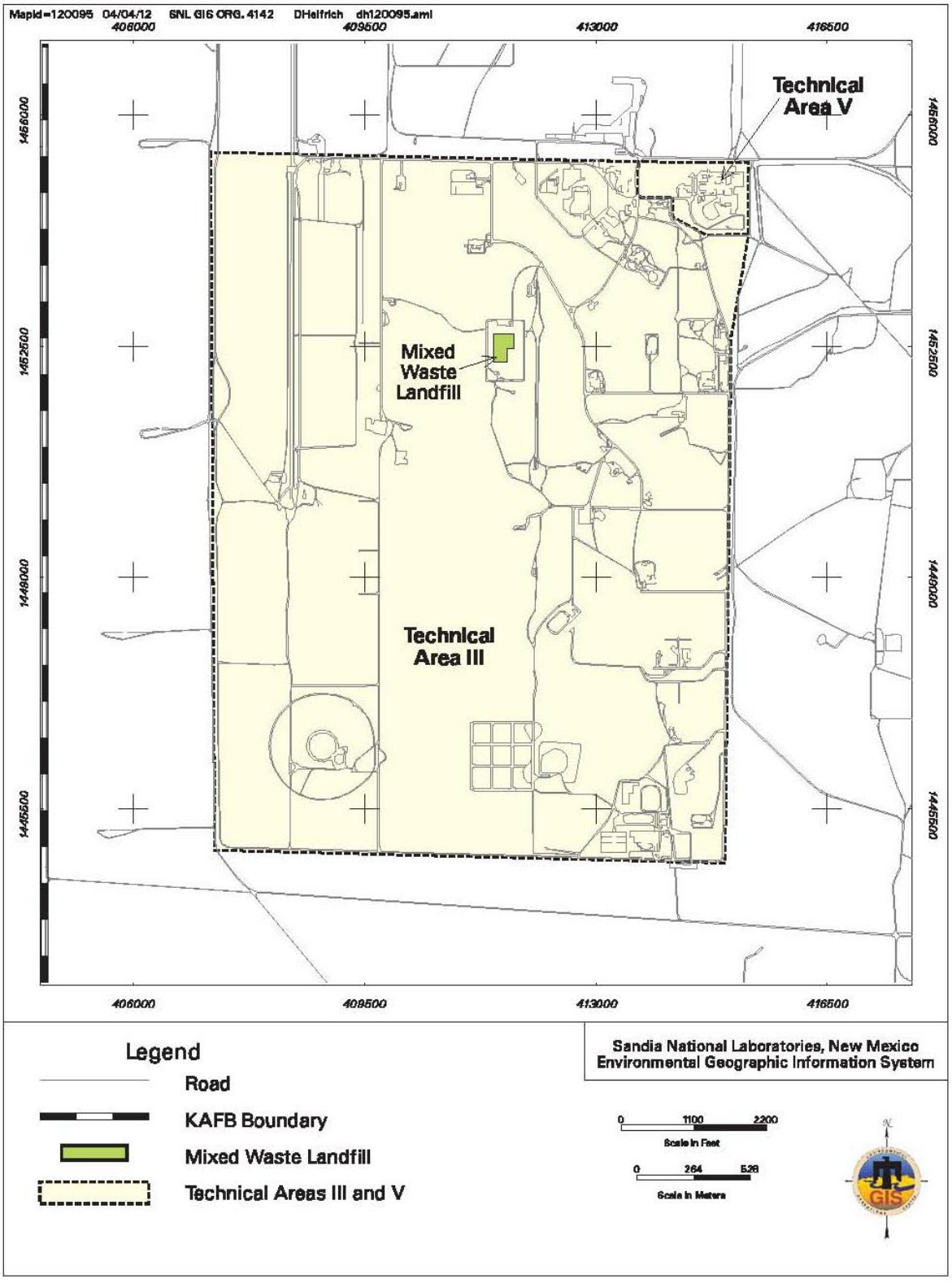

Figure 4-1. Location of the Mixed Waste Landfill within Technical Area III

4.1.1 Monitoring History

The original groundwater monitoring well network at the MWL (wells MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) was installed in 1989. In 1993, MWL-MW4 was completed at an angle of 6 degrees from vertical and was screened at two discrete intervals 20 ft apart to evaluate vertical potentiometric gradients and changes in aquifer parameters with depth. An inflatable packer separates the screened intervals, and nitrogen-gas pressure is maintained in the packer to prevent commingling water from the two screened sections of the aquifer. Monitoring wells MWL-MW5 and MWL-MW6 were installed in 2000 at a distance of approximately 200 and 500 ft west of the MWL, respectively, with the screened intervals placed below the top of the regional water table in the coarse-grained Ancestral Rio Grande (ARG) deposits.

The MWL groundwater monitoring network was modified in 2008 (SNL May 2009). Due to the declining water table and corrosion of stainless-steel well screens, four monitoring wells were plugged and abandoned (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) and four new monitoring wells were installed (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) (SNL April 2008 and September 2008). The four wells installed in 2008 comprise the MWL groundwater monitoring network for the uppermost part of the regional aquifer and were approved by the NMED (Bearzi October 2008 and January 2009).

Wells MWL-MW7, MWL-MW8, MWL-MW9, and MWL-BW2 were considered new wells and, as required by the Compliance Order on Consent (the Order) (NMED April 2004), were sampled a minimum of eight consecutive quarters for a defined suite of parameters in addition to sampling for perchlorate for at least four consecutive quarters. The four consecutive quarters of perchlorate sampling were completed in Calendar Year (CY) 2009 with no detections at or above the screening level of 4 micrograms per liter (µg/L); therefore, these wells have been removed from the perchlorate monitoring network. The required eight quarterly sampling events were completed in CY 2010. Wells MWL-MW4, MWL-MW5, and MWL-MW6 are preexisting wells and are sampled on an annual basis. All seven MWL wells are now sampled annually as required by the Order.

Figure 4-2 shows the current groundwater monitoring well network consisting of seven wells completed within the interfingering, fine-grained, alluvial-fan deposits (MWL-BW2, MWL-MW4 uppermost screened interval, MWL-MW7, MWL-MW8, and MWL-MW9) and coarse-grained ARG deposits (MWL-MW5 and MWL-MW6). The lower screened interval of MWL-MW4 is completed within the coarse-grained ARG deposits, but is not part of the current monitoring network. The seven MWL wells are constructed of 5-inch diameter, Schedule 80 polyvinyl chloride (PVC) casing and have screens composed of slotted Schedule 80 PVC.

During construction of the ET cover, the packer at MWL-MW4 was removed on May 27, 2009 to allow for the well casing to be extended upwards. The packer was serviced and reinstalled on March 4, 2010. References in this report to groundwater samples and water levels from MWL-MW4 refer to groundwater withdrawn or measured from the upper screened interval, and references made to the bottom of this well refer to the depth to the top of the packer.

In April 2010 the DOE and Sandia received a letter from the NMED entitled *Toluene Detections in Groundwater*, which required further investigation to determine the source of very low toluene concentrations in some groundwater samples collected from the MWL in 2008 through early 2010, including conducting a purging/sampling study of the groundwater along with any other studies necessary to determine the source (Bearzi April 2010). The DOE and Sandia submitted the *Mixed Waste Landfill Toluene Investigation Report* in August 2010 and received an NOD with two comments from the NMED in September 2010 (Bearzi September 2010). The DOE/Sandia NOD response (Wagner October 2010)

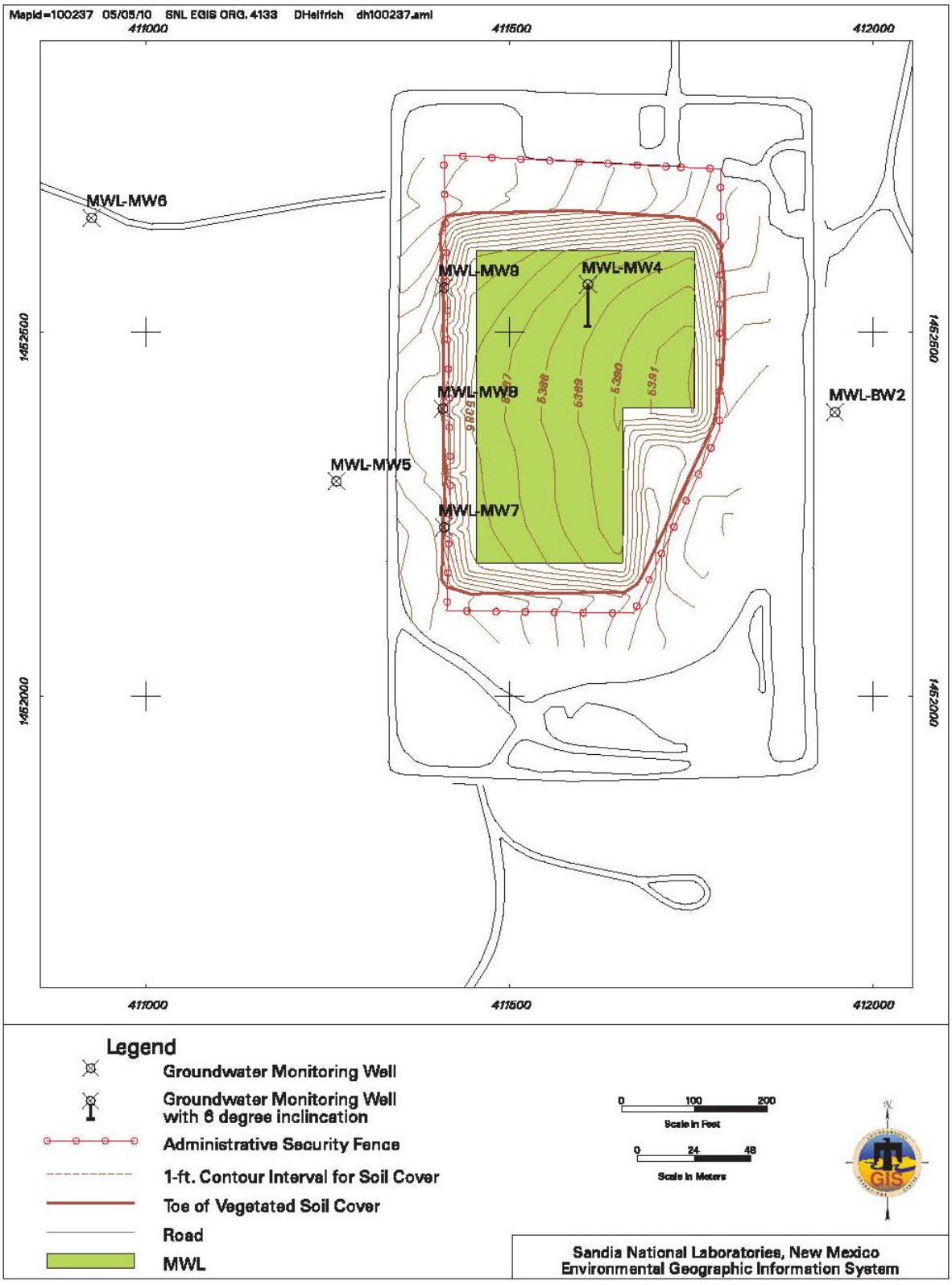

Figure 4-2. Location of Groundwater Monitoring Wells at the Mixed Waste Landfill

that included a revised version of the report (SNL October 2010) was submitted to the NMED in October 2010 and was approved in January 2011 (Bearzi January 2011).

Groundwater at the MWL has been extensively characterized since 1990 for major ion chemistry, volatile organic compounds (VOCs), semivolatile organic compounds, nitrate, metals, radionuclides, and perchlorate. Twenty years of data indicate that groundwater has not been contaminated by the MWL (Goering et al. 2002; SNL December 2001b, January 2002, July 2002, October 2002, June 2003, September 2003, July 2004; Lyon and Goering 2006; SNL November 2006, January 2008, May 2009, June 2010, October 2010, and September 2011).

4.1.2 Monitoring Network

The current groundwater monitoring network at the MWL consists of seven wells, as shown on Figure 4-2 and listed in Table 4-1. A single annual sampling event was conducted at the MWL in CY 2011.

Table 4-1. MWL Annual Groundwater Sampling Event, Calendar Year 2011

Well ID	Installation Year	WQ	WL	June 2011
MWL-BW2	2008	✓	✓	Annual
MWL-MW4*	1993	✓	✓	Annual
MWL-MW5	2000	✓	✓	Annual
MWL-MW6	2000	✓	✓	Annual
MWL-MW7	2008	✓	✓	Annual
MWL-MW8	2008	✓	✓	Annual
MWL-MW9	2008	✓	✓	Annual

NOTES:
Check marks in the WQ and WL columns indicate WQ sampling and WL measurements.
*Upper screen of MWL-MW4 is monitored and represents uppermost portion of regional aquifer.
BW = Background Well.
ID = Identification.
MW = Monitoring Well.
MWL = Mixed Waste Landfill.
WL = Water level.
WQ = Water quality.

4.1.3 Summary of Activities

Annual groundwater sampling was conducted in June 2011 at the MWL as summarized in Table 4-1. Groundwater samples were collected from the seven monitoring wells (MWL-BW2, MWL-MW4, MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9) and analyzed for VOCs, Target Analyte List (TAL) metals plus uranium, anions (as bromide, chloride, fluoride, and sulfate), alkalinity, nitrate plus nitrite (NPN), gamma spectroscopy, gross alpha/beta activity, and tritium. Duplicate environmental samples were collected at monitoring wells MWL-MW6 and MWL-MW8. Attachment 4A provides summary tables for the CY 2011 analytical results.

4.1.4 Summary of Future Activities

The MWL Corrective Measures Implementation (CMI) Report (SNL January 2010) documents the construction of the MWL ET cover and was submitted to the NMED on January 26, 2010. The topography of the ET cover and side slopes is shown on Figure 4-2. On October 14, 2011, the DOE and Sandia received NMED approval of the MWL CMI Report (Bearzi October 2011), and revision of the 2007 MWL Long-Term Monitoring and Maintenance Plan (LTMMP) was initiated. The revised LTMMP will be submitted to the NMED within 180 days of the NMED CMI Report approval, dated October 14,

2011 (anticipated submittal in March 2012). The LTMMP defines the long-term monitoring, maintenance, inspection, and repair requirements for the MWL.

4.1.5 Conceptual Site Model

Tritium and VOCs were identified as the COCs in groundwater at the MWL based on the Phase 2 RFI, CMIP, and more than 20 years of groundwater monitoring. A detailed conceptual site model is provided in the MWL Phase 2 RFI Report (Peace et al. 2002) and the *Mixed Waste Landfill Groundwater Report, 1990 through 2001* (Goering et al. 2002).

Groundwater at the MWL is contained within the regional aquifer, which consists of unconsolidated Santa Fe Group deposits (fine-grained alluvial-fan deposits and coarse-grained ARG deposits). The depth to water is approximately 500 ft bgs. Groundwater flows generally westward away from the Manzanita Mountains and towards the Rio Grande. Several water-supply wells operated by Kirtland Air Force Base (KAFB) and the Albuquerque Bernalillo County Water Utility Authority (ABCWUA) have profoundly modified the natural groundwater flow regime near the MWL and have created a trough in the water table in the western and northern portions of KAFB (Plate 1). As a result, water levels at the MWL have been steadily declining since monitoring began in 1990.

Due to the declining water level, the original groundwater monitoring well network (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3 installed in 1988 and 1989) was replaced, and four new wells were installed in 2008 (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9). The completion intervals of the four 2008 wells are deeper, with the well screens set across the uppermost part of the regional aquifer. The aquifer hydraulic conductivity, based on slug test results performed in the 2008 wells, range from 1.95×10^{-1} to 1.48×10^{-2} ft/day, with an average of 8.58×10^{-2} ft/day. The hydraulic conductivity for the 2008 wells is generally higher than that for the original MWL groundwater monitoring wells, indicating an increase in hydraulic conductivity with depth and proximity to the highly conductive ARG deposits.

Water levels were lower than expected in the 2008 monitoring wells relative to the water levels in the older wells. The lower groundwater elevations in MWL-MW7 through MWL-MW9 appear to be related to the following two major factors:

- Variations in hydraulic conductivity in the upper part of the regional aquifer (showing increasing hydraulic conductivities with depth)
- Ongoing large-scale pumping of groundwater by the KAFB and ABCWUA production wells, which has created a strong downward vertical gradient at the MWL.

The completion intervals of the new wells are deeper and within a higher hydraulic conductivity layer than the shallower wells that were replaced (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3). Thus, the vertical gradient and drawdown of the regional aquifer have greater impact in the new wells, resulting in a lower groundwater elevation relative to the previous monitoring well network.

An updated conceptual site model integrating the findings from the four monitoring wells installed in 2008 is presented in the *Mixed Waste Landfill Annual Groundwater Monitoring Report, Calendar Year 2009* (SNL June 2010). In summary, the geology of the upper portion of the regional aquifer, a stratified system, varies with depth from a low hydraulic conductivity layer (in which MWL-MW2 and former MWL-MW3 were screened) to a medium conductivity layer (in which the deeper screens of MWL-MW7, MWL-MW8, and MWL-MW9 reside) to a high conductivity layer corresponding to the ARG deposits (in which at least part of the screen intervals of MWL-MW4 [lower screen], MWL-MW5,

and MWL-MW6 are located). The uppermost surface of the regional aquifer continues to decline as a result of historic and ongoing large-scale pumping of groundwater by the KAFB and ABCWUA production wells. The overall effect at the MWL is that groundwater flow has a strong vertically downward component in the lower and medium conductivity layers in response to this regional drawdown from pumping (i.e., a draining system).

Figure 4-3 shows the October 2011 potentiometric surface of the regional aquifer beneath the MWL. Groundwater flows towards the west and northwest. Based on the contours, the horizontal gradient varies from approximately 0.02 to 0.08 feet/foot. The map is consistent with the conceptual site model and the base-wide potentiometric surface map presented on Plate 1. As shown on Plate 1, the potentiometric surface contours beneath Technical Area III generally trend north to south with the inferred groundwater flow direction being generally westward.

For the period from July 2008 to October 2011, groundwater levels in the four wells installed in 2008 (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) declined less than 2 ft (Figures 4B-1 and 4B-2). Monitoring wells MWL-MW7, MWL-MW8, and MWL-MW9 declined at rates ranging from 0.18 to 0.27 feet per year (ft/yr). Upgradient well MWL-BW2 showed a greater rate of decline at 0.47 ft/yr. Recharge from infiltration of direct precipitation at the MWL is negligible due to high evapotranspiration, low precipitation, the thick sequence of unsaturated Santa Fe Group deposits above the water table, and the presence of the ET cover. Groundwater recharge of the regional aquifer occurs by the infiltration of precipitation in the Manzanita Mountains located approximately 5 miles to the east.

4.2 Regulatory Criteria

Historically, the NMED Hazardous Waste Bureau has provided regulatory oversight of the MWL as Solid Waste Management Unit (SWMU) 76 under the Hazardous and Solid Waste Amendments module of the SNL/NM RCRA Permit. The NMED confirmed that the MWL is properly designated as a SWMU (Dinwiddie June 1998) and, as such, must comply with the corrective action program defined in Title 20, New Mexico Administrative Code, Section 4.1.50, incorporating Title 40, Code of Federal Regulations (CFR), Section 264.101. The requirements for corrective action at the MWL, including those for groundwater monitoring, are established through the corrective measures process.

The NMED issued the Order in April 2004, which transferred the regulatory authority for corrective action at the MWL to the Order (NMED April 2004). This report has been formatted to address the content criteria set forth in the Order for Periodic Monitoring Reports.

Although radionuclides are being monitored and screened at the MWL, the information related to radionuclides is provided voluntarily by the DOE and Sandia. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements imposed by the NMED, as specified in Section III.A of the Order (NMED April 2004).

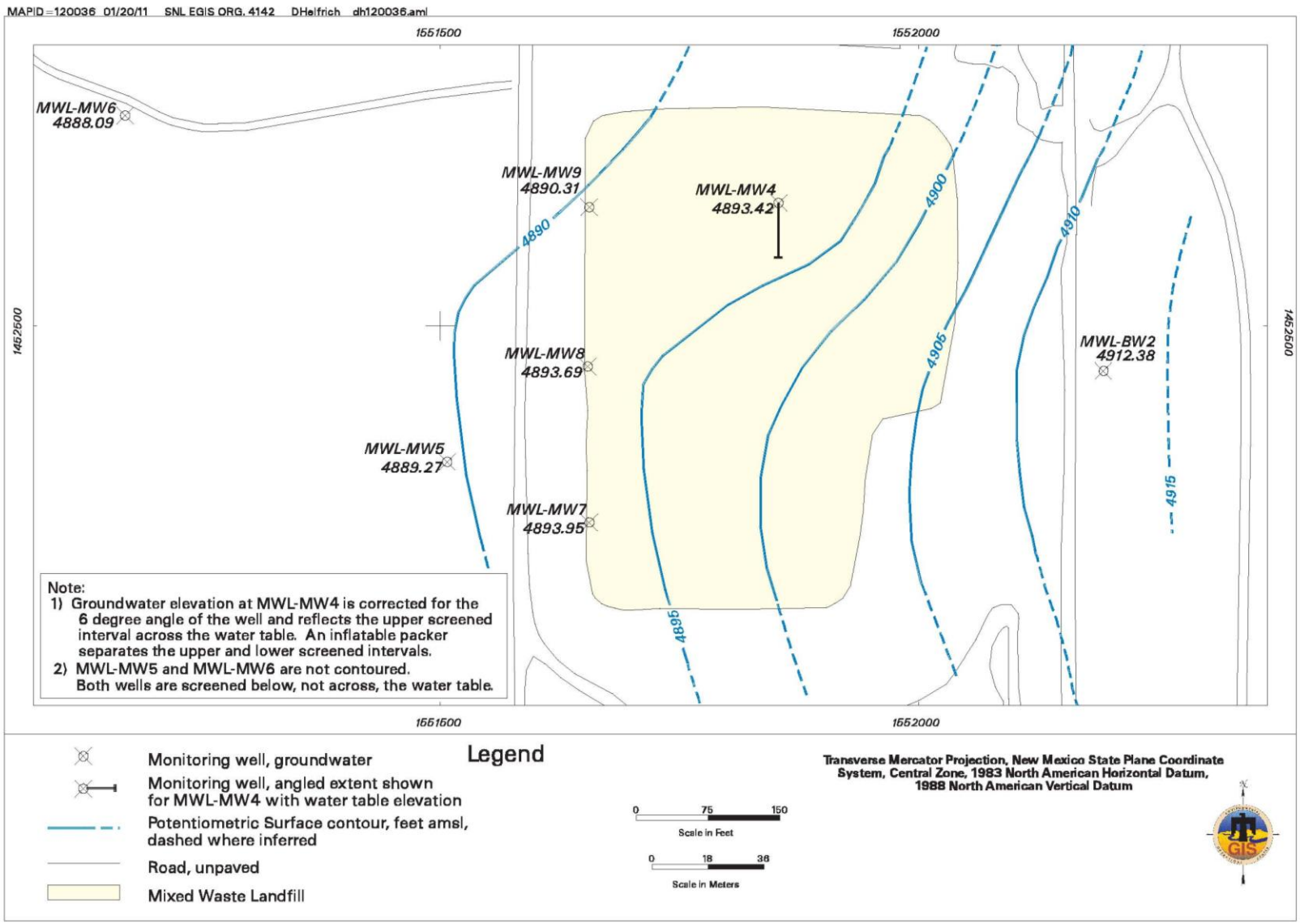

Figure 4-3. Localized Potentiometric Surface of the Basin Fill Aquifer at the Mixed Waste Landfill, October 2011

4.3 Scope of Activities

The CY 2011 annual groundwater sampling is summarized in Section 4.1.3. Table 4-2 lists the analytical parameters and MWL wells sampled. SNL/NM field personnel conducted the sampling from June 14 to June 28, 2011. Groundwater sampling activities were conducted in conformance with procedures outlined in the *Mixed Waste Landfill Groundwater Monitoring, Mini-Sampling and Analysis Plan for Fiscal Year 2011 Annual Sampling* (SNL January 2011).

Table 4-2. Analytical Parameters for the MWL Monitoring Wells, Calendar Year 2011

Analytical Parameter	June 2011
Volatile Organic Compounds	MWL–BW2 MWL–MW4 MWL–MW5 MWL–MW6 MWL–MW6 (dup) MWL–MW7 MWL–MW8 MWL–MW8 (dup) MWL–MW9
TAL metals plus Uranium	
Nitrate plus Nitrite (as nitrogen)	
Major Anions (Bromide, Fluoride, Chloride, and Sulfate)	
Total Alkalinity as Calcium Carbonate	
Radionuclides: Gamma-Emitting Radionuclides Gross Alpha Activity Gross Beta Activity Tritium	

NOTES:
BW = Background Well.
dup = Duplicate.
MW = Monitoring Well.
MWL = Mixed Waste Landfill.
TAL = Target Analyte List.

The MWL groundwater samples were submitted for analysis to GEL Laboratories LLC (GEL) in Charleston, South Carolina. All groundwater sampling results are compared with U.S. Environmental Protection Agency (EPA) maximum contaminant levels (MCLs) for drinking water supplies (EPA 2001 and 2009). The analytical results are summarized in Attachment 4A, Tables 4A-1 through 4A-7.

Field and laboratory quality control (QC) samples were prepared to determine the accuracy of the methods used and to detect inadvertent sample contamination that may have occurred during the sampling and analysis process. Field QC samples included duplicate environmental, equipment blank (EB), field blank (FB), and trip blank (TB) samples. Laboratory QC analyses performed included method blank, laboratory control sample, matrix spike, matrix spike duplicate, and surrogate spike analyses.

Water quality parameters were measured in the field for temperature, specific conductance (SC), oxidation-reduction potential, pH, and dissolved oxygen using an YSI™ Model 6920 Water Quality Meter during the purging process. Turbidity was measured with a Hach™ Model 2100P turbidity meter.

The NMED DOE Oversight Bureau (OB) was on site during the sampling activities and collected split samples for VOCs, metals, anions, NPN, gamma spectroscopy, gross alpha/beta activity, and tritium analyses. Additional samples were collected for isotopic uranium. SNL/NM personnel did not collect comparison samples during this annual sampling event. The NMED DOE OB split sampling results are presented in a separate report and are not discussed in this annual report.

4.4 Field Methods and Measurements

Groundwater elevation and water quality field measurements were obtained during groundwater sampling activities. Field water quality parameters are presented in Table 4A-8 (Attachment 4A). Depth-to-

groundwater measurements were obtained using a Solinst™ depth-to-water meter prior to purging activities. Depth-to-groundwater measurements were performed in accordance with the Field Operating Procedure (FOP), *Long-Term Environmental Stewardship Groundwater Monitoring Well Sampling and Field Analytical Measurements,* FOP 05-01 (SNL November 2009a).

Groundwater elevation measurements at the MWL monitoring wells from CY 2007 through CY 2011 are presented in Attachment 4B, Figures 4B-1 and 4B-2.

A Bennett™ sampling system was used to collect the groundwater samples from all MWL monitoring wells. The pump intake was set near or at the bottom of the screened interval. In accordance with procedures described in SNL/NM FOP 05-01 (SNL November 2009a), purging is conducted to remove stagnant water from the well so that a representative groundwater sample can be obtained. In accordance with the MWL Mini-Sampling and Analysis Plan (SAP) (SNL January 2011), the minimum purge requirement for the portable piston pump is one saturated screen volume (the volume of one length of the saturated screen plus the borehole annulus around the saturated screen interval). Purging continues until four stable water quality measurements for turbidity, pH, temperature, and SC were obtained from the well prior to the collection of groundwater samples. Groundwater stability is considered acceptable when measurements are less than 5 nephelometric turbidity units (NTU) or within 10 percent for turbidity values greater than 5 NTU, pH is within 0.1 standard units, temperature is within 1.0 degree Celsius, and SC is within 5 percent.

The purging requirement was achieved for four of the monitoring wells (MWL-BW2, MWL-MW5, MWL-MW6, and MWL-MW7) in June 2011. The minimum purge requirements were not met at three monitoring wells (MWL-MW4, MWL-MW8, and MWL-MW9). These three monitoring wells were purged to dryness, allowed to recover, and then sampled to collect the most representative groundwater sample possible given the low yield of these wells.

Groundwater samples were submitted to the off-site laboratory (GEL) following analysis request/chain of custody protocol.

4.5 Analytical Methods

The analytical laboratory analyzed the groundwater samples using EPA-approved analytical methods (EPA 1979, 1980, and 1986) and specified performance criteria in accordance with the *SNL/NM Statement of Work for Analytical Laboratories, Revision 5* (SNL March 2011). Prior to each sampling event, the analytical laboratory provided appropriate sample containers prepared with the required sample preservative. Table 4-3 summarizes analytical parameters, EPA Methods (EPA 1986), container types, and holding times applicable to groundwater sampling at the MWL during CY 2011.

4.6 Summary of Analytical Results

The analytical results for chemical, general chemistry, and radiological constituents are presented in Attachment 4A, Tables 4A-1 through 4A-7. Field water quality measurements are presented in Attachment 4A, Table 4A-8. Data qualifiers based on the data validation process are presented with the associated results in the Attachment 4A tables. Data validation and QC sample results associated with each sampling event are discussed in Section 4.7.

All the CY 2011 analytical results were compared with established EPA MCLs where applicable. None of the detected constituents exceed the respective MCLs. The analytical results are discussed in greater detail in the following sections.

Table 4-3. MWL Groundwater Sample Analyses, Methods, Sample Containers, Preservatives, and Holding Times

Analysis	Method[a]	Container Type/ Volume/Preservative	Holding Time
Total Metals (TAL and Uranium)	SW846-6010/6020/7470A	Polyethylene; 500 mL; HNO_3; 4°C	180 days and 28 days for mercury
Volatile Organic Compounds	SW846-8260B	Glass; 3 x 40 mL; HCl; 4°C	14 days
Nitrate plus Nitrite (as nitrogen)	EPA 353.2	Polyethylene; 250 mL; H_2SO_4; 4°C	28 days
Major Anions Total Alkalinity	EPA 353.2 SM2320B	Polyethylene; 500 mL; None; 4°C	28 days for anions 14 days for alkalinity
Gamma-Emitting Radionuclides	EPA 901.1	Polyethylene; 1 L; HNO_3	180 days
Gross Alpha/Beta Activity	EPA 900.0	Polyethylene; 1 L; HNO_3	180 days
Tritium	EPA 906.0	Amber Glass; 250 mL; None	180 days

NOTES:

[a]EPA, 1979, *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, U.S. Environmental Protection Agency, Cincinnati, Ohio.

EPA 1980, *Prescribed Procedures for Measurement of Radioactivity in Drinking Water*, EPA-600/4-80-032, U.S. Environmental Protection Agency, Cincinnati, Ohio.

EPA, 1986, *Test Methods for Evaluating Solid, Physical/Chemical Methods,* 3rd ed., (and updates), SW-846, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C., November; or Clesceri, Greenburg, and Eaton, 1998, *Standard Methods for the Examination of Water and Wastewater*, 20th ed., Method 2320B.

°C = Degree(s) Celsius.
EPA = U.S. Environmental Protection Agency.
H_2SO_4 = Sulfuric acid.
HCl = Hydrochloric acid.
HNO_3 = Nitric acid.
L = Liter(s).
mL = Milliliter(s).
MWL = Mixed Waste Landfill.
SM = Standard Method.
SW = Solid waste.
TAL = Target Analyte List.

4.6.1 Volatile Organic Compounds

Detected VOCs are presented in Attachment 4A, Table 4A-1. No VOCs were detected at concentrations above established MCLs in any groundwater sample. Chloroform was detected in the sample from MWL-MW4 at a concentration of 1.29 µg/L; no MCL is established for this compound. Toluene was qualified as not detected during data validation in both the MWL-MW8 environmental and duplicate environmental samples because the detected concentration is less than 10 times the associated FB sample result. Laboratory method detection limits (MDLs) for all VOCs are presented in Attachment 4A, Table 4A-2.

4.6.2 General Chemistry Parameters

The general chemistry analytical results are presented in Attachment 4A, Tables 4A-3 and 4A-4. NPN was not detected above the nitrate MCL of 10 milligrams per liter (mg/L) in any groundwater sample. NPN was detected at concentrations ranging from 1.04 mg/L in the sample from MWL-MW5 to 3.17 mg/L in the sample from MWL-MW7. The NPN results are summarized in Table 4A-3. Table 4A-4 summarizes the alkalinity and major anions (bromide, chloride, fluoride, and sulfate) results. No parameters were detected above established MCLs.

4.6.3 Metals

Metal analysis includes two sets of analyses and results, filtered and unfiltered. Groundwater samples obtained for total metal analyses are collected without filtering. Dissolved metal samples are collected by filtering the sample prior to analysis (SNL November 2009a). The difference in concentrations between the total and dissolved fraction may be attributed to the original metallic ion content of the particles and any sorption of ions to the suspended particles.

Table 4A-5 (Attachment 4A) summarizes the metal results, including total uranium, for all unfiltered groundwater samples collected during the CY 2011 annual monitoring event at the MWL. Samples were analyzed for TAL metals according to EPA Method 6020 (EPA 1986). Table 4A-6 (Attachment 4A) summarizes the metal results, including total uranium, for the filtered samples collected during the CY 2011 annual groundwater monitoring event.

TAL metals plus uranium were analyzed for each MWL monitoring well sample, in both unfiltered and filtered fractions. No metal parameters were detected above established MCLs in any groundwater sample.

4.6.4 Radiological Parameters

Groundwater samples from the MWL monitoring wells were screened for gamma-emitting radionuclides, gross alpha/beta activity, and tritium (Table 4A-7, Attachment 4A) and are compared with the established EPA MCLs (no MCL has been established for tritium).

Gross alpha activity is measured as a screening tool and according to 40 CFR, Parts 9, 141, and 142, Table I-4 and does not include uranium, which is measured independently. Therefore, gross alpha activity measurements were corrected by subtracting the total uranium activity. Corrected gross alpha activity results are all below the MCL of 15 picocuries per liter (pCi/L) and range from 0.32 to 7.24 pCi/L. Gross beta results do not exceed established MCLs. Tritium activity results are below the laboratory minimum detectable activity levels in all groundwater samples. All radiological parameter results are summarized in Table 4A-7 (Attachment 4A).

4.6.5 Water Quality Parameters

The field water quality parameters represent measurements obtained immediately before sampling. The CY 2011 results for MWL wells are presented in Attachment 4A, Table 4A-8.

4.7 Quality Control Results

Field and laboratory QC samples were used to determine the accuracy of the methods used and to monitor for inadvertent sample contamination that can occur during the sampling and analysis process. All data were reviewed in accordance with AOP [Administrative Operating Procedure] 00-03, *Data Validation Procedure for Chemical and Radiochemical Data* (SNL May 2011). The results for each QC analysis and the impact on data quality are discussed in the following sections.

4.7.1 Field Quality Control Samples

The QC samples collected in the field included duplicate environmental, EB, FB, and TB samples. Duplicate environmental samples are collected immediately after the environmental sample to provide information about sampling variability. EB samples are collected to verify the effectiveness of the sampling equipment decontamination process. FB samples provide a check for potential ambient sources of sample contamination during the sampling process and/or sampling error. TB samples are submitted whenever samples are collected for VOC analysis to assess whether contamination of the samples occurred during shipment and storage. The field QC samples were submitted to GEL for analysis along with the groundwater samples in accordance with the MWL Mini-SAP (SNL January 2011). The following sections discuss the analytical results for each QC sample type.

4.7.1.1 Duplicate Environmental Samples

Duplicate environmental samples were collected from MWL-MW6 and MWL-MW8 to estimate the overall reproducibility of the sampling and analytical process. The duplicate samples were collected immediately after the environmental samples to reduce variability caused by time and/or sampling mechanics. The duplicate environmental samples were analyzed for all analytical parameters.

Relative percent difference (RPD) calculations between duplicate and environmental sample results were performed for the detected chemical analytes. CY 2011 duplicate environmental sample results show good correlation with RPD values less than 20 for organic compounds and less than 35 for metals for all calculated parameters, except vanadium in the samples from MWL-MW8. The RPD values for unfiltered and filtered vanadium results were calculated at 38 and 52, respectively. The RPD values for vanadium are considered estimated values, as the reported concentrations are below the associated practical quantitation limits.

4.7.1.2 Equipment Blank Samples

A total of two EB samples (also referred to as a rinsate blanks) were collected during the CY 2011 sampling event at the MWL to verify the effectiveness of the equipment decontamination process. A portable Bennett™ groundwater sampling system was used to collect groundwater samples in all wells. The sampling pump and tubing bundle were decontaminated prior to installation into monitoring wells according to procedures described in SNL/NM FOP 05-03, *Long-Term Environmental Stewardship General Sampling Equipment Decontamination* (SNL November 2009b). In accordance with SNL/NM FOP 05-03, the following solutions were pumped through the sampling system: 5 gallons of deionized (DI) water mixed with 20 milliliters (mL) of nonphosphate laboratory detergent; 5 gallons of DI water; 5 gallons of DI water mixed with 20 mL of reagent-grade nitric acid; and 15 gallons of DI water. In addition, the outside of the pump tubing was rinsed with DI water. Two EB samples were collected prior to sampling monitoring wells MWL-MW6 and MWL-MW8 and submitted for all analyses.

Arsenic, bromodichloromethane, chloroform, chloride, copper, dibromochloromethane, magnesium, and sodium were detected in the EB samples. No corrective action was required for arsenic, bromodichloromethane, chloroform, or dibromochloromethane because these analytes were not detected in the associated environmental samples. No corrective action was required for chloride, magnesium, or sodium because these parameters were detected in environmental samples at concentrations greater than five times the blank result. All environmental sample results for copper were qualified as not detected during data validation because the associated environmental sample results are less than five times the EB result.

4.7.1.3 Field Blank Samples

FB samples were collected at the various sampling locations, stored with the associated environmental samples throughout the sampling process, and returned to the laboratory for VOC analyses with the associated environmental samples to assess whether contamination of the samples resulted from ambient field conditions. The FB samples are prepared by pouring DI water into sample containers at the sampling point (i.e., in the sampling truck at the well location) to simulate the transfer of environmental samples from the sampling system to the sample container.

A total of seven FB samples were collected during the June 2011 sampling event and submitted for VOC analysis to assess whether contamination of the samples resulted from ambient field conditions. Bromodichloromethane, carbon disulfide, chloroform, dibromochloromethane, and toluene were detected in the FB samples. No corrective action was required for bromodichloromethane, carbon disulfide, chloroform, or dibromochloromethane because these compounds were not detected in the associated environmental samples. Toluene was detected in the FB sample from MWL-MW8 at a concentration greater than the result for the associated environmental sample. As a result, toluene in the MWL-MW8 environmental sample was qualified as not detected during data validation.

4.7.1.4 Trip Blank Samples

TB samples consist of laboratory reagent-grade water with hydrochloric acid preservative contained in 40-mL volatile organic analysis vials prepared by the analytical laboratory. These samples accompany the

empty sample containers supplied by the laboratory and are brought to the field and accompany each VOC sample shipment. Nine TB samples were submitted with the June 2011 samples. No VOCs were detected above associated laboratory MDLs.

4.7.2 Laboratory Quality Control Samples

Internal laboratory QC samples, including method blanks and duplicate laboratory control samples, were analyzed concurrently with the groundwater samples. Additionally, batch matrix spike, matrix spike duplicate, and surrogate spike samples were analyzed. All environmental sample, field QC sample, and laboratory QC sample results were reviewed and qualified in accordance with AOP 00-03, *Data Validation Procedure for Chemical and Radiochemical Data* (SNL May 2011).

Although some analytical results were qualified as not detected or as estimated values during the data validation process, no significant data quality problems were noted for any CY 2011 MWL groundwater monitoring samples. Data validation reports and findings associated with MWL groundwater monitoring are filed in the SNL/NM Records Center.

4.8 Variances and Nonconformances

All analytical and field methods were performed according to the requirements specified in the MWL groundwater monitoring Mini-SAP for FY 2011 (SNL January 2011). No variances and/or nonconformances from requirements in the MWL Mini-SAP were identified during June 2011 sampling activities, and there were no variances from the plans.

4.9 Summary and Conclusions

During June 2011, environmental groundwater samples were collected from seven MWL groundwater monitoring wells. Sample parameters included VOCs, unfiltered and filtered fractions for TAL metals plus uranium, anions (as bromide, chloride, fluoride, and sulfate), alkalinity, NPN, gamma spectroscopy, gross alpha/beta activity, and tritium analyses. Groundwater monitoring results were compared with established EPA MCLs for drinking water (EPA 2009). No parameters were detected above established MCLs in any groundwater sample.

The groundwater monitoring results for the CY 2011 sampling event are consistent with data from previous sampling events, remain within the range of historical MWL groundwater data, and indicate that the MWL has not impacted groundwater beneath the site. Based on the field and laboratory QC sample and data validation results, the CY 2011 groundwater monitoring data are defensible and representative.

4.10 References

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Attachment 4A
Mixed Waste Landfill
Analytical Results Tables

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Attachment 4A Tables

4A-1 Summary of Detected Volatile Organic Compounds, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico, Calendar Year 2011 ..... 4A-5

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Table 4A-1
Summary of Detected Volatile Organic Compounds,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (µg/L)	MDL[b] (µg/L)	PQL[c] (µg/L)	MCL[d] (µg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW4 22-Jun-11	Chloroform	1.29	0.250	1.00	NE			090750-001	SW846-8260B
MWL-MW8 20-Jun-11	Toluene	0.300	0.250	1.00	1000	J	1.0U	090746-001	SW846-8260B
MWL-MW8 (Duplicate) 20-Jun-11	Toluene	0.320	0.250	1.00	1000	J	1.0U	090747-001	SW846-8260B

Refer to footnotes on page 4A-33.

Table 4A-2
Method Detection Limits for Volatile Organic Compounds (Method[g] SW846-8260B), Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Analyte	MDL[b] (µg/L)
1,1,1-Trichloroethane	0.325
1,1,2,2-Tetrachloroethane	0.250
1,1,2-Trichloroethane	0.250
1,1-Dichloroethane	0.300
1,1-Dichloroethene	0.300
1,2-Dichloroethane	0.250
1,2-Dichloropropane	0.250
2-Butanone	1.25
2-Hexanone	1.25
4-methyl-, 2-Pentanone	1.25
Acetone	3.50
Benzene	0.300
Bromodichloromethane	0.250
Bromoform	0.250
Bromomethane	0.300
Carbon disulfide	1.25
Carbon tetrachloride	0.300
Chlorobenzene	0.250
Chloroethane	0.300
Chloroform	0.250
Chloromethane	0.300
Dibromochloromethane	0.300
Ethyl benzene	0.250
Methylene chloride	3.00
Styrene	0.250
Tetrachloroethene	0.300
Toluene	0.250
Trichloroethene	0.250
Vinyl acetate	1.50
Vinyl chloride	0.500
Xylene	0.300
cis-1,2-Dichloroethene	0.300
cis-1,3-Dichloropropene	0.250
trans-1,2-Dichloroethene	0.300
trans-1,3-Dichloropropene	0.250

Refer to footnotes on page 4A-33.

Table 4A-3
Summary of Nitrate plus Nitrite Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-BW2 16-Jun-11	Nitrate plus nitrite as N	1.96	0.100	0.500	10.0			090741-018	EPA 353.2
MWL-MW4 22-Jun-11	Nitrate plus nitrite as N	1.92	0.100	0.500	10.0			090750-018	EPA 353.2
MWL-MW5 14-Jun-11	Nitrate plus nitrite as N	1.04	0.100	0.500	10.0			090732-018	EPA 353.2
MWL-MW6 15-Jun-11	Nitrate plus nitrite as N	1.49	0.100	0.500	10.0			090737-018	EPA 353.2
MWL-MW6 (Duplicate) 15-Jun-11	Nitrate plus nitrite as N	1.49	0.100	0.500	10.0			090738-018	EPA 353.2
MWL-MW7 28-Jun-11	Nitrate plus nitrite as N	3.17	0.100	0.500	10.0			090753-018	EPA 353.2
MWL-MW8 20-Jun-11	Nitrate plus nitrite as N	1.13	0.100	0.500	10.0			090746-018	EPA 353.2
MWL-MW8 (Duplicate) 20-Jun-11	Nitrate plus nitrite as N	1.16	0.100	0.500	10.0			090747-018	EPA 353.2
MWL-MW9 27-Jun-11	Nitrate plus nitrite as N	1.93	0.100	0.500	10.0			090729-018	EPA 353.2

Refer to footnotes on page 4A-33.

Table 4A-4
Summary of Alkalinity and Anion Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-BW2	Bicarbonate alkalinity	253	0.725	1.00	NE	B		090741-022	SM 2320B
16-Jun-11	Carbonate alkalinity	ND	0.725	1.00	NE	U		090741-022	SM 2320B
	Bromide	0.397	0.066	0.200	NE			090741-016	SW846 9056
	Chloride	70.6	0.330	1.00	NE			090741-016	SW846 9056
	Fluoride	0.678	0.033	0.100	4.0			090741-016	SW846 9056
	Sulfate	49.0	0.500	2.00	NE			090741-016	SW846 9056
MWL-MW4	Bicarbonate alkalinity	216	0.725	1.00	NE	B		090750-022	SM 2320B
22-Jun-11	Carbonate alkalinity	ND	0.725	1.00	NE	U		090750-022	SM 2320B
	Bromide	0.367	0.066	0.200	NE			090750-016	SW846 9056
	Chloride	54.2	0.330	1.00	NE			090750-016	SW846 9056
	Fluoride	0.987	0.033	0.100	4.0			090750-016	SW846 9056
	Sulfate	37.0	0.500	2.00	NE			090750-016	SW846 9056
MWL-MW5	Bicarbonate alkalinity	327	0.725	1.00	NE	B		090732-022	SM 2320B
14-Jun-11	Carbonate alkalinity	ND	0.725	1.00	NE	U		090732-022	SM 2320B
	Bromide	0.511	0.066	0.200	NE			090732-016	SW846 9056
	Chloride	82.8	0.660	2.00	NE			090732-016	SW846 9056
	Fluoride	0.736	0.033	0.100	4.0			090732-016	SW846 9056
	Sulfate	55.2	1.00	4.00	NE			090732-016	SW846 9056
MWL-MW6	Bicarbonate alkalinity	314	0.725	1.00	NE	B		090737-022	SM 2320B
15-Jun-11	Carbonate alkalinity	ND	0.725	1.00	NE	U		090737-022	SM 2320B
	Bromide	0.474	0.066	0.200	NE			090737-016	SW846 9056
	Chloride	82.7	0.660	2.00	NE			090737-016	SW846 9056
	Fluoride	0.702	0.033	0.100	4.0			090737-016	SW846 9056
	Sulfate	55.2	1.00	4.00	NE			090737-016	SW846 9056
MWL-MW6 (Duplicate)	Bicarbonate alkalinity	322	0.725	1.00	NE	B		090738-022	SM 2320B
15-Jun-11	Carbonate alkalinity	ND	0.725	1.00	NE	U		090738-022	SM 2320B
	Bromide	0.457	0.066	0.200	NE			090738-016	SW846 9056
	Chloride	82.6	0.660	2.00	NE			090738-016	SW846 9056
	Fluoride	0.685	0.033	0.100	4.0			090738-016	SW846 9056
	Sulfate	55.7	1.00	4.00	NE			090738-016	SW846 9056

Refer to footnotes on page 4A-33.

Table 4A-4 *(Concluded)*
Summary of Alkalinity and Anion Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW7	Bicarbonate alkalinity	215	0.725	1.00	NE	B		090753-022	SM 2320B
28-Jun-11	Carbonate alkalinity	ND	0.725	1.00	NE	U		090753-022	SM 2320B
	Bromide	0.296	0.066	0.200	NE			090753-016	SW846 9056
	Chloride	40.4	0.660	2.00	NE			090753-016	SW846 9056
	Fluoride	1.10	0.033	0.100	4.0			090753-016	SW846 9056
	Sulfate	38.3	0.100	0.400	NE			090753-016	SW846 9056
MWL-MW8	Bicarbonate alkalinity	225	0.725	1.00	NE	B		090746-022	SM 2320B
20-Jun-11	Carbonate alkalinity	ND	0.725	1.00	NE	U		090746-022	SM 2320B
	Bromide	0.318	0.066	0.200	NE			090746-016	SW846 9056
	Chloride	48.6	0.330	1.00	NE			090746-016	SW846 9056
	Fluoride	1.09	0.033	0.100	4.0			090746-016	SW846 9056
	Sulfate	36.2	0.100	0.400	NE			090746-016	SW846 9056
MWL-MW8 (Duplicate)	Bicarbonate alkalinity	225	0.725	1.00	NE	B		090747-022	SM 2320B
20-Jun-11	Carbonate alkalinity	ND	0.725	1.00	NE	U		090747-022	SM 2320B
	Bromide	0.296	0.066	0.200	NE			090747-016	SW846 9056
	Chloride	47.7	0.330	1.00	NE			090747-016	SW846 9056
	Fluoride	1.07	0.033	0.100	4.0			090747-016	SW846 9056
	Sulfate	36.2	0.100	0.400	NE			090747-016	SW846 9056
MWL-MW9	Bicarbonate alkalinity	229	0.725	1.00	NE	B		090729-022	SM 2320B
27-Jun-11	Carbonate alkalinity	ND	0.725	1.00	NE	U		090729-022	SM 2320B
	Bromide	0.295	0.066	0.200	NE			090729-016	SW846 9056
	Chloride	38.5	0.660	2.00	NE			090729-016	SW846 9056
	Fluoride	1.07	0.033	0.100	4.0			090729-016	SW846 9056
	Sulfate	39.5	0.100	0.400	NE			090729-016	SW846 9056

Refer to footnotes on page 4A-33.

Table 4A-5
Summary of Total Metal Results (Unfiltered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-BW2	Aluminum	ND	0.015	0.050	NE	U		090741-009	SW846 6020
16-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090741-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		090741-009	SW846 6020
	Barium	0.0984	0.0006	0.002	2.00			090741-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090741-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090741-009	SW846 6020
	Calcium	76.0	0.600	2.00	NE			090741-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090741-009	SW846 6020
	Cobalt	0.000188	0.0001	0.001	NE	J		090741-009	SW846 6020
	Copper	0.00072	0.00035	0.001	NE	J		090741-009	SW846 6020
	Iron	0.285	0.033	0.100	NE			090741-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090741-009	SW846 6020
	Magnesium	21.9	0.010	0.030	NE			090741-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		090741-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090741-009	SW846 7470
	Nickel	0.00226	0.0005	0.002	NE			090741-009	SW846 6020
	Potassium	3.71	0.080	0.300	NE			090741-009	SW846 6020
	Selenium	0.00241	0.0015	0.005	0.050	J		090741-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090741-009	SW846 6020
	Sodium	63.6	0.800	2.50	NE			090741-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090741-009	SW846 6020
	Uranium	0.00725	0.000067	0.0002	0.030			090741-009	SW846 6020
	Vanadium	0.00623	0.001	0.005	NE			090741-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		090741-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-5 *(Continued)*
Summary of Total Metal Results (Unfiltered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW4	Aluminum	ND	0.015	0.050	NE	U		090750-009	SW846 6020
22-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090750-009	SW846 6020
	Arsenic	0.00308	0.0017	0.005	0.010	J		090750-009	SW846 6020
	Barium	0.0911	0.0006	0.002	2.00			090750-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090750-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090750-009	SW846 6020
	Calcium	61.7	0.300	1.00	NE			090750-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090750-009	SW846 6020
	Cobalt	0.00023	0.0001	0.001	NE	J		090750-009	SW846 6020
	Copper	0.00326	0.00035	0.001	NE			090750-009	SW846 6020
	Iron	0.261	0.033	0.100	NE			090750-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090750-009	SW846 6020
	Magnesium	19.8	0.010	0.030	NE			090750-009	SW846 6020
	Manganese	0.007	0.001	0.005	NE			090750-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090750-009	SW846 7470
	Nickel	0.130	0.0005	0.002	NE			090750-009	SW846 6020
	Potassium	5.16	0.080	0.300	NE			090750-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		090750-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090750-009	SW846 6020
	Sodium	49.8	0.080	0.250	NE			090750-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090750-009	SW846 6020
	Uranium	0.00575	0.000067	0.0002	0.030			090750-009	SW846 6020
	Vanadium	0.00892	0.001	0.005	NE			090750-009	SW846 6010
	Zinc	0.0649	0.0035	0.010	NE			090750-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-5 *(Continued)*
Summary of Total Metal Results (Unfiltered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW5	Aluminum	ND	0.015	0.050	NE	U		090732-009	SW846 6020
14-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090732-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		090732-009	SW846 6020
	Barium	0.121	0.0006	0.002	2.00			090732-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090732-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090732-009	SW846 6020
	Calcium	98.0	0.600	2.00	NE			090732-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090732-009	SW846 6020
	Cobalt	0.00027	0.0001	0.001	NE	J		090732-009	SW846 6020
	Copper	0.000898	0.00035	0.001	NE	J		090732-009	SW846 6020
	Iron	0.371	0.033	0.100	NE			090732-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090732-009	SW846 6020
	Magnesium	30.2	0.010	0.030	NE			090732-009	SW846 6020
	Manganese	0.0214	0.001	0.005	NE			090732-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090732-009	SW846 7470
	Nickel	0.00317	0.0005	0.002	NE			090732-009	SW846 6020
	Potassium	5.74	0.080	0.300	NE			090732-009	SW846 6020
	Selenium	0.00154	0.0015	0.005	0.050	J		090732-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090732-009	SW846 6020
	Sodium	71.8	0.800	2.50	NE			090732-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090732-009	SW846 6020
	Uranium	0.00924	0.000067	0.0002	0.030			090732-009	SW846 6020
	Vanadium	0.00422	0.001	0.005	NE	J		090732-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		090732-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-5 *(Continued)*
Summary of Total Metal Results (Unfiltered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW6	Aluminum	ND	0.015	0.050	NE	U		090737-009	SW846 6020
15-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090737-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		090737-009	SW846 6020
	Barium	0.115	0.0006	0.002	2.00			090737-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090737-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090737-009	SW846 6020
	Calcium	96.4	0.600	2.00	NE			090737-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090737-009	SW846 6020
	Cobalt	0.000237	0.0001	0.001	NE	J		090737-009	SW846 6020
	Copper	0.000949	0.00035	0.001	NE	J	0.0022U	090737-009	SW846 6020
	Iron	0.331	0.033	0.100	NE			090737-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090737-009	SW846 6020
	Magnesium	27.7	0.010	0.030	NE			090737-009	SW846 6020
	Manganese	0.00108	0.001	0.005	NE	J		090737-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090737-009	SW846 7470
	Nickel	0.00266	0.0005	0.002	NE			090737-009	SW846 6020
	Potassium	5.61	0.080	0.300	NE			090737-009	SW846 6020
	Selenium	0.0022	0.0015	0.005	0.050	J		090737-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090737-009	SW846 6020
	Sodium	65.9	0.800	2.50	NE			090737-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090737-009	SW846 6020
	Uranium	0.00979	0.000067	0.0002	0.030			090737-009	SW846 6020
	Vanadium	0.00615	0.001	0.005	NE			090737-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		090737-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-5 *(Continued)*
Summary of Total Metal Results (Unfiltered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW6 (Duplicate)	Aluminum	ND	0.015	0.050	NE	U		090738-009	SW846 6020
15-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090738-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		090738-009	SW846 6020
	Barium	0.115	0.0006	0.002	2.00			090738-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090738-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090738-009	SW846 6020
	Calcium	95.5	0.600	2.00	NE			090738-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090738-009	SW846 6020
	Cobalt	0.000223	0.0001	0.001	NE	J		090738-009	SW846 6020
	Copper	0.000936	0.00035	0.001	NE	J	0.0022U	090738-009	SW846 6020
	Iron	0.329	0.033	0.100	NE			090738-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090738-009	SW846 6020
	Magnesium	27.9	0.010	0.030	NE			090738-009	SW846 6020
	Manganese	0.00106	0.001	0.005	NE	J		090738-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090738-009	SW846 7470
	Nickel	0.00267	0.0005	0.002	NE			090738-009	SW846 6020
	Potassium	5.35	0.080	0.300	NE			090738-009	SW846 6020
	Selenium	0.0022	0.0015	0.005	0.050	J		090738-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090738-009	SW846 6020
	Sodium	71.5	0.800	2.50	NE			090738-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090738-009	SW846 6020
	Uranium	0.0097	0.000067	0.0002	0.030			090738-009	SW846 6020
	Vanadium	0.00648	0.001	0.005	NE			090738-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		090738-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-5 *(Continued)*
Summary of Total Metal Results (Unfiltered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW7	Aluminum	ND	0.015	0.050	NE	U		090753-009	SW846 6020
28-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090753-009	SW846 6020
	Arsenic	0.00231	0.0017	0.005	0.010	J		090753-009	SW846 6020
	Barium	0.100	0.0006	0.002	2.00			090753-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090753-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090753-009	SW846 6020
	Calcium	59.0	0.300	1.00	NE			090753-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090753-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	U		090753-009	SW846 6020
	Copper	0.000447	0.00035	0.001	NE	J		090753-009	SW846 6020
	Iron	0.146	0.033	0.100	NE			090753-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090753-009	SW846 6020
	Magnesium	19.8	0.010	0.030	NE			090753-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		090753-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090753-009	SW846 7470
	Nickel	0.00174	0.0005	0.002	NE	B, J	0.0028U	090753-009	SW846 6020
	Potassium	5.17	0.080	0.300	NE			090753-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		090753-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090753-009	SW846 6020
	Sodium	48.5	0.080	0.250	NE			090753-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090753-009	SW846 6020
	Uranium	0.00816	0.000067	0.0002	0.030			090753-009	SW846 6020
	Vanadium	0.00644	0.001	0.005	NE			090753-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		090753-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-5 *(Continued)*
Summary of Total Metal Results (Unfiltered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW8	Aluminum	ND	0.015	0.050	NE	U		090746-009	SW846 6020
20-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090746-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		090746-009	SW846 6020
	Barium	0.122	0.0006	0.002	2.00			090746-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090746-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090746-009	SW846 6020
	Calcium	57.8	0.300	1.00	NE			090746-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090746-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	U		090746-009	SW846 6020
	Copper	0.000687	0.00035	0.001	NE	J	0.0019U	090746-009	SW846 6020
	Iron	0.163	0.033	0.100	NE			090746-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090746-009	SW846 6020
	Magnesium	18.6	0.010	0.030	NE			090746-009	SW846 6020
	Manganese	0.00284	0.001	0.005	NE	J		090746-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090746-009	SW846 7470
	Nickel	0.00177	0.0005	0.002	NE	J		090746-009	SW846 6020
	Potassium	4.40	0.080	0.300	NE			090746-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		090746-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090746-009	SW846 6020
	Sodium	49.0	0.080	0.250	NE			090746-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090746-009	SW846 6020
	Uranium	0.00712	0.000067	0.0002	0.030			090746-009	SW846 6020
	Vanadium	0.00165	0.001	0.005	NE	J		090746-009	SW846 6010
	Zinc	0.00391	0.0035	0.010	NE	J		090746-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-5 *(Continued)*
Summary of Total Metal Results (Unfiltered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW8 (Duplicate)	Aluminum	ND	0.015	0.050	NE	U		090747-009	SW846 6020
20-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090747-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		090747-009	SW846 6020
	Barium	0.126	0.0006	0.002	2.00			090747-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090747-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090747-009	SW846 6020
	Calcium	59.3	0.300	1.00	NE			090747-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090747-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	U		090747-009	SW846 6020
	Copper	0.000585	0.00035	0.001	NE	J	0.0019U	090747-009	SW846 6020
	Iron	0.175	0.033	0.100	NE			090747-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090747-009	SW846 6020
	Magnesium	18.9	0.010	0.030	NE			090747-009	SW846 6020
	Manganese	0.00287	0.001	0.005	NE	J		090747-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090747-009	SW846 7470
	Nickel	0.00173	0.0005	0.002	NE	J		090747-009	SW846 6020
	Potassium	4.51	0.080	0.300	NE			090747-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		090747-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090747-009	SW846 6020
	Sodium	46.7	0.080	0.250	NE			090747-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090747-009	SW846 6020
	Uranium	0.0075	0.000067	0.0002	0.030			090747-009	SW846 6020
	Vanadium	0.00112	0.001	0.005	NE	J		090747-009	SW846 6010
	Zinc	0.00474	0.0035	0.010	NE	J		090747-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-5 *(Concluded)*
Summary of Total Metal Results (Unfiltered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW9	Aluminum	ND	0.015	0.050	NE	U		090729-009	SW846 6020
27-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090729-009	SW846 6020
	Arsenic	0.00375	0.0017	0.005	0.010	J		090729-009	SW846 6020
	Barium	0.0947	0.0006	0.002	2.00			090729-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090729-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090729-009	SW846 6020
	Calcium	58.9	0.300	1.00	NE			090729-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090729-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	U		090729-009	SW846 6020
	Copper	0.000631	0.00035	0.001	NE	J		090729-009	SW846 6020
	Iron	0.151	0.033	0.100	NE			090729-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090729-009	SW846 6020
	Magnesium	20.7	0.010	0.030	NE			090729-009	SW846 6020
	Manganese	0.00142	0.001	0.005	NE	J		090729-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090729-009	SW846 7470
	Nickel	0.00156	0.0005	0.002	NE	B, J	0.0028U	090729-009	SW846 6020
	Potassium	5.11	0.080	0.300	NE			090729-009	SW846 6020
	Selenium	0.00152	0.0015	0.005	0.050	J		090729-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090729-009	SW846 6020
	Sodium	47.1	0.080	0.250	NE			090729-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090729-009	SW846 6020
	Uranium	0.00926	0.000067	0.0002	0.030			090729-009	SW846 6020
	Vanadium	0.00833	0.001	0.005	NE			090729-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		090729-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6
Summary of Total Metal Results (Filtered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-BW2	Aluminum	ND	0.015	0.050	NE	U		090741-010	SW846 6020
16-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090741-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		090741-010	SW846 6020
	Barium	0.0985	0.0006	0.002	2.00			090741-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090741-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090741-010	SW846 6020
	Calcium	75.3	0.600	2.00	NE			090741-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090741-010	SW846 6020
	Cobalt	0.00021	0.0001	0.001	NE	J		090741-010	SW846 6020
	Copper	0.000729	0.00035	0.001	NE	J		090741-010	SW846 6020
	Iron	0.272	0.033	0.100	NE			090741-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090741-010	SW846 6020
	Magnesium	22.6	0.010	0.030	NE			090741-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		090741-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090741-010	SW846 7470
	Nickel	0.00213	0.0005	0.002	NE			090741-010	SW846 6020
	Potassium	3.69	0.080	0.300	NE			090741-010	SW846 6020
	Selenium	0.0021	0.0015	0.005	0.050	J		090741-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090741-010	SW846 6020
	Sodium	62.3	0.800	2.50	NE			090741-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090741-010	SW846 6020
	Uranium	0.00717	0.000067	0.0002	0.030			090741-010	SW846 6020
	Vanadium	0.00625	0.001	0.005	NE			090741-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		090741-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6 *(Continued)*
Summary of Total Metal Results (Filtered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW4	Aluminum	ND	0.015	0.050	NE	U		090750-010	SW846 6020
22-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090750-010	SW846 6020
	Arsenic	0.00263	0.0017	0.005	0.010	J		090750-010	SW846 6020
	Barium	0.0934	0.0006	0.002	2.00			090750-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090750-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090750-010	SW846 6020
	Calcium	60.0	0.300	1.00	NE			090750-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090750-010	SW846 6020
	Cobalt	0.000235	0.0001	0.001	NE	J		090750-010	SW846 6020
	Copper	0.00171	0.00035	0.001	NE			090750-010	SW846 6020
	Iron	0.157	0.033	0.100	NE			090750-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090750-010	SW846 6020
	Magnesium	19.1	0.010	0.030	NE			090750-010	SW846 6020
	Manganese	0.00619	0.001	0.005	NE			090750-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090750-010	SW846 7470
	Nickel	0.128	0.0005	0.002	NE			090750-010	SW846 6020
	Potassium	5.29	0.080	0.300	NE			090750-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		090750-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090750-010	SW846 6020
	Sodium	50.9	0.400	1.25	NE			090750-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090750-010	SW846 6020
	Uranium	0.00571	0.000067	0.0002	0.030			090750-010	SW846 6020
	Vanadium	0.00892	0.001	0.005	NE			090750-010	SW846 6010
	Zinc	0.0609	0.0035	0.010	NE			090750-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6 *(Continued)*
Summary of Total Metal Results (Filtered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW5	Aluminum	ND	0.015	0.050	NE	U		090732-010	SW846 6020
14-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090732-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		090732-010	SW846 6020
	Barium	0.126	0.0006	0.002	2.00			090732-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090732-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090732-010	SW846 6020
	Calcium	98.6	0.600	2.00	NE			090732-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090732-010	SW846 6020
	Cobalt	0.000277	0.0001	0.001	NE	J		090732-010	SW846 6020
	Copper	0.000858	0.00035	0.001	NE	J		090732-010	SW846 6020
	Iron	0.351	0.033	0.100	NE			090732-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090732-010	SW846 6020
	Magnesium	29.4	0.010	0.030	NE			090732-010	SW846 6020
	Manganese	0.00238	0.001	0.005	NE	J		090732-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090732-010	SW846 7470
	Nickel	0.00285	0.0005	0.002	NE			090732-010	SW846 6020
	Potassium	6.39	0.080	0.300	NE			090732-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		090732-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090732-010	SW846 6020
	Sodium	78.1	0.800	2.50	NE			090732-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090732-010	SW846 6020
	Uranium	0.00908	0.000067	0.0002	0.030			090732-010	SW846 6020
	Vanadium	0.0044	0.001	0.005	NE	J		090732-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		090732-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6 *(Continued)*
Summary of Total Metal Results (Filtered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW6	Aluminum	0.0159	0.015	0.050	NE	J		090737-010	SW846 6020
15-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090737-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		090737-010	SW846 6020
	Barium	0.117	0.0006	0.002	2.00			090737-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090737-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090737-010	SW846 6020
	Calcium	98.1	0.600	2.00	NE			090737-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090737-010	SW846 6020
	Cobalt	0.000234	0.0001	0.001	NE	J		090737-010	SW846 6020
	Copper	0.000973	0.00035	0.001	NE	J	0.0024U	090737-010	SW846 6020
	Iron	0.340	0.033	0.100	NE			090737-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090737-010	SW846 6020
	Magnesium	29.4	0.010	0.030	NE			090737-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		090737-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090737-010	SW846 7470
	Nickel	0.00269	0.0005	0.002	NE			090737-010	SW846 6020
	Potassium	5.67	0.080	0.300	NE			090737-010	SW846 6020
	Selenium	0.00171	0.0015	0.005	0.050	J		090737-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090737-010	SW846 6020
	Sodium	73.1	0.800	2.50	NE			090737-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090737-010	SW846 6020
	Uranium	0.0096	0.000067	0.0002	0.030			090737-010	SW846 6020
	Vanadium	0.00633	0.001	0.005	NE			090737-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		090737-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6 *(Continued)*
Summary of Total Metal Results (Filtered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW6 (Duplicate)	Aluminum	ND	0.015	0.050	NE	U		090738-010	SW846 6020
15-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090738-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		090738-010	SW846 6020
	Barium	0.117	0.0006	0.002	2.00			090738-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090738-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090738-010	SW846 6020
	Calcium	96.6	0.600	2.00	NE			090738-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090738-010	SW846 6020
	Cobalt	0.000232	0.0001	0.001	NE	J		090738-010	SW846 6020
	Copper	0.000891	0.00035	0.001	NE	J	0.0024U	090738-010	SW846 6020
	Iron	0.324	0.033	0.100	NE			090738-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090738-010	SW846 6020
	Magnesium	28.9	0.010	0.030	NE			090738-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		090738-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090738-010	SW846 7470
	Nickel	0.00261	0.0005	0.002	NE			090738-010	SW846 6020
	Potassium	5.65	0.080	0.300	NE			090738-010	SW846 6020
	Selenium	0.00215	0.0015	0.005	0.050	J		090738-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090738-010	SW846 6020
	Sodium	67.7	0.800	2.50	NE			090738-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090738-010	SW846 6020
	Uranium	0.00979	0.000067	0.0002	0.030			090738-010	SW846 6020
	Vanadium	0.00612	0.001	0.005	NE			090738-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		090738-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6 *(Continued)*
Summary of Total Metal Results (Filtered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW7	Aluminum	ND	0.015	0.050	NE	U		090753-010	SW846 6020
28-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090753-010	SW846 6020
	Arsenic	0.00302	0.0017	0.005	0.010	J		090753-010	SW846 6020
	Barium	0.104	0.0006	0.002	2.00			090753-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090753-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090753-010	SW846 6020
	Calcium	59.3	0.300	1.00	NE			090753-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090753-010	SW846 6020
	Cobalt	0.000127	0.0001	0.001	NE	J		090753-010	SW846 6020
	Copper	0.000447	0.00035	0.001	NE	J		090753-010	SW846 6020
	Iron	0.146	0.033	0.100	NE			090753-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090753-010	SW846 6020
	Magnesium	19.9	0.010	0.030	NE			090753-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		090753-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090753-010	SW846 7470
	Nickel	0.00167	0.0005	0.002	NE	B, J	0.0028U	090753-010	SW846 6020
	Potassium	5.24	0.080	0.300	NE			090753-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		090753-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090753-010	SW846 6020
	Sodium	48.5	0.080	0.250	NE			090753-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090753-010	SW846 6020
	Uranium	0.00818	0.000067	0.0002	0.030			090753-010	SW846 6020
	Vanadium	0.00618	0.001	0.005	NE			090753-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		090753-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6 *(Continued)*
Summary of Total Metal Results (Filtered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW8	Aluminum	ND	0.015	0.050	NE	U		090746-010	SW846 6020
20-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090746-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		090746-010	SW846 6020
	Barium	0.122	0.0006	0.002	2.00			090746-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090746-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090746-010	SW846 6020
	Calcium	60.5	0.300	1.00	NE			090746-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090746-010	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	U		090746-010	SW846 6020
	Copper	0.00052	0.00035	0.001	NE	J		090746-010	SW846 6020
	Iron	0.159	0.033	0.100	NE			090746-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090746-010	SW846 6020
	Magnesium	19.9	0.010	0.030	NE			090746-010	SW846 6020
	Manganese	0.00129	0.001	0.005	NE	J		090746-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090746-010	SW846 7470
	Nickel	0.00169	0.0005	0.002	NE	J		090746-010	SW846 6020
	Potassium	4.98	0.080	0.300	NE			090746-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		090746-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090746-010	SW846 6020
	Sodium	47.7	0.080	0.250	NE			090746-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090746-010	SW846 6020
	Uranium	0.00722	0.000067	0.0002	0.030			090746-010	SW846 6020
	Vanadium	0.00228	0.001	0.005	NE	J		090746-010	SW846 6010
	Zinc	0.00352	0.0035	0.010	NE	J		090746-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6 *(Continued)*
Summary of Total Metal Results (Filtered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW8 (Duplicate)	Aluminum	ND	0.015	0.050	NE	U		090747-010	SW846 6020
20-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090747-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		090747-010	SW846 6020
	Barium	0.123	0.0006	0.002	2.00			090747-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090747-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090747-010	SW846 6020
	Calcium	57.6	0.300	1.00	NE			090747-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090747-010	SW846 6020
	Cobalt	0.000119	0.0001	0.001	NE	J		090747-010	SW846 6020
	Copper	0.000551	0.00035	0.001	NE	J		090747-010	SW846 6020
	Iron	0.150	0.033	0.100	NE			090747-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090747-010	SW846 6020
	Magnesium	18.8	0.010	0.030	NE			090747-010	SW846 6020
	Manganese	0.00138	0.001	0.005	NE	J		090747-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090747-010	SW846 7470
	Nickel	0.00163	0.0005	0.002	NE	J		090747-010	SW846 6020
	Potassium	4.84	0.080	0.300	NE			090747-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		090747-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090747-010	SW846 6020
	Sodium	46.5	0.080	0.250	NE			090747-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090747-010	SW846 6020
	Uranium	0.00746	0.000067	0.0002	0.030			090747-010	SW846 6020
	Vanadium	0.00134	0.001	0.005	NE	J		090747-010	SW846 6010
	Zinc	0.00392	0.0035	0.010	NE	J		090747-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6 *(Concluded)*
Summary of Total Metal Results (Filtered),
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW9	Aluminum	ND	0.015	0.050	NE	U		090729-010	SW846 6020
27-Jun-11	Antimony	ND	0.001	0.003	0.006	U		090729-010	SW846 6020
	Arsenic	0.00362	0.0017	0.005	0.010	J		090729-010	SW846 6020
	Barium	0.100	0.0006	0.002	2.00			090729-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		090729-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		090729-010	SW846 6020
	Calcium	60.2	0.300	1.00	NE			090729-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		090729-010	SW846 6020
	Cobalt	0.000127	0.0001	0.001	NE	J		090729-010	SW846 6020
	Copper	0.000628	0.00035	0.001	NE	J		090729-010	SW846 6020
	Iron	0.154	0.033	0.100	NE			090729-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		090729-010	SW846 6020
	Magnesium	19.7	0.010	0.030	NE			090729-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		090729-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		090729-010	SW846 7470
	Nickel	0.00159	0.0005	0.002	NE	B, J	0.0028U	090729-010	SW846 6020
	Potassium	4.90	0.080	0.300	NE			090729-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		090729-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		090729-010	SW846 6020
	Sodium	44.0	0.080	0.250	NE			090729-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		090729-010	SW846 6020
	Uranium	0.00898	0.000067	0.0002	0.030			090729-010	SW846 6020
	Vanadium	0.00698	0.001	0.005	NE			090729-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		090729-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-7
Summary of Gamma Spectroscopy, Gross Alpha, Gross Beta, and Tritium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d] (pCi/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-BW2	Americium-241	-3.24 ± 5.39	8.64	4.32	NE	U	BD	090741-033	EPA 901.1
16-Jun-11	Cesium-137	-0.391 ± 3.40	3.71	1.85	NE	U	BD	090741-033	EPA 901.1
	Cobalt-60	2.04 ± 2.09	3.37	1.69	NE	U	BD	090741-033	EPA 901.1
	Potassium-40	-5.58 ± 38.3	45.1	22.6	NE	U	BD	090741-033	EPA 901.1
	Gross Alpha	4.24	NA	NA	15	NA	None	090741-034	EPA 900.0
	Gross Beta	2.57 ± 1.10	1.53	0.734	4mrem/yr		J	090741-034	EPA 900.0
	Tritium	26.8 ± 89.7	153	74.4	NE	U	BD	090741-036	EPA 906.0 M
MWL-MW4	Americium-241	8.69 ± 8.44	11.4	5.69	NE	U	BD	090750-033	EPA 901.1
22-Jun-11	Cesium-137	1.79 ± 2.15	3.41	1.71	NE	U	BD	090750-033	EPA 901.1
	Cobalt-60	-0.222 ± 1.93	3.20	1.60	NE	U	BD	090750-033	EPA 901.1
	Potassium-40	9.18 ± 59.4	26.6	13.3	NE	U	BD	090750-033	EPA 901.1
	Gross Alpha	0.50	NA	NA	15	NA	None	090750-034	EPA 900.0
	Gross Beta	5.18 ± 1.18	0.999	0.476	4mrem/yr			090750-034	EPA 900.0
	Tritium	-34.3 ± 71.1	141	63.4	NE	U	BD	090750-036	EPA 906.0 M
MWL-MW5	Americium-241	-5.27 ± 11.0	16.0	8.03	NE	U	BD	090732-033	EPA 901.1
14-Jun-11	Cesium-137	1.59 ± 1.94	3.22	1.61	NE	U	BD	090732-033	EPA 901.1
	Cobalt-60	1.25 ± 2.06	3.53	1.77	NE	U	BD	090732-033	EPA 901.1
	Potassium-40	8.26 ± 40.3	34.0	17.0	NE	U	BD	090732-033	EPA 901.1
	Gross Alpha	5.51	NA	NA	15	NA	None	090732-034	EPA 900.0
	Gross Beta	4.45 ± 2.17	3.24	1.57	4mrem/yr		J	090732-034	EPA 900.0
	Tritium	-40.8 ± 86.8	152	74.0	NE	U	BD	090732-036	EPA 906.0 M
MWL-MW6	Americium-241	7.81 ± 13.6	20.6	10.3	NE	U	BD	090737-033	EPA 901.1
15-Jun-11	Cesium-137	1.99 ± 4.31	2.77	1.38	NE	U	BD	090737-033	EPA 901.1
	Cobalt-60	3.32 ± 2.69	4.13	2.07	NE	U	BD	090737-033	EPA 901.1
	Potassium-40	-2.87 ± 40.9	45.6	22.8	NE	U	BD	090737-033	EPA 901.1
	Gross Alpha	7.24	NA	NA	15	NA	None	090737-034	EPA 900.0
	Gross Beta	6.58 ± 2.99	4.46	2.18	4mrem/yr		J	090737-034	EPA 900.0
	Tritium	-88.8 ± 85.2	152	74.0	NE	U	BD	090737-036	EPA 906.0 M

Refer to footnotes on page 4A-33.

Table 4A-7 *(Continued)*
Summary of Gamma Spectroscopy, Gross Alpha, Gross Beta, and Tritium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d] (pCi/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW6 (Duplicate)	Americium-241	3.58 ± 11.2	17.1	8.55	NE	U	BD	090738-033	EPA 901.1
15-Jun-11	Cesium-137	-0.198 ± 2.00	3.35	1.67	NE	U	BD	090738-033	EPA 901.1
	Cobalt-60	0.385 ± 2.25	3.79	1.90	NE	U	BD	090738-033	EPA 901.1
	Potassium-40	29.3 ± 43.5	31.0	15.5	NE	U	BD	090738-033	EPA 901.1
	Gross Alpha	6.10	NA	NA	15	NA	None	090738-034	EPA 900.0
	Gross Beta	6.28 ± 1.94	2.24	1.07	4mrem/yr		J	090738-034	EPA 900.0
	Tritium	-27.5 ± 84.5	148	71.7	NE	U	BD	090738-036	EPA 906.0 M
MWL-MW7	Americium-241	-0.42 ± 13.9	20.9	10.5	NE	U	BD	090753-033	EPA 901.1
28-Jun-11	Cesium-137	2.47 ± 2.26	3.49	1.75	NE	U	BD	090753-033	EPA 901.1
	Cobalt-60	2.20 ± 2.47	4.00	2.00	NE	U	BD	090753-033	EPA 901.1
	Potassium-40	20.6 ± 47.5	33.1	16.5	NE	U	BD	090753-033	EPA 901.1
	Gross Alpha	3.26	NA	NA	15	NA	None	090753-034	EPA 900.0
	Gross Beta	5.03 ± 1.46	1.75	0.843	4mrem/yr		J	090753-034	EPA 900.0
	Tritium	39.0 ± 78.0	137	61.1	NE	U	BD	090753-036	EPA 906.0 M
MWL-MW8	Americium-241	-49.2 ± 30.5	31.8	15.9	NE	U	BD	090746-033	EPA 901.1
20-Jun-11	Cesium-137	-1.77 ± 2.23	3.34	1.67	NE	U	BD	090746-033	EPA 901.1
	Cobalt-60	1.32 ± 2.21	3.75	1.88	NE	U	BD	090746-033	EPA 901.1
	Potassium-40	-23.7 ± 39.8	44.5	22.2	NE	U	BD	090746-033	EPA 901.1
	Gross Alpha	0.32	NA	NA	15	NA	None	090746-034	EPA 900.0
	Gross Beta	6.78 ± 1.59	1.62	0.788	4mrem/yr			090746-034	EPA 900.0
	Tritium	44.0 ± 81.1	141	63.0	NE	U	BD	090746-036	EPA 906.0 M
MWL-MW8 (Duplicate)	Americium-241	0.372 ± 5.87	9.44	4.73	NE	U	BD	090747-033	EPA 901.1
20-Jun-11	Cesium-137	0.116 ± 1.57	2.60	1.30	NE	U	BD	090747-033	EPA 901.1
	Cobalt-60	0.313 ± 1.87	3.11	1.56	NE	U	BD	090747-033	EPA 901.1
	Potassium-40	2.80 ± 29.2	38.5	19.3	NE	U	BD	090747-033	EPA 901.1
	Gross Alpha	3.20	NA	NA	15	NA	None	090747-034	EPA 900.0
	Gross Beta	7.83 ± 1.85	1.95	0.954	4mrem/yr			090747-034	EPA 900.0
	Tritium	19.5 ± 77.8	141	63.2	NE	U	BD	090747-036	EPA 906.0 M

Refer to footnotes on page 4A-33.

Table 4A-7 *(Concluded)*
Summary of Gamma Spectroscopy, Gross Alpha, Gross Beta, and Tritium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d] (pCi/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW9	Americium-241	1.16 ± 2.73	4.06	2.03	NE	U	BD	090729-033	EPA 901.1
27-Jun-11	Cesium-137	-4.58 ± 5.54	5.73	2.87	NE	U	BD	090729-033	EPA 901.1
	Cobalt-60	4.08 ± 3.08	4.54	2.27	NE	U	BD	090729-033	EPA 901.1
	Potassium-40	17.3 ± 43.9	30.3	15.2	NE	U	BD	090729-033	EPA 901.1
	Gross Alpha	4.50	NA	NA	15	NA	None	090729-034	EPA 900.0
	Gross Beta	6.91 ± 1.61	1.47	0.701	4mrem/yr			090729-034	EPA 900.0
	Tritium	0.00 ± 72.8	1.37	61.1	NE	U	BD	090729-036	EPA 906.0 M

Refer to footnotes on page 4A-33.

Table 4A-8
Summary of Field Water Quality Measurements[i],
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2011

Well ID	Sample Date	Temperature (°C)	Specific Conductivity (µmho/cm)	Oxidation Reduction Potential (mV)	pH	Turbidity (NTU)	Dissolved Oxygen (% Sat)	Dissolved Oxygen (mg/L)
MWL-BW2	16-Jun-11	23.16	669	373.5	7.28	0.21	8.2	0.70
MWL-MW4	22-Jun-11	20.09	564	367.2	7.69	1.38	28.7	2.69
MWL-MW5	14-Jun-11	23.05	812	404.7	7.18	0.73	30.0	2.56
MWL-MW6	15-Jun-11	24.04	802	397.5	7.29	0.25	33.0	2.76
MWL-MW7	28-Jun-11	25.85	554	391.0	7.49	0.26	48.0	3.91
MWL-MW8	20-Jun-11	21.48	554	398.4	7.56	0.48	42.4	3.74
MWL-MW9	27-Jun-11	23.86	555	382.7	7.53	2.00	13.3	1.11

Refer to footnotes on page 4A-33.

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Footnotes for Mixed Waste Landfill Groundwater Monitoring Tables

[a]Result
- Values in bold exceed the established MCL.
- ND = not detected (at method detection limit).
- Activities of zero or less are considered to be not detected.
- Gross alpha activity measurements were corrected by subtracting out the total uranium activity (40 CFR Parts 9, 141, and 142, Table 1-4)
- μg/L = micrograms per liter
- mg/L = milligrams per liter
- pCi/L = picocuries per liter

[b]MDL or MDA

Method detection limit. The minimum concentration or activity that can be measured and reported with 99% confidence that the analyte is greater than zero, analyte is matrix specific.

The minimum detectable activity or minimum measured activity in a sample required to ensure a 95% probability that the measured activity is accurately quantified above the critical level.

NA = not applicable for gross alpha activities. The MDA could not be calculated as the gross alpha activity was corrected by subtracting out the total uranium activity.

[c]PQL or Critical Level

Practical quantitation limit. The lowest concentration of analytes in a sample that can be reliably determined within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions.

The minimum activity that can be measured and reported with 99% confidence that the analyte is greater than zero, analyte is matrix specific.

NA = not applicable for gross alpha activities. The critical level could not be calculated as the gross alpha activity was corrected by subtracting out the total uranium activity.

[d]MCL
- Maximum contaminant level. Established by the U.S. Environmental Protection Agency Primary Water Regulations (40 CFR 141.11[b]), National Primary Drinking Water Standards, EPA 816-F-09-0004, May 2009.
- NE = not established.
- The following are the MCLs for gross alpha particles and beta particles in community water systems: 15 pCi/L = Gross alpha particle activity, excluding total uranium (40 CFR Parts 9, 141, and 142, Table I-4). 4 mrem/yr = any combination of beta and/or gamma-emitting radionuclides (as dose rate).

[e]Laboratory Qualifier

B = Analyte is detected in associated laboratory method blank.
J = Estimated value, the analyte concentration is below the practical quantitation limit (PQL).
NA = Not applicable.
U = Analyte is absent or below the method detection limit.

[f]Validation Qualifier

If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.
BD = Below detection limit as used in radiochemistry to identify results that are not statistically different from zero.
J = The associated value is an estimated quantity.
None = No data validation for corrected gross alpha activity.
U = The analyte was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.

Footnotes for Mixed Waste Landfill Groundwater Monitoring Tables (Concluded)

[g]Analytical Method

- U.S. Environmental Protection Agency, 1986 (and updates), *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846, 3rd ed.
- U.S. Environmental Protection Agency, 1984, *Methods for Chemical Analysis of Water and Wastes*, EPA 600-4-79-020.
- U.S. Environmental Protection Agency, 1983, *The Determination of Inorganic Anions in Water by Ion Chromatography-Method 300.0*, EPA-600/4-84-017.
- U.S. Environmental Protection Agency, 1980, *Prescribed Procedures for Measurement of Radioactivity in Drinking Water,* EPA-600/4-80-032, U.S. Environmental Protection Agency, Cincinnati, Ohio.
- U.S. Environmental Protection Agency, Washington, D.C.; or Clesceri, Greenburg, and Eaton, 1998, *Standard Methods for the Examination of Water and Wastewater*, 20th ed., Method 2320B.

[h]Field Water Quality Measurements

- Field measurements collected prior to sampling.

°C	= degrees Celsius.
% Sat	= percent saturation.
µmho/cm	= micromhos per centimeter.
mg/L	= milligrams per liter.
mV	= millivolts.
NTU	= nephelometric turbidity units.
pH	= potential of hydrogen (negative logarithm of the hydrogen ion concentration).

Attachment 4B
Mixed Waste Landfill
Hydrographs

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Attachment 4B Hydrographs

4B-1 MWL Study Area Wells (1 of 2) 4B-5

4B-2 MWL Study Area Wells (2 of 2) 4B-6

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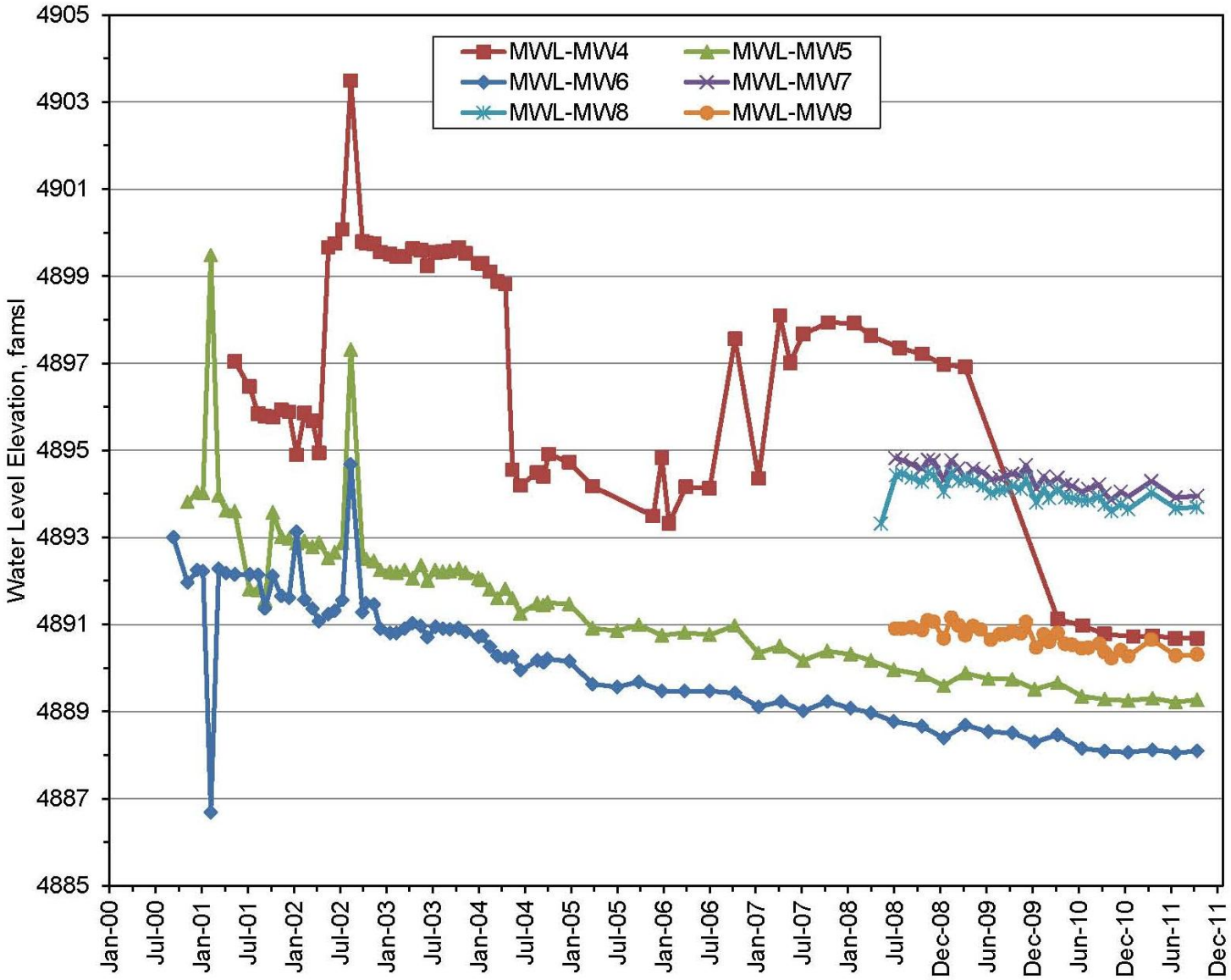

Figure 4B-1. MWL Study Area Wells (1 of 2)

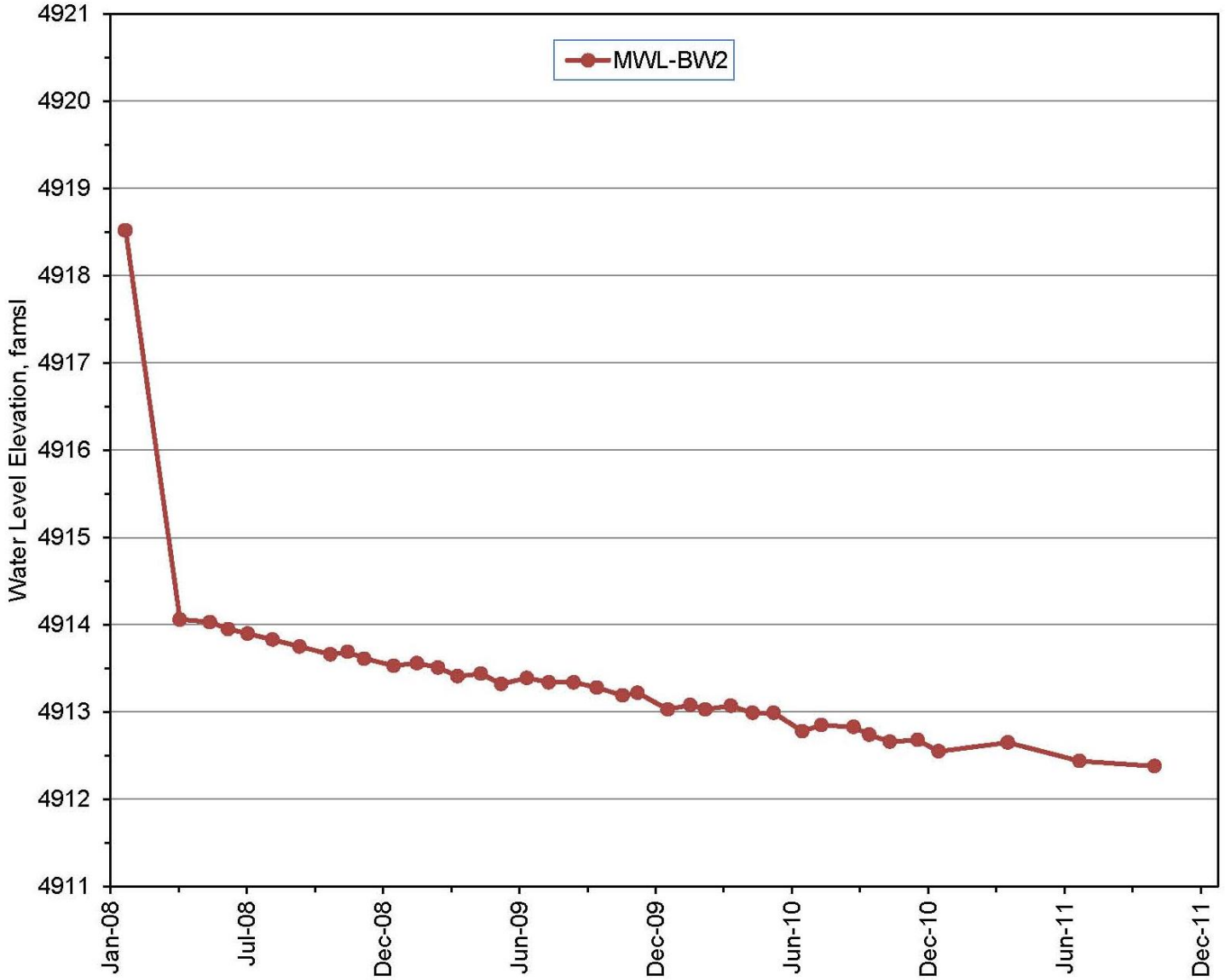

Figure 4B-2. MWL Study Area Wells (2 of 2)

Volume VII

TAB 12

Mixed Waste Landfill Chapter 4 Excerpted from the
Annual Groundwater Monitoring Report, Calendar Year 2012

From: SNL/ Beausoleil
To: NMED/Kieling

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Calendar Year 2012

Annual Groundwater Monitoring Report

Prepared by
Sandia National Laboratories, Albuquerque, New Mexico

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SANDIA REPORT
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Annual Groundwater Monitoring Report
Calendar Year 2012

Long-Term Stewardship Consolidated Groundwater Monitoring Program
Sandia National Laboratories, New Mexico
June 2013

Prepared by:
Long-Term Stewardship (4142) in coordination with
Environmental Restoration Operations (6234)

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Abstract

Sandia National Laboratories, New Mexico (SNL/NM) is a government-owned/contractor-operated laboratory. Sandia Corporation (Sandia), a wholly owned subsidiary of Lockheed Martin Corporation, manages and operates SNL/NM for the U.S. Department of Energy (DOE), National Nuclear Security Administration (NNSA). The DOE/NNSA Sandia Field Office administers the contract and oversees contractor operations at the site. Sandia conducts two types of groundwater surveillance monitoring at SNL/NM: (1) on a site-wide basis as part of the SNL/NM Long-Term Stewardship (LTS) Program's Groundwater Protection Program (GWPP) and (2) as site-specific groundwater monitoring at LTS/Environmental Restoration (ER) Operations sites with ongoing groundwater investigations. This Annual Groundwater Monitoring Report summarizes data collected during groundwater monitoring events conducted at GWPP locations and at the following SNL/NM sites through December 31, 2012: Burn Site Groundwater study area; Chemical Waste Landfill; Mixed Waste Landfill; Solid Waste Management Units 8/58, 49, 68, 116, 149, and 154; Technical Area V study area; and the Tijeras Arroyo Groundwater study area. Environmental monitoring and surveillance programs are required by the New Mexico Environment Department (NMED) and DOE Order 436.1, *Departmental Sustainability,* and DOE Order 231.1B, *Environmental, Safety, and Health Reporting*.

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1 Inventory of Groundwater Monitoring Wells Located at SNL/NM and Surrounding Areas

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1 SNL/NM Monitoring Well Locations and Base-Wide Potentiometric Surface Map for the Kirtland Air Force Base Vicinity, October 2012

Abbreviations and Acronyms

ABCWUA	Albuquerque Bernalillo County Water Utility Authority
amsl	above mean sea level
AOC	area of concern
AOP	Administrative Operating Procedure
ARG	Ancestral Rio Grande
bgs	below ground surface
BSG	Burn Site Groundwater
CAC	Corrective Action Complete
CCBA	Coyote Canyon Blast Area
CFR	Code of Federal Regulations
CME	Corrective Measures Evaluation
CMI	Corrective Measures Implementation
CMIP	Corrective Measures Implementation Plan
CMS	Corrective Measures Study
COA	City of Albuquerque
COC	constituent of concern
CTF	Coyote Test Field
CWL	Chemical Waste Landfill
CY	Calendar Year
DO	dissolved oxygen
DOE	U.S. Department of Energy
DRO	diesel range organics
DSS	Drain and Septic System
EB	equipment blank
EDMS	Environmental Data Management System
EMS	Environmental Management System
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ET	evapotranspirative
FB	field blank
FOP	Field Operating Procedure
GEL	GEL Laboratories LLC
GRO	gasoline range organics
GWPP	Groundwater Protection Program
HE	high explosive
HPT	High Performing Team
HSWA	Hazardous and Solid Waste Amendments
IMWP	Interim Measures Work Plan
IRP	Installation Restoration Program (U.S. Air Force)
JP-4	jet propellant, fuel grade 4
KAFB	Kirtland Air Force Base
LCS	laboratory control sample
LE	Landfill Excavation

Abbreviations and Acronyms (continued)

LRRI	Lovelace Respiratory Research Institute
LTMMP	Long-Term Monitoring and Maintenance Plan
LTS	Long-Term Stewardship
LWDS	Liquid Waste Disposal System
MAC	maximum allowable concentration (established by the NMED)
MCL	maximum contaminant level
MDA	minimum detectable activity
MDL	method detection limit
MWL	Mixed Waste Landfill
NFA	No Further Action
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
NNSA	National Nuclear Security Administration
NOD	Notice of Disapproval
NPN	nitrate plus nitrite
OB	Oversight Bureau
ORP	oxidation-reduction potential
PCCP	Post-Closure Care Permit
PCE	tetrachloroethene
PGWS	perched groundwater system
PQL	practical quantitation limit
PVC	polyvinyl chloride
QC	quality control
QED™	QED Environmental Systems MicroPurge® low-flow sampling method
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-trinitro-triazine
RFI	RCRA Facility Investigation
RPD	relative percent difference
RSI	Request for Supplemental Information
Sandia	Sandia Corporation
SAP	Sampling and Analysis Plan
SC	specific conductance
SDWA	Safe Drinking Water Act
SFO	Sandia Field Office
SMO	Sample Management Office
SNL/NM	Sandia National Laboratories, New Mexico
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TA	Technical Area
TAG	Tijeras Arroyo Groundwater (Investigation)
TAL	Target Analyte List
TA-V study area	Technical Area-V Groundwater Investigation Study Area
TB	trip blank
TCE	trichloroethene (equivalent to trichlorethylene)

Abbreviations and Acronyms (concluded)

tetryl	methyl 2,4,6-trinitrophenylnitramine
the Order	Compliance Order on Consent
TOC	total organic carbon
TOX	total organic halogens
TPH	total petroleum hydrocarbons
UCS	Underground Conduit System
USAF	U.S. Air Force
USGS	U.S. Geological Survey
VA	Veterans Administration
VCM	voluntary corrective measure
VE	Vapor Extraction
VOC	volatile organic compound

Units

µg/L	microgram(s) per liter
ac-ft	acre feet
ft	foot (feet)
ft^3/yr	cubic feet per year
ft/ft	feet per foot
ft/min	feet per minute
ft/yr	feet per year
gal.	gallon(s)
in/yr	inches per year
Ma	Mega Annum
mg/L	milligram(s) per liter
NTU	nephelometric turbidity units
pCi/g	picocuries per gram
pCi/L	picocuries per liter
pH	potential of hydrogen
ppbv	part(s) per billion by volume
sq mi	square mile(s)
yr	year(s)

Monitoring Well Location Descriptions

AVN-#	Area V (North)
CCBA-#	Coyote Canyon Blast Area
CTF-#	Coyote Test Field
CWL-#	Chemical Waste Landfill
CYN-#	Lurance Canyon
EOD	Explosive Ordnance Disposal
HERTF	High Energy Research Test Facility
IP	Isleta Pueblo
ITRI	Inhalation Toxicology Research Institute
LMF	Large Melt Facility
LWDS-#	Liquid Waste Disposal System
MP-#	Montessa Park
MRN-#	Magazine Road North
MVMW#	Mountain View Monitoring Well
MWL-#	Mixed Waste Landfill
NMED-#	New Mexico Environment Department
NWTA3-#	Northwest Technical Area III
OBS-#	Old Burn Site
PGS-#	Parade Ground South
PL-#	Power Line Road, west
SFR-#	South Fence Road
STW-#	Solar Tower (West)
SWTA-#	Southwest Technical Area III
TA1-W-#	Technical Area I (Well)
TA2-NW-#	Technical Area II (Northwest)
TA2-SW-#	Technical Area II (Southwest)
TA2-W-#	Technical Area II (Well)
TAV-#	Technical Area V
TJA-#	Tijeras Arroyo
TRE-#	Thunder Road East
TRN-#	Target Road North
TRS-#	Target Road South
TSA-#	Transportation Safeguards Academy
WYO-#	Wyoming
12AUP-#	ER Site 12A Underflow Piezometer

**** Meteorological Towers***

* SC1	School House
* A-21	TA-I
* A-36	TA-III and TA-V

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Annual Groundwater Monitoring Report

Executive Summary

Sandia Corporation (Sandia) conducts groundwater surveillance monitoring for the U.S. Department of Energy (DOE), National Nuclear Security Administration (NNSA) at Sandia National Laboratories, New Mexico (SNL/NM) on a site-wide basis as part of the SNL/NM Long-Term Stewardship (LTS) Program's Groundwater Protection Program (GWPP) and on a site-specific basis at LTS/Environmental Restoration (ER) Operations (formerly ER Project) sites with ongoing groundwater investigations. The SNL/NM facility is located on Kirtland Air Force Base (KAFB) in central New Mexico.

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia, a wholly owned subsidiary of Lockheed Martin Corporation, for the DOE/NNSA under Contract DE-AC04-94AL85000.

This Annual Groundwater Monitoring Report documents the results of the groundwater monitoring activities at SNL/NM for Calendar Year (CY) 2012. This report has been prepared to meet the environmental reporting requirements for the CY 2012 Annual Site Environmental Report, providing an annual update of groundwater data to regulators, stakeholders, and outside agencies. In addition, it serves as a valuable tool to inform the public about the groundwater quality at SNL/NM. This report includes both water quality sampling results and water level measurements. Separate chapters focus on the investigation activities at each of the following monitoring networks maintained at SNL/NM: GWPP site-wide surveillance (Chapter 2.0); Chemical Waste Landfill (CWL) (Chapter 3.0); Mixed Waste Landfill (MWL) (Chapter 4.0); Technical Area (TA)-V (Chapter 5.0); Tijeras Arroyo Groundwater (TAG) (Chapter 6.0); Burn Site Groundwater (BSG) (Chapter 7.0); Solid Waste Management Units (SWMUs) 8/58 (Chapter 8.0); SWMU 49 (Chapter 9.0); SWMU 68 (Chapter 10.0); SWMU 116 (Chapter 11.0); SWMU 149 (Chapter 12.0); and SWMU 154 (Chapter 13.0).

Chapter 1.0 provides the general site description for the SNL/NM facility and describes the regulatory criteria and sample collection methods for both SNL/NM site-specific and site-wide groundwater monitoring tasks. The regional aquifer supplying the Albuquerque Bernalillo County Water Utility Authority (ABCWUA) and KAFB production wells is located within the Albuquerque Basin. The regional aquifer is mostly contained within the upper unit and, to some extent, the middle unit of the Santa Fe Group. The edge of the basin on the east side is defined by the Sandia, Manzanita, and Manzano Mountains, which have uplifted along normal faults. KAFB straddles the east side of the basin and is divided approximately in half by basin-bounding faults. On KAFB, the basin is primarily defined by the north-south-trending Sandia fault and the Hubbell Springs fault. The Tijeras fault, a strike-slip fault that trends northeast-southwest, intersects the Sandia and Hubbell Springs faults forming a system of faults collectively referred to as the Tijeras fault complex. The faults form a distinct hydrogeological boundary between the regional aquifer within the basin (approximately 500 feet [ft] below ground surface [bgs]) and the more shallow bedrock aquifer systems within the uplifted areas (generally between 50 to 325 ft bgs).

The LTS Program monitors the GWPP network to provide site-wide characterization data. In addition, SNL/NM LTS and ER Operations maintain 11 site-specific groundwater monitoring networks at the following locations:

- CWL
- MWL
- TA-V

- TAG
- BSG
- SWMUs 8/58
- SWMU 49
- SWMU 68
- SWMU 116
- SWMU 149
- SWMU 154

At SNL/NM, SWMUs are regulated under the Hazardous and Solid Waste Amendment (HSWA) module of the SNL/NM Resource Conservation and Recovery Permit. In the HSWA module, a SWMU is defined as "any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste." Monitoring and/or corrective action requirements generally are determined on a SWMU-specific basis following a site investigation. A Compliance Order on Consent (the Order) between the New Mexico Environment Department (NMED), the DOE, and Sandia governs corrective actions for these sites and, accordingly, monitoring performed at the MWL; the TA-V, TAG, BSG study areas; and SWMUs 8/58, 49, 68, 116, 149, and 154. The CWL is a closed regulated unit undergoing post-closure care in accordance with the CWL Post-Closure Care Permit (PCCP) that became effective on June 2, 2011. Groundwater monitoring requirements, procedures, and protocols are detailed CWL PCCP Attachment 2, Groundwater Sampling and Analysis Plan.

Groundwater Quality Monitoring Activities and Results

During CY 2012, groundwater samples were collected from monitoring wells for the 12 investigations (GWPP and 11 LTS/ER Operations sites). The analytical results for samples from all monitoring wells were compared with maximum contaminant levels (MCLs) established by the U.S. Environmental Protection Agency (EPA). The results for GWPP monitoring wells were also compared with NMED maximum allowable concentrations (MACs) promulgated for groundwater by the State of New Mexico Water Quality Control Commission (NMWQCC). The activities and results are summarized for each location in the following sections, and the data are presented in the attachments following each chapter.

In this report groundwater monitoring data are presented for both hazardous and radioactive constituents; however, the monitoring data for radionuclides (gamma spectroscopy, gross alpha/beta activity, and tritium) are provided voluntarily by the DOE/Sandia. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements of the Order, as specified in Section III.A of the Order.

Groundwater Protection Program

Chapter 2.0 documents the results of the CY 2012 groundwater surveillance monitoring activities conducted as part of the SNL/NM GWPP. Water levels were measured at 97 monitoring wells. Water level measurements were obtained either monthly or quarterly depending on the response characteristics of the groundwater system at each well location to pumping or other stresses. The surveillance activities include the annual collection and analysis of groundwater samples from 12 monitoring wells and 1 surface water sample from a spring. Annual sampling of groundwater was conducted during April/May 2012. Samples collected from all locations were analyzed for Safe Drinking Water Act list volatile organic compounds (VOCs), total organic halogens, total phenols, total alkalinity, nitrate plus nitrite (NPN), total cyanide, major anions, Target Analyte List (TAL) metals plus uranium, mercury, radionuclides by gamma spectroscopy, gross alpha/beta activity, radium-226, and radium-228. Additional samples were collected at selected monitoring wells for analysis of high explosive (HE) compounds and isotopic uranium.

No analytical parameters exceed established MCLs or MACs, except for beryllium and fluoride. The concentrations of these analytes that exceed MCLs or MACs in groundwater samples are similar to the results reported for previous years.

Fluoride was detected above the NMWQCC groundwater protection MAC of 1.6 milligrams per liter (mg/L) at four sampling locations (Coyote Springs, SFR-2S, SFR-4T, and TRE-1). The concentrations range from 1.61 to 2.76 mg/L. The EPA MCL for fluoride is 4.0 mg/L.

Beryllium was detected in the surface water sample from Coyote Springs at a concentration of 0.0065 mg/L. The MCL for beryllium is 0.004 mg/L. Beryllium has been consistently detected in the surface water samples from the springs and is considered to be of natural origin.

Groundwater elevation measurements were obtained throughout CY 2012 at 97 locations on a monthly or quarterly basis. Groundwater elevation measurements obtained from representative monitoring wells were used to construct contours of the potentiometric surface. The contours display a pattern that reflects the impact of the groundwater withdrawal by water supply wells located in the northwestern portion of KAFB and ABCWUA wells located north of the base.

Groundwater elevations were also obtained from wells completed in the perched groundwater system (PGWS) to construct a groundwater elevation contour map. The contours indicate groundwater flow in the PGWS is toward the southeast. Water levels are declining in the northwest and increasing slightly in the east presumably due to the drainage of the system to the east and perhaps some additional recharge from the Tijeras Arroyo.

Chemical Waste Landfill

Chapter 3.0 discusses the CWL semiannual groundwater monitoring activities performed during January and July 2012. Groundwater samples were collected from four monitoring wells (CWL-BW5, CWL-MW9, CWL-MW10, and CWL-MW11) and analyzed for trichloroethene (TCE), 1,1,2-trichloro-1,2,2-trifluoroethane, tetrachloroethene, 1,1-dichloroethene, chloroform, trichlorofluoromethane, nickel, and chromium (January) and TCE, nickel, and chromium (July). No analytes were detected at concentrations exceeding the associated EPA MCLs in any of the CWL groundwater samples. The analytical results are comparable to historical values.

Mixed Waste Landfill

Chapter 4.0 discusses the MWL annual groundwater sampling activities conducted in February 2012. Groundwater samples were collected from seven monitoring wells (MWL-BW2, MWL-MW4, MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9) and analyzed for VOCs, TAL metals plus uranium, anions (i.e., bromide, chloride, fluoride, and sulfate), total alkalinity, NPN, radionuclides by gamma spectroscopy, gross alpha/beta activity, and tritium as specified in the Order. No analytes were detected at concentrations exceeding the associated EPA MCLs in any of the MWL groundwater samples. The analytical results are comparable to historical values.

Technical Area V Groundwater Study Area

Chapter 5.0 discusses the TA-V groundwater monitoring activities conducted during CY 2012. Both TCE and nitrate have been identified as constituents of concern (COCs) in groundwater at the TA-V Groundwater Investigation Study Area (TA-V study area) based on detections above the EPA MCL in samples collected from monitoring wells. Currently 16 wells in the TA-V study area are monitored for water quality and water levels. Table XI-1 of the Order specifies that the sampling frequency for groundwater monitoring at TA-V is quarterly. Unique features of the TA-V study area include low concentrations of TCE and nitrate in a deep alluvial aquifer.

The conceptual site model of contaminant transport at TA-V includes release from the source term, migration through the vadose zone, and movement in groundwater. The potential sources of TCE and/or nitrate in the TA-V study area include wastewater disposal systems and seepage pits. Based on the historical use and disposal of chlorinated solvents, the extent of TCE in groundwater is probably associated with multiple aqueous releases of solvents and subsequent vapor-phase transport through the vadose zone. The slow rate of groundwater flow (4 to 20 feet per year) is responsible for the present distribution of TCE in the aquifer.

Only NPN and TCE were detected above the MCLs in groundwater samples from TA-V study area wells. NPN concentrations exceed the MCL of 10 mg/L in samples from monitoring wells LWDS-MW1 and TAV-MW10, with a maximum concentration of 13.6 mg/L in the sample collected from monitoring well LWDS-MW1 in June 2012.

During CY 2012, TCE exceeded the MCL of 5 micrograms per liter (μg/L) in samples from five monitoring wells (LWDS-MW1, TAV-MW6, TAV-MW10, TAV-MW12, and TAV-MW14). The maximum concentration of TCE detected during this reporting period is 20.7 μg/L found in the sample from monitoring well LWDS-MW1 collected in March 2012.

The analytical results for this reporting period are consistent with historical concentrations. The current conceptual site model for the TA-V study area does not require modification based on the sampling results for CY 2012.

The following activities took place for the TA-V study area during CY 2012:

- Monthly or quarterly water level measurements were obtained for all TA-V study area wells.
- Semiannual and quarterly groundwater sampling events were conducted at 16 wells in February/March, May/June, July/August, and October/November 2012.
- Quarterly soil-vapor sampling events were conducted at monitoring wells TAV-SV01, TAV-SV02, and TAV-SV03 in February, May, August, and November 2012.

Tijeras Arroyo Groundwater Study Area

Chapter 6.0 addresses groundwater monitoring activities conducted during CY 2012 at the TAG study area. Currently, 21 wells in the TAG study area are monitored for water quality, and 30 wells are monitored for water levels. Two groundwater systems are present in the TAG study area: the PGWS at approximately 220 to 330 ft bgs and the regional aquifer groundwater system at approximately 440 to 570 ft bgs. Groundwater monitoring wells are completed within either the PGWS or regional aquifer. Unique features of the TAG study area include low concentrations of TCE at scattered locations in the PGWS and low concentrations of nitrate at scattered locations in the PGWS and regional aquifer.

For CY 2012, wells were sampled in March, June, August/September, and November/December. The samples were analyzed for VOCs, NPN, anions, TAL metals (plus uranium), gross alpha/beta activity, tritium, and radionuclides by gamma spectroscopy. Depending on their locations and historical concentrations of COCs, wells were sampled quarterly, semiannually, or annually during this reporting period.

Both TCE and nitrate have been identified as COCs in groundwater at the TAG study area based on historical groundwater monitoring results. Only NPN and TCE were detected above MCLs in samples from TAG study area wells. In CY 2012, NPN concentrations exceeded the MCL of 10 mg/L in samples from monitoring wells TA2-SW1-320, TA2-W-19, TJA-2, TJA-4, and TJA-7, with a maximum concentration of 32.1 mg/L in the sample from monitoring well TJA-4 collected during the September 2012 sampling event. NPN concentrations in monitoring wells TA2-SW1-320, TJA-4, and TJA-7 have generally exceeded the MCL for the life of the wells, whereas NPN concentrations occasionally have exceeded the MCL in samples from monitoring wells TJA-2 and TA2-W-19.

During CY 2012, TCE exceeded the MCL of 5 µg/L in the groundwater sample from one PGWS well, WYO-4. The maximum concentration of TCE detected during this reporting period is 9.42 µg/L in the sample from monitoring well WYO-4 collected during the March 2012 sampling event. TCE concentrations in samples from monitoring well WYO-4 slightly exceed the MCL, and trends are level to slightly increasing over time.

The analytical results for this reporting period are consistent with historical concentrations. The current conceptual site model for the TAG study area does not require modification based on the sampling results for CY 2012.

The following activities took place for the TAG study area during CY 2012:

- Monthly, quarterly, or annual water level measurements were obtained from TAG monitoring wells.
- Quarterly groundwater sampling events were conducted at seven monitoring wells (TA2-SW1-320, TA2-W-19, TA2-W-26, TJA-2, TJA-4, TJA-7, and WYO-4) in March, June, August/September, and November/December 2012.
- Semiannual groundwater sampling was conducted at four monitoring wells (TA2-W-01, TA2-W-27, TJA-3, and TJA-6) in March and August/September 2012.
- Annual groundwater sampling was conducted at 10 monitoring wells (PGS-2, TA1-W-01, TA1-W-02, TA1-W-03, TA1-W-04, TA1-W-05, TA1-W-06, TA1-W-08, TA2-NW1-595, and WYO-3) in August/September 2012.

Burn Site Groundwater Study Area

Chapter 7.0 discusses the groundwater monitoring activities conducted during CY 2012 at the BSG study area, which is located around the active Lurance Canyon Burn Site facility. Groundwater investigations were initiated in 1997 at the request of the NMED after elevated nitrate levels were discovered in the Burn Site Well (a nonpotable production well used for fire suppression). The study area consists of 10 monitoring wells, and samples were collected and analyzed for VOCs, semivolatile organic compounds (SVOCs), HE compounds, total petroleum hydrocarbons (TPH)-diesel range organics, TPH-gasoline range organics, anions, alkalinity, NPN, TAL metals (plus uranium), gross alpha/beta activity, tritium, and radionuclides by gamma spectroscopy. As required by the NMED, semiannual sampling for perchlorate was conducted at monitoring well CYN-MW6.

Only NPN was detected above the MCL in samples from BSG study area wells. NPN results exceed the MCL of 10 mg/L in samples from monitoring wells CYN-MW6, CYN-MW9, CYN-MW11, and CYN-MW12, with a maximum concentration of 33.1 mg/L in the sample from monitoring well CYN-MW9 collected during the April 2012 sampling event.

Perchlorate was detected slightly above the screening level/method detection limit (MDL) of 4 µg/L only in samples collected from monitoring well CYN-MW6. Perchlorate concentrations range from 5.77 J to 7.32 J µg/L, where "J" represents an estimated concentration. Currently, no MCL is established for perchlorate.

The analytical results for this reporting period are consistent with historical concentrations. The current conceptual site model does not require modification based on the sampling results for CY 2012.

The following activities took place for the BSG study area during CY 2012:

- Quarterly groundwater sampling events were conducted at four monitoring wells (CYN-MW9, CYN-MW10, CYN-MW11, and CYN-MW12) in January 2012.
- Semiannual groundwater sampling was conducted at eight monitoring wells (CYN-MW4, CYN-MW6, CYN-MW7, CYN-MW8, CYN-MW9, CYN-MW10, CYN-MW11, and CYN-MW12) in April 2012.
- Semiannual groundwater sampling was conducted at eight monitoring wells (CYN-MW4, CYN-MW6, CYN-MW7, CYN-MW8, CYN-MW9, CYN-MW10, CYN-MW11, and CYN-MW12) in October 2012.
- Semiannual perchlorate screening groundwater sampling and reporting were performed for monitoring well CYN-MW6.
- Monitoring wells CYN-MW1D, CYN-MW2S, and 12AUP-01 were decommissioned in November 2012.
- Monitoring well CYN-MW13 was installed to replace CYN-MW1D in December 2012.

Solid Waste Management Units 8/58

Chapter 8.0 discusses the groundwater monitoring activities conducted during CY 2012 at SWMUs 8/58, which are located in the Arroyo del Coyote watershed that captures runoff from the western flank of the Manzanita Mountains. Monitoring wells CCBA-MW1 and CCBA-MW2 were installed in August 2011, and these wells have been sampled quarterly since then. The groundwater samples from each well were analyzed for VOCs, SVOCs, HE compounds, NPN, major anions (i.e., bromide, chloride, fluoride, and sulfate), major cations (i.e., calcium, magnesium, potassium, and sodium), alkalinity, TAL metals plus uranium, perchlorate, total cyanide, radionuclides by gamma spectroscopy, gross alpha/beta activity, and isotopic uranium.

No parameters were detected above established MCLs, except for fluoride. Fluoride exceeds the established MCL of 4.0 mg/L in monitoring well CCBA-MW1 sample at a concentration ranging from 4.93 to 5.32 mg/L.

The following activities took place for SWMUs 8/58 during CY 2012:

- A report describing the well installation field activities was approved by the NMED in April 2012.
- Quarterly groundwater sampling was conducted at monitoring wells CCBA-MW1 and CCBA-MW2 in January, April, July, and October 2012.

Solid Waste Management Unit 49
Chapter 9.0 discusses the SWMU 49 annual groundwater monitoring activities performed during CY 2012. SWMU 49 is located in Lurance Canyon and consists of a surface discharge area associated with a former trailer used as a darkroom and the area around a drainpipe outfall from Building 9820. The DOE/Sandia received a letter from the NMED on April 14, 2010, that lists SWMU 49 under the heading of "SWMUs/AOCs to be Subject to Groundwater Monitoring Controls" and further states that SWMU 49 requires long-term monitoring of groundwater on an annual basis as a site control. Annual sampling was completed in 2012, and samples were analyzed for general chemistry, VOCs, HE compounds, perchlorate, metals, cyanide, NPN, gross alpha/beta activity, and radionuclides by gamma spectroscopy. No analytes were detected above their respective MCLs.

The following activities took place for SWMU 49 during CY 2012:

- Annual groundwater sampling was conducted at monitoring well CYN-MW5 in January 2012.

- Periodic groundwater elevation data were obtained from monitoring well CYN-MW5.

Solid Waste Management Unit 68
Chapter 10.0 discusses the quarterly groundwater monitoring activities performed during CY 2012 at SWMU 68, which is located in Coyote Test Field. Monitoring wells OBS-MW1, OBS-MW2, and OBS-MW3 were installed in August 2011, and these wells have been sampled quarterly since then. The groundwater samples from each well were analyzed for VOCs, SVOCs, HE compounds, NPN, major anions (i.e., bromide, chloride, fluoride, and sulfate), major cations (i.e., calcium, magnesium, potassium, and sodium), alkalinity, TAL metals plus uranium, perchlorate, total cyanide, hexavalent chromium, gross alpha/beta activity, radionuclides by gamma spectroscopy, and isotopic uranium. No parameters were detected above established MCLs.

The following activities took place for SWMU 68 during CY 2012:

- A report describing the well installation field activities was approved by the NMED in April 2012.

- Quarterly groundwater sampling was conducted at monitoring wells OBS-MW1, OBS-MW2, and OBS-MW3 in January, April, July, and October 2012.

Solid Waste Management Unit 116
Chapter 11.0 discusses the SWMU 116 annual groundwater monitoring activities performed during CY 2012. SWMU 116 is located on the western margin of the Manzanita Mountain foothills and includes the immediate area surrounding the five seepage pits and septic tank located south of Building 9990. The DOE/Sandia received a letter from the NMED on April 14, 2010, that lists SWMU 116 under the heading of "SWMUs/AOCs to be Subject to Groundwater Monitoring Controls" and further states that SWMU 116 requires long-term monitoring of groundwater on an annual basis as a site control. Annual sampling was completed in 2012, and samples were analyzed for general chemistry, VOCs, HE compounds, perchlorate, TAL metals plus uranium, cyanide, and NPN. No analytes were detected above their respective MCLs.

The following activities took place for SWMU 116 during CY 2012:

- Annual groundwater sampling was conducted at monitoring well CTF-MW1 in February 2012.
- Periodic groundwater elevation data were obtained from monitoring well CTF-MW1.

Solid Waste Management Unit 149
Chapter 12.0 discusses the quarterly groundwater monitoring activities performed during CY 2012 at SWMU 149, which is located in the Coyote Test Field. Monitoring well CTF-MW3 was sampled quarterly and the samples were analyzed for VOCs, TAL metals (including selenium), general chemistry parameters, perchlorate, and NPN. No analytical results for the monitoring well CTF-MW3 groundwater samples exceed the corresponding MCLs.

The following activities took place for monitoring well CTF-MW3 near SWMU 149 during CY 2012:

- Quarterly groundwater sampling was conducted at monitoring well CTF-MW3 in March, June, September, and December 2012.
- Quarterly reporting of analytical results for monitoring well CTF-MW3 was conducted.

Solid Waste Management Unit 154
Chapter 13.0 discusses the quarterly groundwater monitoring activities performed during CY 2012 at SWMU 154, which is located in Coyote Test Field. Monitoring well CTF-MW2 was sampled quarterly and the samples were analyzed for VOCs, SVOCs, HE compounds, NPN, major anions, alkalinity, TAL total metals plus uranium, perchlorate, radionuclides by gamma spectroscopy, gross alpha/beta activity, and isotopic uranium.

For all four quarters, arsenic was detected above the established MCL of 0.010 mg/L. Arsenic concentrations ranged from 0.0276 to 0.0559 mg/L, with the maximum concentration reported for the filtered sample collected in March 2012. No other analytical results for the monitoring well CTF-MW2 groundwater samples exceed the corresponding MCLs.

The following activities took place for monitoring well CTF-MW2 near SWMU 154 during CY 2012:

- Quarterly groundwater sampling was conducted at monitoring well CTF-MW2 in March, June, September, and December 2012.
- Quarterly reporting of analytical results for groundwater samples from monitoring well CTF-MW2 was conducted.

Future Groundwater Monitoring Events
The groundwater monitoring events conducted on a site-wide basis as part of the SNL/NM GWPP and at site-specific LTS/ER Operations sites will continue on a quarterly, semiannual, annual, and biennial basis during CY 2013, as specified by regulatory guidance. The results for these monitoring events will be presented in the Annual Groundwater Monitoring Report for CY 2013.

4.0 Mixed Waste Landfill

4.1 Introduction

The Mixed Waste Landfill (MWL) is a 2.6-acre site in the north-central portion of Technical Area III at Sandia National Laboratories, New Mexico (SNL/NM) (Figure 4-1). The MWL consists of two distinct disposal areas: the classified area (occupying 0.6 acres) and the unclassified area (occupying 2.0 acres). Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies of activity (at the time of disposal) were disposed of in the MWL from March 1959 through December 1988. Classified wastes were buried in cylindrical pits in the classified area and unclassified wastes were buried in shallow trenches in the unclassified area.

The Phase 1 Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) was conducted in 1989 and 1990 to determine whether a release of RCRA contaminants had occurred at the MWL (SNL September 1990). The Phase 1 RFI indicated that tritium had been released to the environment. A Phase 2 RFI was conducted from 1992 to 1995 to determine the contaminant source, define the nature and extent of contamination, identify potential contaminant transport pathways, evaluate potential risks, and provide remedial action alternatives for the MWL (Peace et al. 2002).

The Phase 2 RFI confirmed tritium as the constituent of concern (COC) in soil at the MWL. Tritium occurs in surface and near-surface soil in and around the classified area. Tritium levels range from 1,100 picocuries per gram (pCi/g) in surface soil to 206 pCi/g in subsurface soil. The highest tritium levels have been found within 30 feet (ft) below ground surface (bgs) in soil adjacent to and directly below the classified area disposal pits. At depths greater than 30 ft bgs, tritium levels decrease rapidly. At approximately 100 ft bgs, the highest tritium level detected has been 0.074 pCi/g, and at 120 to 140 ft bgs, maximum tritium levels have been 0.029 pCi/g.

On October 11, 2001, the New Mexico Environment Department (NMED) directed the U.S. Department of Energy (DOE), National Nuclear Security Administration (NNSA) and Sandia Corporation (Sandia) to conduct a Corrective Measures Study (CMS) for the MWL (SNL December 2001a). The MWL CMS Report (SNL May 2003) was submitted to the NMED on May 21, 2003, for technical review and comment and recommended that an alternative vegetative soil cover (i.e., evapotranspirative [ET] cover) be deployed as the preferred corrective measure for the MWL. The NMED held a public comment period on the MWL CMS from August 11 to December 9, 2004, and a public hearing was held from December 2 to December 3 and December 8 to December 9, 2004. On May 26, 2005, the Secretary of the NMED selected a vegetative cover with a biointrusion barrier (i.e., ET cover) as the final remedy for the MWL. The selection was documented in the *Final Order, State of New Mexico Before the Secretary of the Environment in the Matter of Request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill* (Final Order; NMED May 2005), which also required a Corrective Measures Implementation (CMI) Plan (CMIP). The MWL CMIP (SNL November 2005) was submitted to the NMED in November 2005. The NMED conditionally approved the CMIP in December 2008 after resolution of two Notices of Disapproval (NODs) (Bearzi December 2008). The MWL ET cover construction was completed from May through September 2009. The MWL CMI Report documenting cover construction in accordance with the CMIP was submitted to NMED in January 2010 (SNL January 2010). The CMI Report was approved by NMED on October 14, 2011 (Bearzi October 2011) after NMED held a public meeting on December 14, 2010, and resolution of an NOD issued in May 2011 (Bearzi May 2011). The MWL Long-term Monitoring and Maintenance Plan (LTMMP) (SNL March 2012) was submitted to the NMED within 180 days of CMI Report approval as required by the Final

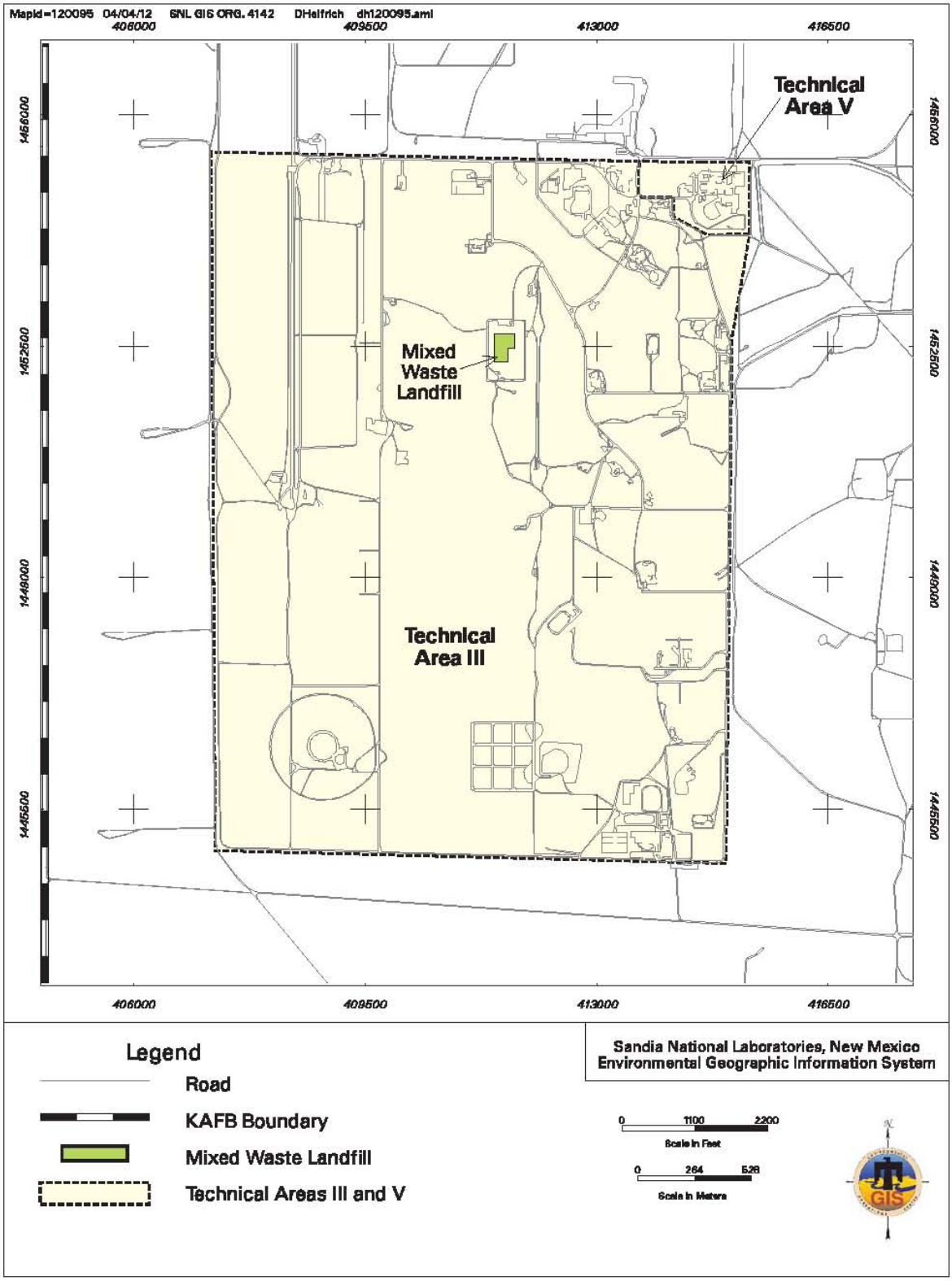

Figure 4-1. Location of the Mixed Waste Landfill within Technical Area III

Order. The original NMED 60-day public comment period for the MWL LTMMP began on September 14, 2011, and was extended twice; the comment period is scheduled to end February 11, 2013. NMED held a public meeting on the LTMMP on October 16, 2012.

4.1.1 Monitoring History

The original groundwater monitoring well network at the MWL (monitoring wells MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) was installed in 1988 and 1989. In 1993, monitoring well MWL-MW4 was completed at an angle of 6 degrees from vertical and was screened at two discrete intervals 20 ft apart to evaluate vertical potentiometric gradients and changes in aquifer parameters with depth. An inflatable packer separates the screened intervals, and nitrogen-gas pressure is maintained in the packer to prevent commingling of water from the two screened sections of the aquifer. Monitoring wells MWL-MW5 and MWL-MW6 were installed in 2000 at a distance of approximately 200 and 500 ft west of the MWL, respectively, with the screened intervals placed below the top of the regional water table in the coarse-grained Ancestral Rio Grande (ARG) deposits.

The MWL groundwater monitoring network was modified in 2008 (SNL May 2009). Due to the declining water table and corrosion of stainless-steel well screens, four monitoring wells were plugged and abandoned (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) and four new monitoring wells were installed (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) (SNL April 2008 and September 2008). The four wells installed in 2008 comprise the MWL groundwater monitoring network for the uppermost part of the regional aquifer and were approved by the NMED (Bearzi October 2008 and January 2009).

Monitoring wells MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9 were considered new wells and, as required by the Compliance Order on Consent (the Order) (NMED April 2004), were sampled a minimum of eight consecutive quarters for a defined suite of parameters in addition to sampling for perchlorate for at least four consecutive quarters. The four consecutive quarters of perchlorate sampling were completed in Calendar Year (CY) 2009 with no detections at or above the screening level of 4 micrograms per liter (µg/L); therefore, these wells have been removed from the perchlorate monitoring network. The required eight quarterly sampling events were completed in CY 2010. Monitoring wells MWL-MW4, MWL-MW5, and MWL-MW6 are preexisting wells and are sampled on an annual basis. All seven MWL wells are now sampled annually as required by the Order.

Figure 4-2 shows the current groundwater monitoring well network consisting of seven monitoring wells completed within the interfingering, fine-grained, alluvial-fan deposits (MWL-BW2, MWL-MW4 uppermost screened interval, MWL-MW7, MWL-MW8, and MWL-MW9) and coarse-grained ARG deposits (MWL-MW5 and MWL-MW6). The lower screened interval of monitoring well MWL-MW4 is completed within the coarse-grained ARG deposits, but is not part of the current monitoring network. The seven MWL wells are constructed of 5-inch diameter, Schedule 80 polyvinyl chloride (PVC) casing and have screens composed of slotted Schedule 80 PVC. References in this report to groundwater samples and water levels from monitoring well MWL-MW4 refer to groundwater withdrawn or measured from the upper screened interval, and references made to the bottom of this well refer to the depth to the top of the packer.

In April 2010, the DOE/NNSA and Sandia received a letter from the NMED which required further investigation to determine the source of very low toluene concentrations in some groundwater samples collected from the MWL in 2008 through early 2010, including conducting a purging/sampling study of the groundwater along with any other studies necessary to determine the source (Bearzi April 2010). The DOE/NNSA and Sandia submitted the *Mixed Waste Landfill Toluene Investigation Report* in

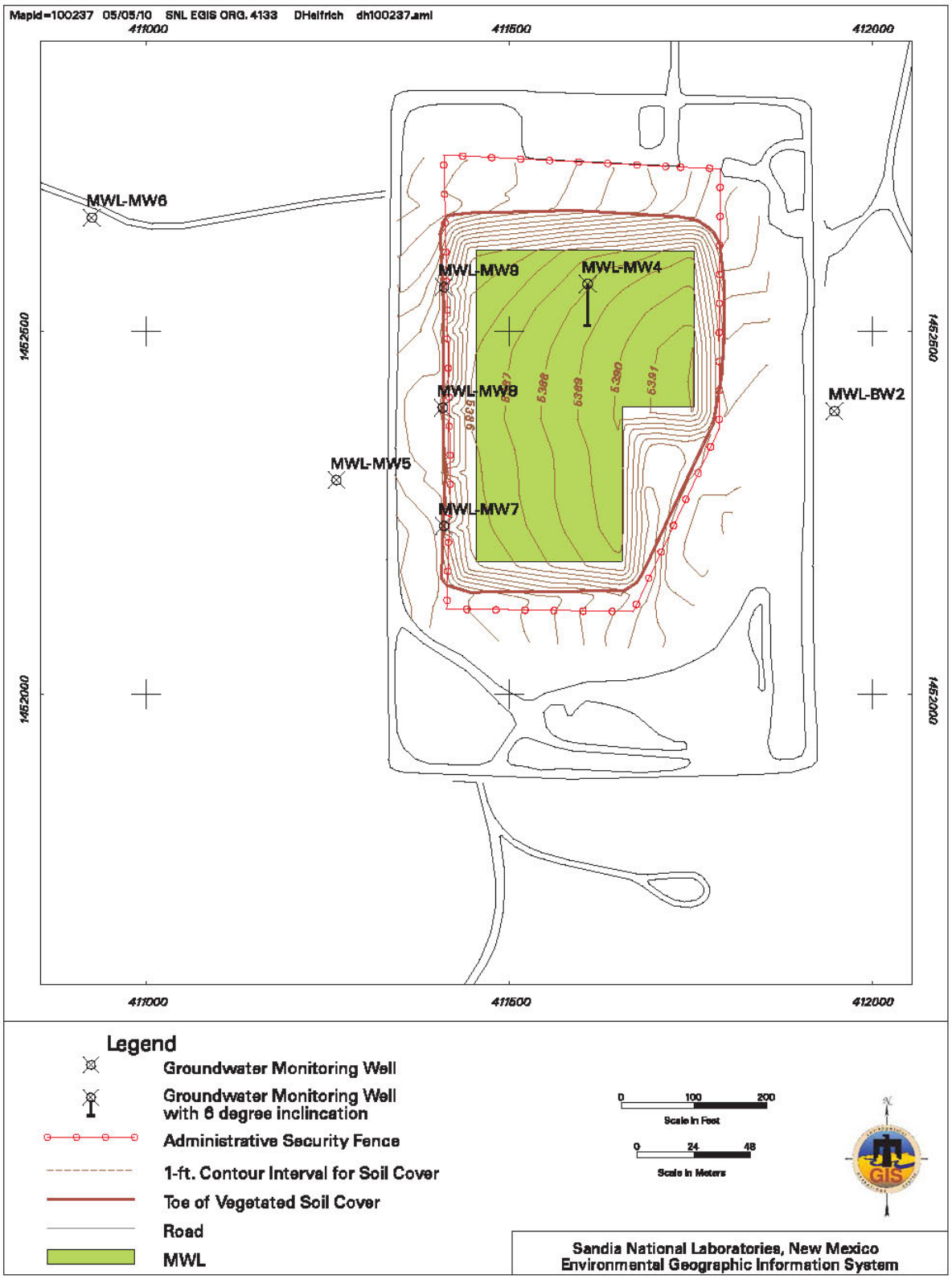

Figure 4-2. Location of Groundwater Monitoring Wells at the Mixed Waste Landfill

August 2010 and received an NOD with two comments from the NMED in September 2010 (Bearzi September 2010). The DOE/NNSA and Sandia NOD response (Wagner October 2010) that included a revised version of the report (SNL October 2010) was submitted to the NMED in October 2010 and was approved in January 2011 (Bearzi January 2011).

Groundwater at the MWL has been extensively characterized since 1990 for major ion chemistry, volatile organic compounds (VOCs), semivolatile organic compounds, nitrate, metals, radionuclides, and perchlorate. Twenty years of data indicate that groundwater has not been contaminated by the MWL (Goering et al. 2002; SNL December 2001b, January 2002, July 2002, October 2002, June 2003, September 2003, July 2004; Lyon and Goering 2006; SNL November 2006, January 2008, May 2009, June 2010, October 2010, September 2011, and June 2012).

4.1.2 Monitoring Network

The current groundwater monitoring network at the MWL consists of seven wells, as shown on Figure 4-2 and listed in Table 4-1. A single annual sampling event was conducted at the MWL in CY 2012.

Table 4-1. MWL Annual Groundwater Sampling Event, Calendar Year 2012

Well ID	Installation Year	WQ	WL	Calendar Year 2012[a]
MWL-BW2	2008	✓	✓	Annual
MWL-MW4[b]	1993	✓	✓	Annual
MWL-MW5	2000	✓	✓	Annual
MWL-MW6	2000	✓	✓	Annual
MWL-MW7	2008	✓	✓	Annual
MWL-MW8	2008	✓	✓	Annual
MWL-MW9	2008	✓	✓	Annual

NOTES:
Check marks in the WQ and WL columns indicate WQ sampling and WL measurements.
[a]Annual groundwater monitoring of all wells was conducted in February, with resampling of monitoring well MWL-MW8 in March.
[b]Upper screen of monitoring well MWL-MW4 is monitored and represents uppermost portion of regional aquifer.
BW = Background Well.
ID = Identification.
MW = Monitoring Well.
MWL = Mixed Waste Landfill.
WL = Water level.
WQ = Water quality.

4.1.3 Summary of Activities

Annual groundwater sampling was conducted in February 2012 at the MWL as summarized in Table 4-1. Groundwater samples were collected from the seven monitoring wells (MWL-BW2, MWL-MW4, MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9) and analyzed for VOCs, Target Analyte List (TAL) metals plus uranium, anions (as bromide, chloride, fluoride, and sulfate), alkalinity, nitrate plus nitrite (NPN), gamma spectroscopy, gross alpha/beta activity, and tritium. Duplicate environmental samples were collected at monitoring wells MWL-MW5 and MWL-MW9. Monitoring well MWL-MW8 was resampled for VOCs only in March. Attachment 4A provides summary tables for the CY 2012 analytical results.

4.1.4 Summary of Future Activities

The revised MWL LTMMP (SNL March 2012) was submitted to NMED in March 2012. The LTMMP defines the long-term monitoring, maintenance, inspection, and repair requirements for the MWL,

including semiannual groundwater monitoring. All LTMMP monitoring, inspection, and maintenance requirements will be implemented upon NMED approval (anticipated in late April 2013) and reported to NMED annually in a separate MWL report. Groundwater monitoring activities and results will also continue to be provided in this Annual Groundwater Monitoring Report.

4.1.5 Conceptual Site Model

Tritium was identified as the COC at the MWL based on the Phase 2 RFI. A detailed conceptual site model is provided in the MWL Phase 2 RFI Report (Peace et al. 2002) and the *Mixed Waste Landfill Groundwater Report, 1990 through 2001, Sandia National Laboratories, Albuquerque, New Mexico* (Goering et al. 2002). An update to the conceptual site model integrating the findings from the four monitoring wells installed in 2008 is presented in the *Mixed Waste Landfill Annual Groundwater Monitoring Report, Calendar Year 2009* (SNL June 2010) and incorporated in this section.

Groundwater at the MWL is contained within the regional aquifer, which consists of unconsolidated Santa Fe Group deposits (fine-grained alluvial-fan deposits and coarse-grained ARG deposits). The depth to water is approximately 500 ft bgs. Groundwater flows generally westward away from the Manzanita Mountains and towards the Rio Grande. Several water-supply wells operated by Kirtland Air Force Base (KAFB) and the Albuquerque Bernalillo County Water Utility Authority (ABCWUA) have profoundly modified the natural groundwater flow regime near the MWL by creating a trough in the water table in the western and northern portions of KAFB (Plate 1). As a result, water levels at the MWL have continued to decline since monitoring began in 1990.

Due to the declining water level, the original groundwater monitoring well network (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3 installed in 1988 and 1989) was replaced, and four new wells were installed in 2008 (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9). The completion intervals of the four 2008 wells are deeper, with the well screens set across the uppermost part of the regional aquifer. The aquifer hydraulic conductivity, based on slug test results performed in the 2008 wells, range from 1.95×10^{-1} to 1.48×10^{-2} ft per day, with an average of 8.58×10^{-2} ft per day. The hydraulic conductivity for the 2008 wells is generally higher than that for the original MWL groundwater monitoring wells, indicating an increase in hydraulic conductivity with depth and proximity to the highly conductive ARG deposits.

Water levels were lower than expected in the 2008 monitoring wells relative to the water levels in the older wells. The lower groundwater elevations in monitoring wells MWL-MW7 through MWL-MW9 appear to be related to the following two major factors:

- Variations in hydraulic conductivity in the upper part of the regional aquifer (showing increasing hydraulic conductivities with depth)
- Ongoing large-scale pumping of groundwater by the KAFB and ABCWUA production wells, which has created a strong downward vertical gradient at the MWL

The completion intervals of the new wells are deeper and within a higher hydraulic conductivity layer than the shallower wells that were replaced (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3). Thus, the vertical gradient and drawdown of the regional aquifer have greater impact in the new wells, resulting in a lower groundwater elevation relative to the previous monitoring well network.

An updated conceptual site model integrating the findings from the four monitoring wells installed in 2008 is presented in the *Mixed Waste Landfill Annual Groundwater Monitoring Report, Calendar Year 2009* (SNL June 2010). In summary, the geology of the upper portion of the regional aquifer, a

stratified system, varies with depth from a low hydraulic conductivity layer (in which former monitoring wells MWL-MW2 and MWL-MW3 were screened) to a medium conductivity layer (in which the deeper screens of monitoring wells MWL-MW7, MWL-MW8, and MWL-MW9 reside) to a high conductivity layer corresponding to the ARG deposits (in which at least part of the screen intervals of monitoring wells MWL-MW4 [lower screen], MWL-MW5, and MWL-MW6 are located). The uppermost surface of the regional aquifer continues to decline as a result of historic and ongoing large-scale pumping of groundwater by the KAFB and ABCWUA production wells. The overall effect at the MWL is that groundwater flow has a strong vertically downward component in the lower and medium conductivity layers in response to this regional drawdown from pumping (i.e., a draining system).

Figure 4-3 shows the October 2012 potentiometric surface of the regional aquifer beneath the MWL. Groundwater flows towards the west and northwest. Based on the contours, the horizontal gradient varies from approximately 0.02 to 0.08 feet per foot. The map is consistent with the conceptual site model and the base-wide potentiometric surface map presented on Plate 1. As shown on Plate 1, the potentiometric surface contours beneath Technical Area III generally trend north to south with the inferred groundwater flow direction being generally westward.

For the period from July 2008 to October 2012, groundwater levels in the four wells installed in 2008 (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) declined less than 2 ft (Figures 4B-1 and 4B-2 of Attachment 4B). Monitoring wells MWL-MW7, MWL-MW8, and MWL-MW9 declined at rates ranging from 0.18 to 0.27 feet per year (ft/yr). Upgradient well MWL-BW2 showed a greater rate of decline at 1.3 ft/yr, but most of this decline occurred in 2008 and may be the result of an inaccurate initial groundwater elevation measurement (Figure 4B-2 of Attachment 4B). Recharge from infiltration of direct precipitation at the MWL is negligible due to high evapotranspiration, low precipitation, the thick sequence of unsaturated Santa Fe Group deposits above the water table, and the presence of the ET cover. Groundwater recharge of the regional aquifer occurs by the infiltration of precipitation in the Manzanita Mountains located approximately 5 miles to the east.

4.2 Regulatory Criteria

Historically, the NMED Hazardous Waste Bureau has provided regulatory oversight of the MWL as Solid Waste Management Unit (SWMU) 76 under the Hazardous and Solid Waste Amendments module of the SNL/NM RCRA Permit. The NMED confirmed that the MWL is properly designated as a SWMU (Dinwiddie June 1998) and, as such, must comply with the corrective action program defined in Title 20, New Mexico Administrative Code (NMAC), Section 4.1.50, incorporating Title 40, Code of Federal Regulations (CFR), Section 264.101. The requirements for corrective action at the MWL, including those for groundwater monitoring, are established through the corrective measures process.

The NMED issued the Order in April 2004, which transferred the regulatory authority for corrective action at the MWL to the Order (NMED April 2004). This report has been formatted to address the content criteria set forth in the Order for Periodic Monitoring Reports.

Although radionuclides are being monitored and screened at the MWL, the information related to radionuclides is provided voluntarily by the DOE/NNSA and Sandia. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements imposed by the NMED, as specified in Section III.A of the Order (NMED April 2004).

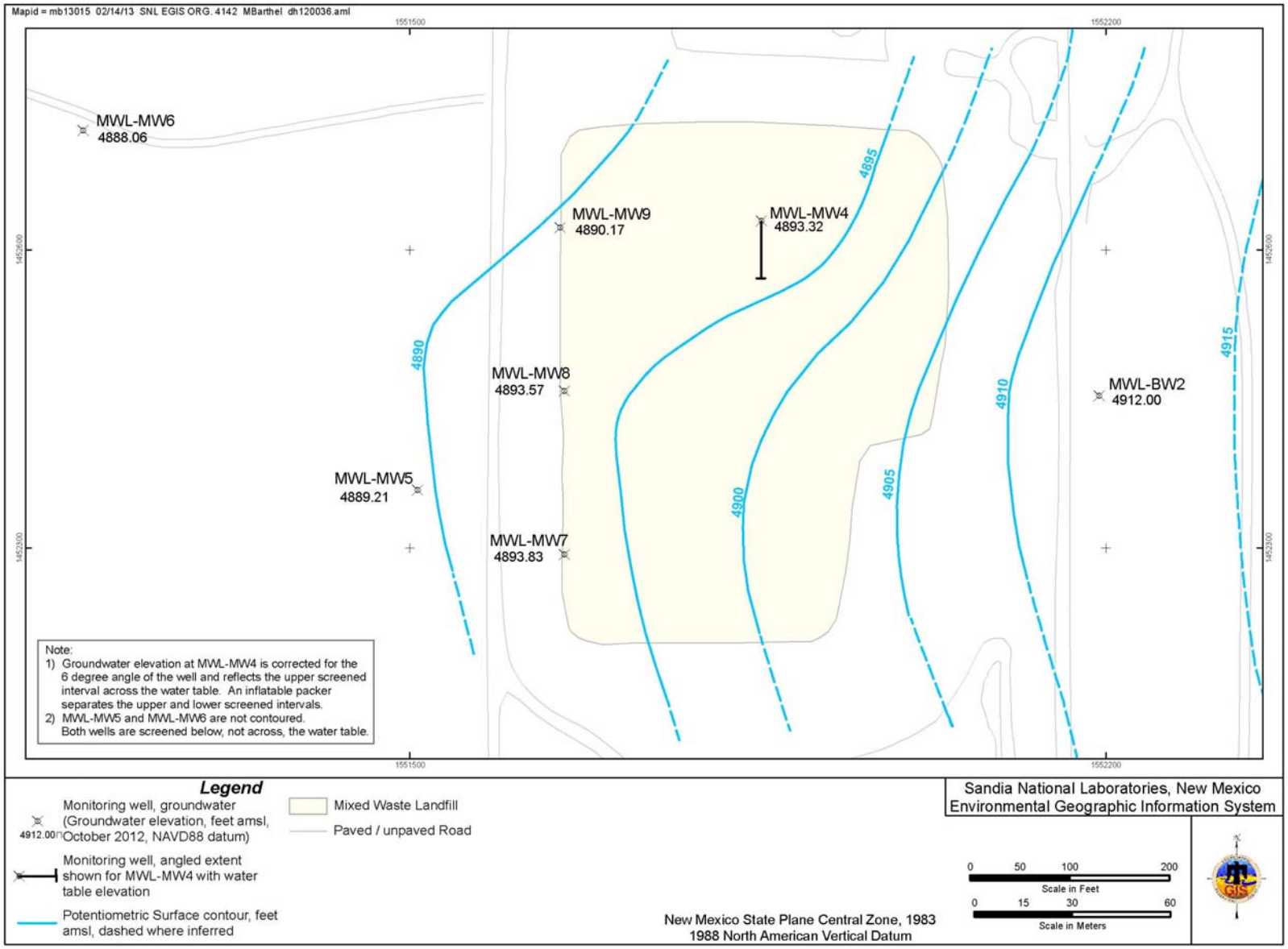

Figure 4-3. Localized Potentiometric Surface of the Basin Fill Aquifer at the Mixed Waste Landfill, October 2012

4.3 Scope of Activities

The CY 2012 annual groundwater sampling is summarized in Section 4.1.3. Table 4-2 lists the analytical parameters and MWL wells sampled. SNL/NM field personnel conducted the sampling from February 2 to 15, 2012. Groundwater sampling activities were conducted in conformance with procedures outlined in the *Mixed Waste Landfill Groundwater Monitoring, Mini-Sampling and Analysis Plan for Fiscal Year 2012 Annual Sampling* (SNL January 2012).

Table 4-2. Analytical Parameters for the MWL Monitoring Wells, Calendar Year 2012

Analytical Parameter	Calendar Year 2012[a]
Volatile Organic Compounds	MWL-BW2 MWL-MW4 MWL-MW5 MWL-MW5 (dup) MWL-MW6 MWL-MW7 MWL-MW8 MWL-MW9 MWL-MW9 (dup)
TAL metals plus Uranium	
Nitrate plus Nitrite (as nitrogen)	
Major Anions (Bromide, Fluoride, Chloride, and Sulfate)	
Total Alkalinity as Bicarbonate and Calcium Carbonate	
Radionuclides: Gamma-Emitting Radionuclides Gross Alpha Activity Gross Beta Activity Tritium	

NOTES:
[a]Annual groundwater sampling was conducted in February, with resampling of MWL-MW8 for VOCs only in March.
BW = Background Well.
dup = Duplicate.
MW = Monitoring Well.
MWL = Mixed Waste Landfill.
TAL = Target Analyte List.

The MWL groundwater samples were submitted for analysis to GEL Laboratories LLC (GEL) in Charleston, South Carolina. All groundwater sampling results are compared with U.S. Environmental Protection Agency (EPA) maximum contaminant levels (MCLs) for drinking water supplies (EPA 2001 and 2009). The analytical results are summarized in Attachment 4A, Tables 4A-1 through 4A-7.

Field and laboratory quality control (QC) samples were prepared to determine the accuracy of the methods used and to detect inadvertent sample contamination that may have occurred during the sampling and analysis process. Field QC samples included duplicate environmental, equipment blank (EB), field blank (FB), and trip blank (TB) samples. Laboratory QC analyses performed included method blank, laboratory control sample (LCS), matrix spike, matrix spike duplicate, and surrogate spike analyses.

Water quality parameters were measured in the field for temperature, specific conductance (SC), oxidation-reduction potential (ORP), pH, and dissolved oxygen (DO) using an YSI™ Model 6920 Water Quality Meter during the purging process. Turbidity was measured with a Hach™ Model 2100P turbidity meter.

4.4 Field Methods and Measurements

Groundwater sampling and depth-to-groundwater measurements were conducted in conformance with procedures specified in the *Mixed Waste Landfill Groundwater Monitoring, Mini-Sampling and Analysis Plan for Fiscal Year 2012 Annual Sampling* (SNL January 2012), which are consistent with the methods described in Section 1.3. Field water quality parameters are presented in Table 4A-8 (Attachment 4A) and current CY 2012 and historical groundwater elevation measurements at the MWL monitoring wells are presented in Attachment 4B, Figures 4B-1 and 4B-2.

A portable Bennett™ groundwater sampling system was used to collect groundwater samples from all wells, except MWL-MW4. Monitoring well MWL-MW4 is installed with a dedicated Bennett™ sampling system. The purging volume requirement was achieved for four of the seven monitoring wells (MWL-BW2, MWL-MW5, MWL-MW6, and MWL-MW7). The minimum purge requirements were not met at monitoring wells MWL-MW4, MWL-MW8, and MWL-MW9. These three monitoring wells were purged to dryness, allowed to recover, and then sampled to collect the most representative groundwater sample possible given the low yield of these wells.

Groundwater samples were submitted to the off-site laboratory (GEL) following analysis request/chain of custody protocol.

4.5 Analytical Methods

All groundwater samples were analyzed by off-site laboratories using EPA-specified protocols described in Section 1.3.2 (Tables 1-5 and 1-6).

4.6 Summary of Analytical Results

The analytical results for chemical, general chemistry, and radiological constituents are presented in Attachment 4A, Tables 4A-1 through 4A-7. Field water quality measurements are presented in Attachment 4A, Table 4A-8. Analytical results that are above the analytical laboratory method detection limit (MDL) but below the practical quantitation limit (PQL) are qualified as estimated values and designated with a "J" qualifier in Tables 4A-1 through 4A-7. Data qualifiers based on the data validation process are presented with the associated results in the Attachment 4A tables. Data validation and QC sample results associated with each sampling event are discussed in Section 4.7.

All the CY 2012 analytical results were compared with established EPA MCLs where applicable. None of the detected constituents exceed the respective MCLs. The analytical results are discussed in greater detail in the following sections.

4.6.1 Volatile Organic Compounds

Detected VOCs are presented in Attachment 4A, Table 4A-1. No VOCs were detected at concentrations above established MCLs in any groundwater sample. Tetrachloroethene (PCE) was detected below the MCL of 5.0 µg/L in monitoring well MWL-MW8 at an estimated concentration of 0.310 µg/L. SNL/NM personnel re-sampled monitoring well MWL-MW8 for VOCs in March 2012, since PCE has not been detected in historical monitoring well MWL-MW8 samples and no VOCs were detected in the resample. Toluene was detected below the MCL of 1,000 µg/L in the monitoring well MWL-MW9 duplicate environmental sample at a concentration of 1.31 µg/L, but was not detected in the associated environmental sample. Laboratory MDLs for all VOCs are presented in Attachment 4A, Table 4A-2.

4.6.2 General Chemistry Parameters

The general chemistry analytical results are presented in Attachment 4A, Tables 4A-3 and 4A-4. NPN was not detected above the nitrate MCL of 10 milligrams per liter (mg/L) in any groundwater sample. NPN was detected at concentrations ranging from 1.12 mg/L in the field duplicate sample from monitoring well MWL-MW5 to 2.08 mg/L in the field duplicate sample from monitoring well MWL-MW9. The NPN results are summarized in Table 4A-3. Table 4A-4 summarizes the alkalinity and major anions (bromide, chloride, fluoride, and sulfate) results. No parameters were detected above established MCLs.

4.6.3 Metals

Metal analysis includes two sets of analyses and results, filtered and unfiltered fractions. Groundwater samples obtained for total metal analyses are collected without filtering. Dissolved metal samples are

collected after groundwater is passed through in-line filters of 0.45 micron pore size. The difference in concentrations between the total and dissolved fraction may be attributed to the original metallic ion content of the particles and any sorption of ions to the suspended particles.

Table 4A-5 (Attachment 4A) summarizes the metal results, including total uranium, for all unfiltered groundwater samples collected during the CY 2012 annual monitoring event at the MWL. Samples were analyzed for TAL metals according to EPA Methods 6010, 6020, and 7470 (EPA 1986). Table 4A-6 (Attachment 4A) summarizes the metal results, including total uranium, for the filtered samples collected during the CY 2012 annual groundwater monitoring event.

TAL metals plus uranium were analyzed for each MWL monitoring well sample, in both unfiltered and filtered fractions. No metal parameters were detected above established MCLs in any groundwater sample.

4.6.4 Radiological Parameters

Groundwater samples from the MWL monitoring wells were screened for gamma-emitting radionuclides, gross alpha/beta activity, and tritium (Table 4A-7, Attachment 4A) and the analytical results are compared with the established EPA MCLs (no MCL has been established for tritium).

Gross alpha activity is measured as a screening tool and in accordance with 40 CFR, Parts 9, 141, and 142, Table I-4 and does not include uranium, which is measured independently. Therefore, gross alpha activity measurements were corrected by subtracting the total uranium activity. Corrected gross alpha activity results are all below the MCL of 15 picocuries per liter (pCi/L) and range from 3.08 to 10.51 pCi/L. Gross beta results do not exceed established MCLs. Tritium and short-list gamma spectroscopy radionuclides activities were below the laboratory minimum detectable activity levels in all groundwater samples. All radiological parameter results are summarized in Table 4A-7 (Attachment 4A).

4.6.5 Water Quality Parameters

The field water quality parameters measured immediately before sampling are presented in Attachment 4A, Table 4A-8. These field parameters consist of temperature, SC, ORP, pH, turbidity, and DO.

4.7 Quality Control Results

Field and laboratory QC samples were used to determine the accuracy of the methods used and to monitor for inadvertent sample contamination that can occur during the sampling and analysis process. All data were reviewed in accordance with Administrative Operating Procedure (AOP) 00-03, *Data Validation Procedure for Chemical and Radiochemical Data* (SNL May 2011). The results for each QC analysis and the impact on data quality are discussed in the following sections.

4.7.1 Field Quality Control Samples

The QC samples collected in the field included duplicate environmental, EB, FB, and TB samples. The purpose of each field QC sample type is presented in Section 1.3.3. The following sections discuss the analytical results for each QC sample type.

4.7.1.1 Duplicate Environmental Samples

Duplicate environmental samples were collected from monitoring wells MWL-MW5 and MWL-MW9, and the results were compared to the results for the corresponding environmental sample. Relative percent difference (RPD) values were calculated for the detected parameters.

CY 2012 duplicate environmental sample results show good correlation with RPD values less than 20 for organic compounds and less than 35 for metals for all calculated parameters, except the unfiltered cobalt results from monitoring well MWL-MW5 (RPD is 54). The cobalt results are considered estimated values because the reported concentrations are below the PQL.

4.7.1.2 Equipment Blank Samples

A total of three EB samples (also referred to as a rinsate blanks) were collected during the CY 2012 sampling event and submitted for all analyses. EB samples were collected prior to sampling monitoring wells MWL-MW5 and MWL-MW9 in February 2012, and prior to resampling monitoring well MWL-MW8 in March 2012.

Various constituents detected in EB samples included acetone, arsenic, bromodichloromethane, chloroform, and dibromochloromethane. No corrective action was required since these analytes were not detected in associated environmental samples.

4.7.1.3 Field Blank Samples

A total of eight FB samples were collected during the CY 2012 sampling and submitted for VOC analysis. Acetone, bromodichloromethane, chloroform, and dibromochloromethane were detected in FB samples. No corrective action was required since these compounds were not detected in associated environmental samples.

4.7.1.4 Trip Blank Samples

A total of 11 TB samples were submitted with the February and March 2012 samples for analysis of VOCs. No VOCs were detected in these samples.

4.7.2 Laboratory Quality Control Samples

Internal laboratory QC samples, including method blanks and duplicate LCSs, were analyzed concurrently with the groundwater samples. Additionally, batch matrix spike, matrix spike duplicate, and surrogate spike samples were analyzed. All environmental sample, field QC sample, and laboratory QC sample results were reviewed and qualified in accordance with AOP 00-03, *Data Validation Procedure for Chemical and Radiochemical Data* (SNL May 2011).

Although some analytical results were qualified during the data validation, no significant data quality problems were noted for any CY 2012 MWL groundwater monitoring samples. Data validation reports are filed in the SNL/NM Customer Funded Records Center.

4.8 Variances and Nonconformances

All analytical and field methods were performed according to the requirements specified in the MWL groundwater monitoring Mini-Sampling and Analysis Plan (SAP) for FY 2011 (SNL January 2012). No variances and/or nonconformances from requirements in the MWL Mini-SAP were identified during CY 2012 sampling activities, and there were no variances from the plans.

4.9 Summary and Conclusions

During CY 2012 environmental groundwater samples were collected from seven MWL groundwater monitoring wells. Sample parameters included VOCs, unfiltered and filtered fractions for TAL metals plus uranium, anions (as bromide, chloride, fluoride, and sulfate), alkalinity, NPN, gamma spectroscopy, gross alpha/beta activity, and tritium analyses. Groundwater monitoring results were compared with established EPA MCLs for drinking water (EPA 2009). No parameters were detected above established MCLs in any groundwater sample.

Based on the field and laboratory QC sample and data validation results, the CY 2012 groundwater monitoring data meet data quality objectives and are in compliance with analytical methods and laboratory procedures (i.e., representative and technically defensible).

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Attachment 4A
Mixed Waste Landfill
Analytical Results Tables

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Attachment 4A Tables

4A-1 Summary of Detected Volatile Organic Compounds, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico, Calendar Year 2012 ..... 4A-5

4A-2 Method Detection Limits for Volatile Organic Compounds (Method[g] SW846-8260B), Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico, Calendar Year 2012 ..... 4A-6

4A-3 Summary of Nitrate plus Nitrite Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico, Calendar Year 2012 ..... 4A-7

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Table 4A-1
Summary of Detected Volatile Organic Compounds,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (µg/L)	MDL[b] (µg/L)	PQL[c] (µg/L)	MCL[d] (µg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW8 10-Feb-12	Tetrachloroethene	0.310	0.300	1.00	5.00	J		091722-001	SW846-8260B
MWL-MW9 (Duplicate) 06-Feb-12	Toluene	1.31	0.250	1.00	1000			091710-001	SW846-8260B

Refer to footnotes on page 4A-33.

Table 4A-2
Method Detection Limits for Volatile Organic Compounds (Method[g] SW846-8260B), Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Analyte	MDL[b] (µg/L)
1,1,1-Trichloroethane	0.325
1,1,2,2-Tetrachloroethane	0.250
1,1,2-Trichloroethane	0.250
1,1-Dichloroethane	0.300
1,1-Dichloroethene	0.300
1,2-Dichloroethane	0.250
1,2-Dichloropropane	0.250
2-Butanone	1.25
2-Hexanone	1.25
4-methyl-, 2-Pentanone	1.25
Acetone	3.50
Benzene	0.300
Bromodichloromethane	0.250
Bromoform	0.250
Bromomethane	0.300
Carbon disulfide	1.25
Carbon tetrachloride	0.300
Chlorobenzene	0.250
Chloroethane	0.300
Chloroform	0.250
Chloromethane	0.300
Dibromochloromethane	0.300
Ethyl benzene	0.250
Methylene chloride	3.00
Styrene	0.250
Tetrachloroethene	0.300
Toluene	0.250
Trichloroethene	0.250
Vinyl acetate	1.50
Vinyl chloride	0.500
Xylene	0.300
cis-1,2-Dichloroethene	0.300
cis-1,3-Dichloropropene	0.250
trans-1,2-Dichloroethene	0.300
trans-1,3-Dichloropropene	0.250

Refer to footnotes on page 4A-33.

Table 4A-3
Summary of Nitrate plus Nitrite Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-BW2 07-Feb-12	Nitrate plus nitrite as N	1.89	0.100	0.500	10.0			091713-018	EPA 353.2
MWL-MW4 14-Feb-12	Nitrate plus nitrite as N	2.01	0.100	0.500	10.0			091725-018	EPA 353.2
MWL-MW5 08-Feb-12	Nitrate plus nitrite as N	1.14	0.100	0.500	10.0			091718-018	EPA 353.2
MWL-MW5 (Duplicate) 08-Feb-12	Nitrate plus nitrite as N	1.12	0.100	0.500	10.0			091719-018	EPA 353.2
MWL-MW6 02-Feb-12	Nitrate plus nitrite as N	1.52	0.100	0.500	10.0			091704-018	EPA 353.2
MWL-MW7 15-Feb-12	Nitrate plus nitrite as N	1.72	0.100	0.500	10.0			091728-018	EPA 353.2
MWL-MW8 10-Feb-12	Nitrate plus nitrite as N	1.20	0.100	0.500	10.0			091722-018	EPA 353.2
MWL-MW9 06-Feb-12	Nitrate plus nitrite as N	2.03	0.100	0.500	10.0			091709-018	EPA 353.2
MWL-MW9 (Duplicate) 06-Feb-12	Nitrate plus nitrite as N	2.08	0.100	0.500	10.0			091710-018	EPA 353.2

Refer to footnotes on page 4A-33.

Table 4A-4
Summary of Alkalinity and Anion Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-BW2	Bicarbonate alkalinity	240	0.725	1.00	NE			091713-022	SM 2320B
07-Feb-12	Carbonate alkalinity	ND	0.725	1.00	NE	U		091713-022	SM 2320B
	Bromide	0.435	0.066	0.200	NE			091713-016	SW846 9056
	Chloride	67.8	0.330	1.00	NE			091713-016	SW846 9056
	Fluoride	0.775	0.033	0.100	4.0			091713-016	SW846 9056
	Sulfate	44.9	0.500	2.00	NE			091713-016	SW846 9056
MWL-MW4	Bicarbonate alkalinity	201	0.725	1.00	NE			091725-022	SM 2320B
14-Feb-12	Carbonate alkalinity	ND	0.725	1.00	NE	U		091725-022	SM 2320B
	Bromide	0.369	0.066	0.200	NE			091725-016	SW846 9056
	Chloride	55.4	0.330	1.00	NE			091725-016	SW846 9056
	Fluoride	0.870	0.033	0.100	4.0			091725-016	SW846 9056
	Sulfate	38.6	0.500	2.00	NE			091725-016	SW846 9056
MWL-MW5	Bicarbonate alkalinity	319	0.725	1.00	NE			091718-022	SM 2320B
08-Feb-12	Carbonate alkalinity	ND	0.725	1.00	NE	U		091718-022	SM 2320B
	Bromide	0.461	0.066	0.200	NE			091718-016	SW846 9056
	Chloride	83.1	0.660	2.00	NE			091718-016	SW846 9056
	Fluoride	0.843	0.033	0.100	4.0			091718-016	SW846 9056
	Sulfate	54.9	1.00	4.00	NE			091718-016	SW846 9056
MWL-MW5 (Duplicate)	Bicarbonate alkalinity	317	0.725	1.00	NE			091719-022	SM 2320B
08-Feb-12	Carbonate alkalinity	ND	0.725	1.00	NE	U		091719-022	SM 2320B
	Bromide	0.506	0.066	0.200	NE			091719-016	SW846 9056
	Chloride	84.5	0.660	2.00	NE			091719-016	SW846 9056
	Fluoride	0.873	0.033	0.100	4.0			091719-016	SW846 9056
	Sulfate	55.6	1.00	4.00	NE			091719-016	SW846 9056
MWL-MW6	Bicarbonate alkalinity	305	0.725	1.00	NE			091704-022	SM 2320B
02-Feb-12	Carbonate alkalinity	ND	0.725	1.00	NE	U		091704-022	SM 2320B
	Bromide	0.470	0.066	0.200	NE			091704-016	SW846 9056
	Chloride	80.8	0.660	2.00	NE		J	091704-016	SW846 9056
	Fluoride	0.692	0.033	0.100	4.0			091704-016	SW846 9056
	Sulfate	52.9	1.00	4.00	NE		J	091704-016	SW846 9056
MWL-MW7	Bicarbonate alkalinity	215	0.725	1.00	NE			091728-022	SM 2320B
15-Feb-12	Carbonate alkalinity	ND	0.725	1.00	NE	U		091728-022	SM 2320B
	Bromide	0.321	0.066	0.200	NE			091728-016	SW846 9056
	Chloride	42.0	0.330	1.00	NE			091728-016	SW846 9056
	Fluoride	1.02	0.033	0.100	4.0			091728-016	SW846 9056
	Sulfate	38.3	0.100	0.400	NE			091728-016	SW846 9056

Refer to footnotes on page 4A-33.

Table 4A-4 *(Concluded)*
Summary of Alkalinity and Anion Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW8	Bicarbonate alkalinity	220	0.725	1.00	NE			091722-022	SM 2320B
10-Feb-12	Carbonate alkalinity	ND	0.725	1.00	NE	U		091722-022	SM 2320B
	Bromide	0.340	0.066	0.200	NE			091722-016	SW846 9056
	Chloride	49.8	0.330	1.00	NE			091722-016	SW846 9056
	Fluoride	0.996	0.033	0.100	4.0			091722-016	SW846 9056
	Sulfate	37.4	0.100	0.400	NE			091722-016	SW846 9056
MWL-MW9	Bicarbonate alkalinity	219	0.725	1.00	NE			091709-022	SM 2320B
06-Feb-12	Carbonate alkalinity	ND	0.725	1.00	NE	U		091709-022	SM 2320B
	Bromide	0.329	0.066	0.200	NE			091709-016	SW846 9056
	Chloride	45.9	0.330	1.00	NE			091709-016	SW846 9056
	Fluoride	1.06	0.033	0.100	4.0			091709-016	SW846 9056
	Sulfate	37.8	0.100	0.400	NE			091709-016	SW846 9056
MWL-MW9 (Duplicate)	Bicarbonate alkalinity	228	0.725	1.00	NE			091710-022	SM 2320B
06-Feb-12	Carbonate alkalinity	ND	0.725	1.00	NE	U		091710-022	SM 2320B
	Bromide	0.307	0.066	0.200	NE			091710-016	SW846 9056
	Chloride	42.2	0.330	1.00	NE			091710-016	SW846 9056
	Fluoride	1.04	0.033	0.100	4.0			091710-016	SW846 9056
	Sulfate	37.7	0.100	0.400	NE			091710-016	SW846 9056

Refer to footnotes on page 4A-33.

Table 4A-5
Summary of Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-BW2	Aluminum	0.0581	0.015	0.050	NE	B	0.1175U	091713-009	SW846 6020
07-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091713-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		091713-009	SW846 6020
	Barium	0.118	0.0006	0.002	2.00		J+	091713-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		091713-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091713-009	SW846 6020
	Calcium	94.2	0.300	1.00	NE	B		091713-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U	UJ	091713-009	SW846 6020
	Cobalt	0.000249	0.0001	0.001	NE	J		091713-009	SW846 6020
	Copper	0.000505	0.00035	0.001	NE	B, J	0.00205U	091713-009	SW846 6020
	Iron	0.205	0.033	0.100	NE			091713-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091713-009	SW846 6020
	Magnesium	23.4	0.010	0.030	NE		J	091713-009	SW846 6020
	Manganese	0.0251	0.001	0.005	NE			091713-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091713-009	SW846 7470
	Nickel	0.00155	0.0005	0.002	NE	B, J	0.00366UJ	091713-009	SW846 6020
	Potassium	4.77	0.080	0.300	NE			091713-009	SW846 6020
	Selenium	0.00178	0.0015	0.005	0.050	J		091713-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091713-009	SW846 6020
	Sodium	69.9	0.400	1.25	NE			091713-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		091713-009	SW846 6020
	Uranium	0.00689	0.000067	0.0002	0.030			091713-009	SW846 6020
	Vanadium	0.00473	0.001	0.005	NE	J		091713-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		091713-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-5 *(Continued)*
Summary of Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW4	Aluminum	ND	0.015	0.050	NE	U		091725-009	SW846 6020
14-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091725-009	SW846 6020
	Arsenic	0.00186	0.0017	0.005	0.010	J		091725-009	SW846 6020
	Barium	0.0855	0.0006	0.002	2.00			091725-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		091725-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091725-009	SW846 6020
	Calcium	58.2	0.600	2.00	NE			091725-009	SW846 6020
	Chromium	0.00259	0.002	0.010	0.100	J		091725-009	SW846 6020
	Cobalt	0.000184	0.0001	0.001	NE	J		091725-009	SW846 6020
	Copper	0.00193	0.00035	0.001	NE			091725-009	SW846 6020
	Iron	0.204	0.033	0.100	NE			091725-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091725-009	SW846 6020
	Magnesium	19.7	0.010	0.030	NE			091725-009	SW846 6020
	Manganese	0.00576	0.001	0.005	NE			091725-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091725-009	SW846 7470
	Nickel	0.194	0.0005	0.002	NE			091725-009	SW846 6020
	Potassium	4.90	0.080	0.300	NE			091725-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		091725-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091725-009	SW846 6020
	Sodium	48.0	0.080	0.250	NE			091725-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		091725-009	SW846 6020
	Uranium	0.00458	0.000067	0.0002	0.030			091725-009	SW846 6020
	Vanadium	0.00731	0.001	0.005	NE			091725-009	SW846 6010
	Zinc	0.0348	0.0035	0.010	NE			091725-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-5 *(Continued)*
Summary of Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW5	Aluminum	ND	0.015	0.050	NE	U		091718-009	SW846 6020
08-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091718-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		091718-009	SW846 6020
	Barium	0.140	0.0006	0.002	2.00		J+	091718-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		091718-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091718-009	SW846 6020
	Calcium	104	0.300	1.00	NE	B		091718-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		091718-009	SW846 6020
	Cobalt	0.000111	0.0001	0.001	NE	J		091718-009	SW846 6020
	Copper	0.0019	0.00035	0.001	NE	B	0.00205U	091718-009	SW846 6020
	Iron	0.165	0.033	0.100	NE			091718-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091718-009	SW846 6020
	Magnesium	35.1	0.050	0.150	NE		J	091718-009	SW846 6020
	Manganese	0.0104	0.001	0.005	NE			091718-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091718-009	SW846 7470
	Nickel	0.00499	0.0005	0.002	NE	B	0.00366UJ	091718-009	SW846 6020
	Potassium	6.50	0.080	0.300	NE			091718-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		091718-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091718-009	SW846 6020
	Sodium	83.9	0.400	1.25	NE			091718-009	SW846 6020
	Thallium	0.000764	0.00045	0.002	0.002	J		091718-009	SW846 6020
	Uranium	0.00879	0.000067	0.0002	0.030			091718-009	SW846 6020
	Vanadium	0.00467	0.001	0.005	NE	J		091718-009	SW846 6010
	Zinc	0.0074	0.0035	0.010	NE	J		091718-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-5 *(Continued)*
Summary of Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW5 (Duplicate)	Aluminum	ND	0.015	0.050	NE	U		091719-009	SW846 6020
08-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091719-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		091719-009	SW846 6020
	Barium	0.136	0.0006	0.002	2.00		J+	091719-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		091719-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091719-009	SW846 6020
	Calcium	112	0.300	1.00	NE	B		091719-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U	UJ	091719-009	SW846 6020
	Cobalt	0.000194	0.0001	0.001	NE	J		091719-009	SW846 6020
	Copper	0.000634	0.00035	0.001	NE	B, J	0.00205U	091719-009	SW846 6020
	Iron	0.147	0.033	0.100	NE		NJ-	091719-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091719-009	SW846 6020
	Magnesium	35.0	0.010	0.030	NE		J	091719-009	SW846 6020
	Manganese	0.00821	0.001	0.005	NE			091719-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091719-009	SW846 7470
	Nickel	0.00285	0.0005	0.002	NE	B	0.00366UJ	091719-009	SW846 6020
	Potassium	6.59	0.080	0.300	NE			091719-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		091719-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091719-009	SW846 6020
	Sodium	77.8	0.400	1.25	NE			091719-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		091719-009	SW846 6020
	Uranium	0.00932	0.000067	0.0002	0.030			091719-009	SW846 6020
	Vanadium	0.00518	0.001	0.005	NE			091719-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		091719-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-5 *(Continued)*
Summary of Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW6	Aluminum	ND	0.015	0.050	NE	U		091704-009	SW846 6020
02-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091704-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		091704-009	SW846 6020
	Barium	0.0929	0.0006	0.002	2.00			091704-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		091704-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091704-009	SW846 6020
	Calcium	74.9	0.300	1.00	NE	B	J	091704-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		091704-009	SW846 6020
	Cobalt	0.000118	0.0001	0.001	NE	J		091704-009	SW846 6020
	Copper	0.000717	0.00035	0.001	NE	B, J	0.0019U	091704-009	SW846 6020
	Iron	0.141	0.033	0.100	NE			091704-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091704-009	SW846 6020
	Magnesium	26.3	0.010	0.030	NE			091704-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		091704-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091704-009	SW846 7470
	Nickel	0.00123	0.0005	0.002	NE	J		091704-009	SW846 6020
	Potassium	4.80	0.080	0.300	NE			091704-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		091704-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091704-009	SW846 6020
	Sodium	71.8	0.400	1.25	NE			091704-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		091704-009	SW846 6020
	Uranium	0.00901	0.000067	0.0002	0.030			091704-009	SW846 6020
	Vanadium	0.00688	0.001	0.005	NE			091704-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		091704-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-5 *(Continued)*
Summary of Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW7	Aluminum	ND	0.015	0.050	NE	U		091728-009	SW846 6020
15-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091728-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		091728-009	SW846 6020
	Barium	0.105	0.006	0.020	2.00			091728-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		091728-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091728-009	SW846 6020
	Calcium	61.5	0.600	2.00	NE			091728-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		091728-009	SW846 6020
	Cobalt	ND	0.0001	0.001	NE	U		091728-009	SW846 6020
	Copper	0.000397	0.00035	0.001	NE	J		091728-009	SW846 6020
	Iron	0.134	0.033	0.100	NE			091728-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091728-009	SW846 6020
	Magnesium	20.5	0.010	0.030	NE			091728-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		091728-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091728-009	SW846 7470
	Nickel	0.000908	0.0005	0.002	NE	J		091728-009	SW846 6020
	Potassium	4.83	0.080	0.300	NE			091728-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		091728-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091728-009	SW846 6020
	Sodium	48.9	0.080	0.250	NE			091728-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		091728-009	SW846 6020
	Uranium	0.00777	0.000067	0.0002	0.030			091728-009	SW846 6020
	Vanadium	0.0069	0.001	0.005	NE			091728-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		091728-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-5 *(Continued)*
Summary of Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW8	Aluminum	0.0348	0.015	0.050	NE	J		091722-009	SW846 6020
10-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091722-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		091722-009	SW846 6020
	Barium	0.131	0.006	0.020	2.00			091722-009	SW846 6020
	Beryllium	0.000233	0.0002	0.0005	0.004	J		091722-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091722-009	SW846 6020
	Calcium	62.2	0.600	2.00	NE			091722-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		091722-009	SW846 6020
	Cobalt	0.000103	0.0001	0.001	NE	J		091722-009	SW846 6020
	Copper	0.00071	0.00035	0.001	NE	J		091722-009	SW846 6020
	Iron	0.186	0.033	0.100	NE			091722-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091722-009	SW846 6020
	Magnesium	20.0	0.010	0.030	NE			091722-009	SW846 6020
	Manganese	0.0128	0.001	0.005	NE			091722-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091722-009	SW846 7470
	Nickel	0.00106	0.0005	0.002	NE	J		091722-009	SW846 6020
	Potassium	5.09	0.080	0.300	NE			091722-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		091722-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091722-009	SW846 6020
	Sodium	47.1	0.080	0.250	NE			091722-009	SW846 6020
	Thallium	0.000505	0.00045	0.002	0.002	J		091722-009	SW846 6020
	Uranium	0.00706	0.000067	0.0002	0.030			091722-009	SW846 6020
	Vanadium	0.00187	0.001	0.005	NE	J		091722-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		091722-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-5 *(Continued)*
Summary of Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW9	Aluminum	ND	0.015	0.050	NE	U		091709-009	SW846 6020
06-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091709-009	SW846 6020
	Arsenic	0.00268	0.0017	0.005	0.010	J		091709-009	SW846 6020
	Barium	0.107	0.0006	0.002	2.00		J+	091709-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		091709-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091709-009	SW846 6020
	Calcium	72.3	0.300	1.00	NE	B		091709-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U	UJ	091709-009	SW846 6020
	Cobalt	0.000108	0.0001	0.001	NE	J		091709-009	SW846 6020
	Copper	0.00101	0.00035	0.001	NE	B	0.00205U	091709-009	SW846 6020
	Iron	0.104	0.033	0.100	NE		NJ-	091709-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091709-009	SW846 6020
	Magnesium	20.4	0.010	0.030	NE		J	091709-009	SW846 6020
	Manganese	0.00309	0.001	0.005	NE	J		091709-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091709-009	SW846 7470
	Nickel	0.0012	0.0005	0.002	NE	B, J	0.00366UJ	091709-009	SW846 6020
	Potassium	5.13	0.080	0.300	NE			091709-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		091709-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091709-009	SW846 6020
	Sodium	60.5	0.400	1.25	NE			091709-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		091709-009	SW846 6020
	Uranium	0.0087	0.000067	0.0002	0.030			091709-009	SW846 6020
	Vanadium	0.00789	0.001	0.005	NE			091709-009	SW846 6010
	Zinc	0.00399	0.0035	0.010	NE	J		091709-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-5 *(Concluded)*
Summary of Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW9 (Duplicate)	Aluminum	ND	0.015	0.050	NE	U		091710-009	SW846 6020
06-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091710-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		091710-009	SW846 6020
	Barium	0.109	0.0006	0.002	2.00		J+	091710-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		091710-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091710-009	SW846 6020
	Calcium	85.3	0.300	1.00	NE	B		091710-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U	UJ	091710-009	SW846 6020
	Cobalt	0.000118	0.0001	0.001	NE	J		091710-009	SW846 6020
	Copper	0.000815	0.00035	0.001	NE	B, J	0.00205U	091710-009	SW846 6020
	Iron	0.115	0.033	0.100	NE		NJ-	091710-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091710-009	SW846 6020
	Magnesium	21.1	0.010	0.030	NE		J	091710-009	SW846 6020
	Manganese	0.0037	0.001	0.005	NE	J		091710-009	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091710-009	SW846 7470
	Nickel	0.00141	0.0005	0.002	NE	B, J	0.00366UJ	091710-009	SW846 6020
	Potassium	5.77	0.080	0.300	NE			091710-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		091710-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091710-009	SW846 6020
	Sodium	47.3	0.080	0.250	NE			091710-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		091710-009	SW846 6020
	Uranium	0.00848	0.000067	0.0002	0.030			091710-009	SW846 6020
	Vanadium	0.00796	0.001	0.005	NE			091710-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		091710-009	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-BW2	Aluminum	ND	0.015	0.050	NE	U		091713-010	SW846 6020
07-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091713-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		091713-010	SW846 6020
	Barium	0.121	0.0006	0.002	2.00		J+	091713-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		091713-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091713-010	SW846 6020
	Calcium	95.0	0.300	1.00	NE	B		091713-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U	UJ	091713-010	SW846 6020
	Cobalt	0.000313	0.0001	0.001	NE	J		091713-010	SW846 6020
	Copper	0.000524	0.00035	0.001	NE	B, J	0.00205U	091713-010	SW846 6020
	Iron	0.123	0.033	0.100	NE		NJ-	091713-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091713-010	SW846 6020
	Magnesium	25.0	0.010	0.030	NE		J	091713-010	SW846 6020
	Manganese	0.0245	0.001	0.005	NE			091713-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091713-010	SW846 7470
	Nickel	0.00156	0.0005	0.002	NE	B, J	0.00366UJ	091713-010	SW846 6020
	Potassium	4.61	0.080	0.300	NE			091713-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		091713-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091713-010	SW846 6020
	Sodium	67.0	0.400	1.25	NE			091713-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		091713-010	SW846 6020
	Uranium	0.00741	0.000067	0.0002	0.030			091713-010	SW846 6020
	Vanadium	0.00444	0.001	0.005	NE	J		091713-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		091713-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW4	Aluminum	ND	0.015	0.050	NE	U		091725-010	SW846 6020
14-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091725-010	SW846 6020
	Arsenic	0.00318	0.0017	0.005	0.010	J		091725-010	SW846 6020
	Barium	0.0859	0.0006	0.002	2.00			091725-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		091725-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091725-010	SW846 6020
	Calcium	60.6	0.600	2.00	NE			091725-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		091725-010	SW846 6020
	Cobalt	0.000321	0.0001	0.001	NE	J		091725-010	SW846 6020
	Copper	0.00113	0.00035	0.001	NE			091725-010	SW846 6020
	Iron	0.140	0.033	0.100	NE			091725-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091725-010	SW846 6020
	Magnesium	20.4	0.010	0.030	NE			091725-010	SW846 6020
	Manganese	0.00556	0.001	0.005	NE			091725-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091725-010	SW846 7470
	Nickel	0.195	0.0005	0.002	NE			091725-010	SW846 6020
	Potassium	5.14	0.080	0.300	NE			091725-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		091725-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091725-010	SW846 6020
	Sodium	50.0	0.080	0.250	NE			091725-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		091725-010	SW846 6020
	Uranium	0.00462	0.000067	0.0002	0.030			091725-010	SW846 6020
	Vanadium	0.0075	0.001	0.005	NE			091725-010	SW846 6010
	Zinc	0.0313	0.0035	0.010	NE			091725-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW5	Aluminum	ND	0.015	0.050	NE	U		091718-010	SW846 6020
08-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091718-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		091718-010	SW846 6020
	Barium	0.139	0.0006	0.002	2.00		J+	091718-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		091718-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091718-010	SW846 6020
	Calcium	132	0.300	1.00	NE	B		091718-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U	UJ	091718-010	SW846 6020
	Cobalt	0.000181	0.0001	0.001	NE	J		091718-010	SW846 6020
	Copper	0.000531	0.00035	0.001	NE	B, J	0.00205U	091718-010	SW846 6020
	Iron	0.175	0.033	0.100	NE			091718-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091718-010	SW846 6020
	Magnesium	31.5	0.010	0.030	NE		J	091718-010	SW846 6020
	Manganese	0.0027	0.001	0.005	NE	J		091718-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091718-010	SW846 7470
	Nickel	0.00203	0.0005	0.002	NE	B	0.00366UJ	091718-010	SW846 6020
	Potassium	6.29	0.080	0.300	NE			091718-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		091718-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091718-010	SW846 6020
	Sodium	75.5	0.400	1.25	NE			091718-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		091718-010	SW846 6020
	Uranium	0.00995	0.000067	0.0002	0.030			091718-010	SW846 6020
	Vanadium	0.00433	0.001	0.005	NE	J		091718-010	SW846 6010
	Zinc	0.00363	0.0035	0.010	NE	J		091718-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW5 (Duplicate)	Aluminum	ND	0.015	0.050	NE	U		091719-010	SW846 6020
08-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091719-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		091719-010	SW846 6020
	Barium	0.143	0.0006	0.002	2.00		J+	091719-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		091719-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091719-010	SW846 6020
	Calcium	116	0.300	1.00	NE	B		091719-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U	UJ	091719-010	SW846 6020
	Cobalt	0.000177	0.0001	0.001	NE	J		091719-010	SW846 6020
	Copper	0.000619	0.00035	0.001	NE	B, J	0.00205U	091719-010	SW846 6020
	Iron	0.180	0.033	0.100	NE			091719-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091719-010	SW846 6020
	Magnesium	33.9	0.010	0.030	NE		J	091719-010	SW846 6020
	Manganese	0.00296	0.001	0.005	NE	J		091719-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091719-010	SW846 7470
	Nickel	0.0021	0.0005	0.002	NE	B	0.00366UJ	091719-010	SW846 6020
	Potassium	6.59	0.080	0.300	NE			091719-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		091719-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091719-010	SW846 6020
	Sodium	77.7	0.400	1.25	NE			091719-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		091719-010	SW846 6020
	Uranium	0.0103	0.000067	0.0002	0.030			091719-010	SW846 6020
	Vanadium	0.0048	0.001	0.005	NE	J		091719-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		091719-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW6	Aluminum	ND	0.015	0.050	NE	U		091704-010	SW846 6020
02-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091704-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		091704-010	SW846 6020
	Barium	0.099	0.0006	0.002	2.00			091704-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		091704-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091704-010	SW846 6020
	Calcium	76.4	0.300	1.00	NE	B	J	091704-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		091704-010	SW846 6020
	Cobalt	0.000277	0.0001	0.001	NE	J		091704-010	SW846 6020
	Copper	0.00057	0.00035	0.001	NE	B, J	0.0019U	091704-010	SW846 6020
	Iron	0.133	0.033	0.100	NE			091704-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091704-010	SW846 6020
	Magnesium	24.7	0.010	0.030	NE			091704-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		091704-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091704-010	SW846 7470
	Nickel	0.00116	0.0005	0.002	NE	J		091704-010	SW846 6020
	Potassium	4.91	0.080	0.300	NE			091704-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		091704-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091704-010	SW846 6020
	Sodium	70.9	0.400	1.25	NE			091704-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		091704-010	SW846 6020
	Uranium	0.00883	0.000067	0.0002	0.030			091704-010	SW846 6020
	Vanadium	0.00667	0.001	0.005	NE			091704-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		091704-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW7	Aluminum	ND	0.015	0.050	NE	U		091728-010	SW846 6020
15-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091728-010	SW846 6020
	Arsenic	0.00185	0.0017	0.005	0.010	J		091728-010	SW846 6020
	Barium	0.0915	0.0006	0.002	2.00			091728-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		091728-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091728-010	SW846 6020
	Calcium	58.5	0.600	2.00	NE			091728-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		091728-010	SW846 6020
	Cobalt	0.000151	0.0001	0.001	NE	J		091728-010	SW846 6020
	Copper	0.00044	0.00035	0.001	NE	J		091728-010	SW846 6020
	Iron	0.130	0.033	0.100	NE			091728-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091728-010	SW846 6020
	Magnesium	20.1	0.010	0.030	NE			091728-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		091728-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091728-010	SW846 7470
	Nickel	0.00112	0.0005	0.002	NE	J		091728-010	SW846 6020
	Potassium	4.81	0.080	0.300	NE			091728-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		091728-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091728-010	SW846 6020
	Sodium	48.2	0.080	0.250	NE			091728-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		091728-010	SW846 6020
	Uranium	0.00712	0.000067	0.0002	0.030			091728-010	SW846 6020
	Vanadium	0.00687	0.001	0.005	NE			091728-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		091728-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW8	Aluminum	ND	0.015	0.050	NE	U		091722-010	SW846 6020
10-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091722-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		091722-010	SW846 6020
	Barium	0.130	0.006	0.020	2.00			091722-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		091722-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091722-010	SW846 6020
	Calcium	62.9	0.600	2.00	NE			091722-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		091722-010	SW846 6020
	Cobalt	0.00015	0.0001	0.001	NE	J		091722-010	SW846 6020
	Copper	0.000641	0.00035	0.001	NE	J		091722-010	SW846 6020
	Iron	0.134	0.033	0.100	NE			091722-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091722-010	SW846 6020
	Magnesium	21.2	0.010	0.030	NE			091722-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		091722-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091722-010	SW846 7470
	Nickel	0.000993	0.0005	0.002	NE	J		091722-010	SW846 6020
	Potassium	5.23	0.080	0.300	NE			091722-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		091722-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091722-010	SW846 6020
	Sodium	51.4	0.800	2.50	NE			091722-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		091722-010	SW846 6020
	Uranium	0.00693	0.000067	0.0002	0.030			091722-010	SW846 6020
	Vanadium	0.00157	0.001	0.005	NE	J		091722-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		091722-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW9	Aluminum	ND	0.015	0.050	NE	U		091709-010	SW846 6020
06-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091709-010	SW846 6020
	Arsenic	0.00385	0.0017	0.005	0.010	J		091709-010	SW846 6020
	Barium	0.111	0.0006	0.002	2.00		J+	091709-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		091709-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091709-010	SW846 6020
	Calcium	73.6	0.300	1.00	NE	B		091709-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U	UJ	091709-010	SW846 6020
	Cobalt	0.000104	0.0001	0.001	NE	J		091709-010	SW846 6020
	Copper	0.00054	0.00035	0.001	NE	B, J	0.00205U	091709-010	SW846 6020
	Iron	0.0983	0.033	0.100	NE	J	NJ-	091709-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091709-010	SW846 6020
	Magnesium	20.5	0.010	0.030	NE		J	091709-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		091709-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091709-010	SW846 7470
	Nickel	0.00131	0.0005	0.002	NE	B, J	0.00366UJ	091709-010	SW846 6020
	Potassium	5.72	0.080	0.300	NE			091709-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		091709-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091709-010	SW846 6020
	Sodium	47.6	0.080	0.250	NE			091709-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		091709-010	SW846 6020
	Uranium	0.00979	0.000067	0.0002	0.030			091709-010	SW846 6020
	Vanadium	0.00904	0.001	0.005	NE			091709-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		091709-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-6 *(Concluded)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW9 (Duplicate)	Aluminum	ND	0.015	0.050	NE	U		091710-010	SW846 6020
06-Feb-12	Antimony	ND	0.001	0.003	0.006	U		091710-010	SW846 6020
	Arsenic	0.00359	0.0017	0.005	0.010	J		091710-010	SW846 6020
	Barium	0.110	0.0006	0.002	2.00		J+	091710-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		091710-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		091710-010	SW846 6020
	Calcium	71.5	0.300	1.00	NE	B		091710-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U	UJ	091710-010	SW846 6020
	Cobalt	0.000126	0.0001	0.001	NE	J		091710-010	SW846 6020
	Copper	0.000606	0.00035	0.001	NE	B, J	0.00205U	091710-010	SW846 6020
	Iron	0.0934	0.033	0.100	NE	J	NJ-	091710-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		091710-010	SW846 6020
	Magnesium	21.1	0.010	0.030	NE		J	091710-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		091710-010	SW846 6020
	Mercury	ND	0.000066	0.0002	0.002	U		091710-010	SW846 7470
	Nickel	0.00128	0.0005	0.002	NE	B, J	0.00366UJ	091710-010	SW846 6020
	Potassium	5.71	0.080	0.300	NE			091710-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		091710-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		091710-010	SW846 6020
	Sodium	47.4	0.080	0.250	NE			091710-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		091710-010	SW846 6020
	Uranium	0.00963	0.000067	0.0002	0.030			091710-010	SW846 6020
	Vanadium	0.00869	0.001	0.005	NE			091710-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		091710-010	SW846 6020

Refer to footnotes on page 4A-33.

Table 4A-7
Summary of Gamma Spectroscopy, Gross Alpha, Gross Beta, and Tritium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d]	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-BW2	Americium-241	-2.59 ± 6.42	10.4	5.10	NE	U	BD	091713-033	EPA 901.1
07-Feb-12	Cesium-137	-2.2 ± 2.12	3.04	1.47	NE	U	BD	091713-033	EPA 901.1
	Cobalt-60	2.32 ± 2.14	3.48	1.66	NE	U	BD	091713-033	EPA 901.1
	Potassium-40	33.4 ± 43.7	29.9	14.1	NE	X	R	091713-033	EPA 901.1
	Gross Alpha	4.82	NA	NA	15 pCi/L	NA	None	091713-034	EPA 900.0
	Gross Beta	4.21 ± 1.43	1.86	0.898	4 mrem/yr		J	091713-034	EPA 900.0
	Tritium	-3.18 ± 57.8	107	48.8	NE	U	BD	091713-036	EPA 906.0 M
MWL-MW4	Americium-241	8.77 ± 8.45	12.2	5.94	NE	U	BD	091725-033	EPA 901.1
14-Feb-12	Cesium-137	-0.612 ± 2.38	4.20	1.99	NE	U	BD	091725-033	EPA 901.1
	Cobalt-60	1.31 ± 2.31	4.34	2.01	NE	U	BD	091725-033	EPA 901.1
	Potassium-40	3.14 ± 45.3	39.1	17.9	NE	U	BD	091725-033	EPA 901.1
	Gross Alpha	1.35	NA	NA	15 pCi/L	NA	None	091725-034	EPA 900.0
	Gross Beta	6.80 ± 1.73	1.83	0.882	4 mrem/yr			091725-034	EPA 900.0
	Tritium	91.8 ± 71.1	110	50.3	NE	U	BD	091725-036	EPA 906.0 M
MWL-MW5	Americium-241	-2.96 ± 8.29	12.1	5.91	NE	U	BD	091718-033	EPA 901.1
08-Feb-12	Cesium-137	0.448 ± 1.71	2.95	1.41	NE	U	BD	091718-033	EPA 901.1
	Cobalt-60	0.222 ± 1.73	3.05	1.43	NE	U	BD	091718-033	EPA 901.1
	Potassium-40	3.07 ± 36.9	29.2	13.6	NE	U	BD	091718-033	EPA 901.1
	Gross Alpha	10.51	NA	NA	15 pCi/L	NA	None	091718-034	EPA 900.0
	Gross Beta	7.87 ± 2.57	3.36	1.63	4 mrem/yr		NJ+	091718-034	EPA 900.0
	Tritium	14.9 ± 62.0	111	50.7	NE	U	BD	091718-036	EPA 906.0 M
MWL-MW5 (Duplicate)	Americium-241	0.139 ± 11.6	17.8	8.75	NE	U	BD	091719-033	EPA 901.1
08-Feb-12	Cesium-137	-0.738 ± 1.92	3.20	1.54	NE	U	BD	091719-033	EPA 901.1
	Cobalt-60	1.91 ± 2.16	3.67	1.75	NE	U	BD	091719-033	EPA 901.1
	Potassium-40	-23.8 ± 40.5	43.9	21.1	NE	U	BD	091719-033	EPA 901.1
	Gross Alpha	6.26	NA	NA	15 pCi/L	NA	None	091719-034	EPA 900.0
	Gross Beta	6.24 ± 2.20	2.94	1.42	4 mrem/yr		NJ+	091719-034	EPA 900.0
	Tritium	50.0 ± 64.7	109	49.4	NE	U	BD	091719-036	EPA 906.0 M

Refer to footnotes on page 4A-33.

Table 4A-7 *(Continued)*
Summary of Gamma Spectroscopy, Gross Alpha, Gross Beta, and Tritium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d]	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW6	Americium-241	-2.49 ± 5.09	8.45	4.14	NE	U	BD	091704-033	EPA 901.1
02-Feb-12	Cesium-137	1.14 ± 1.70	2.96	1.43	NE	U	BD	091704-033	EPA 901.1
	Cobalt-60	1.58 ± 2.13	3.32	1.58	NE	U	BD	091704-033	EPA 901.1
	Potassium-40	-0.218 ± 32.6	42.2	20.3	NE	U	BD	091704-033	EPA 901.1
	Gross Alpha	9.66	NA	NA	15 pCi/L	NA	None	091704-034	EPA 900.0
	Gross Beta	7.04 ± 1.68	1.57	0.754	4 mrem/yr			091704-034	EPA 900.0
	Tritium	21.5 ± 62.7	111	50.7	NE	U	BD	091704-036	EPA 906.0 M
MWL-MW7	Americium-241	2.18 ± 4.07	6.27	3.03	NE	U	BD	091728-033	EPA 901.1
15-Feb-12	Cesium-137	1.42 ± 6.50	6.08	2.91	NE	U	BD	091728-033	EPA 901.1
	Cobalt-60	1.52 ± 3.11	5.78	2.68	NE	U	BD	091728-033	EPA 901.1
	Potassium-40	4.66 ± 52.5	71.7	33.7	NE	U	BD	091728-033	EPA 901.1
	Gross Alpha	4.99	NA	NA	15 pCi/L	NA	None	091728-034	EPA 900.0
	Gross Beta	2.89 ± 1.40	2.04	0.986	4 mrem/yr		J	091728-034	EPA 900.0
	Tritium	-16.4 ± 58.0	110	50.2	NE	U	BD	091728-036	EPA 906.0 M
MWL-MW8	Americium-241	2.52 ± 4.26	6.93	3.35	NE	U	BD	091722-033	EPA 901.1
10-Feb-12	Cesium-137	2.54 ± 3.29	5.68	2.68	NE	U	BD	091722-033	EPA 901.1
	Cobalt-60	0.453 ± 3.11	5.89	2.68	NE	U	BD	091722-033	EPA 901.1
	Potassium-40	-11.5 ± 44.7	73.2	34.0	NE	U	BD	091722-033	EPA 901.1
	Gross Alpha	3.80	NA	NA	15 pCi/L	NA	None	091722-034	EPA 900.0
	Gross Beta	6.62 ± 1.78	2.03	0.983	4 mrem/yr			091722-034	EPA 900.0
	Tritium	57.2 ± 66.3	110	50.1	NE	U	BD	091722-036	EPA 906.0 M
MWL-MW9	Americium-241	-0.545 ± 11.5	17.8	8.71	NE	U	BD	091709-033	EPA 901.1
06-Feb-12	Cesium-137	-1.45 ± 2.22	3.60	1.73	NE	U	BD	091709-033	EPA 901.1
	Cobalt-60	1.29 ± 2.32	4.13	1.95	NE	U	BD	091709-033	EPA 901.1
	Potassium-40	-55.2 ± 49.4	51.3	24.4	NE	U	BD	091709-033	EPA 901.1
	Gross Alpha	3.08	NA	NA	15 pCi/L	NA	None	091709-034	EPA 900.0
	Gross Beta	5.70 ± 1.88	2.46	1.20	4 mrem/yr		J	091709-034	EPA 900.0
	Tritium	-19.3 ± 56.7	108	49.3	NE	U	BD	091709-036	EPA 906.0 M

Refer to footnotes on page 4A-33.

Table 4A-7 *(Concluded)*
Summary of Gamma Spectroscopy, Gross Alpha, Gross Beta, and Tritium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d]	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW9 (Duplicate)	Americium-241	3.32 ± 12.2	19.4	9.50	NE	U	BD	091710-033	EPA 901.1
06-Feb-12	Cesium-137	0.318 ± 2.11	3.69	1.78	NE	U	BD	019710-033	EPA 901.1
	Cobalt-60	1.70 ± 2.32	4.03	1.91	NE	U	BD	091710-033	EPA 901.1
	Potassium-40	-28.4 ± 46.5	53.1	25.5	NE	U	BD	091710-033	EPA 901.1
	Gross Alpha	3.20	NA	NA	15 pCi/L	NA	None	091710-034	EPA 900.0
	Gross Beta	6.27 ± 1.53	1.50	0.719	4 mrem/yr			091710-034	EPA 900.0
	Tritium	14.5 ± 60.4	108	49.3	NE	U	BD	091710-036	EPA 906.0 M

Refer to footnotes on page 4A-33.

Table 4A-8
Summary of Field Water Quality Measurements[h],
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2012

Well ID	Sample Date	Temperature (°C)	Specific Conductivity (µmho/cm)	Oxidation Reduction Potential (mV)	pH	Turbidity (NTU)	Dissolved Oxygen (% Sat)	Dissolved Oxygen (mg/L)
MWL-BW2	07-Feb-12	16.71	761	388.7	7.12	1.34	21.9	2.34
MWL-MW4	14-Feb-12	18.70	651	341.9	8.11	1.28	24.7	2.26
MWL-MW5	08-Feb-12	18.58	966	382.6	6.99	0.30	30.4	2.79
MWL-MW6	02-Feb-12	19.07	936	393.0	7.03	0.15	33.0	3.08
MWL-MW7	15-Feb-12	17.16	638	383.5	7.35	0.56	51.0	4.90
MWL-MW8	10-Feb-12	14.30	646	380.0	7.41	1.62	40.9	4.18
MWL-MW8 (Resample)	28-Mar-12	19.98	573	61.1	7.75	1.60	43.7	3.95
MWL-MW9	06-Feb-12	12.79	636	378.9	7.52	2.60	76.3	8.07

Refer to footnotes on page 4A-33.

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Footnotes for Mixed Waste Landfill Groundwater Monitoring Tables

[a]Result
- Values in bold exceed the established MCL.
- ND = not detected (at method detection limit).
- Activities of zero or less are considered to be not detected.
- Gross alpha activity measurements were corrected by subtracting out the total uranium activity (40 CFR Parts 9, 141, and 142, Table 1-4)
- µg/L = micrograms per liter.
- mg/L = milligrams per liter.
- pCi/L = picocuries per liter.

[b]MDL or MDA

Method detection limit. The minimum concentration or activity that can be measured and reported with 99% confidence that the analyte is greater than zero, analyte is matrix specific.

The minimal detectable activity or minimum measured activity in a sample required to ensure a 95% probability that the measured activity is accurately quantified above the critical level.

NA = not applicable for gross alpha activities. The MDA could not be calculated as the gross alpha activity was corrected by subtracting out the total uranium activity.

[c]PQL or Critical Level

Practical quantitation limit. The lowest concentration of analytes in a sample that can be reliably determined within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions.

The minimum activity that can be measured and reported with 99% confidence that the analyte is greater than zero, analyte is matrix specific.

NA = not applicable for gross alpha activities. The critical level could not be calculated as the gross alpha activity was corrected by subtracting out the total uranium activity.

[d]MCL
- Maximum contaminant level. Established by the U.S. Environmental Protection Agency (EPA) Primary Water Regulations (40 CFR 141.11[b]), National Primary Drinking Water Standards (EPA July 2002).
- NE = not established.
- The following are the MCLs for gross alpha particles and beta particles in community water systems: 15 pCi/L = Gross alpha particle activity, excluding total uranium (40 CFR Parts 9, 141, and 142, Table 4A- 1-4). 4 mrem/yr = any combination of beta and/or gamma emitting radionuclides (as dose rate).

[e]Laboratory Qualifier

B = Analyte is detected in associated laboratory method blank.
J = Estimated value, the analyte concentration is below the practical quantitation limit (PQL).
NA = Not applicable.
U = Analyte is absent or below the method detection limit.
X = Data rejected due to high counting uncertainty.

[f]Validation Qualifier

If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.

BD = Below detection limit as used in radiochemistry to identify results that are not statistically different from zero.
J = The associated value is an estimated quantity.
J+ = The associated numerical value is an estimated quantity with a suspected positive bias.
None = No data validation for corrected gross alpha activity.
NJ- = Presumptive evidence of the presence of the material at an estimated quantity with a suspected negative bias.
R = The data are unusable (compound may or may not be present). Resampling or reanalysis are necessary for verification.
U = The analyte was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.
UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

Footnotes for Mixed Waste Landfill Groundwater Monitoring Tables (Concluded)

[g]Analytical Method

- EPA, 1986 (and updates), *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846, 3rd ed.
- EPA, 1984, *Methods for Chemical Analysis of Water and Wastes*, EPA 600-4-79-020.
- EPA, 1983, *The Determination of Inorganic Anions in Water by Ion Chromatography-Method 300.0*, EPA-600/4-84-017.
- EPA, 1980, *Prescribed Procedures for Measurement of Radioactivity in Drinking Water,* EPA-600/4-80-032, Cincinnati, Ohio.
- Clesceri, L.S., A.E. Greenburg, and A.D. Eaton, 1998. *Standard Methods for the Examination of Water and Wastewater,* 20th ed., Standard Method 2320B, published jointly by American Public Health Association, American Water Works Association, and Water Environment Federation. Washington, D.C.

[h]Field Water Quality Measurements

- Field measurements collected prior to sampling.

°C = degrees Celsius.
% Sat = percent saturation.
µmho/cm = micromhos per centimeter.
mg/L = milligrams per liter.
mV = millivolts.
NTU = nephelometric turbidity units.
pH = potential of hydrogen (negative logarithm of the hydrogen ion concentration).

Attachment 4B
Mixed Waste Landfill
Hydrographs

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Attachment 4B Hydrographs

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4B-2 MWL Study Area Wells (2 of 2)..... 4B-6

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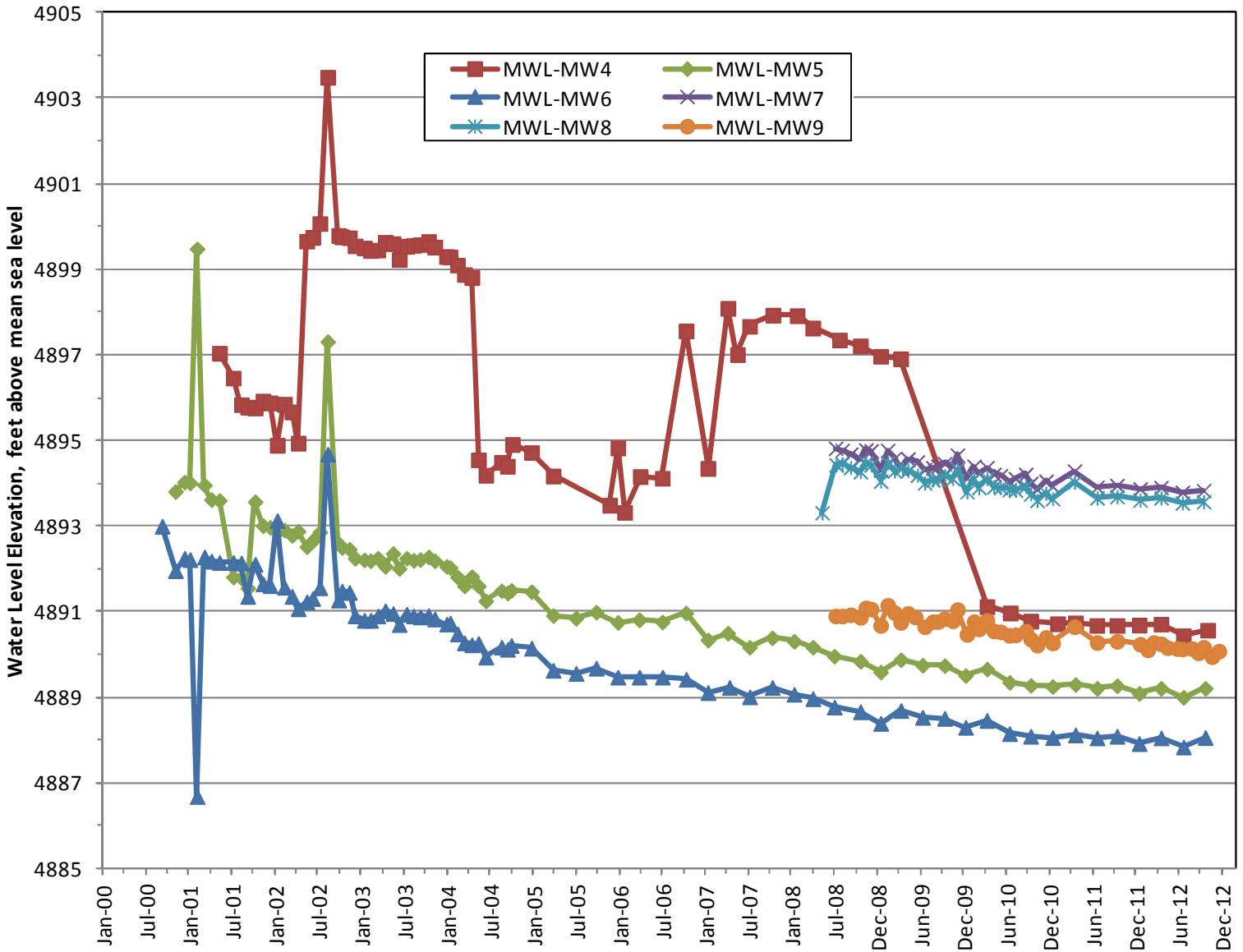

Figure 4B-1. MWL Study Area Wells (1 of 2)

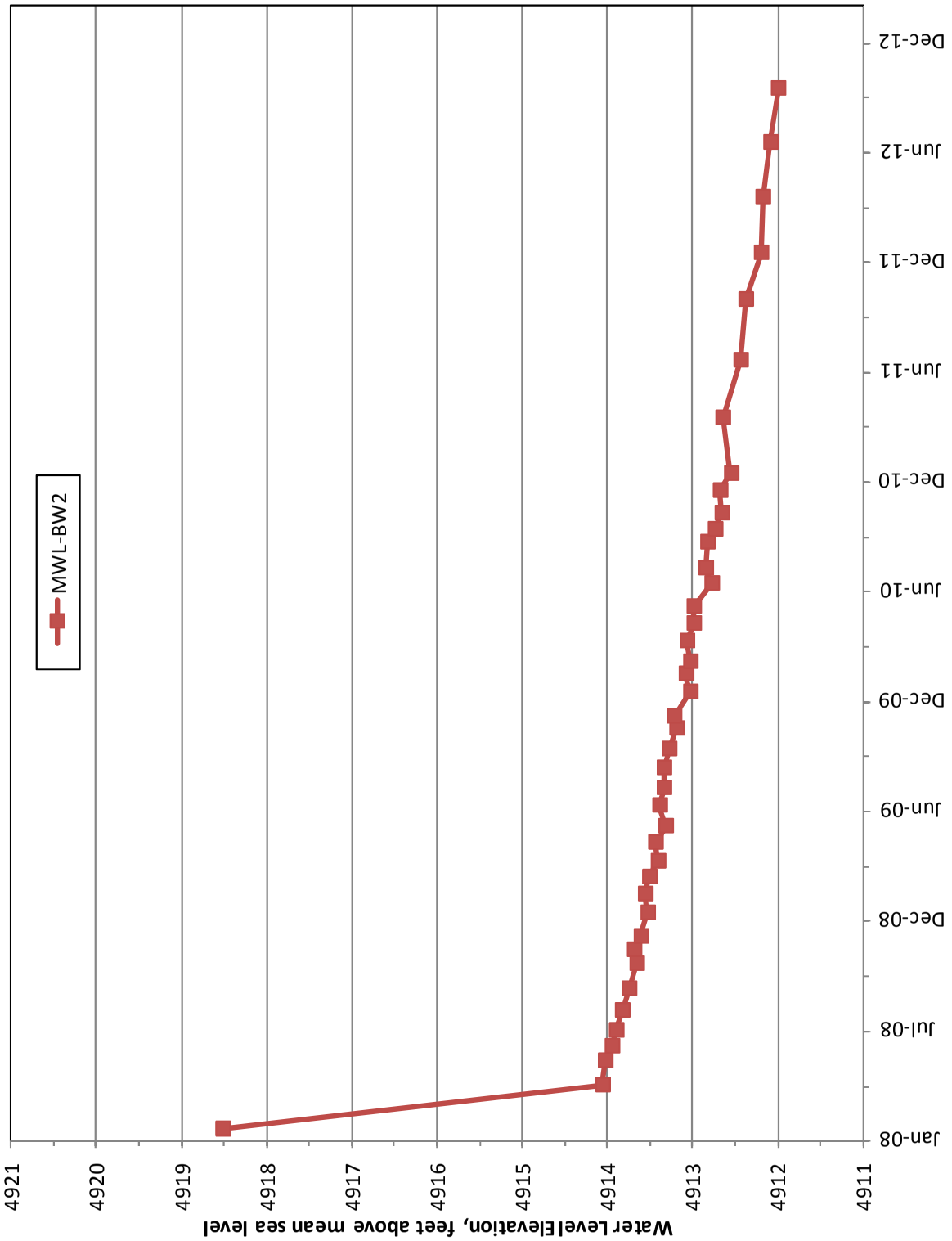

Figure 4B-2. MWL Study Area Wells (2 of 2)

Volume VII

TAB 13

Mixed Waste Landfill Chapter 4 Excerpted from the
Annual Groundwater Monitoring Report, Calendar Year 2013

From: SNL/ Beausoleil
To: NMED/Kieling

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SANDIA REPORT
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Annual Groundwater Monitoring Report

Prepared by
Sandia National Laboratories, Albuquerque, New Mexico

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Annual Groundwater Monitoring Report
Calendar Year 2013

Long-Term Stewardship Consolidated Groundwater Monitoring Program
Sandia National Laboratories, New Mexico
June 2014

Prepared by:
Long-Term Stewardship (4142) in coordination with
Environmental Restoration Operations (6234)

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Abstract

Sandia National Laboratories, New Mexico (SNL/NM) is a government-owned/contractor-operated laboratory. Sandia Corporation (Sandia), a wholly owned subsidiary of Lockheed Martin Corporation, manages and operates SNL/NM for the U.S. Department of Energy (DOE), National Nuclear Security Administration (NNSA). The DOE/NNSA Sandia Field Office administers the contract and oversees contractor operations at the site. Sandia conducts two types of groundwater surveillance monitoring at SNL/NM: (1) on a site-wide basis as part of the SNL/NM Long-Term Stewardship (LTS) Program's Groundwater Monitoring Program (GMP) Groundwater Surveillance Task and (2) as site-specific groundwater monitoring at LTS/Environmental Restoration (ER) Operations sites with ongoing groundwater investigations.

This Annual Groundwater Monitoring Report summarizes data collected during groundwater monitoring events conducted at GMP locations and at the following SNL/NM sites through December 31, 2013: Burn Site Groundwater Study Area; Chemical Waste Landfill; Mixed Waste Landfill; Solid Waste Management Units 8/58, 49, 68, 116, 149, and 154; Technical Area V Study Area; and the Tijeras Arroyo Groundwater Study Area. Environmental monitoring and surveillance programs are required by the New Mexico Environment Department (NMED) and DOE Order 436.1, *Departmental Sustainability,* and DOE Order 231.1B, *Environment, Safety, and Health Reporting*.

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1 SNL/NM Monitoring Well Locations and Base-Wide Potentiometric Surface Map for the Kirtland Air Force Base Vicinity, October/November 2013

Abbreviations and Acronyms

ABCWUA	Albuquerque Bernalillo County Water Utility Authority
amsl	above mean sea level
AOC	area of concern
AOP	Administrative Operating Procedure
ARG	Ancestral Rio Grande
bgs	below ground surface
BSG	Burn Site Groundwater
CAC	Corrective Action Complete
CCBA	Coyote Canyon Blast Area
CFR	Code of Federal Regulations
CME	Corrective Measures Evaluation
CMI	Corrective Measures Implementation
CMIP	Corrective Measures Implementation Plan
CMS	Corrective Measures Study
COA	City of Albuquerque
COC	constituent of concern
CTF	Coyote Test Field
CWL	Chemical Waste Landfill
CY	Calendar Year
DO	dissolved oxygen
DOE	U.S. Department of Energy
DRO	diesel range organics
DSS	Drain and Septic System
EB	equipment blank
EDMS	Environmental Data Management System
EMS	Environmental Management System
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ET	evapotranspirative
FB	field blank
FOP	Field Operating Procedure
GEL	GEL Laboratories LLC
GMP	Groundwater Monitoring Program
GRO	gasoline range organics
GWPP	Groundwater Protection Program
HE	high explosive
HPT	High Performing Team
HSWA	Hazardous and Solid Waste Amendments
IMWP	Interim Measures Work Plan
IRP	Installation Restoration Program (U.S. Air Force)
JP-4	jet propellant, fuel grade 4
KAFB	Kirtland Air Force Base
LCS	laboratory control sample
LE	Landfill Excavation

Abbreviations and Acronyms (continued)

LRRI	Lovelace Respiratory Research Institute
LTMMP	Long-Term Monitoring and Maintenance Plan
LTS	Long-Term Stewardship
LWDS	Liquid Waste Disposal System
MAC	maximum allowable concentration (established by the NMED)
MCL	maximum contaminant level
MDA	minimum detectable activity
MDL	method detection limit
MWL	Mixed Waste Landfill
NFA	No Further Action
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
NNSA	National Nuclear Security Administration
NOD	Notice of Disapproval
NPN	nitrate plus nitrite
OB	Oversight Bureau
ORP	oxidation-reduction potential
PCCP	Post-Closure Care Permit
PCE	tetrachloroethene
PGWS	perched groundwater system
PQL	practical quantitation limit
PVC	polyvinyl chloride
QC	quality control
QED™	QED Environmental Systems MicroPurge® low-flow sampling method
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-trinitro-triazine
RFI	RCRA Facility Investigation
RPD	relative percent difference
RSI	Request for Supplemental Information
Sandia	Sandia Corporation
SAP	Sampling and Analysis Plan
SC	specific conductance
SDWA	Safe Drinking Water Act
SFO	Sandia Field Office
SMO	Sample Management Office
SNL/NM	Sandia National Laboratories, New Mexico
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TA	Technical Area
TAG	Tijeras Arroyo Groundwater (Investigation)
TAL	Target Analyte List
TA-V study area	Technical Area-V Groundwater Investigation Study Area
TB	trip blank
TCE	trichloroethene (equivalent to trichlorethylene)

Abbreviations and Acronyms (concluded)

tetryl	methyl 2,4,6-trinitrophenylnitramine
the Order	Compliance Order on Consent
TOC	total organic carbon
TOX	total organic halogens
TPH	total petroleum hydrocarbons
UCS	Underground Conduit System
USAF	U.S. Air Force
USGS	U.S. Geological Survey
VA	Veterans Administration
VCM	voluntary corrective measure
VE	Vapor Extraction
VOC	volatile organic compound

Units

µg/L	microgram(s) per liter
ac-ft	acre feet
ft	foot (feet)
ft^3/yr	cubic feet per year
ft/ft	feet per foot
ft/min	feet per minute
ft/yr	feet per year
gal.	gallon(s)
in/yr	inches per year
Ma	Mega Annum
mg/L	milligram(s) per liter
NTU	nephelometric turbidity units
pCi/g	picocuries per gram
pCi/L	picocuries per liter
pH	potential of hydrogen
ppbv	part(s) per billion by volume
sq mi	square mile(s)
yr	year(s)

Monitoring Well Location Descriptions

AVN-#	Area V (North)
CCBA-#	Coyote Canyon Blast Area
CTF-#	Coyote Test Field
CWL-#	Chemical Waste Landfill
CYN-#	Lurance Canyon
EOD	Explosive Ordnance Disposal
HERTF	High Energy Research Test Facility
IP	Isleta Pueblo
ITRI	Inhalation Toxicology Research Institute
LMF	Large Melt Facility
LWDS-#	Liquid Waste Disposal System
MP-#	Montessa Park
MRN-#	Magazine Road North
MVMW#	Mountain View Monitoring Well
MWL-#	Mixed Waste Landfill
NMED-#	New Mexico Environment Department
NWTA3-#	Northwest Technical Area III
OBS-#	Old Burn Site
PGS-#	Parade Ground South
PL-#	Power Line Road, west
SFR-#	South Fence Road
STW-#	Solar Tower (West)
SWTA-#	Southwest Technical Area III
TA1-W-#	Technical Area I (Well)
TA2-NW-#	Technical Area II (Northwest)
TA2-SW-#	Technical Area II (Southwest)
TA2-W-#	Technical Area II (Well)
TAV-#	Technical Area V
TJA-#	Tijeras Arroyo
TRE-#	Thunder Road East
TRN-#	Target Road North
TRS-#	Target Road South
TSA-#	Transportation Safeguards Academy
WYO-#	Wyoming
12AUP-#	ER Site 12A Underflow Piezometer

**** Meteorological Towers***

* SC1	School House
* A-21	TA-I
* A-36	TA-III and TA-V

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Annual Groundwater Monitoring Report

Executive Summary

Sandia Corporation (Sandia) conducts groundwater surveillance monitoring for the U.S. Department of Energy (DOE), National Nuclear Security Administration (NNSA) at Sandia National Laboratories, New Mexico (SNL/NM) on a site-wide basis as part of the SNL/NM Long-Term Stewardship (LTS) Program's Groundwater Monitoring Program (GMP) Groundwater Surveillance Task, and on a site-specific basis at LTS/Environmental Restoration (ER) Operations (formerly ER Project) sites with ongoing groundwater investigations. The SNL/NM facility is located on Kirtland Air Force Base (KAFB) in central New Mexico.

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia, a wholly owned subsidiary of Lockheed Martin Corporation, for the DOE/NNSA under Contract DE-AC04-94AL85000.

This Annual Groundwater Monitoring Report documents the results of the groundwater monitoring activities at SNL/NM for Calendar Year (CY) 2013. This report has been prepared to meet the environmental reporting requirements for the CY 2013 Annual Site Environmental Report, providing an annual update of groundwater data to regulators, stakeholders, and outside agencies. In addition, it serves as a valuable tool to inform the public about the groundwater quality at SNL/NM. This report includes both water quality sampling results and water level measurements. Separate chapters focus on the investigation activities at each of the following monitoring networks maintained at SNL/NM: GMP site-wide surveillance (Chapter 2.0); Chemical Waste Landfill (CWL) (Chapter 3.0); Mixed Waste Landfill (MWL) (Chapter 4.0); Technical Area (TA)-V (Chapter 5.0); Tijeras Arroyo Groundwater (TAG) (Chapter 6.0); Burn Site Groundwater (BSG) (Chapter 7.0); Solid Waste Management Units (SWMUs) 8/58 (Chapter 8.0); SWMU 49 (Chapter 9.0); SWMU 68 (Chapter 10.0); SWMU 116 (Chapter 11.0); SWMU 149 (Chapter 12.0); and SWMU 154 (Chapter 13.0).

Chapter 1.0 provides the general site description for the SNL/NM facility and describes the regulatory criteria and sample collection methods for both SNL/NM site-specific and site-wide groundwater monitoring tasks. The regional aquifer supplying the Albuquerque Bernalillo County Water Utility Authority (ABCWUA), Veterans Administration, and KAFB production wells is located within the Albuquerque Basin. The regional aquifer is mostly contained within the upper unit and, to some extent, the middle unit of the Santa Fe Group. The edge of the basin on the east side is defined by the Sandia, Manzanita, and Manzano Mountains. KAFB straddles the east side of the basin and is divided approximately in half by basin-bounding faults. On KAFB, the basin is primarily defined by the north-south-trending Sandia fault and the Hubbell Springs fault. The Tijeras fault, a strike-slip fault that trends northeast-southwest, intersects the Sandia and Hubbell Springs faults forming a system of faults collectively referred to as the Tijeras fault complex. The faults form a distinct hydrogeological boundary between the regional aquifer within the basin (approximately 500 feet [ft] below ground surface [bgs]) and the more shallow bedrock aquifer systems within the uplifted areas (generally between 50 to 325 ft bgs).

The LTS Program monitors the GMP network to provide site-wide characterization data. In addition, SNL/NM LTS and ER Operations maintain 11 site-specific groundwater monitoring networks at the following locations:

- CWL
- MWL

- TA-V
- TAG
- BSG
- SWMUs 8/58
- SWMU 49
- SWMU 68
- SWMU 116
- SWMU 149
- SWMU 154

At SNL/NM, SWMUs are regulated under the Hazardous and Solid Waste Amendment (HSWA) module of the SNL/NM Resource Conservation and Recovery Permit. In the HSWA module, a SWMU is defined as "any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste." Monitoring and/or corrective action requirements generally are determined on a SWMU-specific basis following a site investigation. A Compliance Order on Consent (the Order) between the New Mexico Environment Department (NMED), the DOE, and Sandia governs corrective actions for these sites and, accordingly, monitoring performed at the MWL; the TA-V, TAG, BSG Study Areas; and SWMUs 8/58, 49, 68, 116, 149, and 154. The CWL is a closed, regulated unit undergoing post-closure care in accordance with the CWL Post-Closure Care Permit (PCCP) that became effective on June 2, 2011. Groundwater monitoring requirements, procedures, and protocols are detailed CWL PCCP Attachment 2, Groundwater Sampling and Analysis Plan.

Groundwater Quality Monitoring Activities and Results

During CY 2013, groundwater samples were collected from monitoring wells for the 12 investigations (GMP and 11 LTS/ER Operations sites). The analytical results for samples from all monitoring wells were compared with maximum contaminant levels (MCLs) established by the U.S. Environmental Protection Agency (EPA). The results for GMP monitoring wells were also compared with NMED maximum allowable concentrations (MACs) promulgated for groundwater by the State of New Mexico Water Quality Control Commission (NMWQCC). The activities and results are summarized for each location in the following sections, and the data are presented in the attachments following each chapter.

In this report, groundwater monitoring data are presented for both hazardous and radioactive constituents; however, the monitoring data for radionuclides (gamma spectroscopy, gross alpha/beta activity, and tritium) are provided voluntarily by the DOE/NNSA and Sandia. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements of the Order, as specified in Section III.A of the Order.

Groundwater Monitoring Program

Chapter 2.0 documents the results of the CY 2013 groundwater surveillance monitoring activities conducted as part of the SNL/NM GMP. Water levels were measured at 118 monitoring wells by SNL/NM personnel. Water level measurements were obtained either monthly or quarterly depending on the response characteristics of the groundwater system at each well location to pumping or other stresses. The surveillance activities include the annual collection and analysis of groundwater samples from 12 monitoring wells and 1 surface water sample from a spring. Annual sampling of groundwater was conducted during April/May 2013, with some well-specific resampling completed in August and September 2013. Samples collected from all locations were analyzed for Safe Drinking Water Act list volatile organic compounds (VOCs), total organic halogens, total phenols, total alkalinity, nitrate plus nitrite (NPN), total cyanide, major anions, Target Analyte List (TAL) metals plus uranium, mercury, radionuclides by gamma spectroscopy, gross alpha/beta activity, radium-226, and radium-228. Additional

samples were collected at selected monitoring wells for analysis of high explosive (HE) compounds and isotopic uranium.

No analytical parameters exceed established MCLs or MACs, except for beryllium and fluoride. The concentrations of these analytes that exceed MCLs or MACs in groundwater samples are similar to the results reported for previous years.

Fluoride was detected above the NMWQCC groundwater protection MAC of 1.6 milligrams per liter (mg/L) at four sampling locations (Coyote Springs and monitoring wells SFR-2S, SFR-4T, and TRE-1). The concentrations range from 1.74 to 2.87 mg/L. The EPA MCL for fluoride is 4.0 mg/L.

Beryllium was detected in the surface water sample from Coyote Springs at a concentration of 0.00754 mg/L. The MCL for beryllium is 0.004 mg/L. Beryllium has been consistently detected in the surface water samples from Coyote Springs and is considered to be of natural origin.

Groundwater elevation measurements were obtained throughout CY 2013 at 97 locations on a monthly or quarterly basis. Groundwater elevation measurements obtained from representative monitoring wells were used to construct contours of the potentiometric surface. The contours display a pattern that reflects the impact of the groundwater withdrawal by water supply wells located in the northwestern portion of KAFB and within the city.

Groundwater elevations were also obtained from wells completed in the perched groundwater system (PGWS) to construct a separate potentiometric surface (groundwater elevation) contour map. The contours indicate groundwater flow in the PGWS is toward the southeast. Water levels are declining in the northwest and increasing slightly in the east presumably due to the drainage of the system to the east and perhaps some additional recharge from the Tijeras Arroyo.

Chemical Waste Landfill

Chapter 3.0 discusses the CWL semiannual groundwater monitoring activities performed during January and July 2013. Groundwater samples were collected from four monitoring wells (CWL-BW5, CWL-MW9, CWL-MW10, and CWL-MW11) and analyzed for trichloroethene (TCE), 1,1,2-trichloro-1,2,2-trifluoroethane, tetrachloroethene, 1,1-dichloroethene, chloroform, trichlorofluoromethane, nickel, and chromium (January); and for TCE, nickel, and chromium (July). No analytes were detected at concentrations exceeding the associated EPA MCLs in any of the CWL groundwater samples. The analytical results are comparable to historical values.

Mixed Waste Landfill

Chapter 4.0 discusses the MWL annual groundwater sampling activities conducted in January and February 2013. Groundwater samples were collected from seven monitoring wells (MWL-BW2, MWL-MW4, MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9) and analyzed for VOCs, TAL metals plus uranium, anions (i.e., bromide, chloride, fluoride, and sulfate), total alkalinity, NPN, radionuclides by gamma spectroscopy, gross alpha/beta activity, and tritium as specified in the Order. No analytes were detected at concentrations exceeding the associated EPA MCLs, except for chromium in the unfiltered sample fraction from monitoring well MWL-MW4. This exceedance appears to be related to the corrosion of stainless steel components of the packer and dedicated sampling system in this well (no other wells at MWL have a dedicated sampling system). The analytical results for the other six monitoring wells are comparable to historical values.

Technical Area V Groundwater Study Area

Chapter 5.0 discusses the TA-V groundwater monitoring activities conducted during CY 2013. Both TCE and nitrate have been identified as constituents of concern (COCs) in groundwater at the TA-V

Groundwater Study Area (TA-V study area) based on detections above the EPA MCL in samples collected from monitoring wells. Currently 16 wells in the TA-V Study Area are monitored for water quality and water levels. Table XI-1 of the Order specifies that the sampling frequency for groundwater monitoring at TA-V is quarterly. Unique features of the TA-V Study Area include low concentrations of TCE and nitrate in the regional aquifer.

The conceptual site model of contaminant transport at TA-V includes release from the source term, migration through the vadose zone, and movement in groundwater. The potential sources of TCE and/or nitrate in the TA-V Study Area include wastewater disposal systems and seepage pits. Based on the historical use and disposal of chlorinated solvents, the extent of TCE in groundwater is probably associated with multiple aqueous releases of solvents and subsequent vapor phase transport through the vadose zone. The slow rate of groundwater flow (4 to 20 feet per year) influences the present distribution of TCE in the aquifer.

Only NPN and TCE were detected above the MCLs in groundwater samples from TA-V Study Area wells. NPN concentrations exceed the MCL of 10 mg/L in samples from monitoring wells LWDS-MW1, TAV-MW10, and AVN-1 with a maximum concentration of 13.0 mg/L in the sample collected from monitoring well LWDS-MW1 in November 2013.

During CY 2013, TCE exceeded the MCL of 5 micrograms per liter (μg/L) in samples from five monitoring wells (LWDS-MW1, TAV-MW6, TAV-MW10, TAV-MW12, and TAV-MW14). The maximum concentration of TCE detected during this reporting period is 18.4 μg/L found in the sample from monitoring well LWDS-MW1 collected in March 2013.

The analytical results for this reporting period are consistent with historical concentrations. The current conceptual site model for the TA-V Study Area does not require modification based on the sampling results for CY 2013.

The following activities took place for the TA-V Study Area during CY 2013:

- Monthly or quarterly water level measurements were obtained for all TA-V Study Area wells.
- Semiannual and quarterly groundwater sampling events were conducted at 16 wells in February/March, May/June, July/August, and October/November 2013.
- The final quarterly soil vapor sampling was conducted at monitoring wells TAV-SV01, TAV-SV02, and TAV-SV03 in February/March 2013.

Tijeras Arroyo Groundwater Study Area

Chapter 6.0 addresses groundwater monitoring activities conducted during CY 2013 at the TAG Study Area. Currently, 21 wells in the TAG Study Area are monitored for water quality, and 30 wells are monitored for water levels. Two groundwater systems are present in the TAG Study Area: the PGWS at approximately 220 to 330 ft bgs and the regional aquifer groundwater system at approximately 440 to 570 ft bgs. Groundwater monitoring wells are completed within either the PGWS or regional aquifer. Unique features of the TAG Study Area include concentrations of TCE below to just above the MCL at scattered locations in the PGWS and concentrations of nitrate above the MCL at scattered locations in the PGWS and regional aquifer.

For CY 2013, wells were sampled in March, June, August/September, and November. The samples were analyzed for VOCs, NPN, anions, TAL metals (plus uranium), gross alpha/beta activity, tritium, and

radionuclides by gamma spectroscopy. Depending on their locations and historical concentrations of COCs, wells were sampled quarterly, semiannually, or annually during this reporting period.

Both TCE and nitrate have been identified as COCs in groundwater at the TAG Study Area based on historical groundwater monitoring results. Only NPN and TCE were detected above MCLs in samples from TAG Study Area wells. In CY 2013, NPN concentrations exceeded the MCL of 10 mg/L in samples from monitoring wells TA2-SW1-320, TA2-W-19, TJA-2, TJA-4, and TJA-7, with a maximum concentration of 38.5 mg/L in the sample from monitoring well TJA-4 collected during the November 2013 sampling event. NPN concentrations in monitoring wells TA2-SW1-320, TJA-4, and TJA-7 have generally exceeded the MCL for the life of the wells, whereas NPN concentrations occasionally have exceeded the MCL in samples from monitoring wells TJA-2 and TA2-W-19.

During CY 2013, TCE exceeded the MCL of 5 µg/L in the groundwater sample from one PGWS well, WYO-4. The maximum concentration of TCE detected during this reporting period is 9.23 µg/L in the sample from monitoring well WYO-4 collected during the August 2013 sampling event. TCE concentrations in samples from monitoring well WYO-4 slightly exceed the MCL, and trends are level to slightly increasing over time.

The analytical results for this reporting period are consistent with historical concentrations. The current conceptual site model for the TAG Study Area does not require modification based on the sampling results for CY 2013.

The following activities took place for the TAG Study Area during CY 2013:

- Monthly, quarterly, or annual water level measurements were obtained from TAG monitoring wells.
- Quarterly groundwater sampling events were conducted at seven monitoring wells (TA2-SW1-320, TA2-W-19, TA2-W-26, TJA-2, TJA-4, TJA-7, and WYO-4) in March, June, August/September, and November 2013. The sampling frequency for monitoring well TJA-3 was modified to quarterly sampling in November 2013.
- Semiannual groundwater sampling was conducted at four monitoring wells (TA2-W-01, TA2-W-27, TJA-3, and TJA-6) in March and August/September 2013.
- Annual groundwater sampling was conducted at 10 monitoring wells (PGS-2, TA1-W-01, TA1-W-02, TA1-W-03, TA1-W-04, TA1-W-05, TA1-W-06, TA1-W-08, TA2-NW1-595, and WYO-3) in August/September 2013.

Burn Site Groundwater Study Area

Chapter 7.0 discusses the groundwater monitoring activities conducted during CY 2013 at the BSG Study Area, which is located around the active Lurance Canyon Burn Site facility. Groundwater investigations were initiated in 1997 at the request of the NMED after elevated nitrate levels were discovered in the Burn Site Well (a nonpotable production well used for fire suppression). The study area consists of 10 monitoring wells, and samples were collected and analyzed for VOCs, HE compounds, total petroleum hydrocarbons (TPH)-diesel range organics, TPH-gasoline range organics, anions, NPN, TAL metals (plus uranium), gross alpha/beta activity, isotopic uranium, tritium, and radionuclides by gamma spectroscopy. Additional samples for alkalinity and major cations (as calcium, magnesium, potassium, and sodium) were collected from monitoring well CYN-MW13 only.

Only NPN was detected above the MCL in samples from BSG Study Area wells. NPN results exceed the MCL of 10 mg/L in samples from monitoring wells CYN-MW9, CYN-MW11, CYN-MW12, and CYN-MW13 with a maximum concentration of 41.9 mg/L in the sample from monitoring well CYN-MW9 collected during the December 2013 sampling event.

The analytical results for this reporting period are consistent with historical concentrations. The current conceptual site model requires light modification based on the sampling results for CY 2013.

The following activities took place for the BSG Study Area during CY 2013:

- Semiannual groundwater sampling was conducted at eight monitoring wells (CYN-MW4, CYN-MW7, CYN-MW8, CYN-MW9, CYN-MW10, CYN-MW11, CYN-MW12, and CYN-MW13) in April/May and December 2013.

Solid Waste Management Units 8/58

Chapter 8.0 discusses the groundwater monitoring activities conducted during CY 2013 at SWMUs 8/58, which are located in the Arroyo del Coyote watershed that captures runoff from the western flank of the Manzanita Mountains. Monitoring wells CCBA-MW1 and CCBA-MW2 were installed in August 2011, and these wells have been sampled quarterly since then. The groundwater samples from each well were analyzed for VOCs, SVOCs, HE compounds, NPN, major anions (i.e., bromide, chloride, fluoride, and sulfate), major cations (i.e., calcium, magnesium, potassium, and sodium), alkalinity, TAL metals plus uranium, perchlorate, total cyanide, radionuclides by gamma spectroscopy, gross alpha/beta activity, and isotopic uranium.

No parameters were detected above established MCLs, except for fluoride. Fluoride exceeds the established MCL of 4.0 mg/L in monitoring well CCBA-MW1 samples at concentrations ranging from 4.57 to 5.00 mg/L.

The following activities took place for SWMUs 8/58 during CY 2013:

- Quarterly groundwater sampling was conducted at monitoring wells CCBA-MW1 and CCBA-MW2 in January, April, July, and October 2013.

Solid Waste Management Unit 49

Chapter 9.0 discusses the SWMU 49 annual groundwater monitoring activities performed during CY 2013. SWMU 49 is located in Lurance Canyon and consists of a surface discharge area associated with a former trailer used as a darkroom and the area around a drainpipe outfall from Building 9820. The DOE/NNSA and Sandia received a letter from the NMED on April 14, 2010, that lists SWMU 49 under the heading of "SWMUs/AOCs to be Subject to Groundwater Monitoring Controls" and further states that SWMU 49 requires long-term monitoring of groundwater on an annual basis as a site control. Annual sampling was completed in 2013, and samples were analyzed for general chemistry, VOCs, HE compounds, perchlorate, metals, cyanide, NPN, gross alpha/beta activity, and radionuclides by gamma spectroscopy. No analytes were detected above their respective MCLs.

The following activities took place for SWMU 49 during CY 2013:

- Annual groundwater sampling was conducted at monitoring well CYN-MW5 in January 2013.

- Periodic groundwater elevation data were obtained from monitoring well CYN-MW5.

Solid Waste Management Unit 68
Chapter 10.0 discusses the quarterly groundwater monitoring activities performed during CY 2013 at SWMU 68, which is located in Coyote Test Field. Monitoring wells OBS-MW1, OBS-MW2, and OBS-MW3 were installed in August 2011, and these wells have been sampled quarterly since then. The groundwater samples from each well were analyzed for VOCs, SVOCs, HE compounds, NPN, major anions (i.e., bromide, chloride, fluoride, and sulfate), major cations (i.e., calcium, magnesium, potassium, and sodium), alkalinity, TAL metals plus uranium, perchlorate, total cyanide, hexavalent chromium, gross alpha/beta activity, radionuclides by gamma spectroscopy, and isotopic uranium. No parameters were detected above established MCLs.

The following activities took place for SWMU 68 during CY 2013:

- Quarterly groundwater sampling was conducted at monitoring wells OBS-MW1, OBS-MW2, and OBS-MW3 in January, April, July, and October 2013.

Solid Waste Management Unit 116
Chapter 11.0 discusses the SWMU 116 annual groundwater monitoring activities performed during CY 2013. SWMU 116 is located on the western margin of the Manzanita Mountain foothills and includes the immediate area surrounding the five seepage pits and septic tank located south of Building 9990. The DOE/NNSA and Sandia received a letter from the NMED on April 14, 2010, that lists SWMU 116 under the heading of "SWMUs/AOCs to be Subject to Groundwater Monitoring Controls" and further states that SWMU 116 requires long-term monitoring of groundwater on an annual basis as a site control. Annual sampling was completed in 2013, and samples were analyzed for general chemistry, VOCs, HE compounds, perchlorate, TAL metals plus uranium, cyanide, NPN, gross alpha/beta activity, radionuclides by gamma spectroscopy, and isotopic uranium. No analytes were detected above their respective MCLs.

The following activities took place for SWMU 116 during CY 2013:

- Annual groundwater sampling was conducted at monitoring well CTF-MW1 in January 2013.

- Periodic groundwater elevation data were obtained from monitoring well CTF-MW1.

Solid Waste Management Unit 149
Chapter 12.0 discusses the quarterly groundwater monitoring activities performed during CY 2013 at SWMU 149, which is located in the Coyote Test Field. Monitoring well CTF-MW3 was sampled quarterly and the samples were analyzed for VOCs, TAL metals, general chemistry parameters, perchlorate, and NPN. No analytical results for the monitoring well CTF-MW3 groundwater samples exceed the corresponding MCLs.

The following activities took place for monitoring well CTF-MW3 near SWMU 149 during CY 2013:

- Quarterly groundwater sampling was conducted at monitoring well CTF-MW3 in March, June, and December 2013. Groundwater samples were not collected in September 2013 because severe thunderstorms eroded both roads to monitoring well CTF-MW3.

- Quarterly reporting of analytical results for monitoring well CTF-MW3 was conducted.

Solid Waste Management Unit 154

Chapter 13.0 discusses the quarterly groundwater monitoring activities performed during CY 2013 at SWMU 154, which is located in Coyote Test Field. Monitoring well CTF-MW2 was sampled quarterly and the samples were analyzed for VOCs, SVOCs, HE compounds, NPN, major anions, alkalinity, TAL total metals plus uranium, perchlorate, radionuclides by gamma spectroscopy, gross alpha/beta activity, and isotopic uranium.

For all four quarters, arsenic was detected above the established MCL of 0.010 mg/L. Arsenic concentrations ranged from 0.0366 to 0.0496 mg/L, with the maximum concentration reported for the filtered sample collected in March 2013. No other analytical results for the monitoring well CTF-MW2 groundwater samples exceed the corresponding MCLs.

The following activities took place for monitoring well CTF-MW2 near SWMU 154 during CY 2013:

- Quarterly groundwater sampling was conducted at monitoring well CTF-MW2 in March, June, September, and December 2013.
- Quarterly reporting of analytical results for groundwater samples from monitoring well CTF-MW2 was conducted.

Future Groundwater Monitoring Events

The groundwater monitoring events conducted on a site-wide basis as part of the SNL/NM GMP and at site-specific LTS/ER Operations sites will continue on a quarterly, semiannual, annual, and biennial basis during CY 2014, as specified by regulatory guidance. The results for these monitoring events will be presented in the Annual Groundwater Monitoring Report for CY 2014.

4.0 Mixed Waste Landfill

4.1 Introduction

The Mixed Waste Landfill (MWL) is a 2.6-acre site in the north-central portion of Technical Area III at Sandia National Laboratories, New Mexico (SNL/NM) (Figure 4-1). The MWL consists of two distinct disposal areas: the classified area (occupying 0.6 acres) and the unclassified area (occupying 2.0 acres). Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies of activity (at the time of disposal) were disposed of in the MWL from March 1959 through December 1988. Classified wastes were buried in cylindrical pits in the classified area and unclassified wastes were buried in shallow trenches in the unclassified area.

The Phase 1 Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) was conducted in 1989 and 1990 (SNL September 1990) and the Phase 2 RFI was conducted from 1992 to 1995. The Phase 2 RFI confirmed tritium as the constituent of concern in soil at the MWL (Peace et al. 2002). As directed by the New Mexico Environment Department (NMED), the MWL Corrective Measures Study (SNL May 2003) was submitted to the NMED in May 2003. The NMED held a public comment period on the MWL Corrective Measures Study from August 11 to December 9, 2004, and a public hearing was held from December 2 to December 3 and December 8 to December 9, 2004. On May 26, 2005, the Secretary of the NMED selected a vegetative cover with a biointrusion barrier (i.e., evapotranspirative [ET] cover) as the final remedy for the MWL and required a Corrective Measures Implementation (CMI) Plan within 180 days that included fate and transport modeling (NMED May 2005). The MWL CMI Plan (SNL November 2005) was submitted in November 2005 and conditionally approved by the NMED in December 2008 (Bearzi December 2008). The MWL ET cover construction was completed from May through September 2009. The MWL CMI Report documenting cover construction in accordance with the CMI Plan was submitted to NMED in January 2010 (SNL January 2010). The CMI Report was approved by NMED on October 14, 2011 (Bearzi October 2011) after a 90-day NMED public comment period (November 29, 2010 through February 28, 2011) that included a public meeting on December 14, 2010. The MWL Long-Term Monitoring and Maintenance Plan (LTMMP) previously submitted in September 2007 was revised (SNL March 2012) and submitted to the NMED in March 2012 within 180 days of CMI Report approval as required by the NMED Final Order on the MWL (NMED May 2005). As part of the regulatory review and approval process for the MWL LTMMP, NMED completed a 150-day public comment period from September 14, 2012 through February 11, 2013 that included a public meeting on October 16, 2012. The revised MWL LTMMP is pending NMED approval. Implementation of the monitoring, inspection, and reporting requirements of the LTMMP will begin immediately upon NMED approval and the first five-year reevaluation report specified in the Final Order (NMED May 2005) will be submitted five years after the date of LTMMP approval.

4.1.1 Monitoring History

Groundwater monitoring has been conducted at the MWL since 1990. The original groundwater monitoring well network at the MWL (monitoring wells MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) was installed in 1988 and 1989. In 1993, monitoring well MWL-MW4 was completed at an angle of 6 degrees from vertical and was screened at two discrete intervals, 20 feet (ft) apart, to evaluate vertical potentiometric gradients and changes in aquifer parameters with depth. An inflatable packer separates the screened intervals, and nitrogen-gas pressure is maintained in the packer to prevent commingling of water from the two screened sections of the aquifer. Monitoring wells MWL-MW5 and MWL-MW6 were installed in 2000 at a distance of approximately 200 and 500 ft west of the MWL, respectively, with the screened intervals placed below the top of the regional water table in the coarse-grained Ancestral Rio Grande (ARG) deposits.

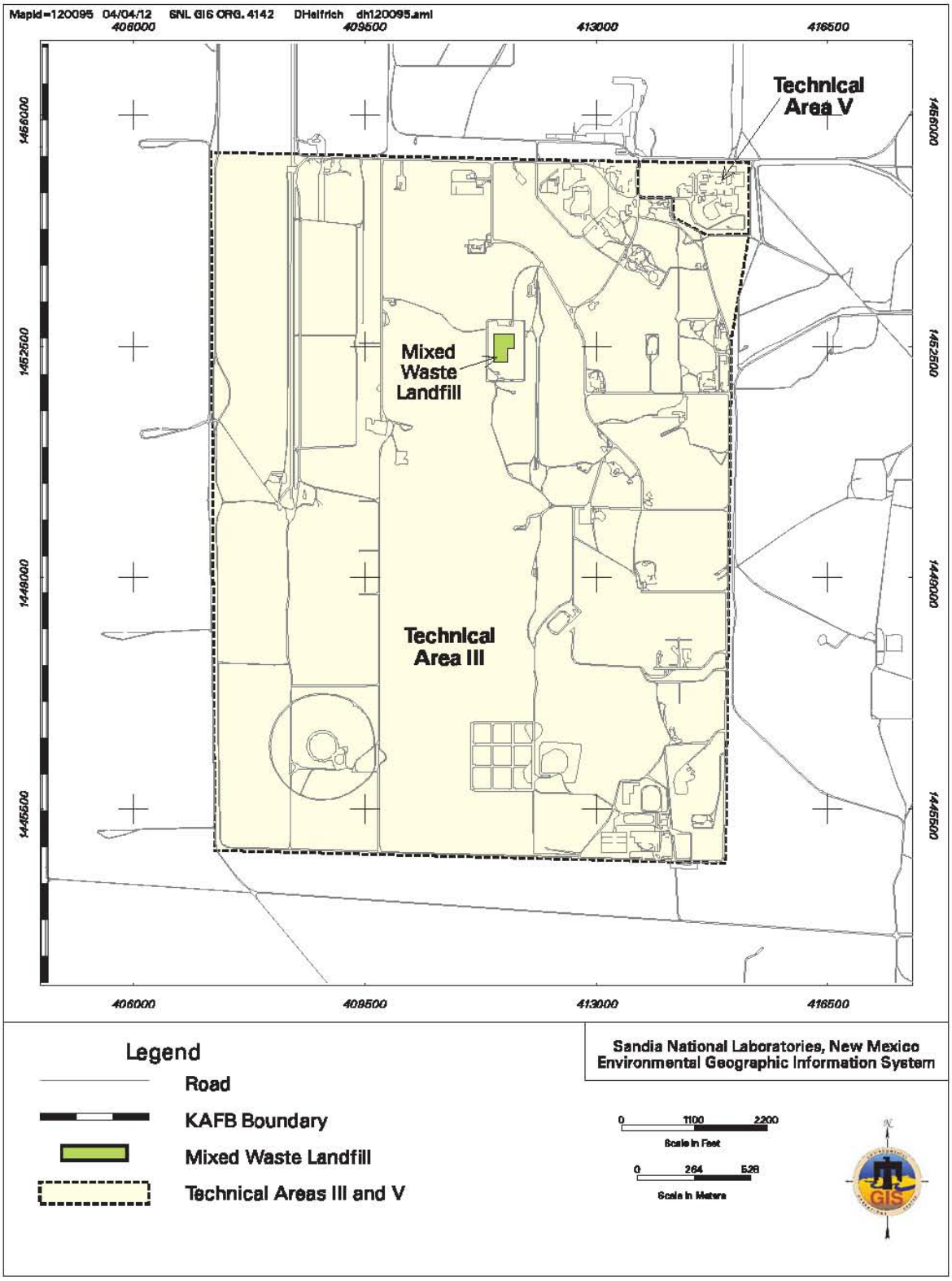

Figure 4-1. Location of the Mixed Waste Landfill within Technical Area III

The MWL groundwater monitoring network was modified in 2008 (SNL May 2009). Due to the declining water table and corrosion of stainless-steel well screens, four monitoring wells were plugged and abandoned (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) and four new monitoring wells were installed (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) (SNL April 2008 and September 2008). The four wells installed in 2008 comprise the MWL groundwater monitoring network for the uppermost part of the regional aquifer and were approved by the NMED (Bearzi October 2008 and January 2009).

Monitoring wells MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9 were considered new wells and, as required by the Compliance Order on Consent (the Order) (NMED April 2004), were sampled a minimum of eight consecutive quarters for a defined suite of parameters in addition to sampling for perchlorate for at least four consecutive quarters. The four consecutive quarters of perchlorate sampling were completed in Calendar Year (CY) 2009 with no detections at or above the screening level of 4 micrograms per liter; therefore, these wells have been removed from the perchlorate monitoring network. The required eight quarterly sampling events were completed in CY 2010. All seven MWL wells are now sampled annually as required by the Order.

In April 2010, the U.S. Department of Energy (DOE)/National Nuclear Security Administration (NNSA) and Sandia Corporation (Sandia) received a letter from the NMED, which required further investigation to determine the source of very low toluene concentrations in some groundwater samples collected from the MWL in 2008 through early 2010 (Bearzi April 2010). The very low concentrations of toluene detected in samples from the MWL groundwater monitoring wells are consistent with detections in samples from other SNL/NM monitoring wells and do not represent a release to the environment or widespread low-concentration toluene contamination in the regional aquifer. They appear to be related to a laboratory and/or ambient environmental source(s) and reflect the ubiquitous nature of toluene and the very low analytical detection limit. The DOE/NNSA and Sandia submitted a report in August 2010 that was subsequently revised to address two NMED comments (Bearzi September 2010). The revised version of the report (SNL October 2010) was approved by NMED in January 2011 (Bearzi January 2011).

Groundwater at the MWL has been extensively characterized and monitored since 1990 for major ion chemistry, volatile organic compounds (VOCs), semivolatile organic compounds, nitrate, metals, radionuclides, and perchlorate. More than twenty years of data indicate that groundwater has not been contaminated by the MWL (Goering et al. 2002; SNL December 2001, January 2002, July 2002, October 2002, June 2003, September 2003, July 2004; Lyon and Goering 2006; SNL November 2006, January 2008, May 2009, June 2010, October 2010, September 2011, June 2012, and June 2013).

4.1.2 Monitoring Network

The current groundwater monitoring network at the MWL consists of seven wells, as shown on Figure 4-2 and listed in Table 4-1. Of the seven wells, four have screen intervals across the upper surface of the regional aquifer (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) and are considered compliance wells that monitor the top of the regional water table. These four wells are completed within the interfingering, fine-grained, Santa Fe Group alluvial-fan deposits. Wells MWL-MW5 and MWL-MW6 are installed with their screen intervals below the upper surface of the regional aquifer; at least part of their screen intervals are within the coarse-grained ARG deposits that underlie the Santa Fe Group alluvial sediments. Monitoring well MWL-MW4 has two screen intervals separated by an inflatable packer; the upper interval is completed across the regional aquifer water table. References in this report to groundwater samples and water levels from monitoring well MWL-MW4 refer to groundwater withdrawn or measured from the upper screened interval, and references made to the bottom of this well refer to the depth to the top of the packer. The lower screen interval of MWL-MW4 is completed within the coarse-grained ARG deposits, but is not part of the current monitoring network (i.e., not sampled or used to measure groundwater elevation).

Figure 4-2. Location of Groundwater Monitoring Wells at the Mixed Waste Landfill

Table 4-1. MWL Monitoring Well Network and Calendar Year 2013 Compliance Activities

Well ID	Installation Year	WQ [a]	WL [a]	Comment [b]
MWL-BW2	2008	✓	✓	Annual
MWL-MW4 [c]	1993	✓	✓	Annual
MWL-MW5	2000	✓	✓	Annual
MWL-MW6	2000	✓	✓	Annual
MWL-MW7	2008	✓	✓	Annual
MWL-MW8	2008	✓	✓	Annual
MWL-MW9	2008	✓	✓	Annual

NOTES:
[a]Check marks in the WQ and WL columns indicate WQ sampling and WL measurements were completed.
[b]Annual groundwater monitoring of all wells was conducted in January and February.
[c]Upper screen of monitoring well MWL-MW4 is monitored and represents uppermost portion of regional aquifer.
BW = Background Well.
ID = Identification.
MW = Monitoring Well.
MWL = Mixed Waste Landfill.
WL = Water level.
WQ = Water quality.

4.1.3 Summary of Activities

Annual groundwater sampling was conducted in January and February 2013 at the MWL as summarized in Table 4-1. Groundwater samples were collected from the seven monitoring wells (MWL-BW2, MWL-MW4, MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9) and analyzed for VOCs, Target Analyte List (TAL) metals plus uranium, anions (as bromide, chloride, fluoride, and sulfate), alkalinity, nitrate plus nitrite (NPN), gamma spectroscopy, gross alpha/beta activity, and tritium. Duplicate environmental samples were collected at monitoring wells MWL-MW5, MWL-MW8, and MWL-MW9. Attachment 4A provides summary tables for the CY 2013 analytical results.

4.1.4 Summary of Future Activities

The revised MWL LTMMP (SNL March 2012) was submitted to NMED in March 2012. The LTMMP defines the long-term monitoring, maintenance, inspection, and repair requirements for the MWL, including semiannual groundwater monitoring. All LTMMP monitoring, inspection, and maintenance requirements will be implemented upon NMED approval and reported to NMED annually in a separate MWL report. Groundwater monitoring activities and results will also continue to be provided in this Annual Groundwater Monitoring Report.

4.1.5 Conceptual Site Model

A detailed conceptual site model is provided in the MWL Phase 2 RFI Report (Peace et al. 2002) and the *Mixed Waste Landfill Groundwater Report, 1990 through 2001, Sandia National Laboratories, Albuquerque, New Mexico* (Goering et al. 2002). An update to the conceptual site model integrating the findings from the four monitoring wells installed in 2008 is presented in the *Mixed Waste Landfill Annual Groundwater Monitoring Report, Calendar Year 2009* (SNL June 2010) and the *Annual Groundwater Monitoring Report, Calendar Year 2012* (SNL June 2013).

The upper surface of the regional aquifer at the MWL is contained within the unconsolidated, fine-grained alluvial-fan deposits of the Santa Fe Group. The more transmissive, coarser-grained ARG sediments underlie the fine-grained alluvial deposits beneath the MWL. The depth to water is approximately 500 ft below ground surface and groundwater flows generally westward away from the Manzanita Mountains and towards the Rio Grande. Several water-supply wells operated by Kirtland Air Force Base

(KAFB) and the Albuquerque Bernalillo County Water Utility Authority have profoundly modified the natural groundwater flow regime near the MWL by creating a trough in the water table in the western and northern portions of KAFB (Plate 1). As a result, water levels at the MWL have continued to decline since monitoring began in 1990.

Figure 4-3 shows the October 2013 potentiometric surface of the regional aquifer beneath the MWL. Groundwater flows towards the west and northwest. Based on the contours, the horizontal gradient varies from approximately 0.02 to 0.08 ft per foot. The map is consistent with the conceptual site model and the base-wide potentiometric surface map presented on Plate 1. As shown on Plate 1, the potentiometric surface contours beneath Technical Area III generally trend north to south with the inferred groundwater flow direction being generally westward.

The rate of groundwater elevation decline at the existing MWL monitoring wells is shown in Attachment 4B, Figures 4B-1 and 4B-2. For the five-year period from October 2008 to October 2013, the rate of groundwater elevation decline in all wells except MWL-MW4 has been very low, and less than 2 ft overall (Figures 4B-1 and 4B-2 of Attachment 4B). Recharge from infiltration of direct precipitation at the MWL is negligible due to high evapotranspiration, low precipitation, the thick sequence of unsaturated Santa Fe Group deposits above the water table, and the presence of the MWL ET Cover. Groundwater recharge of the regional aquifer occurs by the infiltration of precipitation in the Manzanita Mountains located approximately 5 miles to the east.

4.2 Regulatory Criteria

The MWL is regulated as Solid Waste Management Unit 76 under the Hazardous and Solid Waste Amendments module of the SNL/NM RCRA Permit. The NMED issued the Order in April 2004, which transferred the regulatory authority for corrective action at the MWL to the Order (NMED April 2004). This report has been formatted to address the content criteria set forth in the Order for Periodic Monitoring Reports.

Although radionuclides are being monitored and screened at the MWL, the information related to radionuclides is provided voluntarily by the DOE/NNSA and Sandia. The voluntary inclusion of such radionuclide information shall not be enforceable and shall not constitute the basis for any enforcement because such information falls wholly outside the requirements imposed by the NMED, as specified in Section III.A of the Order (NMED April 2004).

4.3 Scope of Activities

The CY 2013 annual groundwater sampling is summarized in Section 4.1.3. Table 4-2 lists the analytical parameters and MWL wells sampled. SNL/NM field personnel conducted the sampling from January 29 to February 11, 2013. Groundwater sampling activities were conducted in conformance with the Order (NMED April 2004) and procedures outlined in the *Mixed Waste Landfill Groundwater Monitoring, Mini-Sampling and Analysis Plan for Fiscal Year 2013 Annual Sampling* (SNL January 2013).

The MWL groundwater samples were submitted for analysis to GEL Laboratories LLC (GEL) in Charleston, South Carolina. All groundwater sampling results are compared with U.S. Environmental Protection Agency (EPA) maximum contaminant levels (MCLs) for drinking water supplies (EPA 2001 and 2009). The analytical results are summarized in Attachment 4A, Tables 4A-1 through 4A-7.

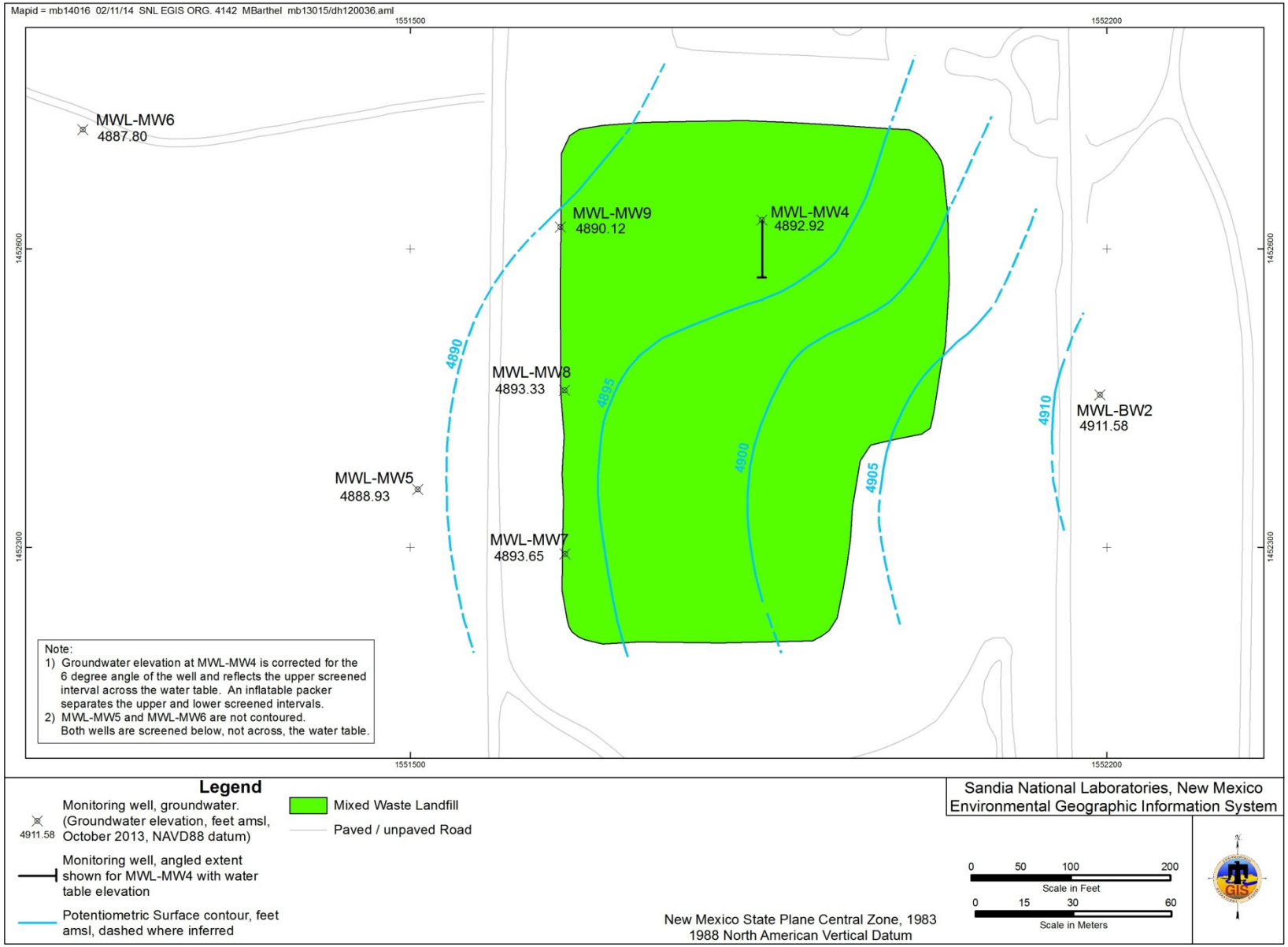

Figure 4-3. Localized Potentiometric Surface of the Basin Fill Aquifer at the Mixed Waste Landfill, October 2013

Table 4-2. Analytical Parameters for the MWL Monitoring Wells, Calendar Year 2013

Analytical Parameter	Calendar Year 2013[a]
Volatile Organic Compounds	MWL-BW2 MWL-MW4 MWL-MW5 MWL-MW5 (dup) MWL-MW6 MWL-MW7 MWL-MW8 MWL-MW8 (dup) MWL-MW9 MWL-MW9 (dup-VOCs only)
TAL metals plus Uranium	
Nitrate plus Nitrite (as nitrogen)	
Major Anions (Bromide, Fluoride, Chloride, and Sulfate)	
Total Alkalinity as Bicarbonate and Calcium Carbonate	
Radionuclides: Gamma-Emitting Radionuclides Gross Alpha Activity Gross Beta Activity Tritium	

NOTES:
[a]Annual groundwater sampling was conducted in February, with resampling of MWL-MW8 for VOCs only in March.
BW = Background Well.
dup = Duplicate.
MW = Monitoring Well.
MWL = Mixed Waste Landfill.
TAL = Target Analyte List.
VOC = Volatile Organic Compound.

Field and laboratory quality control (QC) samples were prepared to determine the accuracy of the methods used and to detect inadvertent sample contamination that may have occurred during the sampling and analysis process as discussed in Section 1.3.3. Field QC samples included duplicate environmental, equipment blank (EB), field blank (FB), and trip blank (TB) samples. Laboratory QC analyses performed included method blank, laboratory control sample, matrix spike, matrix spike duplicate, and surrogate spike analyses.

Water quality parameters were measured in the field for temperature, specific conductance, oxidation-reduction potential, pH, and dissolved oxygen using an YSI™ Model 6920 Water Quality Meter during the purging process. Turbidity was measured with a Hach™ Model 2100P turbidity meter.

4.4 Field Methods and Measurements

Groundwater sampling and depth-to-groundwater measurements were conducted in conformance with procedures specified in the *Mixed Waste Landfill Groundwater Monitoring, Mini-Sampling and Analysis Plan for Fiscal Year 2013 Annual Sampling* (SNL January 2013), which are consistent with the methods described in Section 1.3. Field water quality parameters are presented in Table 4A-7 (Attachment 4A) and current CY 2013 and historical groundwater elevation measurements at the MWL monitoring wells are presented in Attachment 4B, Figures 4B-1 and 4B-2.

A portable Bennett™ groundwater sampling system was used to collect groundwater samples from all wells, except MWL-MW4. Monitoring well MWL-MW4 is equipped with a dedicated Bennett™ sampling system. The purging volume requirement was achieved for four of the seven monitoring wells (MWL-BW2, MWL-MW5, MWL-MW6, and MWL-MW7). The minimum purge requirements were not met at monitoring wells MWL-MW4, MWL-MW8, and MWL-MW9. These three monitoring wells were purged to dryness, allowed to recover, and then sampled to collect the most representative groundwater sample possible given the low yield of these wells.

Groundwater samples were submitted to the off-site laboratory (GEL) following analysis request/chain-of-custody protocol.

4.5 Analytical Methods

All groundwater samples were analyzed by off-site laboratories using EPA-specified protocols described in Section 1.3.2 (Tables 1-5 and 1-6).

4.6 Summary of Analytical Results

The analytical results for chemical, general chemistry, and radiological constituents are presented in Attachment 4A, Tables 4A-1 through 4A-6. Field water quality measurements are presented in Attachment 4A, Table 4A-7. Analytical results that are above the analytical laboratory method detection limit (MDL), but below the practical quantitation limit (PQL) are qualified as estimated values and designated with a "J" qualifier in Tables 4A-1 through 4A-6. Data qualifiers based on the data validation process are presented with the associated results in the Attachment 4A tables. Data validation and QC sample results associated with each sampling event are discussed in Section 4.7.

All the CY 2013 analytical results were compared with established EPA MCLs where applicable. None of the detected constituents exceed the respective MCLs, except for chromium in the unfiltered sample from monitoring well MWL-MW4. The analytical results are discussed in greater detail in the following sections.

4.6.1 Volatile Organic Compounds

No VOCs were detected at concentrations above the laboratory MDLs in any groundwater samples. The laboratory MDLs for VOCs are presented in Attachment 4A, Table 4A-1.

4.6.2 General Chemistry Parameters

The general chemistry analytical results are presented in Attachment 4A, Tables 4A-2 and 4A-3. NPN was not detected above the nitrate MCL of 10 milligrams per liter (mg/L) in any groundwater sample. NPN was detected at concentrations ranging from 1.26 mg/L in the field duplicate sample from monitoring well MWL-MW5 to 3.23 mg/L in the environmental sample from monitoring well MWL-MW7. The NPN results are summarized in Table 4A-2. Table 4A-3 summarizes the alkalinity and major anions (bromide, chloride, fluoride, and sulfate) results. No parameters were detected above established MCLs.

4.6.3 Metals

Metal analysis includes two sets of analyses and results, filtered and unfiltered fractions. Groundwater samples obtained for total metal analyses are collected without filtering. Dissolved metal samples are collected after groundwater is passed through in-line filters of 0.45 micron pore size. The difference in concentrations between the total and dissolved fraction may be attributed to the original metallic ion content of the particles and any sorption of ions to the suspended particles.

Table 4A-4 (Attachment 4A) summarizes the metal results, including total uranium, for the unfiltered groundwater samples and Table 4A-5 (Attachment 4A) summarizes the metal results, including total uranium, for the filtered samples collected during the CY 2013 annual monitoring event at the MWL. Samples were analyzed for TAL metals according to EPA Methods 6010, 6020, and 7470 (EPA 1986).

No metal parameters were detected above established MCLs in any groundwater sample, except chromium. Chromium was detected above the MCL of 0.10 mg/L in the unfiltered sample from monitoring well MWL-MW4 at a concentration of 0.112 mg/L, which is the maximum concentration for the MWL-MW4 historic monitoring data set. In the filtered sample from monitoring well MWL-MW4, chromium was not detected above the laboratory MDL of 0.002 mg/L.

A trend plot showing unfiltered chromium results for samples from monitoring well MWL-MW4 is provided in Attachment 4B, Figure 4B-3. This plot includes groundwater elevation data and unfiltered sample results from a total of 19 sampling events conducted from April 1997 through February 2013. The MWL-MW4 unfiltered data set is dominated by very low detections and non-detections. Prior to CY 2013, the maximum unfiltered chromium concentration was 0.00599 mg/L (April 2001 sample), and from 2008 through 2012 chromium was detected only once in unfiltered samples at a concentration of 0.00259 mg/L (February 2012 sample). The February 2013 unfiltered sample result of 0.112 mg/L represents an unusual increase in chromium concentration (i.e., approximately 2 orders of magnitude), which is 18.7 times higher than the February 2012 result. In contrast, the February 2013 filtered sample result was a non-detection, with a laboratory method detection limit of 0.002 mg/L.

Other metals results for the February 2013 MWL-MW4 unfiltered sample were reported at concentrations significantly higher than previous maximum concentrations. As summarized in Table 4-3, cobalt, copper, iron, and nickel were all reported at new maximum concentrations in the February 2013 unfiltered sample. Cobalt, copper, and iron display a similar pattern to the unfiltered chromium results depicted in Figure 4B-3 (Attachment 4B), characterized by a narrow concentration range through 2012, followed by a sharp increase in 2013 concentrations. Similar to the chromium filtered versus unfiltered results, the filtered sample concentrations for cobalt, copper, and iron are much lower and consistent with historical results.

Table 4-3. MWL-MW4 Unfiltered Metals Results Summary, Calendar Year 2013

Metal	Maximum Concentration 1997–2012	February 2013 Concentration
Chromium	0.00559 mg/L (April 2001 sample)	0.112 mg/L
Cobalt	0.000888 mg/L (June 2007 sample)	0.00229 mg/L
Copper	0.00326 mg/L (June 2011 sample)	0.0335 mg/L
Iron	0.569 mg/L (April 2008 sample)	2.92 mg/L
Nickel	0.194 mg/L (February 2013 sample)	0.417 mg/L

NOTES:
mg/L = Milligrams per liter.

A trend plot showing unfiltered nickel results for monitoring well MWL-MW4 is provided in Attachment 4B, Figure 4B-4. All unfiltered results through 2010 are below or near the NMED-approved background concentration of 0.28 mg/L. Results from 2011, 2012, and 2013 show an increase in concentration by an order of magnitude, as well as an increasing trend (0.13, 0.194, and 0.417 mg/L, respectively). Although generally similar, there are two differences when comparing the MWL-MW4 nickel results to the MWL-MW4 chromium, cobalt, copper, and iron results. First, the substantial increase in the concentration of nickel occurred two years before the increase was observed for chromium, cobalt, copper, and iron (2011 versus 2013). Second, unfiltered and filtered nickel results are similar and do not show substantial differences in concentration (i.e., order of magnitude difference) observed in the 2013 results for chromium, cobalt, copper, and iron. However, the overall trend for unfiltered nickel results is similar to the trend of unfiltered chromium results, as shown in Figures 4B-3 and 4B-4 (Attachment B).

The sharp increases in unfiltered concentrations of chromium, cobalt, copper, iron, and nickel in recent samples from monitoring well MWL-MW4 are indicative of a source within the well and consistent with unfiltered metals results from previous MWL monitoring wells that had stainless steel well screens. The source is most likely corrosion by-products from the dedicated stainless steel sampling pump in monitoring well MWL-MW4. Because of the two screen intervals and orientation (six degree angle from vertical), MWL-MW4 is equipped with both an inflatable packer (separating the two screen intervals) and a dedicated sampling system (sampling pump, connecting rods, mounting bracket, lifting cable, and tubing). Machined stainless steel pipe connects the packer to the bottom of the sampling pump, and the entire assembly is held in the well by one-inch diameter metal rods. The packer and sampling system were removed in May 2009 prior to construction of the MWL ET Cover to allow the inner and outer well

casing to be extended to accommodate the additional height of the ET Cover. Figure 4-4 was taken in May 2009 after the packer and pump were removed from the well. The pump is largely comprised of stainless steel, and the pump intake (to right of technician's hand) shows visible oxide staining indicative of corrosion. The packer contains less overall metal and based on a visual inspection appeared to be in relatively good shape. The pump and packer were sent the manufacturer for routine maintenance and cleaning prior to the March 2010 re-installation. Monitoring well MWL-MW4 is the only MWL monitoring well equipped with dedicated equipment, and evidence of corrosion has been observed every time the equipment has been removed for routine maintenance. This equipment has not been removed since March 2010 and MWL-MW4 is not included in the groundwater monitoring network defined in the MWL LTMMP (SNL March 2012). The well is 20 years old and the water level is declining towards the bottom of the upper well screen (Figures 4B-3 and 4B-4, Attachment B).

Figure 4-4. May 2009 Photograph of the MWL-MW4 Sampling Pump and Inflatable Packer

Table 4-4 summarizes the maximum filtered and unfiltered metals concentrations from previous MWL groundwater monitoring wells with stainless steel screens, including background monitoring well MWL-BW1. These wells were decommissioned in 2008 due to declining water levels and evidence of stainless steel well screen corrosion (Bearzi March 2007 and July 2007). This table compares unfiltered and filtered maximum concentrations, and demonstrates three relevant points. First, elevated results for chromium, cobalt, copper, iron, and nickel were observed in all four of these wells. Second, maximum unfiltered sample concentrations for chromium, cobalt, copper, iron, and nickel are all similar to (but generally higher than) the February 2013 MWL-MW4 sample results. Third, unfiltered samples show maximum concentrations one or more orders of magnitude higher than the filtered results. However, consistent with MWL-MW4 nickel sample results, filtered and unfiltered nickel concentrations are similar (i.e., not substantially different) for samples from MWL-MW1 and MWL-MW3.

Table 4-4. Summary of Maximum Filtered and Unfiltered Metals Results from MWL Monitoring Wells with Stainless Steel Screens

MWL Monitoring Well	Metal	Maximum Filtered Concentration in Milligrams per Liter (mg/L)	Maximum Unfiltered Concentration in Milligrams per Liter (mg/L)
MWL-BW1	Chromium	0.002280	0.09420
	Cobalt	0.000220	0.004520
	Copper	0.001940	0.00807
	Iron	0.070900	1.820
	Nickel	0.01280	0.1910
MWL-MW1	Chromium	0.004220	1.1000
	Cobalt	0.000590	0.004040
	Copper	0.003720	0.02440
	Iron	0.2600	6.100
	Nickel	0.4050	0.5380
MWL-MW2	Chromium	0.005530	0.16200
	Cobalt	0.000148	0.000790
	Copper	0.00737	0.01040
	Iron	0.2390	0.3990
	Nickel	0.007110	0.1240
MWL-MW3	Chromium	0.004520	0.1690
	Cobalt	0.000770	0.003310
	Copper	0.00556	0.01360
	Iron	0.1370	4.220
	Nickel	0.1200	0.1570

NOTES:
BW = Background well.
mg/L = Milligram(s) per liter.
MW = Monitoring well.
MWL = Mixed Waste Landfill.

In summary, the February 2013 unfiltered metals results for chromium, cobalt, copper, iron, and nickel, as well as the 2011 through 2013 unfiltered and filtered nickel results, are anomalous and appear to be related to the corrosion of the stainless steel dedicated sampling pump and possibly other metal components associated with the dedicated sampling system in the well. Evidence of corrosion was observed when the equipment was removed from the well in May 2009 during ET Cover construction. MWL-MW4 is the only groundwater monitoring well at the MWL with dedicated sampling equipment installed in the well, and is the only well showing any indication of elevated metals concentrations. Filtered and unfiltered metals results are consistent with metals results from previous MWL monitoring wells with stainless steel screen sections that were decommissioned in 2008 due to evidence of well screen corrosion and declining water levels.

4.6.4 Radiological Parameters

Groundwater samples from the MWL monitoring wells were screened for gamma-emitting radionuclides, gross alpha/beta activity, and tritium (Table 4A-6, Attachment 4A) and the analytical results are compared with the established EPA MCLs (no MCL has been established for tritium).

Gross alpha activity is measured as a screening tool and in accordance with 40 Code of Federal Regulations, Parts 9, 141, and 142, Table I-4 does not include uranium, which is measured independently. Therefore, gross alpha activity measurements were corrected by subtracting the total uranium activity. Radiological results are further reviewed by an SNL/NM Certified Health Physicist to assure that the samples are nonradioactive. Corrected gross alpha activity results are all below the MCL of 15 picocuries per liter and range from 2.78 to 9.02 picocuries per liter. Gross beta results do not exceed established

MCLs. Tritium and short-list gamma spectroscopy radionuclides activities were below the laboratory minimum detectable activity levels in all groundwater samples. The potassium-40 results for the duplicate samples from monitoring wells MWL-MW5 and MWL-MW8 and the cobalt-60 result for the sample from MWL-MW9 were "X" flagged by the laboratory and rejected during data validation due to the analytical instrument peak not meeting identification criteria. These results are "false positives" for radionuclides that are typically not detected. Potassium-40 was not detected in the corresponding environmental samples from monitoring wells MWL-MW5 and MWL-MW8. All radiological parameter results are summarized in Table 4A-6 (Attachment 4A).

4.6.5 Water Quality Parameters

The field water quality parameters measured immediately before sampling are presented in Attachment 4A, Table 4A-7. These field parameters consist of temperature, specific conductance, oxidation-reduction potential, pH, turbidity, and dissolved oxygen.

4.7 Quality Control Results

Field and laboratory QC samples were used to determine the accuracy of the methods used and to monitor for inadvertent sample contamination that can occur during the sampling and analysis process. All data were reviewed in accordance with Administrative Operating Procedure (AOP) 00-03, *Data Validation Procedure for Chemical and Radiochemical Data* (SNL May 2011). The results for each QC analysis and the impact on data quality are discussed in the following sections.

4.7.1 Field Quality Control Samples

The QC samples collected in the field included duplicate environmental, EB, FB, and TB samples. The purpose of each field QC sample type is presented in Section 1.3.3. The following sections discuss the analytical results for each QC sample type.

4.7.1.1 Duplicate Environmental Samples

Duplicate environmental samples were collected from monitoring wells MWL-MW5 and MWL-MW8 and analyzed for all constituents. The results were compared to the results for the corresponding environmental sample. The duplicate sample collected from monitoring well MWL-MW9 was analyzed for VOCs only. Relative percent difference values were calculated for constituents that were detected above the laboratory MDL in both samples.

CY 2013 duplicate environmental sample results show good correlation. All calculated relative percent difference values are less than 20 for organic compounds and less than or equal to 35 for metals for all calculated parameters.

4.7.1.2 Equipment Blank Samples

Two EB samples (also referred to as a rinsate blanks) associated with monitoring wells MWL-MW5 and MWL-MW8 were collected during the CY 2013 sampling event and submitted for all analyses. One EB sample associated with MWL-MW9 was collected and analyzed for VOCs only.

Various constituents detected in EB samples at low concentrations included bromodichloromethane, bromoform, chloroform, chloride, cobalt, copper, dibromochloromethane, magnesium, manganese, nickel, and sodium. For all but three of these constituents, no corrective action was required because these analytes were not detected in associated environmental samples, or were detected in environmental samples at concentrations greater than five times the EB result. Cobalt, copper, and nickel were detected in the EB samples; associated environmental and duplicate sample concentrations were less than five times the reported concentrations in the EB samples, and therefore, were qualified during data validation as not detected (i.e., "U" qualified). For the unfiltered sample fractions, low concentration detections of

copper (MWL-MW5 and MWL-MW8 environmental and duplicate pairs) and nickel (MWL-MW5 environmental and duplicate pair) were qualified as not detected during data validation. For the filtered sample fractions, low concentration detections of cobalt (MWL-MW5 environmental and duplicate pair) and copper (MWL-MW5 and MWL-MW8 environmental and duplicate pairs) were qualified as not detected during data validation.

4.7.1.3 Field Blank Samples

A total of seven FB samples were collected during the CY 2013 sampling and submitted for VOC analysis. Bromodichloromethane, bromoform, chloroform, and dibromochloromethane were detected in the FB samples. No corrective action was required because these compounds were not detected in associated environmental samples.

4.7.1.4 Trip Blank Samples

A total of 10 TB samples were submitted with the February and March 2013 samples for analysis of VOCs. No VOCs were detected in these samples.

4.7.2 Laboratory Quality Control Samples

Internal laboratory QC samples, including method blanks and duplicate laboratory control samples, were analyzed concurrently with the groundwater samples. Additionally, batch matrix spike, matrix spike duplicate, and surrogate spike samples were analyzed. All environmental sample, field QC sample, and laboratory QC sample results were reviewed and qualified in accordance with AOP 00-03, *Data Validation Procedure for Chemical and Radiochemical Data* (SNL May 2011).

Although some analytical results were qualified during the data validation, no significant data quality problems were noted for any CY 2013 MWL groundwater monitoring samples. Data validation reports are filed in the SNL/NM Customer Funded Records Center.

4.8 Variances and Nonconformances

All analytical and field methods were performed according to the requirements specified in the MWL groundwater monitoring Mini-Sampling and Analysis Plan for FY 2011 (SNL January 2013). No variances and/or nonconformances from requirements in the MWL Mini-Sampling and Analysis Plan were identified during CY 2013 sampling activities and there were no variances from the plans.

4.9 Summary and Conclusions

During CY 2013 environmental groundwater samples were collected from seven MWL groundwater monitoring wells. Sample parameters included VOCs, unfiltered and filtered fractions for TAL metals plus uranium, anions (as bromide, chloride, fluoride, and sulfate), alkalinity, NPN, gamma spectroscopy, gross alpha/beta activity, and tritium analyses. Groundwater monitoring results were compared with established EPA MCLs for drinking water (EPA 2009). No parameters were detected above established MCLs, except for chromium in the unfiltered sample fraction from monitoring well MWL-MW4. This exceedance and elevated results for unfiltered cobalt, copper, iron, and nickel appear to be related to the corrosion of stainless steel dedicated sampling pump and possibly other metal components associated with the dedicated sampling system (no other wells at MWL have dedicated equipment).

Based on the field and laboratory QC sample and data validation results, the CY 2013 groundwater monitoring data meet data quality objectives and are in compliance with analytical methods and laboratory procedures (i.e., representative and technically defensible).

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Attachment 4A
Mixed Waste Landfill
Analytical Results Tables

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Attachment 4A Tables

4A-1 Method Detection Limits for Volatile Organic Compounds (Method[g] SW846-8260B), Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico, Calendar Year 2013 ..... 4A-5

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Table 4A-1
Method Detection Limits for Volatile Organic Compounds (Method[g] SW846 8260B), Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Analyte	MDL[b] (µg/L)	Analyte	MDL[b] (µg/L)
1,1,1-Trichloroethane	0.300	Chlorobenzene	0.300
1,1,2,2-Tetrachloroethane	0.300	Chloroethane	0.300
1,1,2-Trichloroethane	0.300	Chloroform	0.300
1,1-Dichloroethane	0.300	Chloromethane	0.300
1,1-Dichloroethene	0.300	Cyclohexane	0.300
1,2,3-Trichlorobenzene	0.300	Dibromochloromethane	0.300
1,2,4-Trichlorobenzene	0.300	Dichlorodifluoromethane	0.300
1,2-Dibromo-3-chloropropane	0.300	Ethyl benzene	0.300
1,2-Dibromoethane	0.300	Isopropylbenzene	0.300
1,2-Dichlorobenzene	0.300	Methyl acetate	1.50
1,2-Dichloroethane	0.300	Methylcyclohexane	3.00
1,2-Dichloropropane	0.300	Methylene chloride	3.00
1,3-Dichlorobenzene	0.300	Styrene	0.300
1,4-Dichlorobenzene	0.300	Tert-butyl methyl ether	0.300
2,2-trifluoroethane, 1,1,2-Trichloro-1	1.50	Tetrachloroethene	0.300
2-Butanone	2.00	Toluene	0.300
2-Hexanone	2.20	Trichloroethene	0.300
4-methyl-, 2-Pentanone	1.50	Trichlorofluoromethane	0.300
Acetone	3.00	Vinyl chloride	0.300
Benzene	0.300	Xylene	0.300
Bromochloromethane	0.300	cis-1,2-Dichloroethene	0.300
Bromodichloromethane	0.300	cis-1,3-Dichloropropene	0.300
Bromoform	0.300	m-, p-Xylene	0.300
Bromomethane	0.300	o-Xylene	0.300
Carbon disulfide	1.50	trans-1,2-Dichloroethene	0.300
Carbon tetrachloride	0.300	trans-1,3-Dichloropropene	0.300

Refer to footnotes on page 4A-31.

Table 4A-2
Summary of Nitrate plus Nitrite Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-BW2 29-Jan-13	Nitrate plus nitrite	2.18	0.085	0.250	10.0			093409-018	EPA 353.2
MWL-MW4 11-Feb-13	Nitrate plus nitrite	2.43	0.170	0.500	10.0			093441-018	EPA 353.2
MWL-MW5 30-Jan-13	Nitrate plus nitrite	1.28	0.085	0.250	10.0			093414-018	EPA 353.2
MWL-MW5 (Duplicate) 30-Jan-13	Nitrate plus nitrite	1.26	0.085	0.250	10.0			093415-018	EPA 353.2
MWL-MW6 31-Jan-13	Nitrate plus nitrite	1.66	0.085	0.250	10.0			093418-018	EPA 353.2
MWL-MW7 07-Feb-13	Nitrate plus nitrite	3.23	0.085	0.250	10.0			093438-018	EPA 353.2
MWL-MW8 06-Feb-13	Nitrate plus nitrite	1.40	0.085	0.250	10.0			093429-018	EPA 353.2
MWL-MW8 (Duplicate) 06-Feb-13	Nitrate plus nitrite	1.41	0.085	0.250	10.0			093430-018	EPA 353.2
MWL-MW9 04-Feb-13	Nitrate plus nitrite	2.20	0.085	0.250	10.0			093423-018	EPA 353.2

Refer to footnotes on page 4A-31.

Table 4A-3
Summary of Alkalinity and Anion Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-BW2	Bicarbonate alkalinity	244	0.725	1.00	NE			093409-022	SM 2320B
29-Jan-13	Carbonate alkalinity	ND	0.725	1.00	NE	U		093409-022	SM 2320B
	Bromide	0.359	0.067	0.200	NE			093409-016	SW846 9056
	Chloride	66.1	0.335	1.00	NE			093409-016	SW846 9056
	Fluoride	0.741	0.033	0.100	4.0			093409-016	SW846 9056
	Sulfate	44.6	0.665	2.00	NE			093409-016	SW846 9056
MWL-MW4	Bicarbonate alkalinity	191	0.725	1.00	NE			093441-022	SM 2320B
11-Feb-13	Carbonate alkalinity	ND	0.725	1.00	NE	U		093441-022	SM 2320B
	Bromide	0.479	0.067	0.200	NE			093441-016	SW846 9056
	Chloride	48.3	0.670	2.00	NE			093441-016	SW846 9056
	Fluoride	0.931	0.033	0.100	4.0			093441-016	SW846 9056
	Sulfate	38.4	1.33	4.00	NE			093441-016	SW846 9056
MWL-MW5	Bicarbonate alkalinity	332	0.725	1.00	NE			093414-022	SM 2320B
30-Jan-13	Carbonate alkalinity	ND	0.725	1.00	NE	U		093414-022	SM 2320B
	Bromide	0.501	0.067	0.200	NE			093414-016	SW846 9056
	Chloride	84.1	0.670	2.00	NE			093414-016	SW846 9056
	Fluoride	0.789	0.033	0.100	4.0			093414-016	SW846 9056
	Sulfate	54.0	1.33	4.00	NE			093414-016	SW846 9056
MWL-MW5 (Duplicate)	Bicarbonate alkalinity	333	0.725	1.00	NE			093415-022	SM 2320B
30-Jan-13	Carbonate alkalinity	ND	0.725	1.00	NE	U		093415-022	SM 2320B
	Bromide	0.426	0.067	0.200	NE			093415-016	SW846 9056
	Chloride	84.3	0.670	2.00	NE			093415-016	SW846 9056
	Fluoride	0.790	0.033	0.100	4.0			093415-016	SW846 9056
	Sulfate	53.9	1.33	4.00	NE			093415-016	SW846 9056
MWL-MW6	Bicarbonate alkalinity	314	0.725	1.00	NE			093418-022	SM 2320B
31-Jan-13	Carbonate alkalinity	ND	0.725	1.00	NE	U		093418-022	SM 2320B
	Bromide	0.457	0.067	0.200	NE			093418-016	SW846 9056
	Chloride	78.5	0.670	2.00	NE			093418-016	SW846 9056
	Fluoride	0.760	0.033	0.100	4.0			093418-016	SW846 9056
	Sulfate	51.8	1.33	4.00	NE			093418-016	SW846 9056
MWL-MW7	Bicarbonate alkalinity	217	0.725	1.00	NE			093438-022	SM 2320B
07-Feb-13	Carbonate alkalinity	ND	0.725	1.00	NE	U		093438-022	SM 2320B
	Bromide	0.277	0.067	0.200	NE			093438-016	SW846 9056
	Chloride	47.6	0.335	1.00	NE			093438-016	SW846 9056
	Fluoride	1.09	0.033	0.100	4.0			093438-016	SW846 9056
	Sulfate	37.8	0.133	0.400	NE			093438-016	SW846 9056

Refer to footnotes on page 4A-31.

Table 4A-3 *(Concluded)*
Summary of Alkalinity and Anion Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW8	Bicarbonate alkalinity	223	0.725	1.00	NE			093429-022	SM 2320B
06-Feb-13	Carbonate alkalinity	ND	0.725	1.00	NE	U		093429-022	SM 2320B
	Bromide	0.300	0.067	0.200	NE			093429-016	SW846 9056
	Chloride	49.2	0.335	1.00	NE			093429-016	SW846 9056
	Fluoride	0.990	0.033	0.100	4.0			093429-016	SW846 9056
	Sulfate	38.1	0.133	0.400	NE			093429-016	SW846 9056
MWL-MW8 (Duplicate)	Bicarbonate alkalinity	224	0.725	1.00	NE			093430-022	SM 2320B
06-Feb-13	Carbonate alkalinity	ND	0.725	1.00	NE	U		093430-022	SM 2320B
	Bromide	0.346	0.067	0.200	NE			093430-016	SW846 9056
	Chloride	41.2	0.335	1.00	NE			093430-016	SW846 9056
	Fluoride	1.03	0.033	0.100	4.0			093430-016	SW846 9056
	Sulfate	38.0	0.133	0.400	NE			093430-016	SW846 9056
MWL-MW9	Bicarbonate alkalinity	227	0.725	1.00	NE			093423-022	SM 2320B
04-Feb-13	Carbonate alkalinity	ND	0.725	1.00	NE	U		093423-022	SM 2320B
	Bromide	0.272	0.067	0.200	NE			093423-016	SW846 9056
	Chloride	41.0	0.335	1.00	NE			093423-016	SW846 9056
	Fluoride	1.03	0.033	0.100	4.0			093423-016	SW846 9056
	Sulfate	38.7	0.133	0.400	NE			093423-016	SW846 9056

Refer to footnotes on page 4A-31.

Table 4A-4
Summary of Unfiltered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-BW2	Aluminum	0.173	0.015	0.050	NE			093409-009	SW846 6020
29-Jan-13	Antimony	ND	0.001	0.003	0.006	U		093409-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093409-009	SW846 6020
	Barium	0.0988	0.0006	0.002	2.00		J-	093409-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093409-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093409-009	SW846 6020
	Calcium	74.3	1.20	4.00	NE	B		093409-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093409-009	SW846 6020
	Cobalt	0.000213	0.0001	0.001	NE	J		093409-009	SW846 6020
	Copper	0.00114	0.00035	0.001	NE			093409-009	SW846 6020
	Iron	0.382	0.033	0.100	NE			093409-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093409-009	SW846 6020
	Magnesium	24.7	0.010	0.030	NE			093409-009	SW846 6020
	Manganese	0.0138	0.001	0.005	NE			093409-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		093409-009	SW846 7470
	Nickel	0.00257	0.0005	0.002	NE			093409-009	SW846 6020
	Potassium	4.10	0.080	0.300	NE			093409-009	SW846 6020
	Selenium	0.00256	0.0015	0.005	0.050	J		093409-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093409-009	SW846 6020
	Sodium	62.4	1.60	5.00	NE			093409-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093409-009	SW846 6020
	Uranium	0.00686	0.000067	0.0002	0.030			093409-009	SW846 6020
	Vanadium	0.00616	0.001	0.005	NE			093409-009	SW846 6010
	Zinc	0.0102	0.0035	0.010	NE			093409-009	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-4 *(Continued)*
Summary of Unfiltered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW4	Aluminum	0.0284	0.015	0.050	NE	J		093441-009	SW846 6020
11-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093441-009	SW846 6020
	Arsenic	0.00426	0.0017	0.005	0.010	J		093441-009	SW846 6020
	Barium	0.0861	0.0006	0.002	2.00			093441-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093441-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093441-009	SW846 6020
	Calcium	58.9	0.300	1.00	NE			093441-009	SW846 6020
	Chromium	**0.112**	0.002	0.010	0.100			093441-009	SW846 6020
	Cobalt	0.00229	0.0001	0.001	NE			093441-009	SW846 6020
	Copper	0.0335	0.00035	0.001	NE			093441-009	SW846 6020
	Iron	2.92	0.033	0.100	NE			093441-009	SW846 6020
	Lead	0.00126	0.0005	0.002	NE	J		093441-009	SW846 6020
	Magnesium	18.5	0.010	0.030	NE		J	093441-009	SW846 6020
	Manganese	0.0503	0.001	0.005	NE			093441-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093441-009	SW846 7470
	Nickel	0.417	0.0005	0.002	NE			093441-009	SW846 6020
	Potassium	5.10	0.080	0.300	NE		J	093441-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093441-009	SW846 6020
	Silver	0.00236	0.0002	0.001	NE			093441-009	SW846 6020
	Sodium	56.7	0.400	1.25	NE			093441-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093441-009	SW846 6020
	Uranium	0.00455	0.000067	0.0002	0.030			093441-009	SW846 6020
	Vanadium	0.0105	0.001	0.005	NE			093441-009	SW846 6010
	Zinc	0.144	0.0035	0.010	NE			093441-009	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-4 *(Continued)*
Summary of Unfiltered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW5	Aluminum	ND	0.015	0.050	NE	U		093414-009	SW846 6020
30-Jan-13	Antimony	ND	0.001	0.003	0.006	U		093414-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093414-009	SW846 6020
	Barium	0.116	0.0006	0.002	2.00		J-	093414-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093414-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093414-009	SW846 6020
	Calcium	99.9	1.20	4.00	NE	B		093414-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093414-009	SW846 6020
	Cobalt	0.000142	0.0001	0.001	NE	J		093414-009	SW846 6020
	Copper	0.000817	0.00035	0.001	NE	J	0.012UJ	093414-009	SW846 6020
	Iron	0.185	0.033	0.100	NE			093414-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093414-009	SW846 6020
	Magnesium	33.8	0.010	0.030	NE			093414-009	SW846 6020
	Manganese	0.0085	0.001	0.005	NE			093414-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		093414-009	SW846 7470
	Nickel	0.00201	0.0005	0.002	NE		0.0026U	093414-009	SW846 6020
	Potassium	5.71	0.080	0.300	NE			093414-009	SW846 6020
	Selenium	0.00193	0.0015	0.005	0.050	J		093414-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093414-009	SW846 6020
	Sodium	74.9	1.60	5.00	NE			093414-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093414-009	SW846 6020
	Uranium	0.00908	0.000067	0.0002	0.030			093414-009	SW846 6020
	Vanadium	0.00548	0.001	0.005	NE			093414-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093414-009	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-4 *(Continued)*
Summary of Unfiltered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW5 (Duplicate)	Aluminum	ND	0.015	0.050	NE	U		093415-009	SW846 6020
30-Jan-13	Antimony	ND	0.001	0.003	0.006	U		093415-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093415-009	SW846 6020
	Barium	0.114	0.0006	0.002	2.00		J-	093415-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093415-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093415-009	SW846 6020
	Calcium	98.3	1.20	4.00	NE	B		093415-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093415-009	SW846 6020
	Cobalt	0.000139	0.0001	0.001	NE	J		093415-009	SW846 6020
	Copper	0.000619	0.00035	0.001	NE	J	0.012UJ	093415-009	SW846 6020
	Iron	0.182	0.033	0.100	NE			093415-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093415-009	SW846 6020
	Magnesium	33.9	0.010	0.030	NE			093415-009	SW846 6020
	Manganese	0.0086	0.001	0.005	NE			093415-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		093415-009	SW846 7470
	Nickel	0.00208	0.0005	0.002	NE		0.0026U	093415-009	SW846 6020
	Potassium	5.71	0.080	0.300	NE			093415-009	SW846 6020
	Selenium	0.00201	0.0015	0.005	0.050	J		093415-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093415-009	SW846 6020
	Sodium	74.3	1.60	5.00	NE			093415-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093415-009	SW846 6020
	Uranium	0.0093	0.000067	0.0002	0.030			093415-009	SW846 6020
	Vanadium	0.00521	0.001	0.005	NE			093415-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093415-009	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-4 *(Continued)*
Summary of Unfiltered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW6	Aluminum	ND	0.015	0.050	NE	U		093418-009	SW846 6020
31-Jan-13	Antimony	ND	0.001	0.003	0.006	U		093418-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093418-009	SW846 6020
	Barium	0.117	0.0006	0.002	2.00			093418-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093418-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093418-009	SW846 6020
	Calcium	92.4	1.20	4.00	NE			093418-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093418-009	SW846 6020
	Cobalt	0.000115	0.0001	0.001	NE	J		093418-009	SW846 6020
	Copper	0.000849	0.00035	0.001	NE	J		093418-009	SW846 6020
	Iron	0.183	0.033	0.100	NE			093418-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093418-009	SW846 6020
	Magnesium	30.8	0.010	0.030	NE			093418-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		093418-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		093418-009	SW846 7470
	Nickel	0.00228	0.0005	0.002	NE			093418-009	SW846 6020
	Potassium	5.80	0.080	0.300	NE			093418-009	SW846 6020
	Selenium	0.00224	0.0015	0.005	0.050	J		093418-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093418-009	SW846 6020
	Sodium	70.8	1.60	5.00	NE			093418-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093418-009	SW846 6020
	Uranium	0.0102	0.000067	0.0002	0.030			093418-009	SW846 6020
	Vanadium	0.0064	0.001	0.005	NE			093418-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093418-009	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-4 *(Continued)*
Summary of Unfiltered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW7	Aluminum	ND	0.015	0.050	NE	U		093438-009	SW846 6020
07-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093438-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093438-009	SW846 6020
	Barium	0.093	0.0006	0.002	2.00			093438-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093438-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093438-009	SW846 6020
	Calcium	58.3	0.600	2.00	NE	B		093438-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093438-009	SW846 6020
	Cobalt	0.000105	0.0001	0.001	NE	J		093438-009	SW846 6020
	Copper	0.000927	0.00035	0.001	NE	J	J	093438-009	SW846 6020
	Iron	0.115	0.033	0.100	NE			093438-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093438-009	SW846 6020
	Magnesium	18.3	0.010	0.030	NE			093438-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		093438-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093438-009	SW846 7470
	Nickel	0.00152	0.0005	0.002	NE	J		093438-009	SW846 6020
	Potassium	4.66	0.080	0.300	NE			093438-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093438-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093438-009	SW846 6020
	Sodium	41.0	0.080	0.250	NE			093438-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093438-009	SW846 6020
	Uranium	0.00747	0.000067	0.0002	0.030			093438-009	SW846 6020
	Vanadium	0.0076	0.001	0.005	NE			093438-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093438-009	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-4 *(Continued)*
Summary of Unfiltered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW8	Aluminum	0.0265	0.015	0.050	NE	J		093429-009	SW846 6020
06-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093429-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093429-009	SW846 6020
	Barium	0.122	0.006	0.020	2.00			093429-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093429-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093429-009	SW846 6020
	Calcium	60.8	0.600	2.00	NE	B		093429-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093429-009	SW846 6020
	Cobalt	0.000135	0.0001	0.001	NE	J		093429-009	SW846 6020
	Copper	0.00182	0.00035	0.001	NE		0.015UJ	093429-009	SW846 6020
	Iron	0.150	0.033	0.100	NE			093429-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093429-009	SW846 6020
	Magnesium	19.1	0.010	0.030	NE			093429-009	SW846 6020
	Manganese	0.0223	0.001	0.005	NE			093429-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093429-009	SW846 7470
	Nickel	0.00215	0.0005	0.002	NE			093429-009	SW846 6020
	Potassium	5.06	0.080	0.300	NE			093429-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093429-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093429-009	SW846 6020
	Sodium	42.3	0.080	0.250	NE			093429-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093429-009	SW846 6020
	Uranium	0.00755	0.000067	0.0002	0.030			093429-009	SW846 6020
	Vanadium	0.00242	0.001	0.005	NE	J		093429-009	SW846 6010
	Zinc	0.00515	0.0035	0.010	NE	J		093429-009	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-4 *(Continued)*
Summary of Unfiltered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW8 (Duplicate)	Aluminum	0.0378	0.015	0.050	NE	J		093430-009	SW846 6020
06-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093430-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093430-009	SW846 6020
	Barium	0.120	0.0006	0.002	2.00			093430-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093430-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093430-009	SW846 6020
	Calcium	59.1	0.600	2.00	NE	B		093430-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093430-009	SW846 6020
	Cobalt	0.000144	0.0001	0.001	NE	J		093430-009	SW846 6020
	Copper	0.00195	0.00035	0.001	NE		0.015UJ	093430-009	SW846 6020
	Iron	0.162	0.033	0.100	NE			093430-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093430-009	SW846 6020
	Magnesium	19.2	0.010	0.030	NE			093430-009	SW846 6020
	Manganese	0.0227	0.001	0.005	NE			093430-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093430-009	SW846 7470
	Nickel	0.00218	0.0005	0.002	NE			093430-009	SW846 6020
	Potassium	5.10	0.080	0.300	NE			093430-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093430-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093430-009	SW846 6020
	Sodium	43.2	0.080	0.250	NE			093430-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093430-009	SW846 6020
	Uranium	0.00726	0.000067	0.0002	0.030			093430-009	SW846 6020
	Vanadium	0.00174	0.001	0.005	NE	J		093430-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093430-009	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-4 *(Concluded)*
Summary of Unfiltered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW9	Aluminum	0.0358	0.015	0.050	NE	J		093423-009	SW846 6020
04-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093423-009	SW846 6020
	Arsenic	0.00185	0.0017	0.005	0.010	J		093423-009	SW846 6020
	Barium	0.0897	0.0006	0.002	2.00			093423-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093423-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093423-009	SW846 6020
	Calcium	58.9	0.600	2.00	NE	B		093423-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093423-009	SW846 6020
	Cobalt	0.000168	0.0001	0.001	NE	J		093423-009	SW846 6020
	Copper	0.00108	0.00035	0.001	NE		J	093423-009	SW846 6020
	Iron	0.172	0.033	0.100	NE			093423-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093423-009	SW846 6020
	Magnesium	18.6	0.010	0.030	NE			093423-009	SW846 6020
	Manganese	0.00862	0.001	0.005	NE			093423-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093423-009	SW846 7470
	Nickel	0.00208	0.0005	0.002	NE			093423-009	SW846 6020
	Potassium	4.73	0.080	0.300	NE			093423-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093423-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093423-009	SW846 6020
	Sodium	40.7	0.080	0.250	NE			093423-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093423-009	SW846 6020
	Uranium	0.00923	0.000067	0.0002	0.030			093423-009	SW846 6020
	Vanadium	0.00921	0.001	0.005	NE			093423-009	SW846 6010
	Zinc	0.00376	0.0035	0.010	NE	J		093423-009	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-5
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-BW2	Aluminum	ND	0.015	0.050	NE	U		093409-010	SW846 6020
29-Jan-13	Antimony	ND	0.001	0.003	0.006	U		093409-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093409-010	SW846 6020
	Barium	0.0929	0.0006	0.002	2.00		J-	093409-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093409-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093409-010	SW846 6020
	Calcium	72.7	1.20	4.00	NE	B		093409-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093409-010	SW846 6020
	Cobalt	0.000313	0.0001	0.001	NE	J		093409-010	SW846 6020
	Copper	0.000649	0.00035	0.001	NE	J		093409-010	SW846 6020
	Iron	0.135	0.033	0.100	NE			093409-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093409-010	SW846 6020
	Magnesium	24.6	0.010	0.030	NE			093409-010	SW846 6020
	Manganese	0.0093	0.001	0.005	NE			093409-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		093409-010	SW846 7470
	Nickel	0.00218	0.0005	0.002	NE			093409-010	SW846 6020
	Potassium	3.98	0.080	0.300	NE			093409-010	SW846 6020
	Selenium	0.00265	0.0015	0.005	0.050	J		093409-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093409-010	SW846 6020
	Sodium	61.3	1.60	5.00	NE			093409-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093409-010	SW846 6020
	Uranium	0.00679	0.000067	0.0002	0.030			093409-010	SW846 6020
	Vanadium	0.00567	0.001	0.005	NE			093409-010	SW846 6010
	Zinc	0.00979	0.0035	0.010	NE	J		093409-010	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-5 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW4	Aluminum	ND	0.015	0.050	NE	U		093441-010	SW846 6020
11-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093441-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093441-010	SW846 6020
	Barium	0.0864	0.0006	0.002	2.00			093441-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093441-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093441-010	SW846 6020
	Calcium	62.1	0.300	1.00	NE			093441-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093441-010	SW846 6020
	Cobalt	0.000296	0.0001	0.001	NE	J		093441-010	SW846 6020
	Copper	0.00213	0.00035	0.001	NE			093441-010	SW846 6020
	Iron	0.137	0.033	0.100	NE			093441-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093441-010	SW846 6020
	Magnesium	18.9	0.010	0.030	NE		J	093441-010	SW846 6020
	Manganese	0.00414	0.001	0.005	NE	J		093441-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093441-010	SW846 7470
	Nickel	0.179	0.0005	0.002	NE			093441-010	SW846 6020
	Potassium	4.48	0.080	0.300	NE		J	093441-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093441-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093441-010	SW846 6020
	Sodium	48.6	0.080	0.250	NE			093441-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093441-010	SW846 6020
	Uranium	0.00549	0.000067	0.0002	0.030			093441-010	SW846 6020
	Vanadium	0.00821	0.001	0.005	NE			093441-010	SW846 6010
	Zinc	0.0462	0.0035	0.010	NE			093441-010	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-5 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW5	Aluminum	ND	0.015	0.050	NE	U		093414-010	SW846 6020
30-Jan-13	Antimony	ND	0.001	0.003	0.006	U		093414-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093414-010	SW846 6020
	Barium	0.113	0.0006	0.002	2.00		J-	093414-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093414-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093414-010	SW846 6020
	Calcium	96.0	1.20	4.00	NE	B		093414-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093414-010	SW846 6020
	Cobalt	0.000126	0.0001	0.001	NE	J	0.00064U	093414-010	SW846 6020
	Copper	0.000995	0.00035	0.001	NE	J	0.011UJ	093414-010	SW846 6020
	Iron	0.179	0.033	0.100	NE			093414-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093414-010	SW846 6020
	Magnesium	32.5	0.010	0.030	NE			093414-010	SW846 6020
	Manganese	0.00226	0.001	0.005	NE	J		093414-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		093414-010	SW846 7470
	Nickel	0.00199	0.0005	0.002	NE	J		093414-010	SW846 6020
	Potassium	5.47	0.080	0.300	NE			093414-010	SW846 6020
	Selenium	0.00225	0.0015	0.005	0.050	J		093414-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093414-010	SW846 6020
	Sodium	72.8	1.60	5.00	NE			093414-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093414-010	SW846 6020
	Uranium	0.00914	0.000067	0.0002	0.030			093414-010	SW846 6020
	Vanadium	0.00559	0.001	0.005	NE			093414-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093414-010	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-5 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW5 (Duplicate)	Aluminum	ND	0.015	0.050	NE	U		093415-010	SW846 6020
30-Jan-13	Antimony	ND	0.001	0.003	0.006	U		093415-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093415-010	SW846 6020
	Barium	0.107	0.0006	0.002	2.00		J-	093415-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093415-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093415-010	SW846 6020
	Calcium	94.0	1.20	4.00	NE	B		093415-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093415-010	SW846 6020
	Cobalt	0.000128	0.0001	0.001	NE	J	0.00064U	093415-010	SW846 6020
	Copper	0.000713	0.00035	0.001	NE	J	0.011UJ	093415-010	SW846 6020
	Iron	0.178	0.033	0.100	NE			093415-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093415-010	SW846 6020
	Magnesium	31.9	0.010	0.030	NE			093415-010	SW846 6020
	Manganese	0.00217	0.001	0.005	NE	J		093415-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		093415-010	SW846 7470
	Nickel	0.00199	0.0005	0.002	NE	J		093415-010	SW846 6020
	Potassium	5.25	0.080	0.300	NE			093415-010	SW846 6020
	Selenium	0.00236	0.0015	0.005	0.050	J		093415-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093415-010	SW846 6020
	Sodium	70.2	1.60	5.00	NE			093415-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093415-010	SW846 6020
	Uranium	0.00876	0.000067	0.0002	0.030			093415-010	SW846 6020
	Vanadium	0.00481	0.001	0.005	NE	J		093415-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093415-010	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-5 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW6	Aluminum	ND	0.015	0.050	NE	U		093418-010	SW846 6020
31-Jan-13	Antimony	ND	0.001	0.003	0.006	U		093418-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093418-010	SW846 6020
	Barium	0.114	0.0006	0.002	2.00			093418-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093418-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093418-010	SW846 6020
	Calcium	97.6	1.20	4.00	NE			093418-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093418-010	SW846 6020
	Cobalt	0.000124	0.0001	0.001	NE	J		093418-010	SW846 6020
	Copper	0.000678	0.00035	0.001	NE	J		093418-010	SW846 6020
	Iron	0.178	0.033	0.100	NE			093418-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093418-010	SW846 6020
	Magnesium	30.8	0.010	0.030	NE			093418-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		093418-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		093418-010	SW846 7470
	Nickel	0.00191	0.0005	0.002	NE	J		093418-010	SW846 6020
	Potassium	5.68	0.080	0.300	NE			093418-010	SW846 6020
	Selenium	0.00202	0.0015	0.005	0.050	J		093418-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093418-010	SW846 6020
	Sodium	72.6	1.60	5.00	NE			093418-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093418-010	SW846 6020
	Uranium	0.0101	0.000067	0.0002	0.030			093418-010	SW846 6020
	Vanadium	0.00713	0.001	0.005	NE			093418-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093418-010	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-5 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW7	Aluminum	ND	0.015	0.050	NE	U		093438-010	SW846 6020
07-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093438-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093438-010	SW846 6020
	Barium	0.0929	0.0006	0.002	2.00			093438-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093438-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093438-010	SW846 6020
	Calcium	56.3	0.600	2.00	NE	B		093438-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093438-010	SW846 6020
	Cobalt	0.000135	0.0001	0.001	NE	J		093438-010	SW846 6020
	Copper	0.00107	0.00035	0.001	NE		J	093438-010	SW846 6020
	Iron	0.105	0.033	0.100	NE			093438-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093438-010	SW846 6020
	Magnesium	18.4	0.010	0.030	NE			093438-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		093438-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093438-010	SW846 7470
	Nickel	0.00156	0.0005	0.002	NE	J		093438-010	SW846 6020
	Potassium	4.65	0.080	0.300	NE			093438-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093438-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093438-010	SW846 6020
	Sodium	42.0	0.080	0.250	NE			093438-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093438-010	SW846 6020
	Uranium	0.00761	0.000067	0.0002	0.030			093438-010	SW846 6020
	Vanadium	0.00776	0.001	0.005	NE			093438-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093438-010	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-5 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW8	Aluminum	ND	0.015	0.050	NE	U		093429-010	SW846 6020
06-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093429-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093429-010	SW846 6020
	Barium	0.120	0.0006	0.002	2.00			093429-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093429-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093429-010	SW846 6020
	Calcium	62.4	0.600	2.00	NE	B		093429-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093429-010	SW846 6020
	Cobalt	0.000114	0.0001	0.001	NE	J		093429-010	SW846 6020
	Copper	0.00151	0.00035	0.001	NE		0.008UJ	093429-010	SW846 6020
	Iron	0.107	0.033	0.100	NE			093429-010	SW846 6020
	Lead	0.00109	0.0005	0.002	NE	J		093429-010	SW846 6020
	Magnesium	19.3	0.010	0.030	NE			093429-010	SW846 6020
	Manganese	0.0131	0.001	0.005	NE			093429-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093429-010	SW846 7470
	Nickel	0.00196	0.0005	0.002	NE	J		093429-010	SW846 6020
	Potassium	5.11	0.080	0.300	NE			093429-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093429-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093429-010	SW846 6020
	Sodium	43.0	0.080	0.250	NE			093429-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093429-010	SW846 6020
	Uranium	0.00742	0.000067	0.0002	0.030			093429-010	SW846 6020
	Vanadium	0.00191	0.001	0.005	NE	J		093429-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093429-010	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-5 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW8 (Duplicate)	Aluminum	ND	0.015	0.050	NE	U		093430-010	SW846 6020
06-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093430-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093430-010	SW846 6020
	Barium	0.118	0.0006	0.002	2.00			093430-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093430-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093430-010	SW846 6020
	Calcium	60.3	0.600	2.00	NE	B		093430-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093430-010	SW846 6020
	Cobalt	0.000116	0.0001	0.001	NE	J		093430-010	SW846 6020
	Copper	0.00154	0.00035	0.001	NE		0.008UJ	093430-010	SW846 6020
	Iron	0.109	0.033	0.100	NE			093430-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093430-010	SW846 6020
	Magnesium	18.8	0.010	0.030	NE			093430-010	SW846 6020
	Manganese	0.0128	0.001	0.005	NE			093430-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093430-010	SW846 7470
	Nickel	0.00186	0.0005	0.002	NE	J		093430-010	SW846 6020
	Potassium	4.98	0.080	0.300	NE			093430-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093430-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093430-010	SW846 6020
	Sodium	42.4	0.080	0.250	NE			093430-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093430-010	SW846 6020
	Uranium	0.00737	0.000067	0.0002	0.030			093430-010	SW846 6020
	Vanadium	0.00178	0.001	0.005	NE	J		093430-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093430-010	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-5 *(Concluded)*
Summary of Filtered Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW9	Aluminum	ND	0.015	0.050	NE	U		093423-010	SW846 6020
04-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093423-010	SW846 6020
	Arsenic	0.00307	0.0017	0.005	0.010	J		093423-010	SW846 6020
	Barium	0.0896	0.0006	0.002	2.00			093423-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093423-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093423-010	SW846 6020
	Calcium	59.1	0.600	2.00	NE	B		093423-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093423-010	SW846 6020
	Cobalt	0.00018	0.0001	0.001	NE	J		093423-010	SW846 6020
	Copper	0.00134	0.00035	0.001	NE		J	093423-010	SW846 6020
	Iron	0.108	0.033	0.100	NE			093423-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093423-010	SW846 6020
	Magnesium	18.7	0.010	0.030	NE			093423-010	SW846 6020
	Manganese	0.00225	0.001	0.005	NE	J		093423-010	SW846 6020
	Mercury	0.0003	0.000067	0.0002	0.002		NJ-	093423-010	SW846 7470
	Nickel	0.00174	0.0005	0.002	NE	J		093423-010	SW846 6020
	Potassium	4.73	0.080	0.300	NE			093423-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093423-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093423-010	SW846 6020
	Sodium	40.6	0.080	0.250	NE			093423-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093423-010	SW846 6020
	Uranium	0.00911	0.000067	0.0002	0.030			093423-010	SW846 6020
	Vanadium	0.00975	0.001	0.005	NE			093423-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093423-010	SW846 6020

Refer to footnotes on page 4A-31.

Table 4A-6
Summary of Gamma Spectroscopy, Gross Alpha, Gross Beta, and Tritium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d]	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-BW2	Americium-241	6.54 ± 7.97	12.0	5.88	NE	U	BD	093409-033	EPA 901.1
29-Jan-13	Cesium-137	-0.843 ± 3.15	3.66	1.77	NE	U	BD	093409-033	EPA 901.1
	Cobalt-60	1.38 ± 1.81	3.22	1.52	NE	U	BD	093409-033	EPA 901.1
	Potassium-40	12.0 ± 41.7	28.2	13.2	NE	U	BD	093409-033	EPA 901.1
	Gross Alpha	5.80	NA	NA	15 pCi/L	NA	None	093409-034	EPA 900.0
	Gross Beta	7.55 ± 1.79	1.83	0.890	4mrem/yr		J	093409-034	EPA 900.0
	Tritium	10.2 ± 65.4	118	54.0	NE	U	BD	093409-036	EPA 906.0 M
MWL-MW4	Americium-241	0.304 ± 9.59	16.0	7.83	NE	U	BD	093441-033	EPA 901.1
11-Feb-13	Cesium-137	0.367 ± 2.54	3.38	1.63	NE	U	BD	093441-033	EPA 901.1
	Cobalt-60	1.20 ± 1.83	2.88	1.35	NE	U	BD	093441-033	EPA 901.1
	Potassium-40	-4.41 ± 34.9	43.4	20.8	NE	U	BD	093441-033	EPA 901.1
	Gross Alpha	6.60	NA	NA	15 pCi/L	NA	None	093441-034	EPA 900.0
	Gross Beta	7.38 ± 1.51	1.04	0.497	4mrem/yr		J	093441-034	EPA 900.0
	Tritium	-29.5 ± 78.3	152	68.7	NE	U	BD	093441-036	EPA 906.0 M
MWL-MW5	Americium-241	0.840 ± 7.72	12.5	6.09	NE	U	BD	093414-033	EPA 901.1
30-Jan-13	Cesium-137	-0.757 ± 1.73	2.82	1.35	NE	U	BD	093414-033	EPA 901.1
	Cobalt-60	-0.77 ± 1.85	3.20	1.51	NE	U	BD	093414-033	EPA 901.1
	Potassium-40	62.6 ± 25.6	62.6	15.5	NE	U	BD	093414-033	EPA 901.1
	Gross Alpha	9.02	NA	NA	15 pCi/L	NA	None	093414-034	EPA 900.0
	Gross Beta	8.21 ± 2.31	2.88	1.41	4mrem/yr		J	093414-034	EPA 900.0
	Tritium	17.1 ± 66.7	119	54.5	NE	U	BD	093414-036	EPA 906.0 M
MWL-MW5 (Duplicate)	Americium-241	8.97 ± 11.5	16.3	7.97	NE	U	BD	093415-033	EPA 901.1
30-Jan-13	Cesium-137	-0.257 ± 2.07	3.58	1.73	NE	U	BD	093415-033	EPA 901.1
	Cobalt-60	0.164 ± 1.83	3.28	1.55	NE	U	BD	093415-033	EPA 901.1
	Potassium-40	81.1 ± 39.4	33.0	15.6	NE	X	R	093415-033	EPA 901.1
	Gross Alpha	4.27	NA	NA	15 pCi/L	NA	None	093415-034	EPA 900.0
	Gross Beta	8.35 ± 2.27	2.70	1.31	4mrem/yr			093415-034	EPA 900.0
	Tritium	-43.9 ± 62.1	122	55.9	NE	U	BD	093415-036	EPA 906.0 M
MWL-MW6	Americium-241	7.48 ± 8.39	12.8	6.23	NE	U	BD	093418-033	EPA 901.1
31-Jan-13	Cesium-137	0.721 ± 1.67	2.86	1.37	NE	U	BD	093418-033	EPA 901.1
	Cobalt-60	-0.264 ± 1.63	2.92	1.37	NE	U	BD	093418-033	EPA 901.1
	Potassium-40	1.24 ± 42.2	31.8	15.0	NE	U	BD	093418-033	EPA 901.1
	Gross Alpha	5.17	NA	NA	15 pCi/L	NA	None	093418-034	EPA 900.0
	Gross Beta	7.33 ± 2.11	2.60	1.27	4mrem/yr		J	093418-034	EPA 900.0
	Tritium	34.5 ± 91.8	164	73.2	NE	U	BD	093418-036	EPA 906.0 M

Refer to footnotes on page 4A-31.

Table 4A-6 *(Concluded)*
Summary of Gamma Spectroscopy, Gross Alpha, Gross Beta, and Tritium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Activity[a] (pCi/L)	MDA[b] (pCi/L)	Critical Level[c] (pCi/L)	MCL[d]	Laboratory Qualifier[e]	Validation Qualifier[f]	Sample No.	Analytical Method[g]
MWL-MW7	Americium-241	-1.07 ± 6.40	11.0	5.35	NE	U	BD	093438-033	EPA 901.1
07-Feb-13	Cesium-137	-2.27 ± 2.80	2.78	1.33	NE	U	BD	093438-033	EPA 901.1
	Cobalt-60	-4.75 ± 3.70	3.17	1.50	NE	U	BD	093438-033	EPA 901.1
	Potassium-40	-26.8 ± 33.9	39.7	19.0	NE	U	BD	093438-033	EPA 901.1
	Gross Alpha	5.50	NA	NA	15 pCi/L	NA	None	093438-034	EPA 900.0
	Gross Beta	6.59 ± 1.41	0.993	0.469	4mrem/yr		J	093438-034	EPA 900.0
	Tritium	4.17 ± 106	182	88.5	NE	U	BD	093438-036	EPA 906.0 M
MWL-MW8	Americium-241	-7.92 ± 7.42	10.4	5.10	NE	U	BD	093429-033	EPA 901.1
06-Feb-13	Cesium-137	-0.448 ± 2.60	2.95	1.42	NE	U	BD	093429-033	EPA 901.1
	Cobalt-60	1.20 ± 2.08	3.07	1.45	NE	U	BD	093429-033	EPA 901.1
	Potassium-40	12.2 ± 33.1	23.8	11.0	NE	U	BD	093429-033	EPA 901.1
	Gross Alpha	5.24	NA	NA	15 pCi/L	NA	None	093429-034	EPA 900.0
	Gross Beta	76.5 ± 12.7	1.02	0.488	4mrem/yr		J	093429-034	EPA 900.0
	Tritium	-2.1 ± 106	184	89.2	NE	U	BD	093429-036	EPA 906.0 M
MWL-MW8 (Duplicate)	Americium-241	0.622 ± 7.05	10.3	5.06	NE	U	BD	093430-033	EPA 901.1
06-Feb-13	Cesium-137	-1.68 ± 2.09	3.18	1.54	NE	U	BD	093430-033	EPA 901.1
	Cobalt-60	1.38 ± 1.89	3.34	1.59	NE	U	BD	093430-033	EPA 901.1
	Potassium-40	35.7 ± 45.5	30.5	14.4	NE	X	R	093430-033	EPA 901.1
	Gross Alpha	6.84	NA	NA	15 pCi/L	NA	None	093430-034	EPA 900.0
	Gross Beta	7.32 ± 1.50	0.994	0.474	4mrem/yr		J	093430-034	EPA 900.0
	Tritium	-114 ± 101	181	87.9	NE	U	BD	093430-036	EPA 906.0 M
MWL-MW9	Americium-241	2.53 ± 11.2	16.6	8.12	NE	U	BD	093423-033	EPA 901.1
04-Feb-13	Cesium-137	1.27 ± 2.11	3.61	1.75	NE	U	BD	093423-033	EPA 901.1
	Cobalt-60	5.69 ± 2.86	3.31	1.56	NE	X	R	093423-033	EPA 901.1
	Potassium-40	-24.2 ± 36.5	42.5	20.3	NE	U	BD	093423-033	EPA 901.1
	Gross Alpha	2.78	NA	NA	15 pCi/L	NA	None	093423-034	EPA 900.0
	Gross Beta	7.90 ± 1.62	1.18	0.568	4mrem/yr		J	093423-034	EPA 900.0
	Tritium	80.9 ± 108	181	88.0	NE	U	BD	093423-036	EPA 906.0 M

Refer to footnotes on page 4A-31.

Table 4A-7
Summary of Field Water Quality Measurements[h],
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Sample Date	Temperature (°C)	Specific Conductivity (µmhos/cm)	Oxidation Reduction Potential (mV)	pH	Turbidity (NTU)	Dissolved Oxygen (% Sat)	Dissolved Oxygen (mg/L)
MWL-BW2	29-Jan-13	15.29	646	95.8	7.01	2.23	20.3	1.89
MWL-MW4	11-Feb-13	17.12	531	229.5	7.71	1.75	74.3	7.19
MWL-MW5	30-Jan-13	18.37	825	170.3	6.90	0.64	30.1	2.82
MWL-MW6	31-Jan-13	18.93	792	174.6	6.99	0.47	32.6	3.02
MWL-MW7	07-Feb-13	18.27	538	228.6	7.24	0.59	64.2	6.04
MWL-MW8	06-Feb-13	16.26	551	218.6	7.27	1.60	58.4	5.71
MWL-MW9	04-Feb-13	15.01	540	218.2	7.21	1.45	49.3	4.89

Refer to footnotes on page 4A-31.

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Footnotes for Mixed Waste Landfill Groundwater Analytical Results Tables

%	= percent.
µg/L	= micrograms per liter.
CFR	= Code of Federal Regulations.
EPA	= U.S. Environmental Protection Agency.
ID	= Identifier.
No.	= Number.
mg/L	= milligrams per liter.
mrem/yr	= millirem per year.

[a]Result

Gross alpha activity measurements were corrected by subtracting out the total uranium activity (40 CFR Parts 9, 141, and 142, Table 1-4).

Bold	= Indicates the value bold exceeds the established MCL.
ND	= not detected (at method detection limit). Activities of zero or less are considered to be not detected.

[b]MDL or MDA

MDL applies to the data listed in Tables 4A-1 through 4A-5. MDA applies to radiological data in Table 4A-6.

MDL	= Method detection limit. The minimum concentration or activity that can be measured and reported with 99% confidence that the analyte is greater than zero, analyte is matrix specific.
MDA	= Minimum detectable activity. The minimal detectable activity or minimum measured activity in a sample required to ensure a 95% probability that the measured activity is accurately quantified above the critical level.
NA	= Not applicable for gross alpha activities. The MDA could not be calculated as the gross alpha activity was corrected by subtracting out the total uranium activity.

[c]PQL or Critical Level

The PQL applies to Tables 4A-1 through 4A-5. Critical Level applies to Table 4A-6.

NA	= Not applicable for gross alpha activities. The critical level could not be calculated as the gross alpha activity was corrected by subtracting out the total uranium activity.
Critical level	= The minimum activity that can be measured and reported with 99% confidence that the analyte is greater than zero, analyte is matrix specific.
PQL	= Practical quantitation limit. The lowest concentration of analytes in a sample that can be reliably determined within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions.

[d]MCL

MCL = Maximum contaminant level. MCLs were established by the EPA Office of Water, National Primary Water Regulations (EPA May 2009).

The following are the MCLs for gross alpha particles and beta particles in community water systems:

- Gross alpha particle activity, excluding total uranium = 15 pCi/L (40 CFR Parts 9, 141, and 142, Table 1-4).
- Beta and/or Gamma-emitting radionuclides (any combination) = 4 mrem/yr (as dose rate).

NE = Not established.

[e]Lab Qualifier

If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.

B	= Analyte is detected in associated laboratory method blank.
J	= Estimated value, the analyte concentration is below the PQL.
NA	= Not applicable.
U	= Analyte is absent or below the method detection limit.
X	= Data rejected due to high counting uncertainty.

Footnotes for Mixed Waste Landfill Groundwater Analytical Results Tables (Concluded)

[f]Validation Qualifier

If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.

BD = Below detection limit as used in radiochemistry to identify results that are not statistically different from zero.
J = The associated value is an estimated quantity.
J- = The associated numerical value is an estimated quantity with a suspected negative bias.
None = No data validation for corrected gross alpha activity.
NJ- = Presumptive evidence of the presence of the material at an estimated quantity with a suspected negative bias.
R = The data are unusable (compound may or may not be present). Resampling or reanalysis are necessary for verification.
U = The analyte was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.
UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

[g]Analytical Method

Clesceri, Greenburg, and Eaton, 1998, *Standard Methods for the Examination of Water and Wastewater*, 20th ed., Method 2320B, published jointly by American Public Health Association, American Water Works Association, and Water Environment Federation. Washington, D.C.
EPA, 1980, "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032, U.S. Environmental Protection Agency, Cincinnati, Ohio.
EPA, 1984, "Methods for Chemical Analysis of Water and Wastes." EPA 600-4-79-020.
EPA, 1986 (and updates), "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed.

[h]Field Water Quality Measurements

Field measurements collected prior to sampling.

°C = degrees Celsius.
% Sat = percent saturation.
μmhos/cm = micromhos per centimeter.
mg/L = milligrams per liter.
mV = millivolts.
NTU = nephelometric turbidity units.
pH = potential of hydrogen (negative logarithm of the hydrogen ion concentration).

Attachment 4B
Mixed Waste Landfill
Hydrographs

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Attachment 4B Hydrographs

4B-1 MWL Study Area Wells (1 of 2) 4B-5

4B-2 MWL Study Area Wells (2 of 2) 4B-6

4B-3 Unfiltered Chromium Concentrations, MWL-MW4 ..... 4B-7

4B-4 Unfiltered Nickel Concentrations, MWL-MW4 ..... 4B-8

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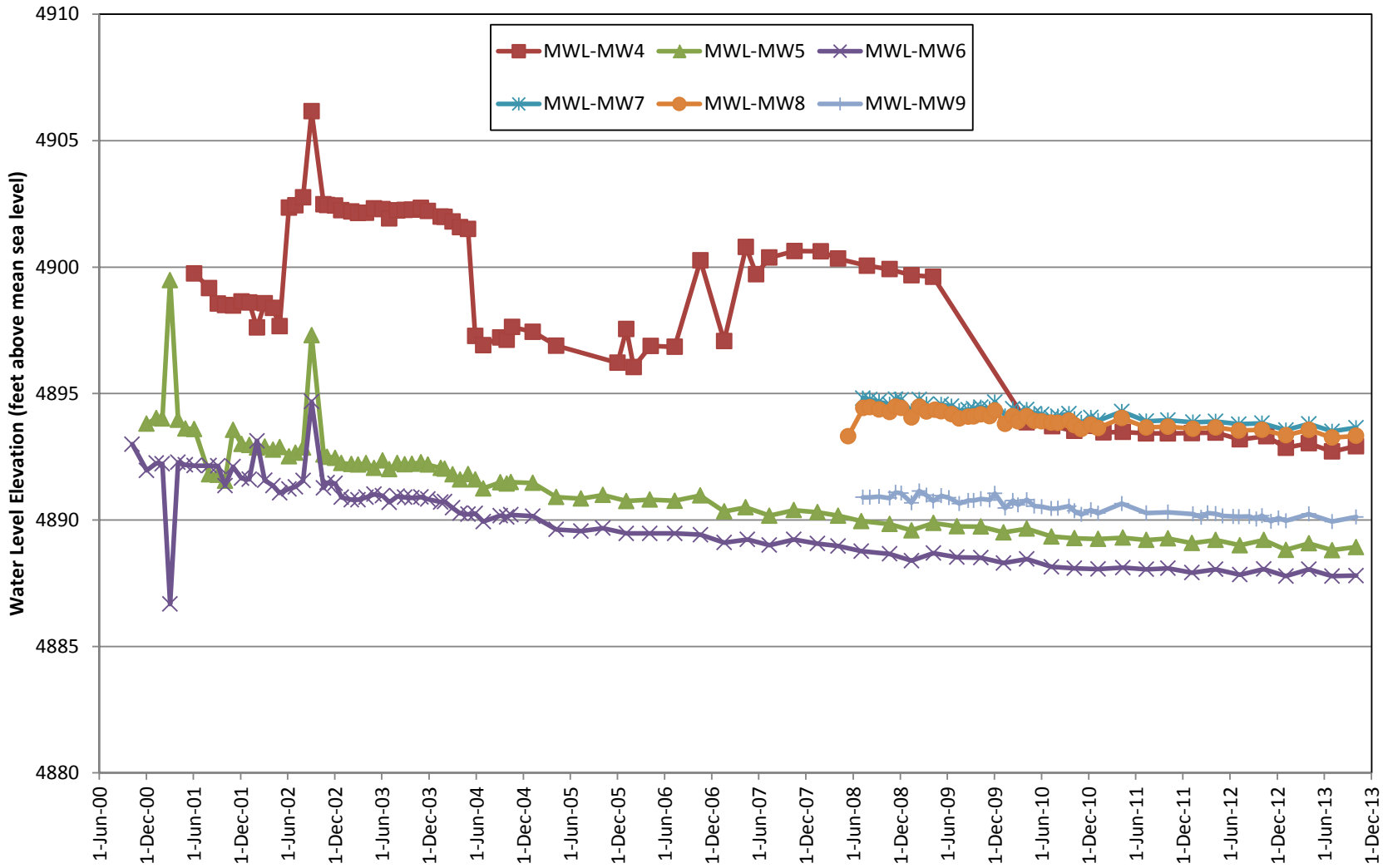

Figure 4B-1. MWL Study Area Wells (1 of 2)

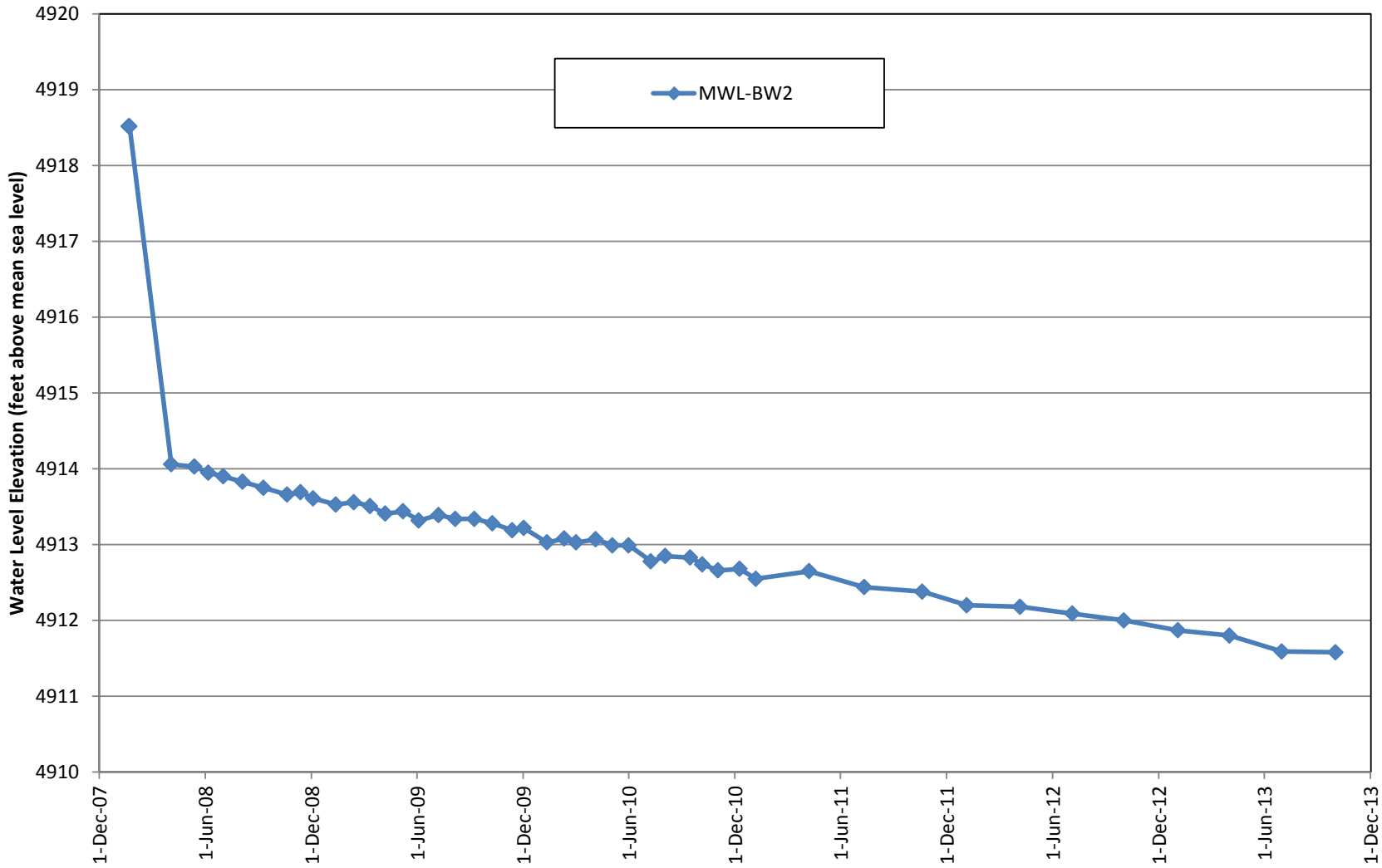

Figure 4B-2. MWL Study Area Wells (2 of 2)

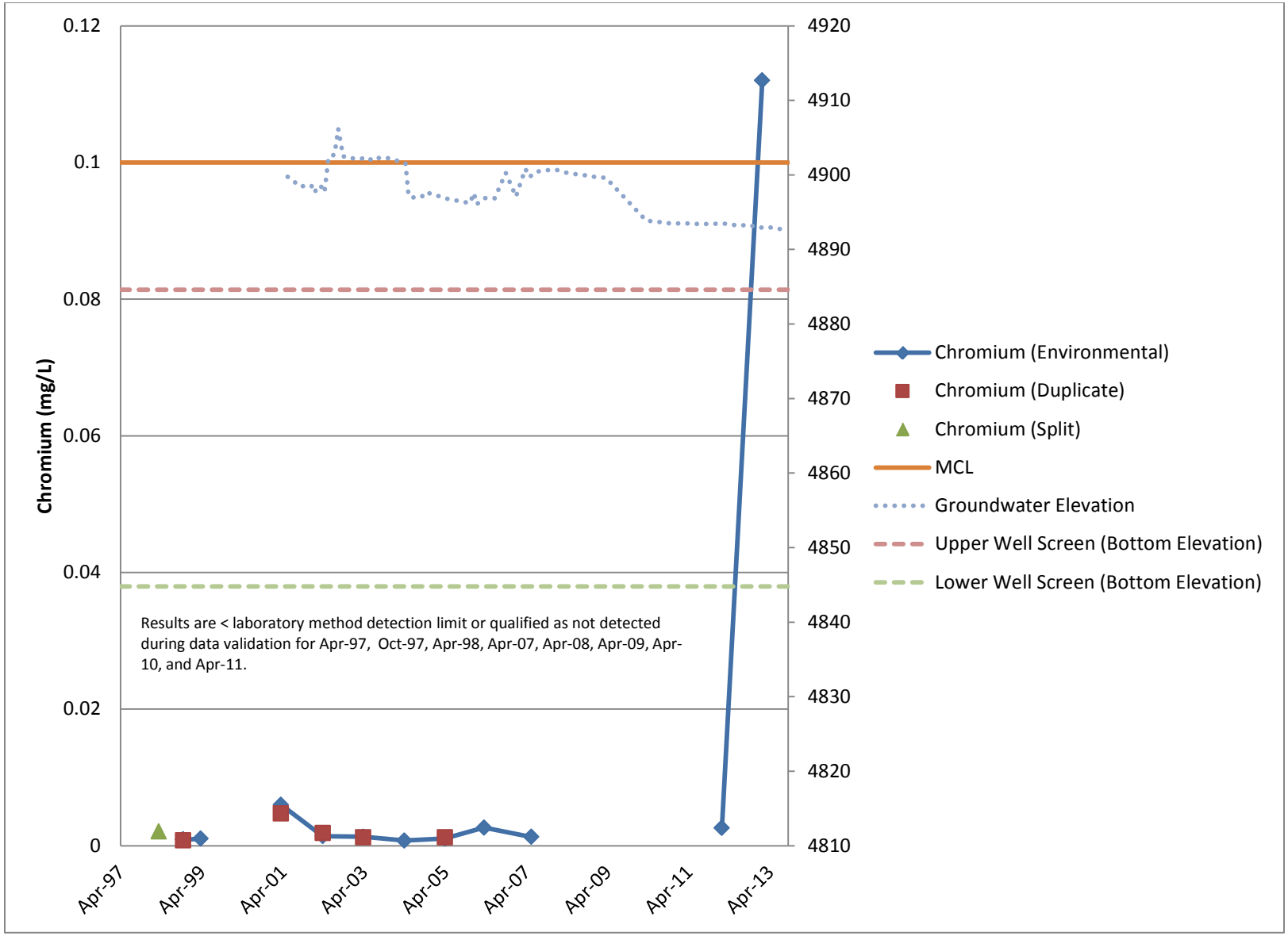

Figure 4B-3. Unfiltered Chromium Concentrations, MWL-MW4

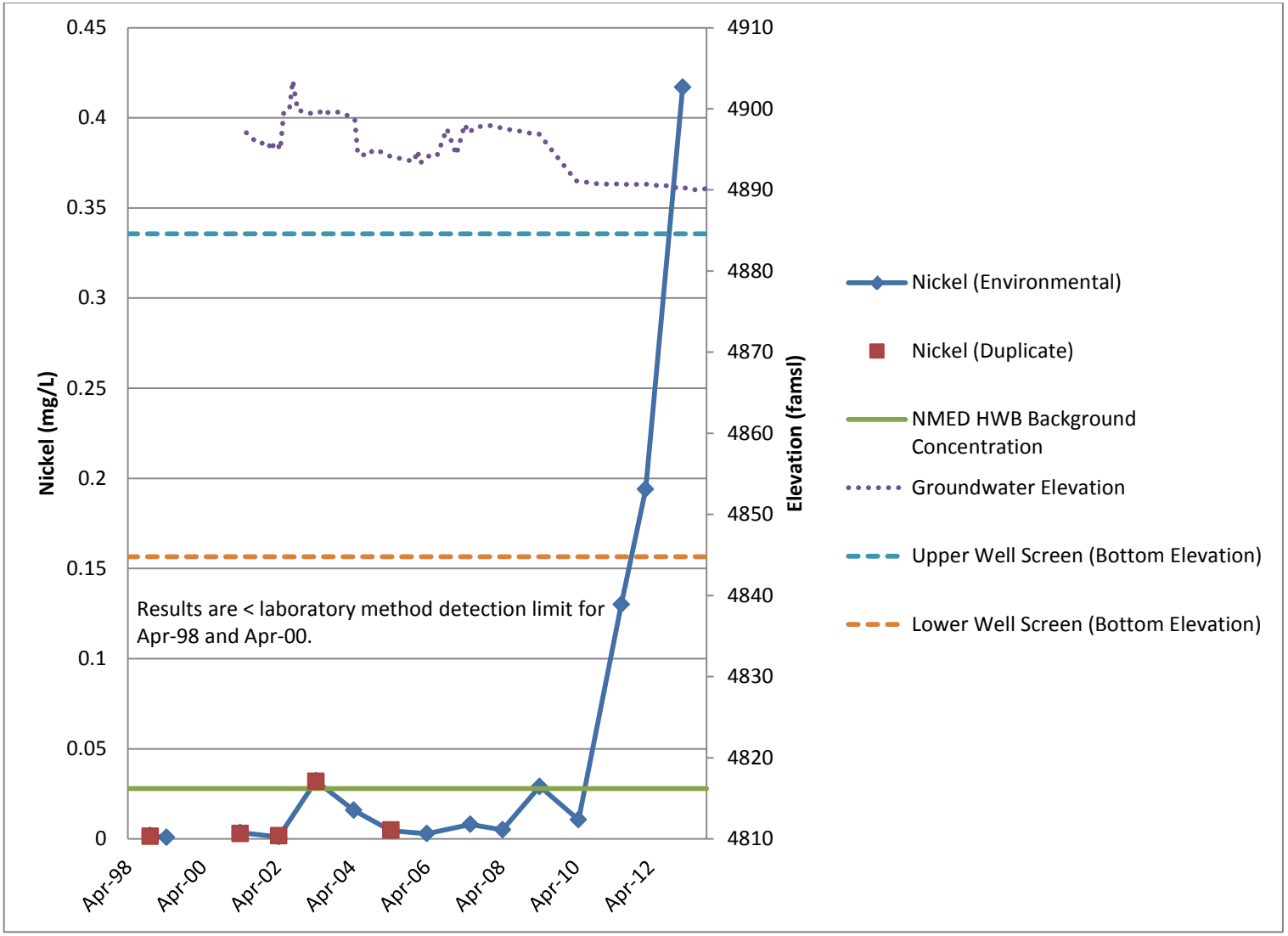

Figure 4B-4. Unfiltered Nickel Concentrations, MWL-MW4

Sandia National Laboratories

Justification for Class 3 Permit Modification
Corrective Action Complete with Controls
Solid Waste Management Unit 76
Mixed Waste Landfill

October 2014

Volume VIII of VIII
Groundwater Monitoring Well Documents and Groundwater Studies

Environmental Restoration Operations

U.S. DEPARTMENT OF ENERGY

United States Department of Energy
Sandia Field Office

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2	Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2	SNL/ Wagner	NMED/ Bearzi	04/17/2007	22
3	NOD: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2	NMED/ Bearzi	SNL/ Wagner	06/19/2007	4
4	Replacement of Mixed Waste Landfill Groundwater Monitoring Wells MWL-MW1 and MWL-MW3	NMED/ Bearzi	SNL/ Wagner	07/02/2007	2
5	Response to NOD: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1; Installation of Well MWL-BW2, April 9, 2007; and Submittal of Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1; Installation of Well MWL-BW2, Revision 1	SNL/ Wagner	NMED/ Bearzi	08/03/2007	32
6	Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Wells MWL-MW1 and MWL-MW-3; Installation of Wells MWL-MW7 and MWL-MW8	SNL/ Wagner	NMED/ Bearzi	08/10/2007	24
7	Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2, Revision 1	NMED/ Bearzi	SNL/ Wagner	10/10/2007	2
8	Correction for Notice of Approval Dated October 10, 2007 Regarding Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2	NMED/ Bearzi	SNL/ Wagner	10/12/2007	2
9	Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Wells MWL-MW1 and MWL-MW3; Installation of Wells MWL-MW7 and MWL-MW8	NMED/ Bearzi	SNL/ Wagner	10/30/2007	2
10	Response to October 30, 2007 Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Wells MWL-MW1 and MWL-MW3; Installation of Wells MWL-MW7 and MWL-MW8	SNL/ Wagner	NMED/ Bearzi	12/05/2007	6
11	Location of Monitoring Wells MWL-MW7 and MWL-MW8	NMED/ Bearzi	SNL/ Wagner	02/12/2008	2
12	Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-MW2 Installation of Well MWL-MW9	SNL/ Wagner	NMED/ Bearzi	03/06/2008	20

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13	Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-MW2, Installation of Well MWL-MW9	NMED/ Bearzi	SNL/ Wagner	03/21/2008	2
14	Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2	SNL/ Wagner	NMED/ Bearzi	04/23/2008	62
15	Notice of Disapproval: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2	NMED/ Bearzi	SNL/ Wagner	08/25/2008	4
16	Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Wells MWL-MW1, MWL-MW2, MWL-MW3, Installation of Wells MWL-MW7, MWL-MW8, MWL-MW9	SNL/ Davis	NMED/ Bearzi	09/23/2008	150
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Groundwater Monitoring Well Documents

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Volume VIII

TAB 1

Replacement of Mixed Waste Landfill
Groundwater Monitoring Well MWL-BW1

From: NMED/Bearzi
To: SNL/Wagner

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State of New Mexico
ENVIRONMENT DEPARTMENT
Hazardous Waste Bureau
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Santa Fe, New Mexico 87505-6303
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BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

CINDY PADILLA
DEPUTY SECRETARY

CERTIFIED MAIL -- RETURN RECEIPT REQUESTED

March 23, 2007

Ms. Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P. O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Mr. Les E. Shephard
Vice President
Energy, Information and Infrastructure Surety
Sandia National Laboratories
P. O. Box 5800, MS 0724
Albuquerque, NM 87185

RE: REPLACEMENT OF MIXED WASTE LANDFILL GROUNDWATER MONITORING WELL MWL-BW1
SANDIA NATIONAL LABORATORIES, EPA ID NM5890110518

Dear Ms. Wagner and Mr. Shephard:

The New Mexico Environment Department (NMED) has become aware of the need to replace groundwater monitoring well MWL-BW1 at the Sandia National Laboratories' (SNL) Mixed Waste Landfill (MWL). According to the *Field Measurement Log For Groundwater Sample Collection*, dated April 4, 2006, the water level in MWL-BW1 has declined to the point that the sampling crew used de-ionized water to recover the April 2006 water sample from this well. Such a sampling practice, which has the potential to dilute any contaminants in groundwater samples, as well as significantly alter the general chemistry of the sample, is unacceptable to the NMED.

A spreadsheet provided to the NMED shows that the water level in MWL-BW1 (measured in January 2006) is only 2.29 feet above the bottom of the well screen. Because the well at this time cannot deliver sufficient water to properly obtain samples, it is no longer capable of providing representative water samples.

In accordance with Section VIII.A of the Order on Consent (April 24, 2004), if a well is any way unusable for its intended purpose, it must be replaced with an equivalent well. Thus, the U. S. Department of Energy and Sandia Corporation (the Permittees) shall replace well MWL-BW1.

The Permittees shall submit to the NMED within 30 days of receipt of this letter a plan for NMED review and approval describing how the well is to be replaced and a schedule for implementation of this work.

Because of problems associated with stainless-steel screened wells at the MWL (chromium and nickel detections), the replacement well shall be screened with polyvinyl (PVC) plastic casing. Although NMED agrees that the current cross-gradient location of well MWL-BW1 allows for the collection of representative background water-quality data, the Permittees shall replace the well at another location east and more directly upgradient of the MWL, consistent with normal practice for the installation of background wells. The Permittees shall install the well in a manner that avoids the use of drilling fluids or construction materials that have the potential to interfere with the reliability of hydrologic or analytical data obtained from the well. Finally, the well shall be installed in such a way that it is screened in the uppermost portion of the saturated zone.

The Permittees shall inform NMED within 30 days of any other wells at the MWL or elsewhere at SNL where current water levels have fallen to levels such that representative groundwater samples can not be obtained. Please contact William Moats of my staff at (505) 222-9551 should you have any questions.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
T. Fox, NMED OGC
T. Skibitski, NMED DOE OB
L. King, EPA-Region 6 (6PD-N)
J. Gould, DOE/NNSA/SSO, MS 0184
P. Freshour, SNL, MS 1087
File: Reading and SNL 2007

Volume VIII

TAB 2

Monitoring Well Plug and Abandonment Plan and
Well Construction Plan; Decommissioning of Well MWL-BW1,
Installation of Well MWL-BW2

From: SNL/Wagner
To: NMED/Bearzi

Back of Tab 2

Notes for Volume VIII, Tab 2:

The document included herein was revised as part of the DOE/SNL response to comments received in the NMED Notice of Disapproval (NOD) dated June 19, 2007. The August 3, 2007 response included the submission of "Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan; Decommissioning of Well MWL-BW1 and; Installation of Replacement Well MWL-BW2, Revision 1," can be found in Justification Binder Volume VIII, Tab 5.

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

APR 17 2007

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

Mr. James Bearzi
Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Rd. East, Building 1
Santa Fe, New Mexico 87505

Dear Mr. Bearzi:

On behalf of the Department of Energy (DOE) and Sandia Corporation (Sandia), DOE is submitting a copy of the Plug and Abandonment/Replacement Plan for groundwater monitoring well MWL-BW1. This plan was developed in response to the New Mexico Environment Department (NMED) letter, dated March 26, 2007 entitled "Replacement of Mixed Waste Landfill Groundwater Monitoring Well MWL-BW1; Sandia National Laboratories, EPA ID NM5890110518".

The enclosed Plug and Abandonment/Replacement Plan for MWL-BW1 describes how the well will be replaced, and includes a tentative schedule for implementation of this work. The proposed replacement well will be drilled with air-rotary casing hammer techniques and screened with PVC casing. The replacement well will be located upgradient (east) of the Mixed Waste Landfill (MWL).

The NMED letter expressed concerns regarding use of de-ionized water to collect the April 2006 water sample from MWL-BW1. De-ionized water is routinely used to decontaminate the portable non-dedicated piston pump and spool prior to sampling in accordance with field operating procedures. A check valve is used to prevent backflow through the system, and the de-ionized water remaining in the tubing is completely purged prior to collection of the sample. Purge volumes and indicator parameters are closely monitored, and the transition from de-ionized water to groundwater is clear and well-defined based on conductivity. Hence, there is no potential for dilution of contaminants or alteration of the general chemistry of the samples; a concern expressed by NMED in the letter of March 23, 2007.

The NMED letter also requested a list of other wells at the MWL, or elsewhere at Sandia, where current water levels have fallen to levels such that representative groundwater samples cannot be obtained. The water level in TAV-MW1 was measured at 1.48 ft above the bottom of the well screen; this well is scheduled for plug and abandonment/replacement in the latter half of FY 2007. All other wells in the current Sandia monitoring network have sufficient groundwater to allow representative samples to be collected.

APR 17 2007

If you have any questions, please contact me at (505)845-6036, or Dan Pellegrino of my staff at (505) 845-6089.

Sincerely,

Dan Pellegrino
for Patty Wagner
Manager

Enclosure

cc w/enclosure:
W. Moats, NMED-HWB (Via Certified Mail)
J. Kieling, NMED-HWB
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB
T. Longo, HQ/GTN, NA-56
M. Reynolds, SSO

cc w/o enclosure:
A. Blumberg, SNL/NM, Org. 11100, MS 0141
F. Nimick, SNL/NM, Org. 6790, MS 0701
P. Freshour, SNL/NM, Org. 6765, MS 1089
T. Goering, SNL/NM, Org. 6765, MS 1089
S. Griffith, SNL/NM, Org. 6765, MS 1089
M. Skelly, SNL/NM, Org. 6765, MS 1089
M. Miller, SNL/NM, Org. 10333, MS 1042
M. J. Davis, SNL/NM, Org. 6765, MS 1089
F. Lauffer, SNL/NM, Org. 10333, MS 1042
Records Center, SNL/NM, Org. 6765, MS 1089
J. Estrada, NNSA/SSO, MS 0184

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: Plug and Abandonment/Replacement Plan for MWL-BW1, April 2007

Document author: Mike Skelly, Dept. 6765

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 4/10/07
Date

Les E. Shephard
Vice President
Energy, Security & Defense Technologies Division 6000
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ 4/10/07
Date

Patty Wagner
Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Monitoring Well Plug and Abandonment Plan
and
Replacement Well Construction Plan

Decommissioning of
Groundwater Monitoring Well MWL-BW1

Installation of Replacement
Groundwater Monitoring Well MWL-BW2

Environmental Restoration Project
Sandia National Laboratories, New Mexico

Plan Authorization and Implementation

Prepared by _____ Date 09APR07
Michael Skelly, 6765
Assistant Task Leader

Reviewed by _____ Date 04-09-07
Tim Goering, 6765
Assistant Task Leader

Reviewed by _____ Date 4-9-07
Tim Jackson, 6765
Assistant Task Leader

Approved by _____ Date 4-9-07
Paul Freshour, 6765
ER/LTS Project Manager

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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Attachment 1--Monitoring Well Completion Diagram for MWL-BW1
Attachment 2--Groundwater Well Abandonment Diagram
Attachment 3--Well Plug and Abandonment Form
Attachment 4--Groundwater Monitoring Well Data Sheet

1 Project and Site Information

Task Description: Sandia National Laboratories/New Mexico (SNL/NM) decommissioning with plug and abandonment of one groundwater monitoring well, and installation of one replacement groundwater monitoring well

Case No.: 98026.01.08

Project Leader/Department No.: Paul Freshour/6765

Scheduled Start Date: June 2007

Estimated Completion Date: August 2007

Operations/Technical Area: Mixed Waste Landfill/Technical Area III

2 Regulatory Criteria

This Plug and Abandonment (P&A) Plan outlines the activities and procedures to decommission existing groundwater monitoring well MWL-BW1, and install replacement groundwater monitoring well MWL-BW2.

Regulatory guidance for well plug and abandonment can be found in New Mexico Environment Department, Hazardous Waste Bureau (NMED/HWB) requirements. Section VIII.C of the Compliance Order on Consent (the Order) discusses well abandonment (NMED April 2004):

> *"Wells shall be abandoned when they are no longer required in the monitoring network, no longer provide representative groundwater samples because of falling water levels or insufficient productivity, or become damaged beyond repair. The goal of well abandonment is to seal the well in such a manner that it cannot act as a conduit for the migration of contaminants from either the ground surface to the saturated zone or between saturated zones. Respondents shall prepare an abandonment plan for any and all wells that are to be plugged and abandoned, and shall submit the plan to the Department for approval. Respondents shall not abandon any groundwater monitoring well without prior written approval of the Department."*

Further guidance for well P&A procedures can be found in the New Mexico Office of the State Engineer (OSE) "Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells" (NM OSE August 2005):

> *"To plug a well, the entire well shall be filled from the bottom upwards to land surface using a tremie pipe. The well shall be plugged with neat cement slurry, bentonite based plugging material, or other sealing material approved by the state engineer for use in the plugging of non-artesian wells"*

The OSE guidance also states that:

> "*Wells encountering contaminated water or soil may require coordination between the office of the state engineer and the New Mexico environment department (or other authorized agency or department) prior to the plugging of the well.*"

And,

> *"A licensed well driller shall keep a record of each well plugged as the work progresses. The well driller shall file a complete plugging record with the state engineer and the permit holder no later than twenty (20) days after completion of the plugging. The plugging record shall be on a form prescribed by the state engineer . . ."*

To meet these regulatory requirements, the following tasks will be completed at SNL/NM:

- Decommission well MWL-BW1 because it no longer provides representative groundwater samples due to falling water levels and insufficient productivity.
- Submit this P&A Plan to the NMED/HWB and OSE for review and approval.
- Use a licensed well driller and approved materials to seal the well so that it cannot act as a conduit for the migration of potential contaminants from the ground surface to the saturated zone.
- Upon completion of the P&A activities, submit a plugging record to the OSE and submit a P&A Report describing the field activities to the NMED/HWB.

3 Existing Well Information

Groundwater monitoring well MWL-BW1 is proposed for decommissioning in this P&A Plan. The monitoring well completion diagram is presented in Attachment 1, and the pertinent well completion information is summarized below.

MWL-BW1 is a background groundwater monitoring well located at the Mixed Waste Landfill (Figure 1). This well was installed in July 1989 and is completed in the regional aquifer with the following well completion details:

- Total depth of the well -- 477 feet (ft) below ground surface (bgs).
- Screened interval -- 452 to 472 ft bgs.
- Construction materials – Polyvinyl chloride (PVC) riser pipe, stainless steel screen, carbon steel protective surface casing and guard posts, and a concrete well pad.
- Current water level -- ~472 ft bgs.
- Water-bearing strata – Groundwater occurs in unconsolidated silts and sands (alluvial fan facies) of the upper Santa Fe Group that have relatively low hydraulic conductivities.
- Reason for decommissioning – The regional water table has dropped to the lowest portion of the screened interval and the well requires excessive time to recover between purging and sampling. There is no evidence that suggests the annular seal is compromised.

4 Plugging and Abandonment

Based on the requirements established by the NMED/HWB and OSE, the groundwater monitoring well MWL-BW1 will be decommissioned. Applicable Field Operating Procedures (FOPs) and Administrative Operating Procedures (AOPs) are listed in Table 1; however, this site-specific P&A Plan should be used as the primary guidance in the field.

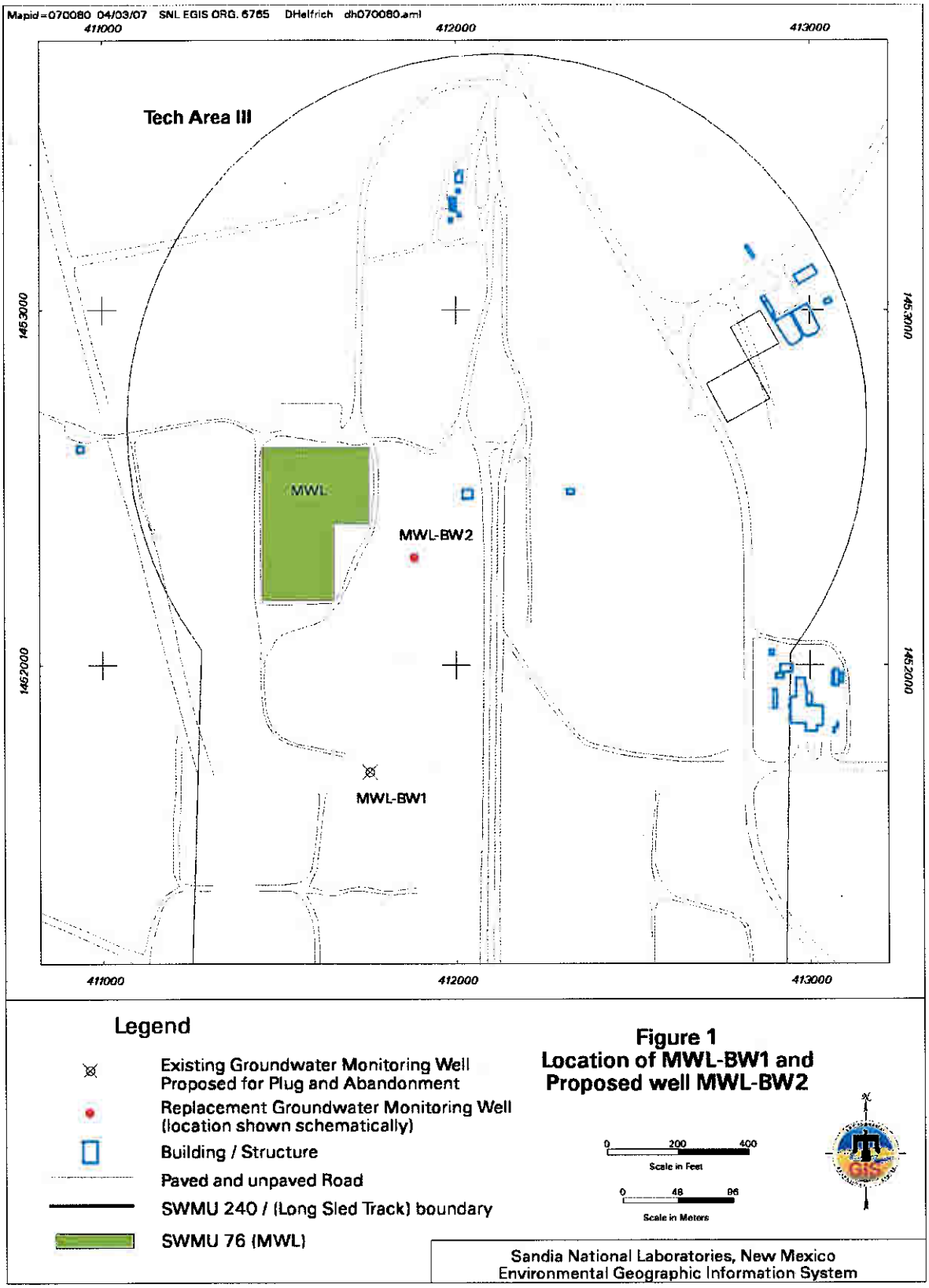


Figure 1
Location of MWL-BW1 and Proposed well MWL-BW2

Table 1. Applicable Operating Procedures

Number of Procedure	Title of Procedure
FOP 94-01	Safety Meetings, Inspections, and Pre-Entry Briefings Rev. 1, 12/16/96
FOP 94-05	Borehole Lithologic Logging, Rev. 0, 2/10/94
FOP 94-25	Documentation of Field Activities, Rev. 0, 11/4/94
FOP 94-26	General Equipment Decontamination, Rev. 1, 2/20/97
FOP 94-28	Health and Safety Monitoring of Organic Vapors (FID and PID), Rev. 2, 4/27/97
FOP 94-38	Drilling Methods and Drill Site Management, Rev. 0, 4/14/94
FOP 94-41	Well Development, Rev. 0, 11/21/94
FOP 94-42	Integration of the design, Installation, Rehabilitation, and Decommissioning of Environmental Restoration Wells, Rev. 1, 5/31/94
FOP 94-43	Decommissioning Of Wells, Rev 0, 5/31/94
FOP 94-45	Designing and Installing Groundwater Monitoring Wells, Rev. 0, 5/31/94
FOP 94-57	Decontaminating Drilling and Other Field Equipment, Rev. 0, 5/31/94
FOP 94-68	Field Change Control, Rev. 2 (in revision)
FOP 94-69	Personnel Decontamination (Level D, C, and B Protection), Rev. 1, 1/23/98
AOP 94-24	System and Performance Audits, Rev. 0, 1/12/95
AOP 94-25	Deficiency Reporting, Rev. 0, 1/12/95
AOP 95-16	Administrative Operating Procedure for Sample Management and Custody, Rev. 1, 4/18/96

4.1 Goal

The goal for decommissioning monitoring well MWL-BW1 is to eliminate the potential of this well to act as a conduit for the migration of potential contamination to groundwater. The well materials and annular seals are not believed to pose a threat to groundwater, and therefore will be backfilled in place with proper sealing materials.

4.2 Objective

The objective is to seal this monitoring well in such a manner that there is reasonable certainty that the abandonment has adequately eliminated the potential for cross-communication between the land surface and the aquifer, and the potential for downward migration of potential contaminants through the borehole annulus to the aquifer. All grouting techniques and grout mixtures used during decommissioning will minimize grout intrusion into the native formation.

4.3 Implementation

General activities for the implementation of the P&A include:

1) Remove all monitoring well surface completion features,
2) Backfill the casing with well-plugging materials, and
3) Construct a new surface pad/monument.

SNL/NM personnel and the selected drilling contractor will remove all surface completion features, such as guard posts, concrete well pads, and surface protective casing. Care will be taken to prevent materials from falling down the well casing and possibly causing a downhole obstruction. The well will be abandoned with casing left in place, and the well casing will be cut off at approximately 5 ft bgs.

The well screen and blank well casing will be sealed by lowering a tremie pipe to the base of the well casing (below the base of the screen) and injecting the plug material (bentonite grout) using a diaphragm or equivalent pump system. The plug material will be filled to within 5 ft of the ground surface and allowed to set overnight. If the level of the plug material in the well casing drops overnight, additional bentonite grout will be added to again reach within 5 ft of ground level.

Once the well has been properly plugged, the decommissioning process will be completed by placing concrete in the upper 5 ft of the well/borehole and installing a concrete slab on the surface. The concrete pad will be 4 inches thick with a 2 ft by 2 ft area, constructed in the ground so that the surface of the finished concrete slab will be 1 to 2 inches above the natural ground surface. A brass marker containing the well name and date of decommissioning will be set in the concrete pad.

5 Monitoring Well Installation

A replacement monitoring well (TAV-MW10) will be installed after MWL-BW1 has been decommissioned.

5.1 Objective

Install a 5-inch (inside diameter) PVC casing replacement monitoring well to provide representative groundwater samples. The replacement monitoring well borehole will be drilled using Air-Rotary Casing-Hammer (ARCH) drilling methods at a location a minimum of 25 ft away from existing well location (if possible). Based on discussions with NMED/HWB personnel, the replacement well for MWL-BW1 was determined to be better suited at a location approximately 700 ft northeast of the original location (Figure 1). The proposed replacement well location on Figure 1 is shown schematically; the actual location will be selected with concurrence with NMED/HWB personnel and may vary due to utility clearance and land use issues.

5.2 Implementation

Applicable FOPs and AOPs are listed in Table 1; however, this site-specific plan should be used as the primary guidance in the field.

5.2.1 Borehole Drilling

The ARCH drilling method will use environmentally-friendly lubricants and will be able to penetrate highly variable lithologies such as cobbles, boulders, gravel, sand, clay, and caliche while maintaining an open, competent borehole. The total depth of the borehole will be determined by the SNL/NM field geologist, but the depths are anticipated to be 30 to 35 ft deeper than the original well. After reaching total depth, the cased borehole will be logged using natural gamma and neutron wire-line geophysical methods.

Minimal water (but no other foams/liquids) in the form of "mist" may be introduced into the borehole to aid in the removal of cuttings. Waste generation will be kept to a minimum. Borehole cuttings will be contained within an area adjacent to the well. Water produced from the well during drilling or development will be contained in 55-gallon drums and placed on spill control pallets.

Monitoring well MWL-BW2 is anticipated to be drilled to approximately 507 ft bgs. The well screen completion interval is expected to be approximately 472 to 502 ft bgs with a 5-foot sump placed below the screen.

5.2.2 Well Construction

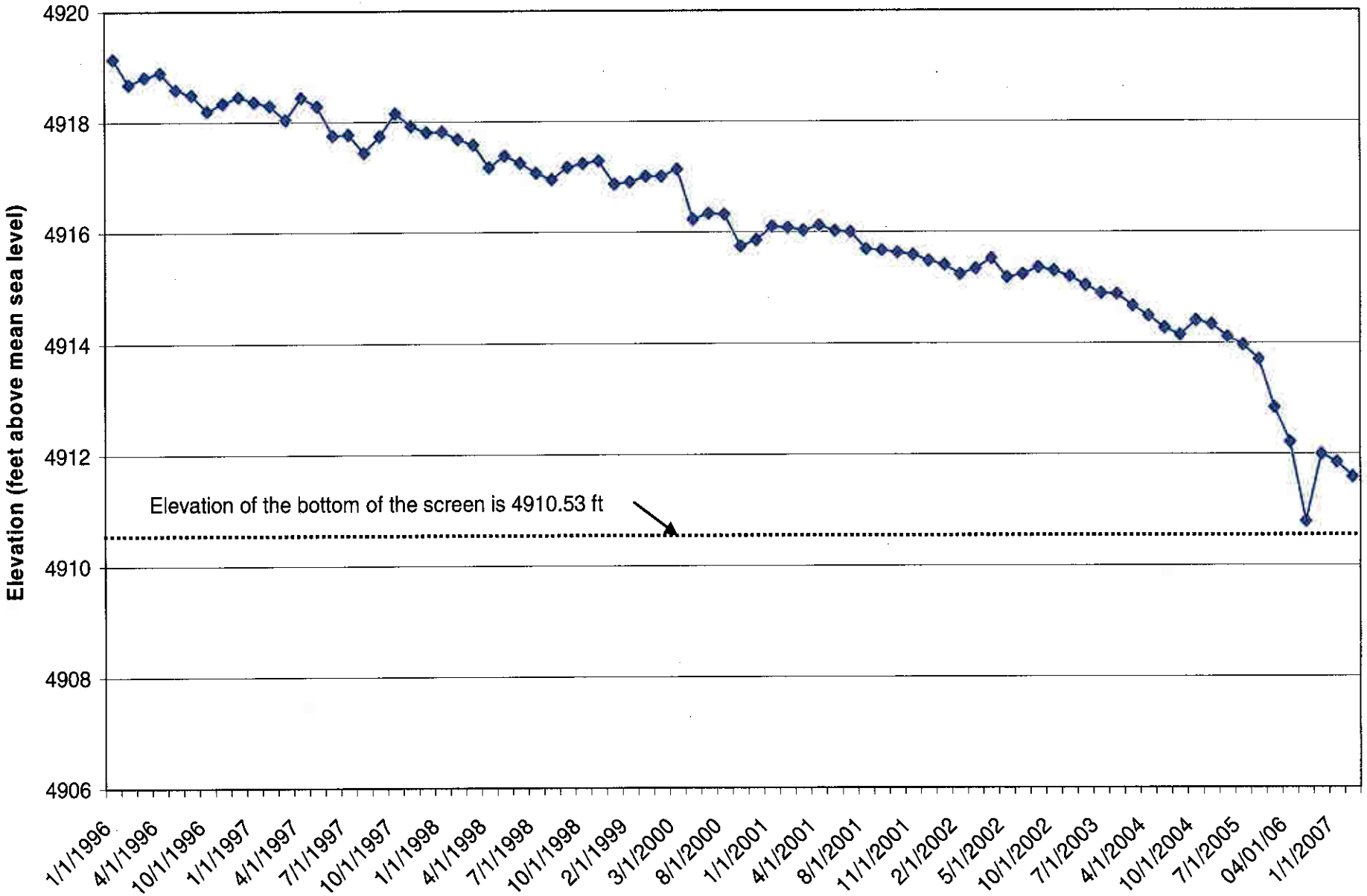
The monitoring well will be completed as specified in this plan. The water-table monitoring well will be installed through the temporary steel drive casing (nominal 10-inch diameter), and completed using 5-inch inner diameter, flush threaded, PVC Schedule-80 water well casing. No solvents, cleaners, or lubricants will be used for construction of the monitoring well. The casing will be delivered pre-cleaned and bagged, or steam-cleaned on site prior to installation. To preserve the integrity of the well materials, the well screen and riser pipe will be suspended in the borehole until the primary filter pack, bentonite pellet seal and annular seal are installed.

The regional aquifer in the study area is being over-pumped and the water table at MWL-BW1 is rapidly declining with a decline rate of 1.14 feet/year over the last several years (Figure 2). To accommodate the rapidly declining water table, a 30-ft length of screen with a 0.020-inch slot size will be used for the replacement well. A 5-ft sump will be placed at the base of the screen and sealed with a threaded end cap. PVC centralizers will be placed at the base and top of the well screen. The screen for this water-table well will be placed so that the top of the screen is approximately 5 feet above the static water level.

The annulus surrounding the well screen will be filled with a primary filter pack of clean 10-20 silica sand. The primary filter pack will extend from the bottom of the sump to at least 5 ft above the top of the screen. A 5-ft thick layer of clean 40-60 sand will be placed above the primary filter pack. Both sand packs will be tagged using a tag line to verify their depth. Preliminary well development using a surge block will be performed at this time to help settle the filter pack.

A 30-foot thick layer of ¼-inch bentonite pellets or 3/8-inch bentonite chips will be placed above the filter pack prior to emplacement of the bentonite-grout annular seal. Each 5 ft thickness of bentonite pellets/chips added will be hydrated before adding the next 5-ft thickness of bentonite pellets/chips. The final lift of bentonite pellets/chips will be allowed to set for a time adequate for hydration (at least I hour). The remaining annular space to ground surface will then be filled with bentonite grout. To prevent overloading, the bentonite grout will be installed in at least 2 lifts (each lift filling approximately one-half of the borehole annulus above the bentonite pellets/chips). Each lift of bentonite grout will be allowed to set overnight. The bentonite grout will be topped off to within 6-inches to 1-ft bgs.

Figure 2 MWL-BW1 Groundwater Elevations Over Time



The well casing will extend approximately 30 inches above ground surface with a water-tight cap. The monitoring well will be completed with protective steel casing with a hinged locking cap. The protective casing will be primed and painted yellow. A 3-ft by 3-ft, sloped concrete pad will be constructed around the casing. The pad will contain a 3-in brass cap stamped with the well identification. Three, 4-inch diameter concrete-filled, steel guard posts (also primed and painted yellow) will be placed around the pad, equidistant from the well.

5.2.3 Well Development

Well development will be completed at least 48 hours after grouting. The well will be developed for approximately 10 hours, and will consist of pumping, surge-block, swabbing, and/or bailing techniques. During development, the groundwater field parameters will be continuously monitored, and development will continue until parameters have stabilized. All development water will be contained in drums and will not be allowed to discharge to the ground surface.

6 Equipment Decontamination

The drilling rig and related equipment will be decontaminated at the decontamination pad in Technical Area III prior to the beginning of drilling operations. Decontamination of equipment will also be required after completing the well. Decontamination waste will be kept to a minimum and containerized in drums placed on spill control pallets at the decontamination pad.

7 Health and Safety

Level D personal protective equipment is required for all drilling operations. Health and Safety records associated with drilling and development personnel will be maintained on site and will be available at the commencement of drilling activities. All field personnel will operate under an SNL/NM Health and Safety Plan (HASP) and will have SNL/NM-required training including 40-Hr OSHA HAZWOPER and subsequent yearly refresher courses. An SNL/NM Subject Matter Expert will perform a safety inspection of the drill rig before drilling commences.

8 Pre-field activities

Pre-field activities that must be completed prior to drilling include:

- Preparation of the Statement of Work for drilling and monitoring well installation;
- SNL/NM digging permit request and approval;
- HASP preparation, review, and signatures;
- National Environmental Policy Act (NEPA) review and signatures;
- Sample bottle order for waste samples through Sample Management Office;
- Waste Management Plan preparation;
- Field checklist completion, review, and approval; and
- Readiness review meeting.

9 Mobilization and Site Setup

SNL/NM personnel will ensure that containers for cuttings have been obtained and are ready for drilling operations. Roll-off bins supplied by SNL/NM will be used to collect drill cuttings for waste management purposes.

10 Reporting

Based on the requirements established by the NMED/HWB, OSE and SNL/NM FOPs, the field activities associated with decommissioning and installation of the monitoring wells will be documented.

10.1 Decommissioning Records

All decommissioning field activities will be documented in a field log book per guidance in FOP 94-25. Upon completion of decommissioning of a well, the P&A Report will document all site activities and provide final as-built well decommissioning diagram (Attachment 2). Attachment 3 will be used to assure that all records are completed, approved, and submitted for proper records management. The following list of documents and records that are generated as part of the decommissioning process will be provided to the SNL/NM Well File Coordinator who, in turn, will submit them to the SNL/NM Customer-Funded Records Center:

- Monitoring Well Plugging and Abandonment Request
- Well Plugging and Abandonment Form
- Site-Specific Well Plugging and Abandonment Work Plan
- Site-Specific Well Plugging and Abandonment Report
- Plugging and Abandonment Documentation and Approval Checklist
- Waste Management Plan
- Field Log Book
- Detailed as-built diagram (Attachment 2)

All decommissioning activities performed at SNL/NM will be accurately and concisely documented in a final P&A Report to be submitted to the NMED/HWB and the OSE. The P&A Report will contain a brief narrative describing actual work performed at the site and any variances to the site-specific P&A Plan. Information to be contained in the P&A Report include: (1) daily field activity notes, (2) all materials used, (3) a final "as-built" plugging and abandonment diagram, and (4) documentation of notification of SNL/NM GIS group and the appropriate regulatory agencies. The Well Plugging and Abandonment Form (Attachment 2) will be completed and included as part of the P&A Report.

Further P&A reporting elements are required by the OSE (OSE August 2005). SNL/NM personnel and the licensed well driller (contractor) will submit a plugging record with the state engineer no later than twenty (20) days after completion of the plugging. The record will include the following elements:

- Name and address of the well owner
- Well driller's name and license number
- Name of each drill rig supervisor that supervised the well plugging
- State engineer file number for the well (if available)
- Location of the well (reported in latitude and longitude)
- Dates when plugging began/concluded
- Plugging material(s) used
- Depth of the well
- Size and type of casing
- Location of perforations

- Location of the sanitary seal
- Completed well log with depth and thickness of all strata plugged, including whether each stratum was water bearing

10.2 Well Installation Records

All well installation field activities will be documented in a field log book per guidance in FOP 94-45. Upon completion of the well installation, the Field Report will document all site activities and provide final as-built well completion diagrams (Attachment 4). The Field Report will contain a brief narrative describing actual work performed at the site and any variances to the site-specific Well Installation Plan. Information to be contained in the Field Report include: (1) daily field activity notes, (2) all materials used, (3) a final "as-built" well completion diagram, and (4) documentation of notification of SNL/NM GIS group and the appropriate regulatory agencies. The documentation will also include the 37 information elements required in Section VIII.D of the Order (NMED April 2004). The following list of documents and records that are generated as part of the well installation process will be provided to the SNL/NM Well File Coordinator who, in turn, will submit them to the SNL/NM Customer-Funded Records Center:

- Well permit agreement
- Well file contents checklist
- Well data summary sheet
- Statement of work for drilling the well
- Drilling permit
- Lithologic (boring) log
- Well construction diagram and completion parameters
- Well development data and groundwater parameters
- Copies of field logbook (geologist, driller)
- Surveyed elevations and location in State Plane coordinates
- Location map
- Water level measurements
- Aquifer test data
- Analytical data
- Waste management documentation
- Photographs

11 References

NMED April 2004, "Compliance Order on Consent Pursuant to the New Mexico Hazardous Waste Act 74-4-10: Sandia National Laboratories Consent Order," New Mexico Environment Department, April 24, 2004.

OSE August 2005, "Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells" New Mexico Office of the State Engineer, August 2005.

Attachment 1

Monitoring Well Completion Diagram for MWL-BW1

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA III
ER ADS #:	1289	**Well Completion Date:**	01-JUL-1989
Well Name:	MWL-BW1	**Completion Zone:**	SAND AND GRAVEL
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE
Date Drilling Started:	24-JUN-1989	**Well Comment:**	WATER LEVEL MEASURED ON 5/14/90
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	MUD ROTARY		
Borehole Depth:	519		
Casing Depth:	477.17		

Survey Data

Survey Date: 12-APR-1990

Surveyed By: SANTIAGO ROMERO AND ASSOCIATES

State Plane Coordinates

(X) Easting: 411756.001

(Y) Northing: 1451698.73

Surveyed Elevations (FAMSL)

Protective Casing:	5385.05
Top of Inner Well Casing:	5384.51
Concrete Pad:	5383.35
Ground Surface:	5382.7

Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4923.3	FASL
Initial Depth To Water: (FBGS)	461.21	

Last measured water level was measured on 17-OCT-2006

Date Updated: 14-MAR-00

Date Printed: 12-MAR-2007

Completion Data Measured Depths (FBGS)

Casing Stickup: 1.16

Interval	Start	Stop
GROUT/BACKFILL	0'	433'
NEAT CEMENT		

Interval	Start	Stop
CASING	0'	477.17'
PVC	I.D. 5"	

Interval	Start	Stop
BOREHOLE	0'	519'
	O.D.	12.25"

Interval	Start	Stop
SECONDARY PACK	441'	443'
16/40		

Interval	Start	Stop
PRIMARY PACK	443'	478'
10/20 SAND		

Interval	Start	Stop
SCREEN	452.17'	472.17'
304 STAINLESS STEEL		
	Slot Size	.01"

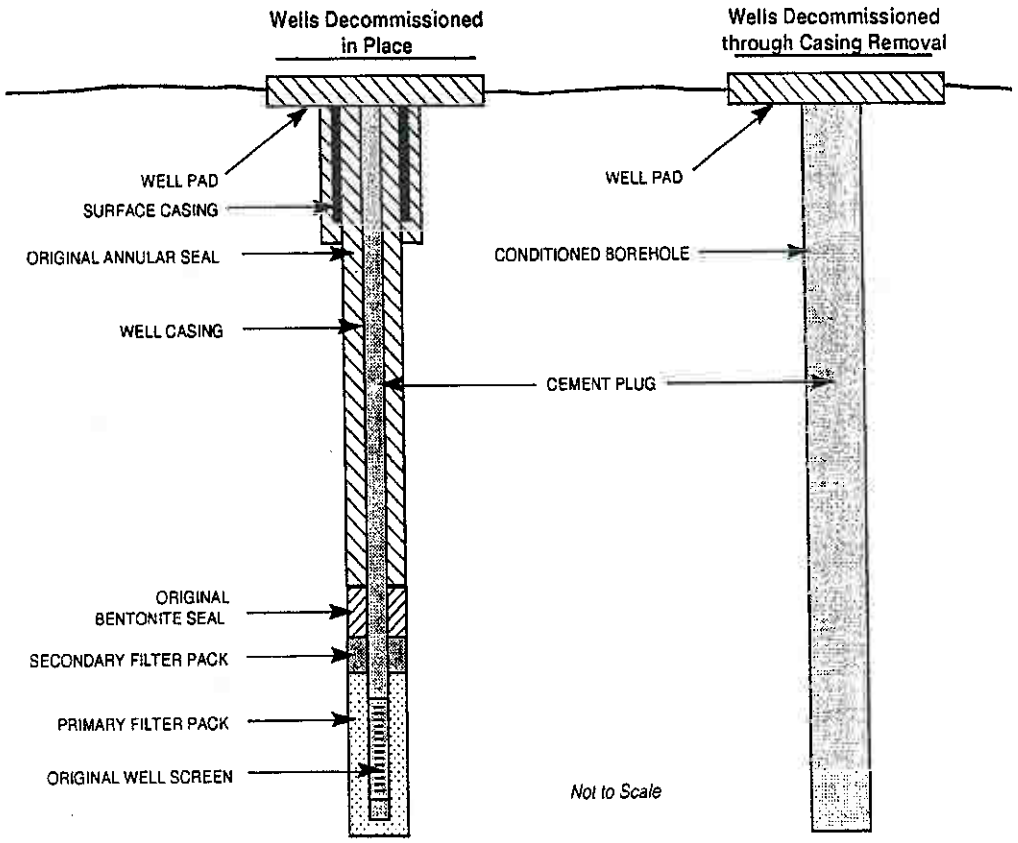
Interval	Start	Stop
SUMP	472.17'	477.17'

Interval	Start	Stop
PLUG BACK	477.17'	519'

Attachment 2

Groundwater Well Abandonment Diagram

SNL/NM ER PROJECT
GROUNDWATER MONITORING WELL ABANDONMENT DIAGRAM



WELL NAME _____
LOCATION DESCRIPTIVE _____
STATE PLANE COORDINATE X: _____
Y: _____
SURFACE CASING TYPE _____
SURFACE CASING LENGTH _____
I.D. OF WELL CASING _____
WELL CASING DEPTH _____
SCREEN INTERVAL _____
PLUGGING GROUT TYPE _____
GROUT VOLUME USED _____
DEPTH LIFT 1 _____
DEPTH LIFT 2 _____
DEPTH LIFT 3 _____
DATE OF DECOMMISSIONING _____

WELL NAME _____
LOCATION DESCRIPTIVE _____
STATE PLANE COORDINATE X: _____
Y: _____
CASING REMOVAL METHOD _____
FINAL HOLE DIAMETER _____
FINAL HOLE TOTAL DEPTH _____
PLUGGING GROUT TYPE _____
GROUT VOLUME USED _____
DEPTH LIFT 1 _____
DEPTH LIFT 2 _____
DEPTH LIFT 3 _____
DATE OF DECOMMISSIONING _____

Attachment 3

Well Plug and Abandonment Form

SNL/NM ER PROJECT
WELL PLUGGING AND ABANDONMENT FORM

1. Preabandonment Well Specifics:
   a. Well Identification _____
   b. Location (geographic description and state plane coordinates) _____
   c. Reported Well Depth (feet) _____
   d. Field Well Depth (feet) _____
   e. Screened Intervals(s) (feet) _____
   f. Screen Diameter(s) (inches) _____
   g. Screen Type(s) (SS or PVC, etc.) _____
   h. Casing Diameter(s) (inches) _____
   i. Casing Type (PVC, steel, etc.) _____
   j. Artesian or Nonartesian Aquifer _____

2. Reason for Abandonment:
   _____
   _____

3. Abandonment Specifics:
   a. Date Abandonment Started _____
   b. Date Abandonment Completed _____
   c. ID Number of Field Log Book Used _____
   d. Site Personnel _____
   e. Drilling Method Used _____
   f. Grout Used _____
   g. Casing Removed (Y or N) _____
   h. Concrete Pad Inscription _____

   j. Briefly Describe Abandonment Method:
   _____
   _____
   _____

   k. Disposition of Materials Removed From Well: _____
   _____
   _____

4. Comments or Problems Encountered: _____
   _____

Completed by: _____
Printed Name Signature Date

Subcontractor: _____

Drilling Contractor: _____ License No.: _____

Attachment 4

Groundwater Monitoring Well Data Sheet

SNL/NM Groundwater Monitoring Well Data Sheet

PROJECT NAME: _____
ER ADS #: _____
WELL NAME: _____
OWNER: _____
DATE DRILLING BEGAN: _____
DRILLING CONTRACTOR: _____
DRILLING METHOD: _____
BOREHOLE DEPTH: _____
BOREHOLE DIAMETER/S: _____

GEOGRAPHIC LOCATION: _____
WELL COMPLETION DATE: _____
COMPLETION ZONE: _____
FORMATION OF COMPLETION: _____
REMARKS: _____

Survey Data

Survey Date: _____
Surveyed by: _____

State Plane Coordinates
(X) Easting = _____
(Y) Northing = _____

Surveyed Elevations
(feet above sea level)

Protective Casing: _____
(Elev. D - FOP 94-71)

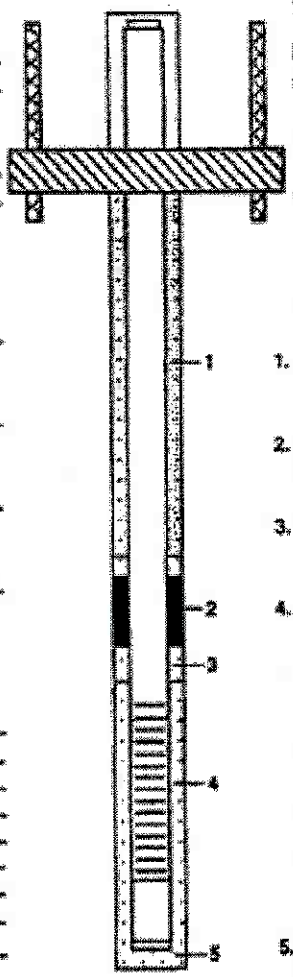
Top of Inner Well Casing: _____
(Elev C - FOP 94-71)

Concrete Pad: _____
(Elev B - FOP 94-71)

Ground Surface: _____
(Elev A - FOP 94-71)

Calculated Elevations
(feet above sea level)
Initial Water Level: _____
Other: _____
Comments: _____

Form Completed by: _____
Verified by: _____



Completion Data

Measured Depths
(feet below ground surface)

Initial Water Level: _____

Casing Stickup: _____
(above ground level)

Casing OD (in.): _____
Casing ID (in.): _____

1. Grout/Backfill Interval: _____
Material: _____

2. Seal Interval: _____
Material: _____

3. Secondary Pack Interval: _____
Secondary Pack Size: _____

4. Primary Pack Interval: _____
Primary Pack Size: _____

Screen Interval: _____
Slot Size: _____
Material: _____

Sump Length: _____

Casing Depth: _____
Material: _____

5. Plug Back Interval (if used): _____
(Casing TD-Hole TD) _____
Plug Material (if used): _____

Volume VIII

TAB 3

NOD: Monitoring Well Plug and Abandonment Plan and
Well Construction Plan; Decommissioning of Well MWL-BW1,
Installation of Well MWL-BW2

From: NMED/Bearzi
To: SNL/Wagner

Back of Tab 3

State of New Mexico
ENVIRONMENT DEPARTMENT
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Telephone (505) 476-6000
Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

CINDY PADILLA
DEPUTY SECRETARY

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

June 19, 2007

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Securities Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: NOTICE OF DISAPPROVAL: MONITORING WELL PLUG AND ABANDONMENT PLAN AND REPLACEMENT WELL CONSTRUCTION PLAN, DECOMMISIONING OF GROUNDWATER MONITORING WELL MWL-BW1, INSTALLATION OF REPLACEMENT GROUNDWATER MONITORING WELL MWL-BW2,
APRIL 9, 2007
SANDIA NATIONAL LABORATORIES NM5890110518
HWB-SNL-07-014

Dear Ms. Wagner and Mr. Nimick:

The New Mexico Environment Department (NMED) has reviewed the subject document dated April 9, 2007 (with transmittal letter dated April 17, 2007), and has determined that there are several deficiencies in the plan for replacement of the background monitoring well at the Mixed Waste Landfill (MWL). The U. S. Department of Energy and Sandia Corporation ("Permittees") must respond to the following comments within 60 days of receipt of this letter.

1. Page 5, Section 5 – the one sentence in this paragraph references well TAV-MW10. This appears to be a typographical error and likely should refer to proposed replacement well MWL-BW2. If in error, modify the plan to correct the error.

2. Page 5, Section 5.1 – this section states that MWL-BW2 will be installed a minimum of 25 feet away from the existing well (MWL-BW1) location. Later, the text states that

MWL-BW2 will be located about 700 feet northeast of MWL-BW1, but that the actual location will be selected with concurrence from NMED. The proposed location for MWL-BW2 as shown on Figure 1 is acceptable to the NMED. A location about 200 feet east of the Mixed Waste Landfill (MWL) should be sufficient. Modify the plan to more precisely indicate the location of proposed well MWL-BW2.

3. Page 5, Section 5.2.1 – This section states that the total depth of the borehole in which MWL-BW2 is to be constructed will be determined by a field geologist. The anticipated well screen depth as discussed in the subject plan is 472-502 feet below ground surface. NMED expects MWL-BW2 to be screened in the uppermost part of the saturated zone, with about 5 feet of screen above the water table. Because of the proposal to use 30 feet of screen, instead of 20 feet, and because of the significant vertical gradient that exists at the MWL site, the water level in MWL-BW2 is expected to be significantly lower than that observed in existing well MWL-BW1. This will need to be considered when generating future water-level maps. Modify the plan to indicate that the well screen for MWL-BW2 will be set with about 5 feet of screen situated above the water table.
4. Page 5, Section 5.2.1 – The Permittees shall log the geology of the borehole during drilling, given that MWL-BW2 is to be located a substantial distance from the well it will replace. Modify the plan to state that the geology of the borehole will be logged during drilling.

5. Page 5, Section 5.2.1 – The Permittees shall log the depth of the first encounter with regional groundwater and any perched groundwater, during drilling. Modify the plan to state that the depth of regional groundwater and the depth of any perched groundwater will be logged during drilling.

6. Page 6, Section 5.2.2 – The screen shall be constructed of slotted schedule 80 polyvinyl chloride (PVC). Although the transmittal letter implies that the screen will be made of PVC, the plan does not. Modify the plan to state that the screen will be made of PVC.

7. Page 6, Section 5.2.2 – At the MWL, sediments making up the uppermost part of the saturated zone are fine-grained. The subject plan calls for the use of 10-20 silica sand for the primary filter pack and 0.020 inch slotted screen. The Permittees need to ensure that the screen slot size and gradation of the filter pack material is of proper size to prevent water samples collected from the well from exhibiting high turbidity. Modify the plan to state that primary filter pack and screen slot size will be changed in the field if necessary based on the gradation of sediments actually encountered in the interval to be monitored.

8. Page 6, Section 5.2.2 – The plan calls for the installation of grout in at least two lifts. Please note that during the installation of well MWL-MW5, grout intruded the well screen. Although there are several possible explanations for what caused this grout

intrusion to occur, the emplacement of grout in lifts that were too long may have led to this problem. Modify the plan to place the grout using more lifts, with a minimum of 24 hours of setting time between the first two lifts.

9. Page 6, Section 5.2.2 – The plan states that PVC centralizers will be placed at the top and bottom of the screen. Modify the plan to state that additional centralizers will be added from the top of the screen to the surface, not to exceed an interval of 100 feet.

10. Page 6, Section 5.2.2 – Modify the plan to indicate that the well location (easting/northing or latitude/longitude and top of casing) will be surveyed. Indicate also the degree of accuracy for the survey.

11. Page 8, Section 5.2.3 – Modify the plan to state the parameters that are to be measured during well development.

12. Page 8, Section 5.2.3 – Modify the plan to indicate that the method of development, the volume of water added or removed, the parameters measured, the results of the measurements, and the time these activities take place are to be documented in writing during well development. Indicate in the plan that only potable water shall be used to develop the well.

13. Modify the plan to specify in detail the criteria for which well development will be considered adequate and complete.

If you have any questions regarding this matter, please contact Mr. William Moats of my staff at (505) 222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
L. King, EPA-6
P. Freshour, SNL, MS 1089
File: SNL 2007 and Reading

Volume VIII

TAB 4

Replacement of Mixed Waste Landfill Groundwater Monitoring Wells
MWL-MW1 and MWL-MW3

From: NMED/Bearzi
To: SNL/Wagner

Back of Tab 4

State of New Mexico
ENVIRONMENT DEPARTMENT
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Telephone (505) 476-6000
Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

CINDY PADILLA
DEPUTY SECRETARY

CERTIFIED MAIL -- RETURN RECEIPT REQUESTED

July 2, 2007

Ms. Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P. O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Securities Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: REPLACEMENT OF MIXED WASTE LANDFILL GROUNDWATER MONITORING WELLS MWL-MW1 AND MWL-MW3 SANDIA NATIONAL LABORATORIES, EPA ID NM5890110518

Dear Ms. Wagner and Mr. Nimick:

The New Mexico Environment Department (NMED) has determined that groundwater monitoring wells MWL-MW1 and MWL-MW3 at the Sandia National Laboratories' (SNL) Mixed Waste Landfill (MWL) require replacement. Data provided to NMED indicates that the water level will soon drop to levels that MWL-MW3 cannot be properly sampled. Additionally, both wells are also constructed with stainless steel screens which are suffering corrosion to such a degree that the wells can longer produce water samples that are representative of aquifer conditions for chromium, iron, and nickel.

In accordance with Section VIII.A of the Order on Consent (April 24, 2004), if a well is any way unusable for its intended purpose, it must be replaced. The U. S. Department of Energy and Sandia Corporation (the Permittees) shall therefore replace wells MWL-MW1 and MWL-MW3. The Permittees shall submit to the NMED within 60 days of receipt of this letter a plan for approval describing how the wells are to be replaced and a schedule for implementation of this work. The plan shall also describe how the existing wells shall be plugged and abandoned.

Because of problems associated with stainless-steel screened wells at the MWL (chromium and nickel detections), the replacement wells shall be screened with polyvinyl (PVC) plastic casing. The mud rotary drilling method shall not be used to install the wells. Each well shall be installed to monitor groundwater at the water table. Additionally, each well shall be installed at locations as close as possible to the western boundary of the landfill, taking into account the footprint of the future landfill cover. This change in well locations, particularly for MWL-MW1, is based on better preparing the MWL for long-term monitoring of the groundwater which flows west-southwest.

Should you have any questions regarding this letter, please contact William Moats of my staff at (505) 222-9551

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED, HWB
W. Moats, NMED, HWB
T. Skibitski, NMED DOE OB
L. King, EPA-Region 6 (6PD-N)
J. Gould, DOE/NNSA/SSO, MS 0184
P. Freshour, SNL, MS 1089
File: Reading and SNL 2007

Volume VIII

TAB 5

Response to NOD: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1; Installation of Well MWL-BW2, April 9, 2007; and Submittal of Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1; Installation of Well MWL-BW2, Revision 1

From: SNL/Wagner
To: NMED/Bearzi

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SNL MWL 07

07-D30

ENTERED

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

AUG 0 3 2007

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

RECEIVED
AUG 2007
NMED Hazardous Waste Bureau

Mr. James Bearzi
Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road, Bldg. E
Santa Fe, New Mexico 87505

Dear Mr. Bearzi:

On behalf of Sandia Corporation and the Department of Energy (DOE), DOE is submitting two enclosed documents:

1) Response to NMED's "Notice of Disapproval: Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan; Decommissioning of Groundwater Monitoring Wells MWL-BW1; Installation of Replacement Groundwater Monitoring Wells MWL-BW2, April 9, 2007" (Enclosure 1); and

2) Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan; Decommissioning of Groundwater Monitoring Wells MWL-BW1; Installation of Replacement Groundwater Monitoring Wells MWL-BW2, Revision 1" (Enclosure 2).

This Plug and Abandonment Plan is required under Section VIII.C of the Compliance Order on Consent.

In order to be efficient and save limited funding, we have scheduled the replacement of monitoring well MWL-BW1 for August 2007 to coincide with other field work scheduled for August. If possible, we would very much appreciate it if your office could notify us within two weeks of receipt of this letter if the enclosed documents meet your requirements.

If you have any questions regarding this submittal, please contact me at (505) 845-6036, or Dan Pellegrino of my staff at (505) 845-5398.

Sincerely,

Patty Wagner
Manager

James Bearzi (2)

JUL 3 0 2007

Enclosures (2)

cc w/enclosures:
W. Moats, NMED-HWB (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB-DOE

cc w/o enclosures:
A. Blumberg, SNL/NM, Org. 11100, MS 0141
D. Miller, SNL/NM, Org. 6765, MS 0718
P. Freshour, SNL/NM, Org. 6765, MS 1089
M. Skelly, SNL/NM, Org. 6765, MS 1089
M. Davis, SNL/NM, Org. 6765, MS 1089
Records Center, SNL/NM, Org. 6765, MS 1089
T. Longo, HQ/GTN, NA-56
M. Reynolds, SSO, MS 0184
J. Estrada, SSO, MS 0184

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: DOE/Sandia Response to NMED's "Notice of Disapproval: Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan, Decommissioning of Groundwater Monitoring Well MWL-BW1, Installation of Replacement Groundwater Monitoring Well MWL-BW2, April 9, 2007"; and Revised Plan, July 2007

Document author: Mike Skelly, Dept. 6765

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 7/19/07

Francis B. Nimick Date
Deputy to the
Nuclear Energy and Global Security Technologies
Center 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ for 7/30/07

Patty Wagner Date
Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

ENCLOSURE 1

July 9, 2007

DOE/Sandia Responses to NMED's

"Notice of Disapproval: Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan, Decommissioning of Groundwater Monitoring Well MWL-BW1, Installation of Replacement Groundwater Monitoring Well MWL-BW2, April 9, 2007"

INTRODUCTION

This document responds to the comments received in a Notice of Disapproval (NOD) letter from the New Mexico Environment Department (NMED) to the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia) on June 19th, 2007 regarding the plug and abandonment of a groundwater monitoring well with the installation of a replacement well at the Mixed Waste Landfill (MWL) at Sandia National Laboratories (SNL). The letter is entitled *"Notice of Disapproval: Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan Decommissioning of Groundwater Monitoring Well MWL-BW1, Installation of Replacement Groundwater Monitoring Well MWL-BW2, April 9, 2007; Sandia National Laboratories NM5890110518; HWB-SNL-07-014."*

The NMED NOD letter contained 13 comments. This document lists each NMED comment in boldface, followed by the DOE/Sandia response, written in normal font under "Response". Attached to this reponse to comments is a revised version of the *"Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan, Decommissioning of Groundwater Monitoring Well MWL-BW1, Installation of Replacement Groundwater Monitoring Well MWL-BW2, Revision 1"*

Sandia National Laboratories is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.

1. Page 5, Section 5 – the one sentence in this paragraph references well TAV-MW10. This appears to be a typographical error and likely should refer to proposed replacement well MWL-BW2. If in error, modify the plan to correct the error.

Response: The typographical error in the referenced sentence has been corrected. The sentence in the revised *"Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan, Decommissioning of Groundwater Monitoring Well MWL-BW1, Installation of Replacement Groundwater Monitoring Well MWL-BW2, Revision 1"* (hereafter referred to as the plan) now reads: "A replacement monitoring well (MWL-BW2) will be installed after MWL-BW1 has been decommissioned."

2. Page 5, Section 5.1 – this section states that MWL-BW2 will be installed a minimum of 25 feet away from the existing well (MWL-BW1) location. Later, the text states that MWL-BW2 will be located about 700 feet northeast of MWL-BW1, but that the actual location will be selected with concurrence from NMED. The proposed location for MWL-BW2 as shown on Figure 1 is acceptable to the NMED. A location about 200 feet east of the Mixed Waste Landfill (MWL) should be sufficient. Modify the plan to more precisely indicate the location of proposed well MWL-BW2.

Response: This section of the plan has been clarified and now reads: "MWL-BW2 will be installed at a location approximately 710 ft northeast of MWL-BW1, and approximately 140 ft east of the MWL (Figure 1)." Also, please note that the proposed location for MWL-BW2 has been adjusted slightly to the north from the location shown in the original Figure 1. The new proposed location is now due east of the center of the MWL footprint.

3. Page 5, Section 5.2.1 – This section states that the total depth of the borehole in which MWL-BW2 is to be constructed will be determined by a field geologist. The anticipated well screen depth as discussed in the subject plan is 472-502 feet below ground surface. NMED expects MWL-BW2 to be screened in the uppermost part of the saturated zone, with about 5 feet of screen above the water table. Because of the proposal to use 30 feet of screen, instead of 20 feet, and because of the significant vertical gradient that exists at the MWL site, the water level in MWL-BW2 is expected to be significantly lower than that observed in existing well MWL-BW1. This will need to be considered when generating future water-level maps. Modify the plan to indicate that the well screen for MWL-BW2 will be set with about 5 feet of screen situated above the water table.

Response: The third paragraph in this section of the plan has been clarified and now reads: "Based on current conditions in MWL-BW1 and the most recent groundwater level measurements (March 2007), monitoring well MWL-BW2 is anticipated to be drilled to approximately 502 ft bgs. The well screen for MWL-BW2 will be set with approximately 5 ft of screen situated above the static water level. The anticipated depth to water at this location is 472 ft bgs, therefore, the screen completion interval is expected to be approximately 467 to 497 ft bgs with a 5-foot sump placed below the screen."

4. Page 5, Section 5.2.1 – The Permittees shall log the geology of the borehole during drilling, given that MWL-BW2 is to be located a substantial distance from the well it will replace. Modify the plan to state that the geology of the borehole will be logged during drilling.

Response: The Field Operating Procedure (FOP) 94-05 "Borehole Lithologic Logging" was referenced in Table 1 of the plan; this reference represented the intent of DOE/Sandia to describe the geology of the borehole during drilling. This reference remains in the revised plan, and to clarify, a sentence has been added to the first paragraph of this section that reads: "The geology of the borehole will be logged during drilling."

5. Page 5, Section 5.2.1 – The Permittees shall log the depth of the first encounter with regional groundwater and any perched groundwater, during drilling. Modify the plan to state that the depth of regional groundwater and the depth of any perched groundwater will be logged during drilling.

Response: As with Comment 4, by referencing Field Operating Procedure (FOP) 94-05 "Borehole Lithologic Logging" in Table 1 of the plan, DOE/Sandia indicated the intent to describe the depth of regional groundwater and the depth of any perched groundwater encountered during drilling. To clarify our intent, a sentence has been added to the first paragraph of this section that reads: "The depth of the first encounter with regional groundwater and any perched groundwater will be logged during drilling."

6. Page 6, Section 5.2.2 – The screen shall be constructed of slotted schedule 80 polyvinyl chloride (PVC). Although the transmittal letter implies that the screen will be made of PVC, the plan does not. Modify the plan to state that the screen will be made of PVC.

Response: The second sentence of the second paragraph in Section 5.2.2 has been changed to read: "To accommodate the rapidly declining water table, a 30-ft length of PVC screen with a 0.010-inch or 0.020-inch slot size will be used for the replacement well."

7. Page 6, Section 5.2.2 – At the MWL, sediments making up the uppermost part of the saturated zone are fine-grained. The subject plan calls for the use of 10-20 silica sand for the primary filter pack and 0.020 inch slotted screen. The Permittees need to ensure that the screen slot size and gradation of the filter pack material is of proper size to prevent water samples collected from the well from exhibiting high turbidity. Modify the plan to state that primary filter pack and screen slot size will be changed in the field if necessary based on the gradation of sediments actually encountered in the interval to be monitored.

Response: The first sentence of the third paragraph in Section 5.2.2 has been replaced with the following sentences: "The appropriate screen slot size and gradation of the filter pack

material will be based on the gradation of the sediments in the screen interval as determined in the field by the geologist logging the borehole. If the predominant water-bearing interval consists mostly of clay and silt, a 0.010-inch screen slot and a primary filter pack of clean 20-40 silica sand will be placed in the annulus. However, if the predominant water-bearing interval consists mostly of silt and sand, a 0.020-inch screen slot and a primary filter pack of clean 10-20 silica will be placed in the annulus."

8. Page 6, Section 5.2.2 – The plan calls for the installation of grout in at least two lifts. Please note that during the installation of well MWL-MW5, grout intruded the well screen. Although there are several possible explanations for what caused this grout intrusion to occur, the emplacement of grout in lifts that were too long may have led to this problem. Modify the plan to place grout using more lifts, with a minimum of 24 hours of setting time between the first two lifts.

Response: The fifth and sixth sentences of the fourth paragraph in Section 5.2.2 have been replaced with the following sentences: "To prevent overloading, the bentonite grout will be installed in multiple lifts. The first bentonite grout lift will be approximately 100 ft thick and will be allowed to set a minimum of 24 hours before installation of the next lift. Subsequent bentonite grout lifts will each be approximately 200 ft thick."

Also, please note that the first sentence of the fourth paragraph in Section 5.2.2 of plan has been changed from "A 30-ft thick layer of ¼-inch bentonite pellets or 3/8-inch bentonite chips will be placed above the filter pack . . . " to now read "A 10-ft thick layer of ¼-inch bentonite pellets or 3/8-inch bentonite chips . . . ". This change was made based on consultations with experienced well drillers who pointed out that a 30-ft thick layer of bentonite pellets/chips was difficult to confidently install inside the drive casing. A 10-ft thickness reflects current standard industry practice for a bentonite pellet/chip plug.

9. Page 6, Section 5.2.2 – The plan states that PVC centralizers will be placed at the top and bottom of the screen. Modify the plan to state that additional centralizers will be added from the top of the screen to the surface, not to exceed an interval of 100 feet.

Response: The following text has been added to the fourth sentence of the second paragraph in Section 5.2.2: ". . . and then at intervals not to exceed 100 feet up to the ground surface."

10. Page 6, Section 5.2.2 – Modify the plan to indicate that the well location (easting/northing or latitude/longitude and top of casing) will be surveyed. Indicate also the degree of accuracy for the survey.

Response: The well location survey requirements are identified in Section 10.2 "Well Installation Records". To clarify, the tenth bulleted item in Section 10.2 now reads:

"Surveyed elevations and location in New Mexico state plane coordinates (with a degree of accuracy of ± 0.01 feet)."

11. Page 8, Section 5.2.3 – Modify the plan to state the parameters that are to be measured during well development.

Response: The third sentence of this section now reads: "During development, the groundwater field parameters (pH, specific conductivity, temperature, and turbidity) will be continuously monitored, and development will continue until parameters have stabilized."

12. Page 8, Section 5.2.3 – Modify the plan to indicate that the method of development, the volume of water added or removed, the parameters measured, the results of the measurements, and the time these activities take place are to be documented in writing during well development. Indicate in the plan that only potable water shall be used to develop the well.

Response: By referencing Field Operating Procedure (FOP) 94-41 "Well Development" in Table 1 of the plan, DOE/Sandia intended to document the well development activities. To clarify our intent, the following sentences have been added to the end of the first paragraph in this section: "The method of development, the volume of water added or removed, the parameters measured, the results of the measurements, and the time these activities take place will be documented in writing during well development. If required, only potable water shall be added to the well during development."

13. Modify the plan to specify in detail the criteria for which well development will be considered adequate and complete.

Response: The well development criteria are specified in FOP 94-41 "Well Development". To clarify our intent, the following paragraph has been added to the end of Section 5.2.3: "During development of this water-table completion well, a minimum of 5 well bore volumes will be removed. After the minimum well bore volume has been removed, development will continue until representative water is obtained. Representative water is assumed to be obtained when pH, temperature, turbidity, and specific conductivity readings stabilize (less than 10% variability over 3 consecutive well bore volumes) and the water is visually clear of suspended solids with a target turbidity of less than 5 Nephelometric Turbidity Units (NTUs)."

ENCLOSURE 2

Monitoring Well Plug and Abandonment Plan
and
Replacement Well Construction Plan

Decommissioning of
Groundwater Monitoring Well MWL-BW1

Installation of Replacement
Groundwater Monitoring Well MWL-BW2

Revision 1

Environmental Restoration Project
Sandia National Laboratories, New Mexico

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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Attachment 2--Groundwater Well Abandonment Diagram
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1 Project and Site Information

Task Description: Sandia National Laboratories/New Mexico (SNL/NM) decommissioning with plug and abandonment of one groundwater monitoring well, and installation of one replacement groundwater monitoring well

Case No.: 98026.01.08

Project Leader/Department No.: Paul Freshour/6765

Scheduled Start Date: June 2007

Estimated Completion Date: August 2007

Operations/Technical Area: Mixed Waste Landfill/Technical Area III

2 Regulatory Criteria

This Plug and Abandonment (P&A) Plan outlines the activities and procedures to decommission existing groundwater monitoring well MWL-BW1, and install replacement groundwater monitoring well MWL-BW2.

Regulatory guidance for well plug and abandonment can be found in New Mexico Environment Department, Hazardous Waste Bureau (NMED/HWB) requirements. Section VIII.C of the Compliance Order on Consent (the Order) discusses well abandonment (NMED April 2004):

> *"Wells shall be abandoned when they are no longer required in the monitoring network, no longer provide representative groundwater samples because of falling water levels or insufficient productivity, or become damaged beyond repair. The goal of well abandonment is to seal the well in such a manner that it cannot act as a conduit for the migration of contaminants from either the ground surface to the saturated zone or between saturated zones. Respondents shall prepare an abandonment plan for any and all wells that are to be plugged and abandoned, and shall submit the plan to the Department for approval. Respondents shall not abandon any groundwater monitoring well without prior written approval of the Department."*

Further guidance for well P&A procedures can be found in the New Mexico Office of the State Engineer (OSE) "Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells" (NM OSE August 2005):

> *"To plug a well, the entire well shall be filled from the bottom upwards to land surface using a tremie pipe. The well shall be plugged with neat cement slurry, bentonite based plugging material, or other sealing material approved by the state engineer for use in the plugging of non-artesian wells"*

The OSE guidance also states that:

> "*Wells encountering contaminated water or soil may require coordination between the office of the state engineer and the New Mexico environment department (or other authorized agency or department) prior to the plugging of the well*."

And,

> "*A licensed well driller shall keep a record of each well plugged as the work progresses. The well driller shall file a complete plugging record with the state engineer and the permit holder no later than twenty (20) days after completion of the plugging. The plugging record shall be on a form prescribed by the state engineer . . .*"

To meet these regulatory requirements, the following tasks will be completed at SNL/NM:

- Decommission well MWL-BW1 because it no longer provides representative groundwater samples due to falling water levels and insufficient productivity.
- Submit this P&A Plan to the NMED/HWB and OSE for review and approval.
- Use a licensed well driller and approved materials to seal the well so that it cannot act as a conduit for the migration of potential contaminants from the ground surface to the saturated zone.
- Upon completion of the P&A activities, submit a plugging record to the OSE and submit a P&A Report describing the field activities to the NMED/HWB.

3 Existing Well Information

Groundwater monitoring well MWL-BW1 is proposed for decommissioning in this P&A Plan. The monitoring well completion diagram is presented in Attachment 1, and the pertinent well completion information is summarized below.

MWL-BW1 is a background groundwater monitoring well located at the Mixed Waste Landfill (Figure 1). This well was installed in July 1989 and is completed in the regional aquifer with the following well completion details:

- Total depth of the well – 477 feet (ft) below ground surface (bgs).
- Screened interval – 452 to 472 ft bgs.
- Construction materials – Polyvinyl chloride (PVC) riser pipe, stainless steel screen, carbon steel protective surface casing and guard posts, and a concrete well pad.
- Current water level – approximately 472 ft bgs.
- Water-bearing strata – Groundwater occurs in unconsolidated silts and sands (alluvial fan facies) of the upper Santa Fe Group that have relatively low hydraulic conductivities.
- Reason for decommissioning – The regional water table has dropped to the lowest portion of the screened interval and the well requires excessive time to recover between purging and sampling. There is no evidence that suggests the annular seal is compromised.

4 Plugging and Abandonment

Based on the requirements established by the NMED/HWB and OSE, the groundwater monitoring well MWL-BW1 will be decommissioned. Applicable Field Operating Procedures (FOPs) and Administrative Operating Procedures (AOPs) are listed in Table 1; however, this site-specific P&A Plan should be used as the primary guidance in the field.

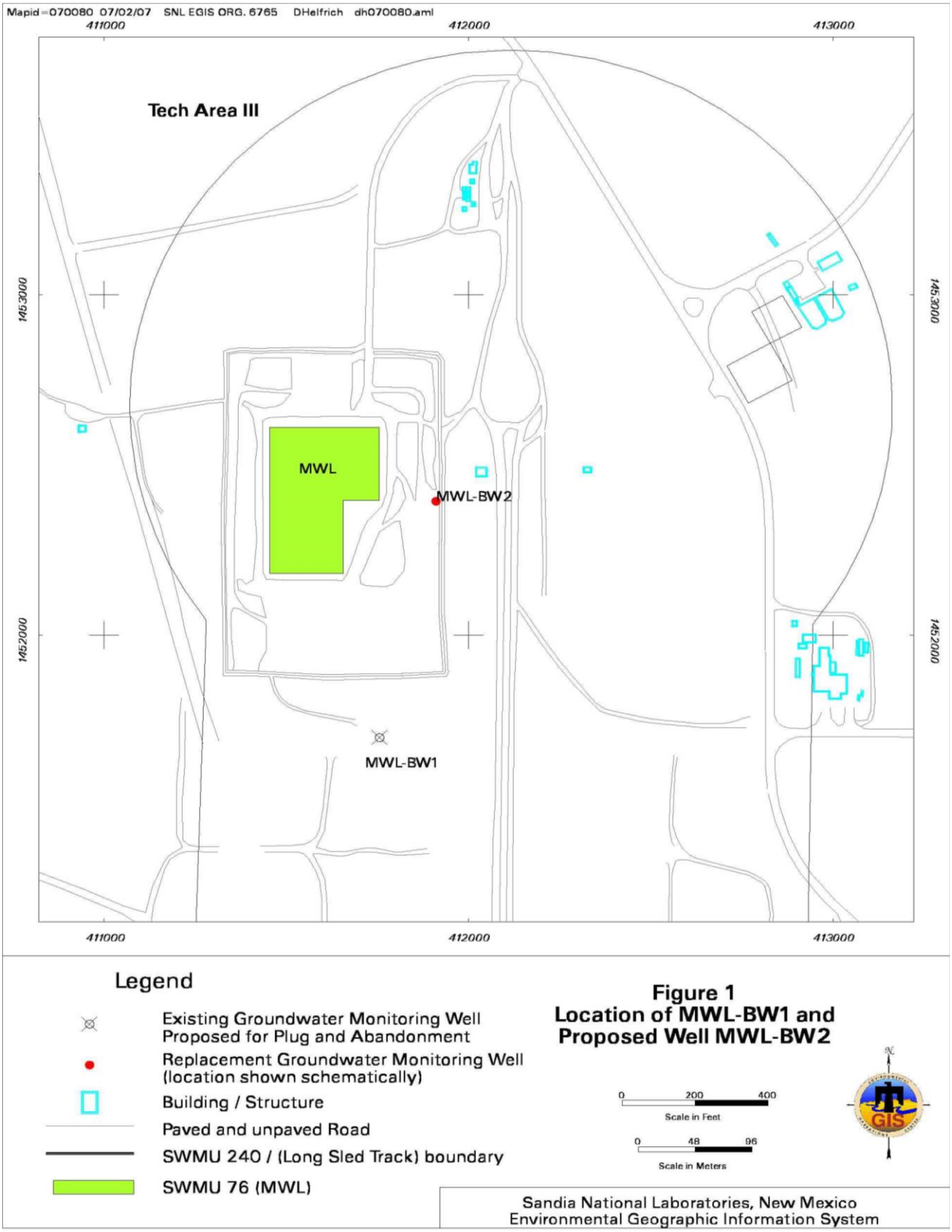


Figure 1
Location of MWL-BW1 and Proposed Well MWL-BW2

Table 1. Applicable Operating Procedures

Number of Procedure	Title of Procedure
FOP 94-01	Safety Meetings, Inspections, and Pre-Entry Briefings Rev. 1, 12/16/96
FOP 94-05	Borehole Lithologic Logging, Rev. 0, 2/10/94
FOP 94-25	Documentation of Field Activities, Rev. 0, 11/4/94
FOP 94-26	General Equipment Decontamination, Rev. 1, 2/20/97
FOP 94-28	Health and Safety Monitoring of Organic Vapors (FID and PID), Rev. 2, 4/27/97
FOP 94-38	Drilling Methods and Drill Site Management, Rev. 0, 4/14/94
FOP 94-41	Well Development, Rev. 0, 11/21/94
FOP 94-42	Integration of the design, Installation, Rehabilitation, and Decommissioning of Environmental Restoration Wells, Rev. 1, 5/31/94
FOP 94-43	Decommissioning Of Wells, Rev 0, 5/31/94
FOP 94-45	Designing and Installing Groundwater Monitoring Wells, Rev. 0, 5/31/94
FOP 94-57	Decontaminating Drilling and Other Field Equipment, Rev. 0, 5/31/94
FOP 94-68	Field Change Control, Rev. 2 (in revision)
FOP 94-69	Personnel Decontamination (Level D, C, and B Protection), Rev. 1, 1/23/98
AOP 94-24	System and Performance Audits, Rev. 0, 1/12/95
AOP 94-25	Deficiency Reporting, Rev. 0, 1/12/95
AOP 95-16	Administrative Operating Procedure for Sample Management and Custody, Rev. 1, 4/18/96

4.1 Goal

The goal for decommissioning monitoring well MWL-BW1 is to eliminate the potential of this well to act as a conduit for the migration of potential contamination to groundwater. The well materials and annular seals are not believed to pose a threat to groundwater, and therefore will be backfilled in place with proper sealing materials.

4.2 Objective

The objective is to seal this monitoring well in such a manner that there is reasonable certainty that the abandonment has adequately eliminated the potential for cross-communication between the land surface and the aquifer, and the potential for downward migration of potential contaminants through the borehole annulus to the aquifer. All grouting techniques and grout mixtures used during decommissioning will minimize grout intrusion into the native formation.

4.3 Implementation

General activities for the implementation of the P&A include:

1) Remove all monitoring well surface completion features,
2) Backfill the casing with well-plugging materials, and
3) Construct a new surface pad/monument.

SNL/NM personnel and the selected drilling contractor will remove all surface completion features, such as guard posts, concrete well pads, and surface protective casing. Care will be taken to prevent materials from falling down the well casing and possibly causing a downhole obstruction. The well will be abandoned with casing left in place, and the well casing will be cut off at approximately 5 ft bgs.

The well screen and blank well casing will be sealed by lowering a tremie pipe to the base of the well casing (below the base of the screen) and injecting the plug material (bentonite grout) using a diaphragm or equivalent pump system. The plug material will be filled to within 5 ft of the ground surface and allowed to set overnight. If the level of the plug material in the well casing drops overnight, additional bentonite grout will be added to again reach within 5 ft of ground level.

Once the well has been properly plugged, the decommissioning process will be completed by placing concrete in the upper 5 ft of the well/borehole and installing a concrete slab on the surface. The concrete pad will be 4 inches thick with a 2 ft by 2 ft area, constructed in the ground so that the surface of the finished concrete slab will be 1 to 2 inches above the natural ground surface. A brass marker containing the well name and date of decommissioning will be set in the concrete pad.

5 Monitoring Well Installation

A replacement monitoring well (MWL-BW2) will be installed after MWL-BW1 has been decommissioned.

5.1 Objective

Install a 5-inch nominal diameter PVC casing replacement monitoring well to provide representative groundwater samples. The replacement monitoring well borehole will be drilled using Air-Rotary Casing-Hammer (ARCH) drilling methods.. MWL-BW1 will be installed at a location approximately 710 ft northeast of MWL-BW1, and 140 ft east of the MWL (Figure 1). The proposed replacement well location on Figure 1 is shown schematically; the actual location may vary due to utility clearance and land use issues.

5.2 Implementation

Applicable FOPs and AOPs are listed in Table 1; however, this site-specific plan should be used as the primary guidance in the field.

5.2.1 Borehole Drilling

The ARCH drilling method will use environmentally-friendly lubricants and will be able to penetrate highly variable lithologies such as cobbles, boulders, gravel, sand, clay, and caliche while maintaining an open, competent borehole. The geology of the borehole will be logged during drilling. The total depth of the borehole will be determined by the SNL/NM field geologist, but the depths are anticipated to be 30 to 35 ft deeper than the original well. The depth of the first encounter with regional groundwater and any perched groundwater will be logged during drilling. After reaching total depth, the cased borehole will be logged using natural gamma and neutron wire-line geophysical methods.

Minimal water (but no other foams/liquids) in the form of “mist” may be introduced into the borehole to aid in the removal of cuttings. Waste generation will be kept to a minimum. Borehole cuttings will be contained within an area adjacent to the well. Water produced from the well during drilling or development will be contained in 55-gallon drums and placed on spill control pallets.

Based on current conditions in MWL-BW1 and the most recent groundwater level measurements (March 2007), monitoring well MWL-BW2 is anticipated to be drilled to approximately 502 ft bgs. The well screen for MWL-BW2 will be set with approximately 5 ft of screen situated above the static water level. The anticipated depth to water at this location is 472 ft bgs; therefore, the screen completion interval is expected to be approximately 467 to 497 ft bgs with a 5-ft sump placed below the screen.

5.2.2 Well Construction

The monitoring well will be completed as specified in this plan. The water-table monitoring well will be installed through the temporary steel drive casing (nominal 10-inch diameter), and completed using 5-inch inner diameter, flush threaded, PVC Schedule-80 water well casing. No solvents, cleaners, or lubricants will be used for construction of the monitoring well. The casing will be delivered pre-cleaned and bagged, or steam-cleaned on site prior to installation. To preserve the integrity of the well materials, the well screen and riser pipe will be suspended in the borehole until the primary filter pack, bentonite pellet seal and annular seal are installed.

The regional aquifer in the study area is being over-pumped and the water table at MWL-BW1 is rapidly declining with a decline rate of 1.14 ft/year over the last several years (Figure 2). To accommodate the rapidly declining water table, a 30-ft length of PVC screen with a 0.010-inch or 0.020-inch slot size will be used for the replacement well. A 5-ft sump will be placed at the base of the screen and sealed with a threaded end cap. PVC centralizers will be placed at the base and top of the well screen and then at intervals not to exceed 100 ft up to the land surface. The screen for this water-table well will be placed so that the top of the screen is approximately 5 ft above the static water level.

The appropriate screen slot size and gradation of the filter pack material will be based on the gradation of the sediments in the screen interval as determined in the field by the geologist logging the borehole. If the predominant water-bearing interval consists mostly of clay and silt, a 0.010-inch screen slot and a primary filter pack of clean 20-40 silica sand will be placed in the annulus. However, if the predominant water-bearing interval consists mostly of silt and sand, a 0.020-inch screen slot and a primary filter pack of clean 10-20 silica will be placed in the annulus. The primary filter pack will extend from the bottom of the sump to at least 5 ft above the top of the screen. A 5-ft thick layer of clean 40-60 sand will be placed above the primary filter pack. Both sand packs will be tagged using a tag line to verify their depth. Preliminary well development using a surge block will be performed at this time to help settle the filter pack.

A 10-ft thick layer of ¼-inch bentonite pellets or 3/8-inch bentonite chips will be placed above the filter pack prior to emplacement of the bentonite-grout annular seal. Each 5 ft thickness of bentonite pellets/chips added will be hydrated before adding the next 5-ft thickness of

bentonite pellets/chips. The final lift of bentonite pellets/chips will be allowed to set for a time adequate for hydration (at least I hour). The remaining annular space to ground surface will then be filled with bentonite grout. To prevent overloading, the bentonite grout will be installed in multiple lifts. The first bentonite grout lift will be approximately 100 ft thick and will be allowed to set a minimum of 24 hours before installation of the next lift. Subsequent bentonite grout lifts will each be approximately 200 ft thick. The bentonite grout will be topped off to within 6-inches to 1-ft bgs.

The well casing will extend approximately 30 inches above ground surface with a water-tight cap. The monitoring well will be completed with protective steel casing with a hinged locking cap. The protective casing will be primed and painted yellow. A 3-ft by 3-ft, sloped concrete pad will be constructed around the casing. The pad will contain a 3-in brass cap stamped with the well identification. Three, 4-inch diameter concrete-filled, steel guard posts (also primed and painted yellow) will be placed around the pad, equidistant from the well.

5.2.3 Well Development

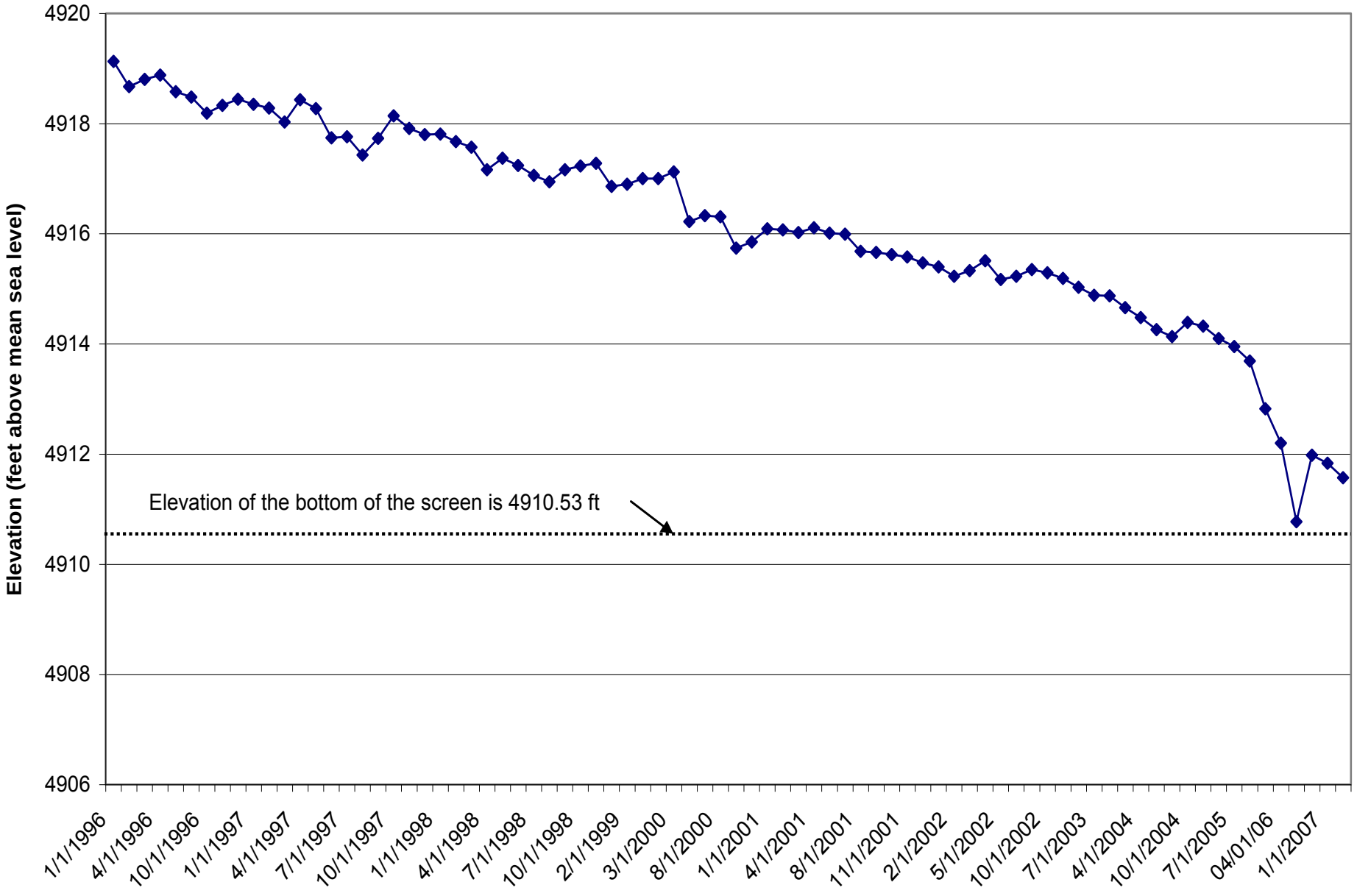
Well development will be completed at least 48 hours after grouting. The well will be developed for approximately 10 hours, and will consist of pumping, surge-block, swabbing, and/or bailing techniques. During development, the groundwater field parameters (pH, specific conductivity, temperature, and turbidity) will be continuously monitored, and development will continue until parameters have stabilized. All development water will be contained in drums and will not be allowed to discharge to the ground surface. The method of development, the volume of water added or removed, the parameters measured, the results of the measurements, and the time these activities take place will be documented in writing during well development. If required, only potable water shall be added to the well during development.

During development of this water-table completion well, a minimum of 5 well bore volumes will be removed. After the minimum volume has been removed, development will continue until representative water is obtained. Representative water is assumed to be obtained when pH, temperature, turbidity, and specific conductivity readings stabilize (less than 10% variability over 3 consecutive well bore volumes) and the water is visually clear of suspended solids with a target turbidity of less than 5 Nephelometric Turbidity Units (NTUs).

6 Equipment Decontamination

The drilling rig and related equipment will be decontaminated at the decontamination pad in Technical Area III prior to the beginning of drilling operations. Decontamination of equipment will also be required after completing the well. Decontamination waste will be kept to a minimum and containerized in drums placed on spill control pallets at the decontamination pad.

Figure 2 MWL-BW1 Groundwater Elevations Over Time



7 Health and Safety

Level D personal protective equipment is required for all drilling operations. Health and Safety records associated with drilling and development personnel will be maintained on site and will be available at the commencement of drilling activities. All field personnel will operate under an SNL/NM Health and Safety Plan (HASP) and will have SNL/NM-required training including 40-Hr OSHA HAZWOPER and subsequent yearly refresher courses. An SNL/NM Subject Matter Expert will perform a safety inspection of the drill rig before drilling commences.

8 Pre-field activities

Pre-field activities that must be completed prior to drilling include:

- Preparation of the Statement of Work for drilling and monitoring well installation;
- SNL/NM digging permit request and approval;
- HASP preparation, review, and signatures;
- National Environmental Policy Act (NEPA) review and signatures;
- Sample bottle order for waste samples through Sample Management Office;
- Waste Management Plan preparation;
- Field checklist completion, review, and approval; and
- Readiness review meeting.

9 Mobilization and Site Setup

SNL/NM personnel will ensure that containers for cuttings have been obtained and are ready for drilling operations. Roll-off bins supplied by SNL/NM will be used to collect drill cuttings for waste management purposes.

10 Reporting

Based on the requirements established by the NMED/HWB, OSE and SNL/NM FOPs, the field activities associated with decommissioning and installation of the monitoring wells will be documented.

10.1 Decommissioning Records

All decommissioning field activities will be documented in a field log book per guidance in FOP 94-25. Upon completion of decommissioning of a well, the P&A Report will document all site activities and provide final as-built well decommissioning diagram (Attachment 2). Attachment 3 will be used to assure that all records are completed, approved, and submitted for proper records management. The following list of documents and records that are generated as part of the decommissioning process will be provided to the SNL/NM Well File Coordinator who, in turn, will submit them to the SNL/NM Customer-Funded Records Center:

- Monitoring Well Plugging and Abandonment Request
- Well Plugging and Abandonment Form
- Site-Specific Well Plugging and Abandonment Work Plan
- Site-Specific Well Plugging and Abandonment Report
- Plugging and Abandonment Documentation and Approval Checklist
- Waste Management Plan
- Field Log Book
- Detailed as-built diagram (Attachment 2)

All decommissioning activities performed at SNL/NM will be accurately and concisely documented in a final P&A Report to be submitted to the NMED/HWB and the OSE. The P&A Report will contain a brief narrative describing actual work performed at the site and any variances to the site-specific P&A Plan. Information to be contained in the P&A Report include: (1) daily field activity notes, (2) all materials used, (3) a final "as-built" plugging and abandonment diagram, and (4) documentation of notification of SNL/NM GIS group and the appropriate regulatory agencies. The Well Plugging and Abandonment Form (Attachment 2) will be completed and included as part of the P&A Report.

Further P&A reporting elements are required by the OSE (OSE August 2005). SNL/NM personnel and the licensed well driller (contractor) will submit a plugging record with the state engineer no later than twenty (20) days after completion of the plugging. The record will include the following elements:

- Name and address of the well owner
- Well driller's name and license number
- Name of each drill rig supervisor that supervised the well plugging
- State engineer file number for the well (if available)
- Location of the well (reported in New Mexico state plane coordinates to ±0.01 ft)
- Dates when plugging began/concluded
- Plugging material(s) used
- Depth of the well
- Size and type of casing
- Location of perforations
- Location of the sanitary seal
- Completed well log with depth and thickness of all strata plugged, including whether each stratum was water bearing

10.2 Well Installation Records

All well installation field activities will be documented in a field log book per guidance in FOP 94-45. Upon completion of the well installation, the Field Report will document all site activities and provide final as-built well completion diagrams (Attachment 4). The Field Report will contain a brief narrative describing actual work performed at the site and any variances to the site-specific Well Installation Plan. Information to be contained in the Field Report include: (1) daily field activity notes, (2) all materials used, (3) a final "as-built" well completion diagram, and (4) documentation of notification of SNL/NM GIS group and the appropriate regulatory agencies. The documentation will also include the 37 information elements required in Section VIII.D of the Order (NMED April 2004). The following list of documents and records that are generated as part of the well installation process will be provided to the SNL/NM Well File Coordinator who, in turn, will submit them to the SNL/NM Customer-Funded Records Center:

- Well permit agreement
- Well file contents checklist
- Well data summary sheet
- Statement of work for drilling the well
- Drilling permit

- Lithologic (boring) log
- Well construction diagram and completion parameters
- Well development data and groundwater parameters
- Copies of field logbook (geologist, driller)
- Surveyed elevations and location in New Mexico state plane coordinates(with a degree of accuracy of ± 0.01 ft)
- Location map
- Water level measurements
- Aquifer test data
- Analytical data
- Waste management documentation
- Photographs

11 References

NMED April 2004, “Compliance Order on Consent Pursuant to the New Mexico Hazardous Waste Act 74-4-10: Sandia National Laboratories Consent Order,” New Mexico Environment Department, April 24, 2004.

OSE August 2005, “Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells” New Mexico Office of the State Engineer, August 2005.

Attachment 1

Monitoring Well Completion Diagram for MWL-BW1

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA III
ER ADS #:	1289	**Well Completion Date:**	01-JUL-1989
Well Name:	MWL-BW1	**Completion Zone:**	SAND AND GRAVEL
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE
Date Drilling Started:	24-JUN-1989	**Well Comment:**	WATER LEVEL MEASURED ON 5/14/90
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	MUD ROTARY		
Borehole Depth:	519		
Casing Depth:	477.17		

Survey Data

Survey Date: 12-APR-1990

Surveyed By: SANTIAGO ROMERO AND ASSOCIATES

State Plane Coordinates

(X) Easting: 411756.001

(Y) Northing: 1451698.73

Surveyed Elevations (FAMSL)

Protective Casing:	5385.05
Top of Inner Well Casing:	5384.51
Concrete Pad:	5383.35
Ground Surface:	5382.7

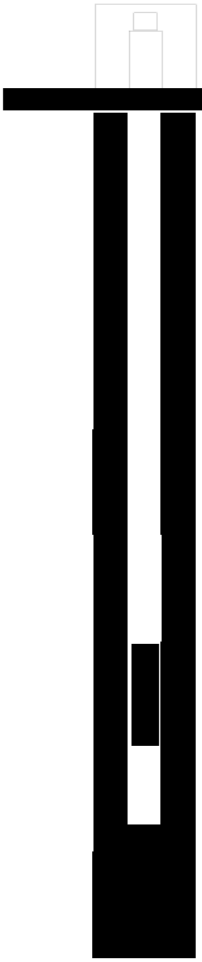
Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4923.3
Initial Depth To Water: (FBGS)	461.21

Last measured water level was measured on 17-OCT-2006 **FASL**

Date Updated: 14-MAR-00

Date Printed: 12-MAR-2007



Completion Data Measured Depths (FBGS)

Casing Stickup: 1.16

Interval	Start	Stop
GROUT/BACKFILL	0'	433'
NEAT CEMENT		

Interval	Start	Stop
CASING	0'	477.17'
PVC	I.D. 5"	

Interval	Start	Stop
BOREHOLE	0'	519'
	O.D.	12.25"

Interval	Start	Stop
SECONDARY PACK	441'	443'
16/40		

Interval	Start	Stop
PRIMARY PACK	443'	478'
10/20 SAND		

Interval	Start	Stop
SCREEN	452.17'	472.17'
304 STAINLESS STEEL		
	Slot Size	.01"

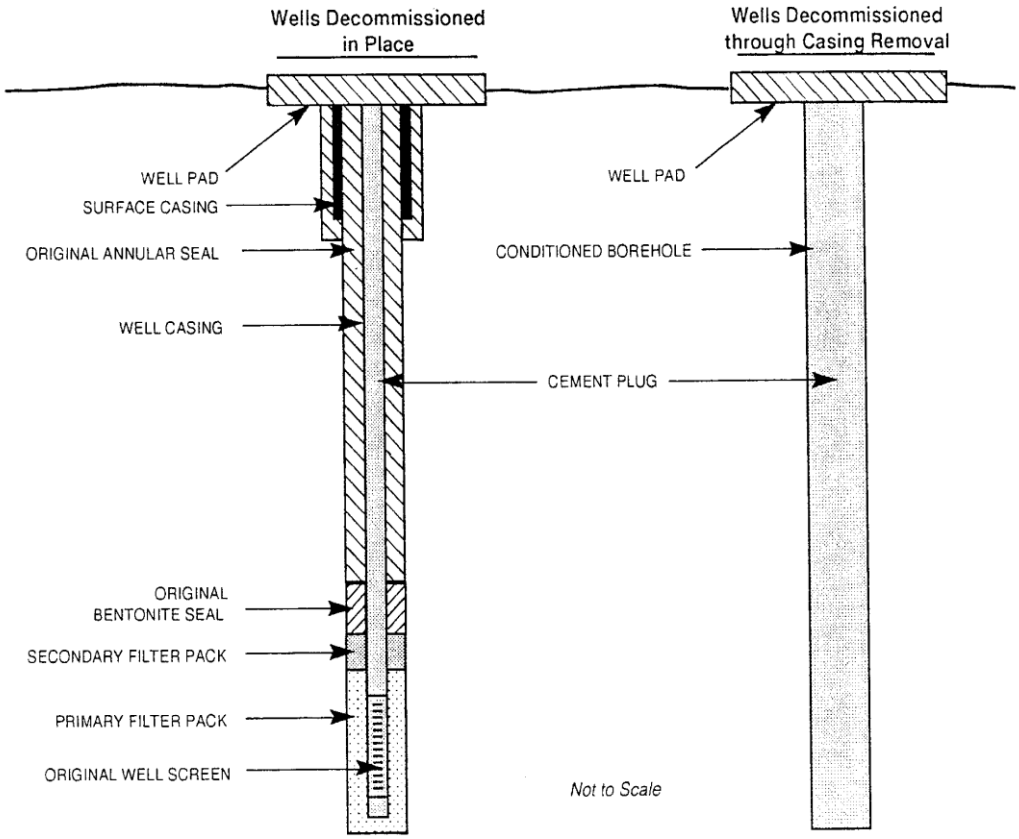
Interval	Start	Stop
SUMP	472.17'	477.17'

Interval	Start	Stop
PLUG BACK	477.17'	519'

Attachment 2

Groundwater Well Abandonment Diagram

SNL/NM ER PROJECT
GROUNDWATER MONITORING WELL ABANDONMENT DIAGRAM



WELL NAME _____
LOCATION DESCRIPTIVE _____
STATE PLANE COORDINATE X: _____
Y: _____
SURFACE CASING TYPE _____
SURFACE CASING LENGTH _____
I.D. OF WELL CASING _____
WELL CASING DEPTH _____
SCREEN INTERVAL _____
PLUGGING GROUT TYPE _____
GROUT VOLUME USED _____
DEPTH LIFT 1 _____
DEPTH LIFT 2 _____
DEPTH LIFT 3 _____
DATE OF DECOMMISSIONING _____

WELL NAME _____
LOCATION DESCRIPTIVE _____
STATE PLANE COORDINATE X: _____
Y: _____
CASING REMOVAL METHOD _____
FINAL HOLE DIAMETER _____
FINAL HOLE TOTAL DEPTH _____
PLUGGING GROUT TYPE _____
GROUT VOLUME USED _____
DEPTH LIFT 1 _____
DEPTH LIFT 2 _____
DEPTH LIFT 3 _____
DATE OF DECOMMISSIONING _____

Attachment 3

Well Plug and Abandonment Form

SNL/NM ER PROJECT
WELL PLUGGING AND ABANDONMENT FORM

1. Preabandonment Well Specifics:
   a. Well Identification _____
   b. Location (geographic description and state plane coordinates) _____
   c. Reported Well Depth (feet) _____
   d. Field Well Depth (feet) _____
   e. Screened Intervals(s) (feet) _____
   f. Screen Diameter(s) (inches) _____
   g. Screen Type(s) (SS or PVC, etc.) _____
   h. Casing Diameter(s) (inches) _____
   i. Casing Type (PVC, steel, etc.) _____
   j. Artesian or Nonartesian Aquifer _____

2. Reason for Abandonment:
   _____
   _____

3. Abandonment Specifics:
   a. Date Abandonment Started _____
   b. Date Abandonment Completed _____
   c. ID Number of Field Log Book Used _____
   d. Site Personnel _____
   e. Drilling Method Used _____
   f. Grout Used _____
   g. Casing Removed (Y or N) _____
   h. Concrete Pad Inscription _____

   j. Briefly Describe Abandonment Method:
   _____
   _____
   _____

   k. Disposition of Materials Removed From Well: _____
   _____
   _____

4. Comments or Problems Encountered: _____
   _____

Completed by: _____
Printed Name Signature Date

Subcontractor: _____

Drilling Contractor: _____ License No.: _____

Attachment 4

Groundwater Monitoring Well Data Sheet

SNL/NM Groundwater Monitoring Well Data Sheet

PROJECT NAME: _____
ER ADS #: _____
WELL NAME: _____
OWNER: _____
DATE DRILLING BEGAN: _____
DRILLING CONTRACTOR: _____
DRILLING METHOD: _____
BOREHOLE DEPTH: _____
BOREHOLE DIAMETERS: _____

GEOGRAPHIC LOCATION: _____
WELL COMPLETION DATE: _____
COMPLETION ZONE: _____
FORMATION OF COMPLETION: _____
REMARKS: _____

Survey Data

Survey Date: _____
Surveyed by: _____

State Plane Coordinates
(X) Easting = _____
(Y) Northing = _____

Surveyed Elevations
(feet above sea level)

Protective Casing: _____
(Elev. D - FOP 94–71)

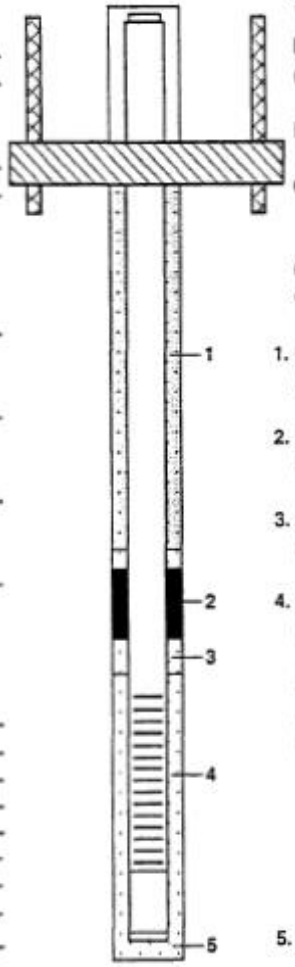
Top of Inner Well Casing: _____
(Elev C - FOP 94–71)

Concrete Pad: _____
(Elev B - FOP 94–71)

Ground Surface: _____
(Elev A - FOP 94–71)

Calculated Elevations
(feet above sea level)
Initial Water Level: _____
Other: _____
Comments: _____

Form Completed by: _____
Verified by: _____



Completion Data

Measured Depths
(feet below ground surface)

Initial Water Level: _____

Casing Stickup: _____
(above ground level)

Casing OD (in.): _____
Casing ID (in.): _____

1. Grout/Backfill Interval: _____
   Material: _____

2. Seal Interval: _____
   Material: _____

3. Secondary Pack Interval: _____
   Secondary Pack Size: _____

4. Primary Pack Interval: _____
   Primary Pack Size: _____

   Screen Interval: _____
   Slot Size: _____
   Material: _____

   Sump Length: _____

   Casing Depth: _____
   Material: _____

5. Plug Back Interval (if used): _____
   (Casing TD-Hole TD) _____
   Plug Material (if used): _____

301462.71.01/cw A1

Volume VIII

TAB 6

Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Wells MWL-MW1 and MWL-MW-3; Installation of Wells MWL-MW7 and MWL-MW8

From: SNL/Wagner
To: NMED/Bearzi

Back of Tab 6

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

AUG 1 0 2007

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. James Bearzi
Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road, Bldg. E
Santa Fe, New Mexico 87505

Dear Mr. Bearzi:

On behalf of Sandia Corporation and the Department of Energy (DOE), DOE is submitting a Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan; Decommissioning of Groundwater Monitoring Wells MWL-MW1 and MWL-MW3; Installation of Replacement Groundwater Monitoring Wells MWL-MW7 and MWL-MW8. This Plug and Abandonment Plan is required under Section VIII.C of the Compliance Order of Consent.

For efficiency and cost savings, we have scheduled this work to coincide with other field work scheduled for late summer. We would appreciate your review of the enclosed documents as soon as possible.

If you have any questions regarding this submittal, please contact me at (505) 845-6036, or Dan Pellegrino of my staff at (505) 845-5398.

Sincerely,

Patty Wagner
Manager

Enclosures (2)

cc w/enclosures:
W. Moats, NMED-HWB (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB

AUG 1 0 2007

cc w/o enclosures:
A. Blumberg, SNL/NM, Org. 11100, MS 0141
D. Miller, SNL/NM, Org. 6765, MS 0718
P. Freshour, SNL/NM, Org. 6765, MS 1089
M. Skelly, SNL/NM, Org. 6765, MS 1089
M. Davis, SNL/NM, Org. 6765, MS 1089
Records Center, SNL/NM, Org. 6765, MS 1089
T. Longo, HQ/GTN, NA-56
J. Estrada, SSO, MS 0184

AOP 95-45, 06

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan; Decommissioning of Groundwater Monitoring Wells MWL-MW1 and MWL-MW3; Installation of Replacement Groundwater Monitoring Wells MWL-MW7 and MWL-MW8, July 2007**

Document author: Mike Skelly, Dept. 6765

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: Francis B Nimick 7/31/07
Francis B. Nimick Date
Deputy to the
Nuclear Energy and Global Security Technologies
Center 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: Kimberly A Davis 8/10/07
Patty Wagner Date
Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Monitoring Well Plug and Abandonment Plan
and
Replacement Well Construction Plan

Decommissioning of Groundwater Monitoring Wells
MWL-MW1 and MWL-MW3

Installation of Replacement Groundwater Monitoring Wells
MWL-MW7 and MWL-MW8

Environmental Restoration Project
Sandia National Laboratories, New Mexico

Sandia is a multiprogram laboratory managed and operated by Sandia Corporation, a wholly-owned subsidiary of Lockheed Martin Corporation, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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1 Project and Site Information

Task Description: Sandia National Laboratories/New Mexico (SNL/NM) decommissioning with plug and abandonment of two groundwater monitoring wells, and installation of two replacement groundwater monitoring wells

Case No.: 98026.01.08

Project Leader/Department No.: Paul Freshour/6765

Scheduled Start Date: September 2007

Estimated Completion Date: October 2007

Operations/Technical Area: Mixed Waste Landfill/Technical Area III

2 Regulatory Criteria

This Plug and Abandonment (P&A) Plan outlines the activities and procedures to decommission existing groundwater monitoring wells MWL-MW1 and MWL-MW3; with the installation of replacement groundwater monitoring wells MWL-MW7 and MWL-MW8.

In July 2007, the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia) received a letter from the New Mexico Environment Department/Hazardous Waste Bureau (NMED/HWB) entitled "*Replacement of Mixed Waste Landfill Groundwater Monitoring Wells MWL-MW1 and MWL-MW3*" (NMED July 2007). In this letter the NMED requested that due to well construction issues, DOE/Sandia are required to replace these two groundwater monitoring wells. The letter also stated that DOE/Sandia shall submit to the NMED within 60 days a plan for approval describing how the wells are to be replaced and a schedule for implementation of this work.Section VIII.C of the Compliance Order on Consent (the Order) discusses well abandonment (NMED April 2004):

> *"Wells shall be abandoned when they are no longer required in the monitoring network, no longer provide representative groundwater samples because of falling water levels or insufficient productivity, or become damaged beyond repair. The goal of well abandonment is to seal the well in such a manner that it cannot act as a conduit for the migration of contaminants from either the ground surface to the saturated zone or between saturated zones. Respondents shall prepare an abandonment plan for any and all wells that are to be plugged and abandoned, and shall submit the plan to the Department for approval. Respondents shall not abandon any groundwater monitoring well without prior written approval of the Department."*

Further regulatory requirements for well P&A procedures can be found in the New Mexico Office of the State Engineer (OSE) "Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells" (NM OSE August 2005):

> *"To plug a well, the entire well shall be filled from the bottom upwards to land surface using a tremie pipe. The well shall be plugged with neat cement slurry, bentonite based plugging material, or other sealing material approved by the state engineer for use in the plugging of non-artesian wells."*

The OSE regulations also state that:

> "*Wells encountering contaminated water or soil may require coordination between the office of the state engineer and the New Mexico environment department (or other authorized agency or department) prior to the plugging of the well*."

And,

> "*A licensed well driller shall keep a record of each well plugged as the work progresses. The well driller shall file a complete plugging record with the state engineer and the permit holder no later than twenty (20) days after completion of the plugging. The plugging record shall be on a form prescribed by the state engineer . . .*"

To meet these regulatory requirements, the following tasks will be completed at SNL/NM:

- Decommission wells MWL-MW1 and MWL-MW3 because they no longer provide representative groundwater samples due to falling water levels and insufficient productivity, and/or due to corrosion of their stainless steel screens.
- Submit this P&A Plan to the NMED/HWB and OSE for review and approval.
- Use a licensed well driller and approved materials to seal the wells so that they cannot act as a conduit for the migration of potential contaminants from the ground surface to the saturated zone.
- Upon completion of the P&A activities, submit a plugging record to the OSE and submit a P&A Report describing the field activities to the NMED/HWB.

3 Existing Well Information

Groundwater monitoring wells MWL-MW1 and MWL-MW3 are proposed for decommissioning in this P&A Plan. The monitoring well completion diagrams are presented in Attachments 1 and 2, and the pertinent well completion information is summarized below.

MWL-MW1 is a groundwater monitoring well located at the Mixed Waste Landfill (Figure 1). This well was installed in October 1988 and is completed in the regional aquifer with the following well completion details:

- Total depth of the well – 478 feet (ft) below ground surface (bgs).
- Screened interval – 456 to 476 ft bgs.
- Construction materials – Polyvinyl chloride (PVC) riser pipe, stainless steel screen, carbon steel protective surface casing and guard posts, and a concrete well pad.
- Current water level – approximately 465 ft bgs.
- Water-bearing strata – Groundwater occurs in unconsolidated silts and sands (alluvial fan facies) of the upper Santa Fe Group that have relatively low hydraulic conductivities.
- Reason for decommissioning – The stainless-steel screen is corroding and the well requires excessive time to recover between purging and sampling. There is no evidence that suggests the annular seal is compromised.

MWL-MW3 is a groundwater monitoring well located at the Mixed Waste Landfill (Figure 1). This well was installed in August 1989 and is completed in the regional aquifer with the following well completion details:

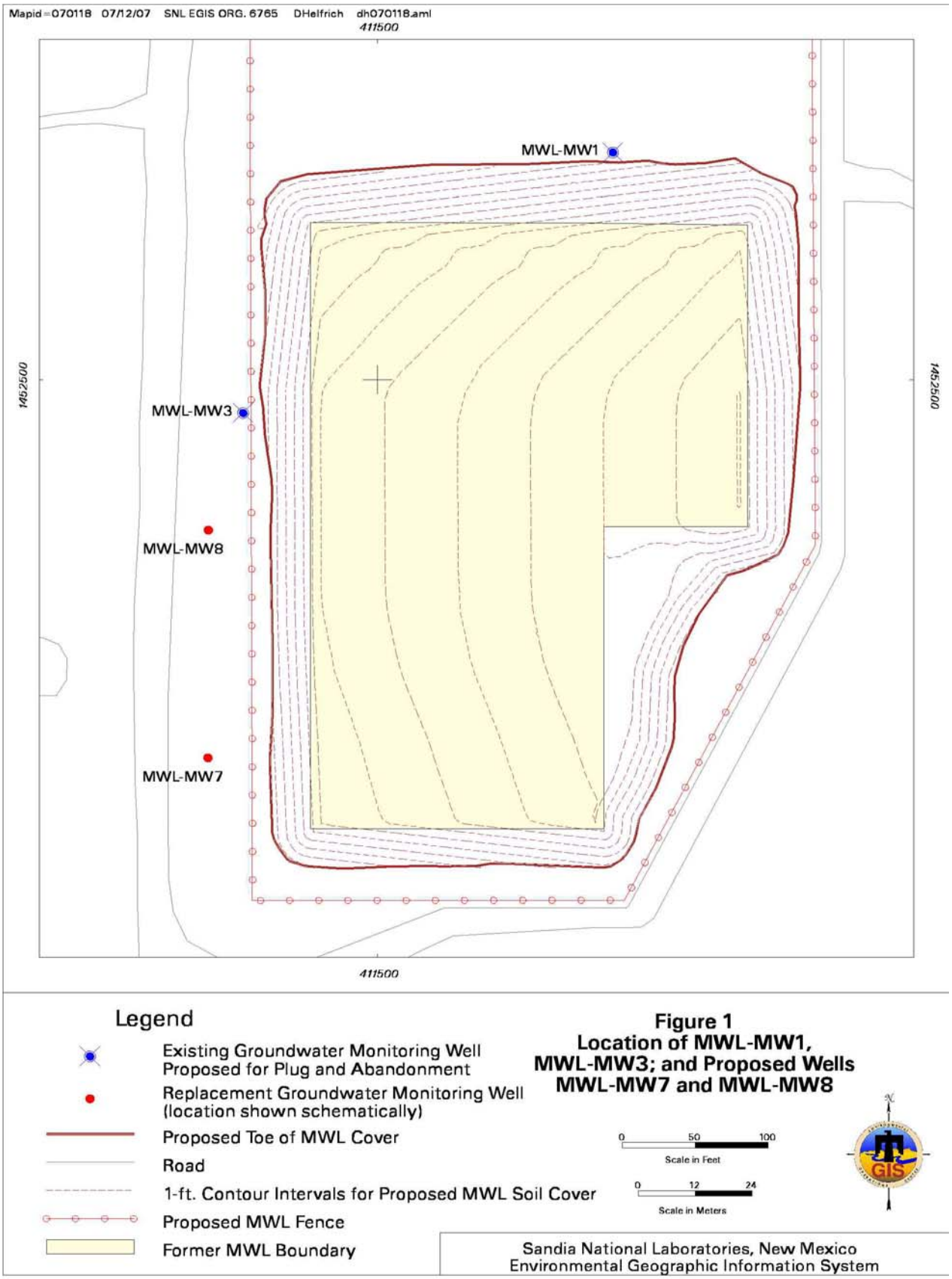
- Total depth of the well – 476 feet (ft) below ground surface (bgs).
- Screened interval – 451 to 471 ft bgs.
- Construction materials – Polyvinyl chloride (PVC) riser pipe, stainless steel screen, carbon steel protective surface casing and guard posts, and a concrete well pad.
- Current water level – approximately 468 ft bgs.
- Water-bearing strata – Groundwater occurs in unconsolidated silts and sands (alluvial fan facies) of the upper Santa Fe Group that have relatively low hydraulic conductivities.
- Reason for decommissioning – The regional water table has dropped to the lowest portion of the screened interval and the well requires excessive time to recover between purging and sampling. Also, the stainless-steel screen is corroding. There is no evidence that suggests the annular seal is compromised.

4 Plugging and Abandonment

Based on the requirements established by the NMED/HWB and OSE, the groundwater monitoring wells MWL-MW1 and MWL-MW3 will be decommissioned. Applicable Field Operating Procedures (FOPs) and Administrative Operating Procedures (AOPs) are listed in Table 1; however, this site-specific P&A Plan should be used as the primary guidance in the field.

Table 1. Applicable Operating Procedures

Number of Procedure	Title of Procedure
FOP 94-01	Safety Meetings, Inspections, and Pre-Entry Briefings Rev. 1, 12/16/96
FOP 94-05	Borehole Lithologic Logging, Rev. 0, 2/10/94
FOP 94-25	Documentation of Field Activities, Rev. 0, 11/4/94
FOP 94-26	General Equipment Decontamination, Rev. 1, 2/20/97
FOP 94-28	Health and Safety Monitoring of Organic Vapors (FID and PID), Rev. 2, 4/27/97
FOP 94-38	Drilling Methods and Drill Site Management, Rev. 0, 4/14/94
FOP 94-41	Well Development, Rev. 0, 11/21/94
FOP 94-42	Integration of the design, Installation, Rehabilitation, and Decommissioning of Environmental Restoration Wells, Rev. 1, 5/31/94
FOP 94-43	Decommissioning Of Wells, Rev 0, 5/31/94
FOP 94-45	Designing and Installing Groundwater Monitoring Wells, Rev. 0, 5/31/94
FOP 94-57	Decontaminating Drilling and Other Field Equipment, Rev. 0, 5/31/94
FOP 94-68	Field Change Control, Rev. 2 (in revision)
FOP 94-69	Personnel Decontamination (Level D, C, and B Protection), Rev. 1, 1/23/98
AOP 94-24	System and Performance Audits, Rev. 0, 1/12/95
AOP 94-25	Deficiency Reporting, Rev. 0, 1/12/95
AOP 95-16	Administrative Operating Procedure for Sample Management and Custody, Rev. 1, 4/18/96


Mapid = 070118 07/12/07 SNL EGIS ORG. 6765 DHelfrich dh070118.aml
411500
MWL-MW1
MWL-MW3
MWL-MW8
MWL-MW7
1452500
1452500
411500
Legend
Existing Groundwater Monitoring Well Proposed for Plug and Abandonment
Replacement Groundwater Monitoring Well (location shown schematically)
Proposed Toe of MWL Cover
Road
1-ft. Contour Intervals for Proposed MWL Soil Cover
Proposed MWL Fence
Former MWL Boundary
Figure 1
Location of MWL-MW1, MWL-MW3; and Proposed Wells MWL-MW7 and MWL-MW8
0 50 100
Scale in Feet
0 12 24
Scale in Meters
GIS
Sandia National Laboratories, New Mexico
Environmental Geographic Information System

4.1 Goal

The goal for decommissioning monitoring wells MWL-MW1 and MWL-MW3 is to eliminate the potential of these wells to act as conduits for the migration of potential contamination to groundwater. The well materials and annular seals are not believed to pose a threat to groundwater, and therefore will be backfilled in place with proper sealing materials.

4.2 Objective

The objective is to seal these monitoring wells in such a manner that there is reasonable certainty that the abandonment has adequately eliminated the potential for cross-communication between the land surface and the aquifer, and the potential for downward migration of potential contaminants through the borehole annulus to the aquifer. All grouting techniques and grout mixtures used during decommissioning will minimize grout intrusion into the native formation.

4.3 Implementation

General activities for the implementation of the P&A include:

1) Remove all monitoring well surface completion features,
2) Backfill the casings with well-plugging materials, and
3) Construct new surface pad/monuments.

SNL/NM personnel and the selected drilling contractor will remove all surface completion features, such as guard posts, concrete well pads, and surface protective casing. Care will be taken to prevent materials from falling down the well casing and possibly causing a downhole obstruction. The wells will be abandoned with casing left in place, and each well casing will be cut off at approximately 5 ft bgs.

For each well, the well screen and blank well casing will be sealed by lowering a tremie pipe to the base of the well casing (below the base of the screen) and injecting the plug material (bentonite grout) using a diaphragm or equivalent pump system. The plug material will be filled to within 5 ft of the ground surface and allowed to set overnight. If the level of the plug material in the well casing drops overnight, additional bentonite grout will be added to again reach within 5 ft of ground level.

Once the wells have been properly plugged, the decommissioning process will be completed by placing concrete in the upper 5 ft of the well/borehole and installing concrete slabs on the surface. The concrete pads will be 4 inches thick with a 2 ft by 2 ft area, constructed in the ground so that the surface of the finished concrete slab will be 1 to 2 inches above the natural ground surface. A brass marker containing the well name and date of decommissioning will be set in each of the concrete pads.

5 Monitoring Well Installation

Two replacement monitoring wells (MWL-MW7 and MWL-MW8) will be installed after MWL-MW1 and MWL-MW3 have been decommissioned.

5.1 Objective

Install two 5-inch nominal diameter PVC casing replacement monitoring wells to provide representative groundwater samples. The replacement monitoring well boreholes will be drilled using Air-Rotary Casing-Hammer (ARCH) drilling methods.

Based on the July 2007 letter from the NMED/HWB (NMED July 2007) the replacement wells shall be installed at locations as close as possible to the western boundary of the landfill, taking into account the footprint of the future landfill cover. The new well locations were selected for use during long-term monitoring of the groundwater. To meet this request, MWL-MW7 will be installed at a location approximately 520 ft southwest of MWL-MW1, and MWL-MW8 will be installed at a location approximately 90 ft south of MWL-MW3 (Figure 1). The proposed replacement well locations on Figure 1 are shown schematically; the actual location of each may vary due to utility clearance and land use issues.

5.2 Implementation

Applicable FOPs and AOPs are listed in Table 1; however, this site-specific plan should be used as the primary guidance in the field.

5.2.1 Borehole Drilling

The ARCH drilling method will use environmentally-friendly lubricants and will be able to penetrate highly variable lithologies such as cobbles, boulders, gravel, sand, clay, and caliche while maintaining an open, competent borehole. The geology of the borehole will be logged during drilling. The total depth of the borehole will be determined by the SNL/NM field geologist, but the depths are anticipated to be 30 to 35 ft deeper than the original well. The depth of the first encounter with regional groundwater and any perched groundwater will be logged during drilling. After reaching total depth, the cased borehole will be logged using natural gamma and neutron wire-line geophysical methods.

Minimal water (but no other foams/liquids) in the form of “mist” may be introduced into the borehole to aid in the removal of cuttings. Waste generation will be kept to a minimum. Borehole cuttings will be contained within an area adjacent to the well. Water produced from the well during drilling or development will be contained in 55-gallon drums and placed on spill control pallets.

Based on the most recent groundwater level measurements for the MWL Study Area (April 2007), monitoring well MWL-MW7 is anticipated to be drilled to approximately 495 ft bgs. The 30-ft well screen for MWL-MW7 will be set with approximately 5 ft of screen situated above the static water level. The anticipated depth to water at this location is approximately 465 ft bgs; therefore, the screen completion interval is expected to be approximately 460 to 490 ft bgs with a 5-ft sump placed below the screen.

Monitoring well MWL-MW8 is anticipated to be drilled to approximately 497 ft bgs. The 30-ft well screen for MWL-MW8 will be set with approximately 5 ft of screen situated above the static water level. The anticipated depth to water at this location is approximately 467 ft bgs; therefore, the screen completion interval is expected to be approximately 462 to 492 ft bgs with a 5-ft sump placed below the screen.

5.2.2 Well Construction

The monitoring wells will be completed as specified in this plan. The water-table monitoring wells will be installed through the temporary steel drive casing (nominal 10-inch diameter), and completed using 5-inch nominal diameter, flush threaded, PVC Schedule-80 water well casing. No solvents, cleaners, or lubricants will be used for construction of the monitoring well. The casing will be delivered pre-cleaned and bagged, or steam-cleaned on site prior to installation. To preserve the integrity of the well materials, the well screen and riser pipe will be suspended in the borehole until the primary filter pack, bentonite pellet seal and annular seal are installed.

The regional aquifer in the area is being over-pumped and the water table at MWL-MW1 and MWL-MW3 is rapidly declining with a decline rate of approximately 0.5 to 1.5 ft/year, respectively, over the last several years (Figures 2 and 3). To accommodate the rapidly declining water table, a 30-ft length of PVC screen with a 0.010-inch or 0.020-inch slot size will be used for the replacement wells. A 5-ft sump will be placed at the base of the screen and sealed with a threaded end cap. PVC centralizers will be placed at the base and top of the well screen and then at intervals not to exceed 100 ft up to the land surface. The screen for these water-table wells will be placed so that the top of the screens are approximately 5 ft above the static water level.

The appropriate screen slot size and gradation of the filter pack material will be based on the gradation of the sediments in the screen interval as determined in the field by the geologist logging the borehole. If the predominant water-bearing interval consists mostly of clay and silt, a 0.010-inch screen slot and a primary filter pack of clean 20-40 silica sand will be placed in the annulus. However, if the predominant water-bearing interval consists mostly of silt and sand, a 0.020-inch screen slot and a primary filter pack of clean 10-20 silica will be placed in the annulus. The primary filter pack will extend from the bottom of the sump to at least 5 ft above the top of the screen. A 5-ft thick layer of clean 40-60 sand will be placed above the primary filter pack. Both sand packs will be tagged using a tag line to verify their depth. Preliminary well development using a surge block will be performed at this time to help settle the filter pack.

A 10-ft thick layer of ¼-inch bentonite pellets or 3/8-inch bentonite chips will be placed above the filter pack prior to emplacement of the bentonite-grout annular seal. Each 5-ft thickness of bentonite pellets/chips added will be hydrated before adding the next 5-ft thickness of bentonite pellets/chips. The final lift of bentonite pellets/chips will be allowed to set for a time adequate for hydration (at least I hour). The remaining annular space to ground surface will then be filled with bentonite grout. To prevent overloading, the bentonite grout will be installed in multiple lifts. Per NMED requirements (NMED June 2007; SNL/NM in preparation), the first bentonite grout lift will be approximately 100 ft thick and will be allowed to set a minimum of 24 hours before installation of the next lift. Subsequent bentonite grout lifts will each be approximately 200 ft thick. The bentonite grout will be topped off to within 6-inches to 1-ft bgs.

The well casing will extend approximately 30 inches above ground surface with a water-tight cap. The monitoring well will be completed with protective steel casing with a hinged locking cap. The protective casing will be primed and painted yellow. A 3-ft by 3-ft, sloped concrete

Figure 2 MWL-MW1 Groundwater Elevations Over Time

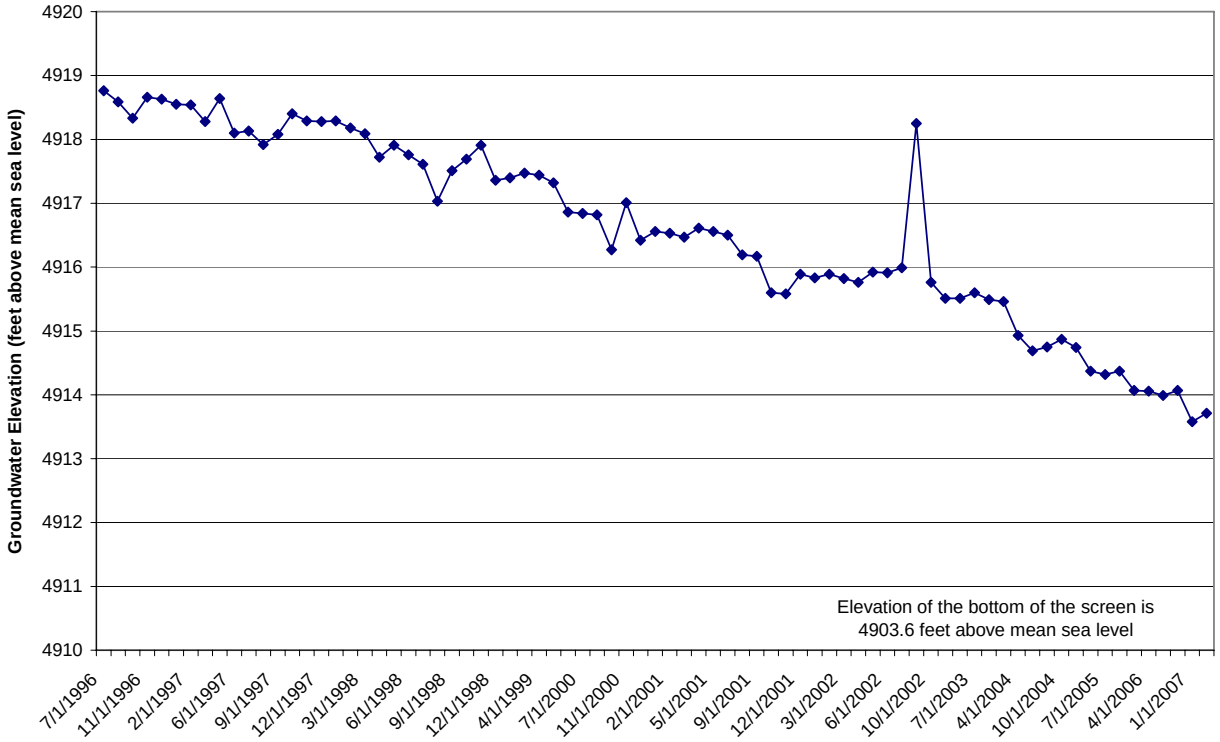
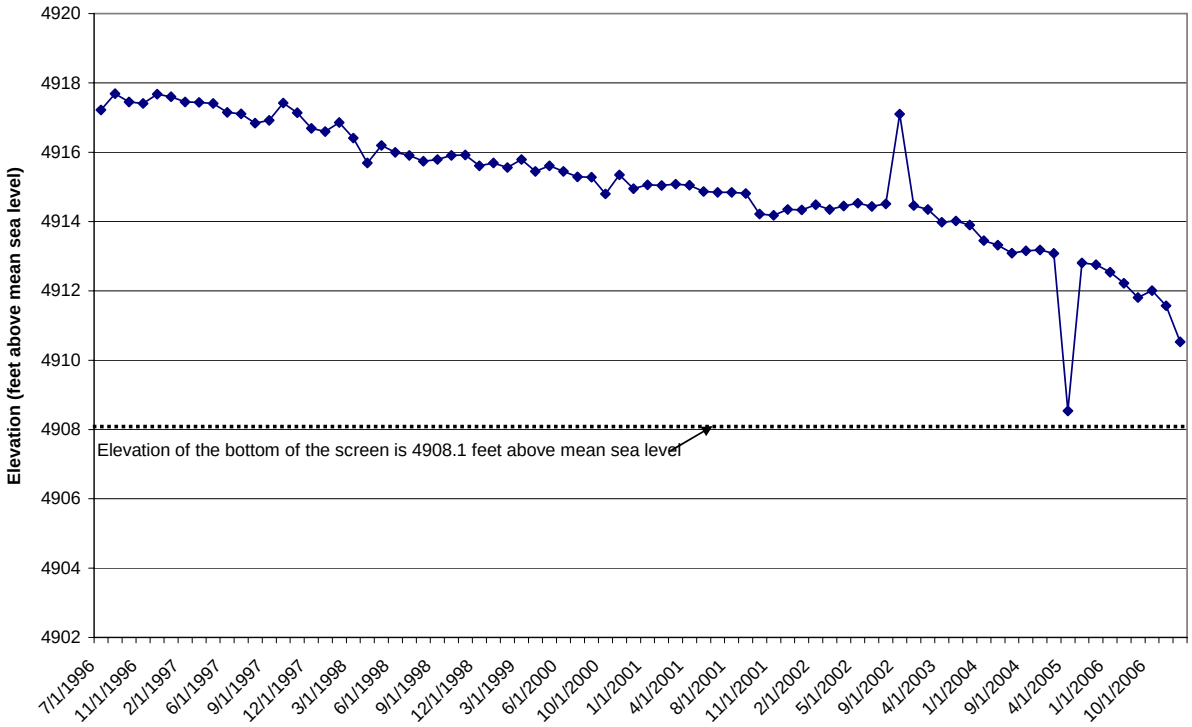


Figure 3 MWL-MW3 Groundwater Elevations Over Time



pad will be constructed around the casing. The pad will contain a 3-in brass cap stamped with the well identification. Three, 4-inch diameter concrete-filled, steel guard posts (also primed and painted yellow) will be placed around the pad, equidistant from the well.

5.2.3 Well Development

Well development will be initiated at least 48 hours after grouting. Each well will be developed for approximately 10 hours, and will consist of pumping, surge-block, swabbing, and/or bailing techniques. During development, the groundwater field parameters (pH, specific conductivity, temperature, and turbidity) will be continuously monitored, and development will continue until parameters have stabilized. All development water will be contained in drums and will not be allowed to discharge to the ground surface. The method of development, the volume of water added or removed, the parameters measured, the results of the measurements, and the time these activities take place will be documented in writing during well development. If required, only potable water shall be added to the wells during development.

During development of these water-table completion wells, a minimum of five well bore volumes will be removed. After the minimum volume has been removed, development will continue until representative water is obtained. Representative water is assumed to be obtained when pH, temperature, turbidity, and specific conductivity readings stabilize (less than 10% variability over three consecutive well bore volumes) and the water is visually clear of suspended solids with a target turbidity of less than five Nephelometric Turbidity Units (NTUs).

6 Equipment Decontamination

The drilling rig and related equipment will be decontaminated at the decontamination pad in Technical Area III prior to the beginning of drilling operations and between well locations. Decontamination of equipment will also be required after completing the well. Decontamination waste will be kept to a minimum and containerized in drums placed on spill control pallets at the decontamination pad.

7 Health and Safety

Level D personal protective equipment is required for all drilling operations. Health and Safety records associated with drilling and development personnel will be maintained on site and will be available at the commencement of drilling activities. All field personnel will operate under an SNL/NM Health and Safety Plan (HASP) and will have SNL/NM-required training including 40-Hr OSHA HAZWOPER and subsequent yearly refresher courses. An SNL/NM Subject Matter Expert will perform a safety inspection of the drill rig before drilling commences.

8 Pre-field activities

Pre-field activities that must be completed prior to drilling include:

- Preparation of the Statement of Work for drilling and monitoring well installation;
- SNL/NM digging permit request and approval;
- HASP preparation, review, and signatures;
- National Environmental Policy Act (NEPA) review and signatures;
- Sample bottle order for waste samples through Sample Management Office;
- Waste Management Plan preparation;
- Field checklist completion, review, and approval; and
- Readiness review meeting.

9 Mobilization and Site Setup

SNL/NM personnel will ensure that containers for cuttings have been obtained and are ready for drilling operations. Roll-off bins supplied by SNL/NM will be used to collect drill cuttings for waste management purposes.

10 Reporting

Based on the requirements established by the NMED/HWB, OSE and SNL/NM FOPs, the field activities associated with decommissioning and installation of the monitoring wells will be documented.

10.1 Decommissioning Records

All decommissioning field activities will be documented in a field log book per guidance in FOP 94-25. Upon completion of decommissioning of the wells, the P&A Report will document all site activities and provide final as-built well decommissioning diagram (Attachment 3). Attachment 4 will be used to assure that all records are completed, approved, and submitted for proper records management. The following list of documents and records that are generated as part of the decommissioning process will be provided to the SNL/NM Well File Coordinator who, in turn, will submit them to the SNL/NM Customer-Funded Records Center:

- Monitoring Well Plugging and Abandonment Request
- Well Plugging and Abandonment Form
- Site-Specific Well Plugging and Abandonment Work Plan
- Site-Specific Well Plugging and Abandonment Report
- Plugging and Abandonment Documentation and Approval Checklist
- Waste Management Plan
- Field Log Book
- Detailed as-built diagram (Attachment 3)

All decommissioning activities performed at SNL/NM will be accurately and concisely documented in a final P&A Report to be submitted to the NMED/HWB and the OSE. The P&A Report will contain a brief narrative describing actual work performed at the site and any variances to the site-specific P&A Plan. Information to be contained in the P&A Report include: (1) daily field activity notes, (2) all materials used, (3) a final "as-built" plugging and abandonment diagram, and (4) documentation of notification of SNL/NM GIS group and the appropriate regulatory agencies. The Well Plugging and Abandonment Form (Attachment 3) will be completed and included as part of the P&A Report.

Further P&A reporting elements are required by the OSE (OSE August 2005). SNL/NM personnel and the licensed well driller (contractor) will submit a plugging record with the state engineer no later than twenty (20) days after completion of the plugging. The record will include the following elements:

- Name and address of the well owner
- Well driller's name and license number
- Name of each drill rig supervisor that supervised the well plugging
- State engineer file number for the well (if available)
- Location of the well (reported in New Mexico state plane coordinates to ±0.01 ft)
- Dates when plugging began/concluded
- Plugging material(s) used
- Depth of the well
- Size and type of casing
- Location of perforations
- Location of the sanitary seal
- Completed well log with depth and thickness of all strata plugged, including whether each stratum was water bearing

10.2 Well Installation Records

All well installation field activities will be documented in a field log book per guidance in FOP 94-45. Upon completion of the well installation, the Field Report will document all site activities and provide final as-built well completion diagrams (Attachment 5). The Field Report will contain a brief narrative describing actual work performed at the site and any variances to the site-specific Well Installation Plan. Information to be contained in the Field Report include: (1) daily field activity notes, (2) all materials used, (3) a final "as-built" well completion diagram, and (4) documentation of notification of SNL/NM GIS group and the appropriate regulatory agencies. The documentation will also include the 37 information elements required in Section VIII.D of the Order (NMED April 2004). The following list of documents and records that are generated as part of the well installation process will be provided to the SNL/NM Well File Coordinator who, in turn, will submit them to the SNL/NM Customer-Funded Records Center:

- Well permit agreement
- Well file contents checklist
- Well data summary sheet
- Statement of work for drilling the well
- Drilling permit
- Lithologic (boring) log
- Well construction diagram and completion parameters
- Well development data and groundwater parameters
- Copies of field logbook (geologist, driller)
- Surveyed elevations and location in New Mexico state plane coordinates (with a degree of accuracy of ± 0.01 ft)
- Location map
- Water level measurements
- Aquifer test data
- Analytical data

- Waste management documentation
- Photographs

11 References

New Mexico Environment Department (NMED) April 2004, “Compliance Order on Consent Pursuant to the New Mexico Hazardous Waste Act 74-4-10: Sandia National Laboratories Consent Order,” New Mexico Environment Department, April 24, 2004.

New Mexico Environment Department (NMED) June 2007, “Notice of Disapproval: Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan, Decommissioning of Groundwater Monitoring Well MWL-BW1, Installation of Replacement Groundwater Monitoring Well MWL-BW2, April 9, 2007, Sandia National Laboratories NM5890110518, HWB-SNL-07-014.” Letter to Patty Wagner (SSO/NNSA) and Francis Nimick (Sandia) from James Bearzi, June 19, 2007

New Mexico Environment Department (NMED) July 2007, “Replacement of Mixed Waste Landfill Groundwater Monitoring Wells MWL-MW1 and MWL-MW3, Sandia National Laboratories, EPA ID NM5890110518” Letter to Patty Wagner (SSO/NNSA) and Francis Nimick (Sandia) from James Bearzi, July 2, 2007.

OSE August 2005, “Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells” New Mexico Office of the State Engineer, August 2005.

Sandia National Laboratories, New Mexico (SNL/NM), in preparation “Response to Notice of Disapproval: Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan, Decommissioning of Groundwater Monitoring Well MWL-BW1, Installation of Replacement Groundwater Monitoring Well MWL-BW2”, and Revised Plan, Sandia National Laboratories Environmental Restoration Project.

Attachment 1

Monitoring Well Completion Diagram for MWL-MW1

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	MIXED WASTE LANDFILL
ER ADS #:	1289	**Well Completion Date:**	01-OCT-1988
Well Name:	MWL-MW1	**Completion Zone:**	SILTY SAND
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	28-SEP-1988	**Well Comment:**	BOREHOLE DIAM IS 14" TO 200' - 10" TO 478.67 - WATER LEV ELEV 8/16/90
Drilling Contractor:	WATER DEVELOPMENT		
Drilling Method:	AIR ROTARY CASING HAMMER		
Borehole Depth:	478.67		
Casing Depth:	478		

Survey Data

Survey Date: 01-JAN-1990

Surveyed By: SANTIAGO ROMERO AND ASSOCIATES

State Plane Coordinates

(X) Easting: 411661.747

(Y) Northing: 1452661.099

Surveyed Elevations (FAMSL)

Protective Casing:	5382.2
Top of Inner Well Casing:	5381.54
Concrete Pad:	5379.56
Ground Surface:	5379.12

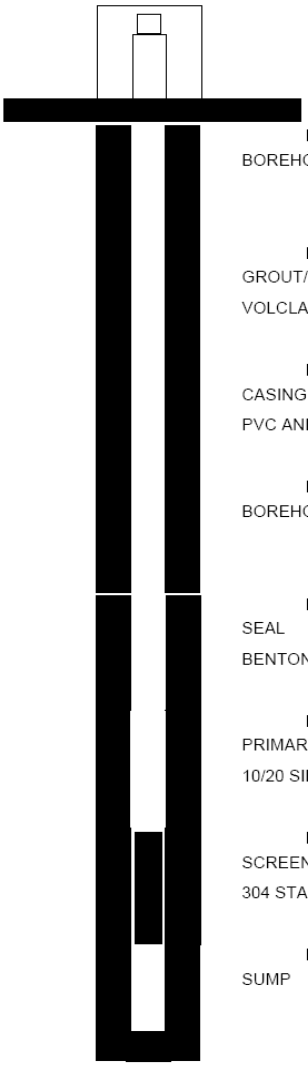
Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4923.36
Initial Depth To Water: (FBGS)	458.18

Last measured water level was measured on 12-APR-2007 **FASL**

Date Updated: 29-AUG-2006

Date Printed: 10-JUL-2007



Completion Data Measured Depths (FBGS)

Casing Stickup: 1.98

Interval	Start	Stop	
BOREHOLE	0'	200'	
		O.D.	14"
Interval	**Start**	**Stop**	
GROUT/BACKFILL	0'	434.9'	
VOLCLAY			
Interval	**Start**	**Stop**	
CASING	0'	478'	
PVC AND STEEL	**I.D.**	5"	
Interval	**Start**	**Stop**	
BOREHOLE	200'	478.67'	
		O.D.	10"
Interval	**Start**	**Stop**	
SEAL	434.9'	445.5'	
BENTONITE PELLETS			
Interval	**Start**	**Stop**	
PRIMARY PACK	445.5'	478.67'	
10/20 SILICA SAND			
Interval	**Start**	**Stop**	
SCREEN	456'	476'	
304 STAINLESS STEEL			
		Slot Size	.01"
Interval	**Start**	**Stop**	
SUMP	476'	478'	

Attachment 2

Monitoring Well Completion Diagram for MWL-MW3

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA-III
ER ADS #:	1289	**Well Completion Date:**	22-AUG-1989
Well Name:	MWL-MW3	**Completion Zone:**	SAND
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE
Date Drilling Started:	20-AUG-1989	**Well Comment:**	BOREHOLE TD AT 501', BACKFILL WITH .4 BENTONITE/CEMENT PLUG TO 478' ABOUT 1' OF 16/40 FN SIL SAND AT TOP OF FILTER PACK
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	MUD ROTARY		
Borehole Depth:	501		
Casing Depth:	476.3		

Survey Data

Survey Date:	16-AUG-1990
Surveyed By:	SANTIAGO ROMERO AND ASSOCIATES

State Plane Coordinates

(X) Easting:	411407.995
(Y) Northing:	1452476.617

Surveyed Elevations (FAMSL)

Protective Casing:	5381.78
Top of Inner Well Casing:	5381.32
Concrete Pad:	5379.41
Ground Surface:	5378.97

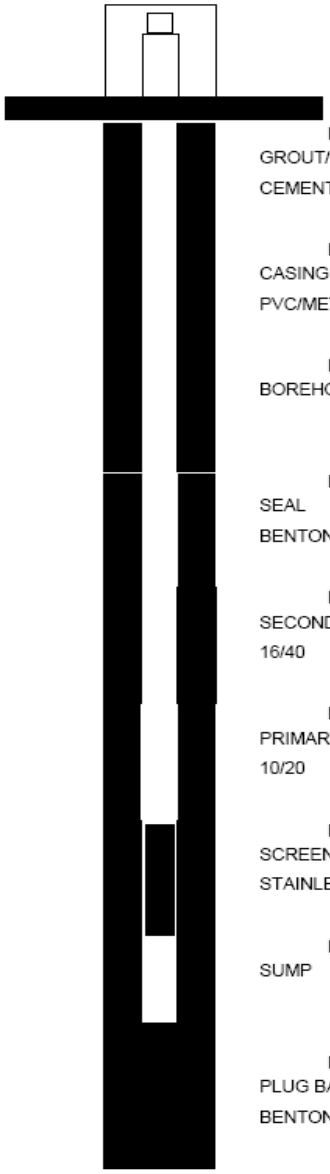
Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4921.1	
Initial Depth To Water: (FBGS)	460.22	

Last measured water level was measured on 26-APR-2007 **FASL**

Date Updated: 14-MAR-00

Date Printed: 10-JUL-2007



Completion Data Measured Depths (FBGS)

Casing Stickup: 1.91

Interval	Start	Stop
GROUT/BACKFILL	0'	429'
CEMENT/BENTONITE		

Interval	Start	Stop
CASING	0'	478.8'
PVC/METAL	O.D.	5"

Interval	Start	Stop
BOREHOLE	0'	501'
	O.D.	12.25"

Interval	Start	Stop
SEAL	429'	444'
BENTONITE		

Interval	Start	Stop
SECONDARY PACK	444'	446'
16/40		

Interval	Start	Stop
PRIMARY PACK	446'	476'
10/20		

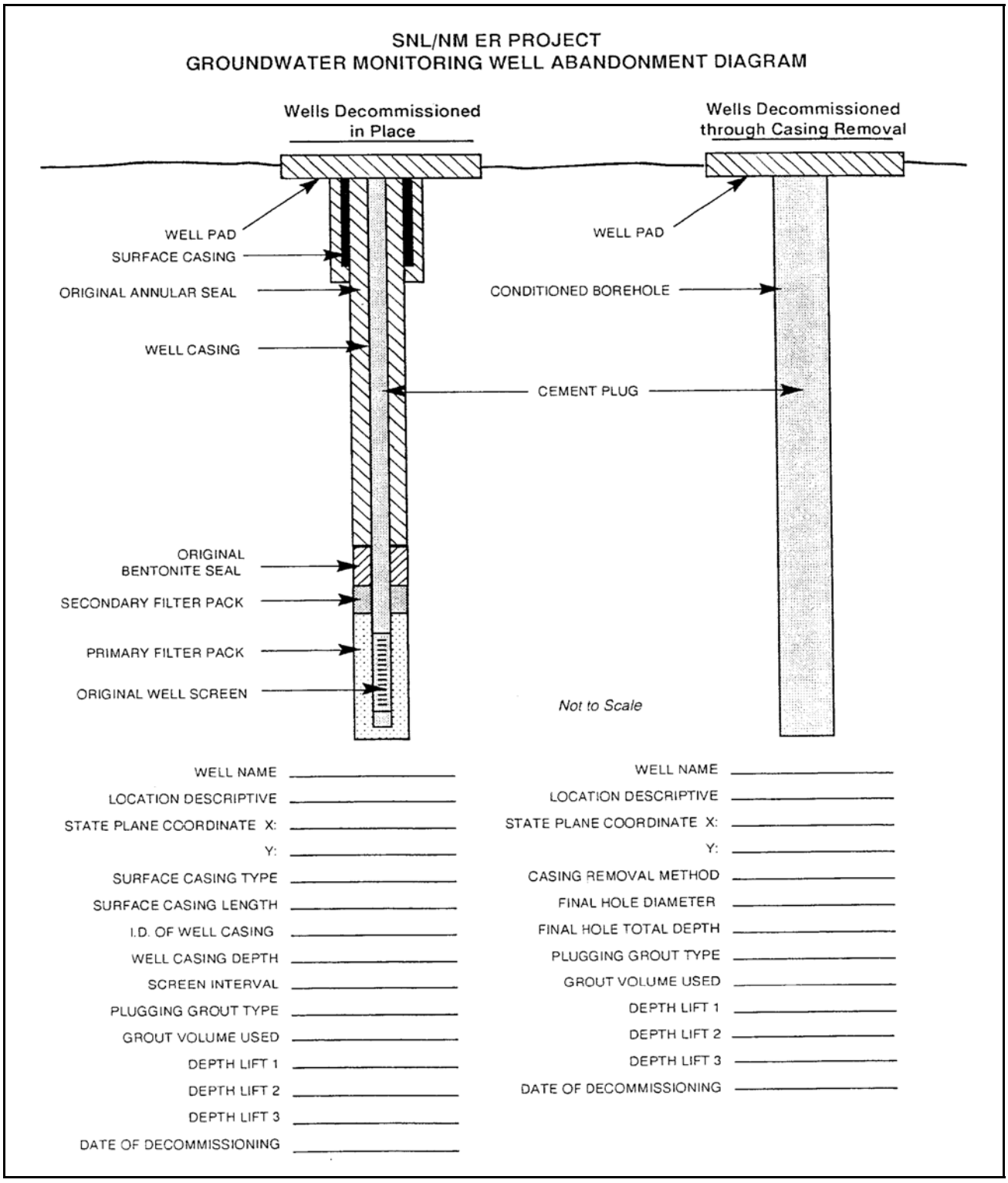
Interval	Start	Stop
SCREEN	451.3'	471.3'
STAINLESS STEEL		
	Slot Size	.01"

Interval	Start	Stop
SUMP	471.3'	476.3'

Interval	Start	Stop
PLUG BACK	476.3'	501'
BENTONITE		

Attachment 3

Groundwater Well Abandonment Diagram



Attachment 4

Well Plug and Abandonment Form

SNL/NM ER PROJECT
WELL PLUGGING AND ABANDONMENT FORM

1. Preabandonment Well Specifics:
   a. Well Identification _____
   b. Location (geographic description and state plane coordinates) _____
   c. Reported Well Depth (feet) _____
   d. Field Well Depth (feet) _____
   e. Screened Intervals(s) (feet) _____
   f. Screen Diameter(s) (inches) _____
   g. Screen Type(s) (SS or PVC, etc.) _____
   h. Casing Diameter(s) (inches) _____
   i. Casing Type (PVC, steel, etc.) _____
   j. Artesian or Nonartesian Aquifer _____

2. Reason for Abandonment:
   _____
   _____

3. Abandonment Specifics:
   a. Date Abandonment Started _____
   b. Date Abandonment Completed _____
   c. ID Number of Field Log Book Used _____
   d. Site Personnel _____
   e. Drilling Method Used _____
   f. Grout Used _____
   g. Casing Removed (Y or N) _____
   h. Concrete Pad Inscription _____

   j. Briefly Describe Abandonment Method:
   _____
   _____
   _____

   k. Disposition of Materials Removed From Well: _____
   _____
   _____

4. Comments or Problems Encountered: _____
   _____

Completed by: _____
Printed Name Signature Date

Subcontractor: _____

Drilling Contractor: _____ License No.: _____

Attachment 5

Groundwater Monitoring Well Data Sheet

SNL/NM Groundwater Monitoring Well Data Sheet

PROJECT NAME: _____
ER ADS #: _____
WELL NAME: _____
OWNER: _____
DATE DRILLING BEGAN: _____
DRILLING CONTRACTOR: _____
DRILLING METHOD: _____
BOREHOLE DEPTH: _____
BOREHOLE DIAMETERS: _____

GEOGRAPHIC LOCATION: _____
WELL COMPLETION DATE: _____
COMPLETION ZONE: _____
FORMATION OF COMPLETION: _____
REMARKS: _____

Survey Data

Survey Date: _____
Surveyed by: _____

State Plane Coordinates
(X) Easting = _____
(Y) Northing = _____

Surveyed Elevations
(feet above sea level)

Protective Casing: _____
(Elev. D - FOP 94–71)

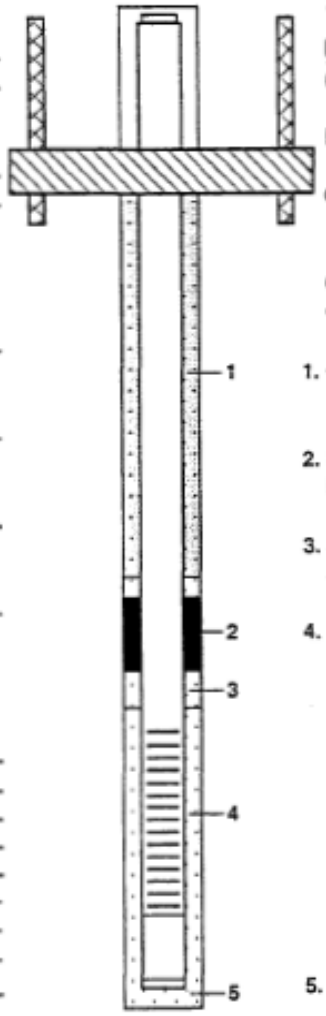
Top of Inner Well Casing: _____
(Elev C - FOP 94–71)

Concrete Pad: _____
(Elev B - FOP 94–71)

Ground Surface: _____
(Elev A - FOP 94–71)

Calculated Elevations
(feet above sea level)
Initial Water Level: _____
Other: _____
Comments: _____

Form Completed by: _____
Verified by: _____



Completion Data

Measured Depths
(feet below ground surface)

Initial Water Level: _____

Casing Stickup: _____
(above ground level)

Casing OD (in.): _____
Casing ID (in.): _____

1. Grout/Backfill Interval: _____
   Material: _____
2. Seal Interval: _____
   Material: _____
3. Secondary Pack Interval: _____
   Secondary Pack Size: _____
4. Primary Pack Interval: _____
   Primary Pack Size: _____

Screen Interval: _____
Slot Size: _____
Material: _____

Sump Length: _____

Casing Depth: _____
Material: _____

5. Plug Back Interval (if used): _____
   (Casing TD-Hole TD) _____
   Plug Material (if used): _____

301462.71.01/cw A1

Volume VIII

TAB 7

Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2, Revision 1

From: NMED/Bearzi
To: SNL/Wagner

Back of Tab 7

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

CINDY PADILLA
Deputy Secretary

CERTIFIED MAIL, RETURN RECEIPT REQUESTED

October 10, 2007

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Securities Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: NOTICE OF APPROVAL: MONITORING WELL PLUG AND ABANDONMENT PLAN AND REPLACEMENT WELL CONSTRUCTION PLAN; DECOMMISIONING OF GROUNDWATER MONITORING WELL MWL-BW1, INSTALLATION OF REPLACEMENT GROUNDWATER MONITORING WELL MWL-BW2, REVISION 1, AUGUST 3, 2007
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-07-014

Dear Ms. Wagner and Mr. Nimick:

The New Mexico Environment Department (NMED) has reviewed the subject document dated August 3, 2007. The U. S. Department of Energy/Sandia Corporation's document dated July 9, 2007 "Responses to NMED's Notice of Disapproval" was included in the same transmittal. All 13 deficiencies noted in NMED's Notice of Disapproval dated June 19, 2007 have been adequately addressed. The NMED therefore approves the subject plan with the submitted revisions. The scope of work, excluding the report, in the subject plan shall be concluded by January 1, 2008. The report documenting the work shall be submitted to NMED by April 30, 2008.

If you have any questions regarding this matter, please contact Mr. Brian L. Salem of my staff at (505) 222-9576.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
B. Salem, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
P. Freshour, SNL MS 1089
J. Gould, DOE, MS 0184
File: SNL 2007 and Reading
SNL-07-014

Volume VIII

TAB 8

Correction for Notice of Approval Dated October 10, 2007 Regarding Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-BW1, Installation of Well MWL-BW2

From: NMED/Bearzi
To: SNL/Wagner

Back of Tab 8

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

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Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

CINDY PADILLA
Deputy Secretary

CERTIFIED MAIL, RETURN RECEIPT REQUESTED

October 12, 2007

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Securities Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: CORRECTION FOR NOTICE OF APPROVAL DATED OCTOBER 10, 2007, REGARDING MONITORING WELL PLUG AND ABANDONMENT PLAN AND REPLACEMENT WELL CONSTRUCTION PLAN; DECOMMISIONING OF GROUNDWATER MONITORING WELL MWL-BW1, INSTALLATION OF REPLACEMENT GROUNDWATER MONITORING WELL MWL-BW2, REVISION 1, AUGUST 3, 2007
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-07-014

Dear Ms. Wagner and Mr. Nimick:

The New Mexico Environment Department (NMED) issued a Notice of Approval (NOA) for the subject well plug and abandonment/installation plan on October 10, 2007. The NOA refers to a due date of January 1, 2008, as the date that the U. S. Department of Energy/Sandia Corporation must complete the scope of work, excluding the report, in the subject plan. This date is in error; the actual due date to complete the work shall be January 31, 2008.

The report documenting completion of the work is still due to be submitted to the NMED by April 30, 2008. If you have any questions regarding this matter, please contact Mr. William Moats of my staff at (505) 222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
B. Salem, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
P. Freshour, SNL MS 1089
J. Gould, DOE, MS 0184
File: SNL 2007 and Reading
SNL-07-014

Volume VIII

TAB 9

Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Wells MWL-MW1 and MWL-MW3; Installation of Wells MWL-MW7 and MWL-MW8

From: NMED/Bearzi
To: SNL/Wagner

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BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

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Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

RON CURRY
Secretary

CINDY PADILLA
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

October 30, 2007

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Securities Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: NOTICE OF APPROVAL: MONITORING WELL PLUG AND ABANDONMENT PLAN AND REPLACEMENT WELL CONSTRUCTION PLAN; DECOMMISIONING OF GROUNDWATER MONITORING WELLS MWL-MW1 AND MWL-MW3; INSTALLATION OF REPLACEMENT GROUNDWATER MONITORING WELLS MWL-MW-7 AND MWL-MW8, JULY 2007
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-07-016

Dear Ms. Wagner and Mr. Nimick:

The New Mexico Environment Department (NMED) has reviewed the subject document with cover letter dated August 10, 2007. The new wells need to be placed as close to the old landfill boundary as possible to ensure the detection of any contaminants in the groundwater. Thus, NMED approves the work plan with the following conditions.

- The proposed location of monitor well MWL-MW7 must be moved 80 feet at a bearing of 30° northeast from where it is shown on Figure 1 in the work plan.
- The proposed location of well MWL-MW8 must be moved 100 feet at a bearing of 40° northeast.

- Both new wells shall be positioned as close as possible to the former west fence that originally surrounded the Mixed Waste Landfill.

NMED is aware that, once installed, the new wells will fall within the footprint of the new cover.

The scope of work, excluding the report, in the subject work plan shall be concluded by March 31, 2008. The report documenting the work shall be submitted to NMED by June 30, 2008. If you have any questions regarding this matter, please contact Mr. Brian L. Salem of my staff at (505) 222-9576.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
B. Salem, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
P. Freshour, SNL MS 1089
J. Gould, DOE, MS 0184
File: SNL 2007 and Reading

Volume VIII

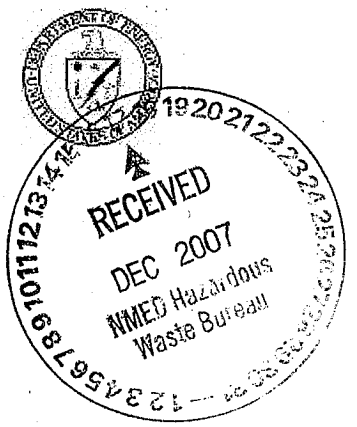
TAB 10

Response to October 30, 2007 Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Wells MWL-MW1 and MWL-MW3; Installation of Wells MWL-MW7 and MWL-MW8

From: SNL/Wagner
To: NMED/Bearzi

Back of Tab 10

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400



DEC 0 5 2007

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. James Bearzi
Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East Building E
Santa Fe, New Mexico 87505

Dear Mr. Bearzi:

On behalf of the Department of Energy (DOE) and Sandia Corporation (Sandia), DOE is responding to the October 30, 2007 Notice of Approval: Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan; Decommissioning of Groundwater Wells MWL-MW1 and MWL-MW3; MWL-MW7 and MWL-MW8, July 2007, Sandia National Laboratories, EPA ID No. NM5890110518, HWB-SNL-07-016. As detailed below, we have a number of concerns regarding the conditions of approval that define the locations of groundwater monitoring wells at the Mixed Waste Landfill (MWL).

The New Mexico Environment Department (NMED) identified the following conditions:

- *The proposed location of monitor well MWL-MW7 must be moved 80 feet at a bearing of 30° northeast from where it is shown on Figure 1 in the work plan.*
- *The proposed location of monitor well MWL-MW8 must be moved 100 feet at a bearing of 40° northeast.*
- *Both new wells shall be positioned as close as possible to the former west fence that originally surrounded the Mixed Waste Landfill.*

In addition, the NMED states that they are "*. . . aware that, once installed, the new wells will fall within the footprint of the new cover.*"

As DOE and Sandia believe the cited conditions will have the potential to affect the integrity of the MWL engineered cover over the long term and conflict with the groundwater monitoring well locations proposed in Long-Term Monitoring Maintenance Plan (LTMMP), DOE and Sandia respectfully request that NMED reconsider these conditions. DOE and Sandia detail the following reasons:

- Structural Integrity and Performance of the Engineered Cover--The NMED locations pose a threat to the integrity of the engineered cover. Placement of wells through the cover could result in preferential pathways for liquids over the long term. As noted on

Figure 1 from the work plan (see enclosure for revised Figure 1) the engineered topography of the cover slopes to the west. In order to protect the wellhead, the slope of the cover would need to be redesigned which would involve a significant effort and significant delays in implementing the remedy. While design changes could alleviate some concerns, such as protecting the wellhead, the potential for creating conduits over the long term remains a critical issue.

- Structural Integrity and Performance of the Monitoring Wells--If the wells are installed prior to the installation of the cover (as currently planned), the well casing would have to be extended to the new surface of the cover. In addition, the protective casing would have to be extended approximately 8 to 10 feet and the concrete pad and other surface completion features would have to be installed. Any disturbance to the well could compromise the integrity of the well. The revised completion on the cover would require re-survey of the critical monitoring well elevations. In addition, during the cover installation there will be significant traffic of heavy equipment in a very close proximity to the wellheads, again, affording an opportunity for damage.

- Access and Security Issues--DOE and Sandia proposed the locations of the wells to be just outside of the security fence that will be installed following cover completion. With this location outside the fence, there is no need for the sampling equipment truck to drive onto the cover to access the wells for sampling. The security plan specifies that only one gate will access the cover and that is on the north side. Driving across the cover would have the potential to cause damage to the crucial vegetation on the cover and to the integrity of the soil compaction that may lead to erosion.

- Conflicts with the Monitoring Network Proposed in the LTMMP--In the LTMMP (currently in NMED and public review) the DOE and Sandia proposed three wells on the western side of the landfill (outside of the security fence) to replace current monitoring wells, MWL-MW-1, -2, and -3. These three wells (MWL-MW-7, -8, and -9) are shown on Figure 3.5.1-1 in the LTMMP. The wells proposed in the LTMMP are evenly spaced along the western side of the landfill and represent downgradient points of compliance. The proposed NMED locations would significantly change this configuration. In addition, the NMED locations interfere with the neutron access tubes (already in place) and the locations for the soil-vapor sampling wells as proposed in the LTMMP. The two proposed soil-vapor wells located on the west side of the landfill are evenly space along the edge of the cover (Figure 3.4.1-1 in the LTMMP). Please refer to Figure 1 (enclosed), which includes all monitoring and soil-vapor well locations proposed in the LTMMP and the proposed NMED locations. DOE- and Sandia are currently preparing a plugging and abandonment plan for MWL-MW2 that includes the installation of MWL-MW9 at the location shown on Figure 1.

DOE and Sandia would like to meet with you and your staff to discuss this issue. We believe that a quick resolution is of the utmost importance for complying with the March 31, 2008 deadline imposed by the NMED. DOE and Sandia are currently in the process of obtaining approvals from the Office of the State Engineer and scheduling a drilling contractor for this work.

If you have any questions regarding this submittal, please contact me at (505) 845-6036, or Dan Pellegrino of my staff at (505) 845-5398.

Sincerely,

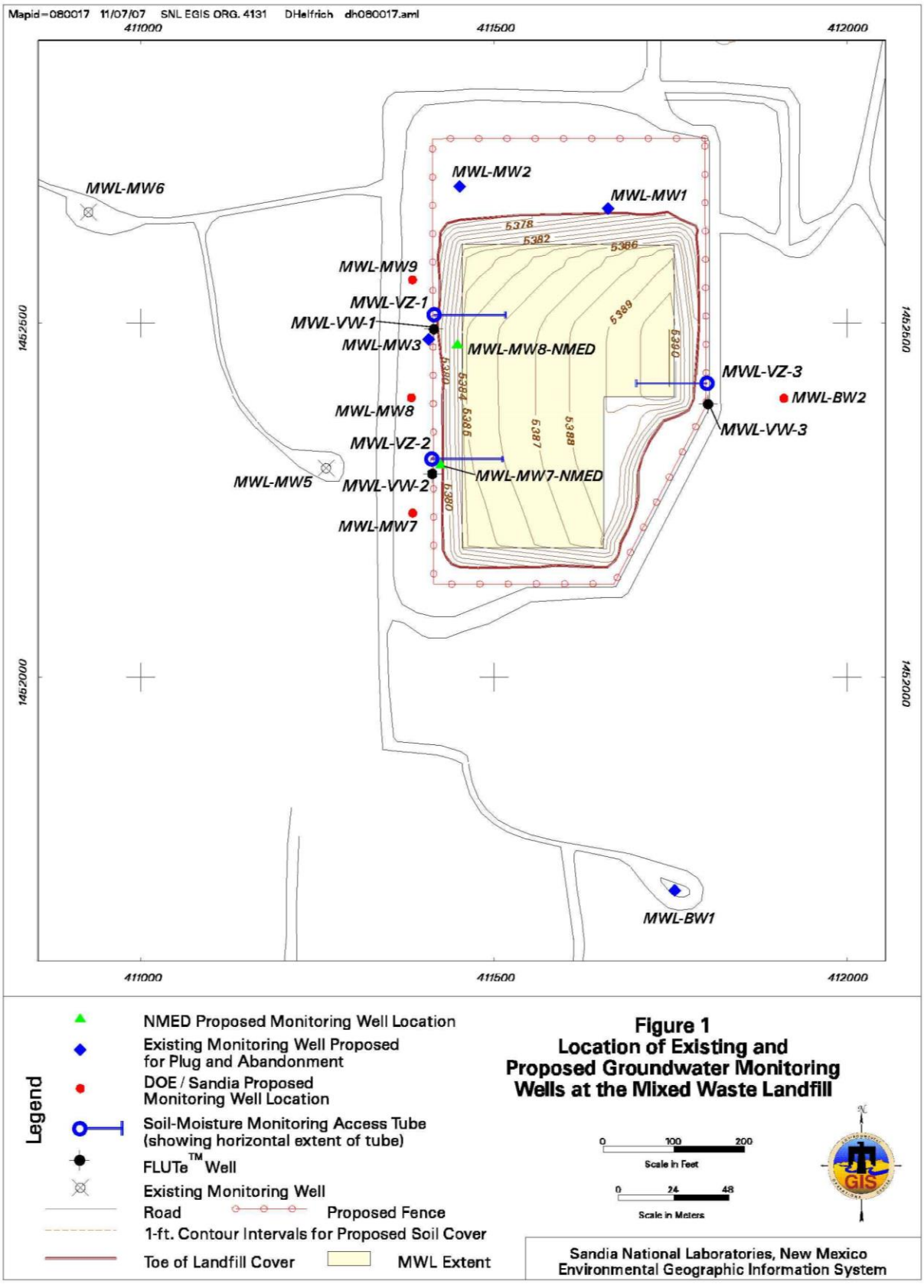
Kimberly A Davis for

Patty Wagner
Manager

Enclosure

cc w/enclosure:
W. Moats, NMED-HWB (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB
B. Birch. NMED-OB

cc w/o enclosure:
A. Blumberg, SNL/NM, Org. 11100, MS 0141
D. Miller, SNL/NM, Org 6765, MS 0718
P. Freshour, SNL/NM, Org. 6765, MS 1089
S. Griffith, SNL/NM, Org.6765, MS 1089
M. Davis, SNL/NM, Org. 6765, MS 1089
Records Center, SNL/NM, Org.6765, MS 1089
T. Longo, HQ/GTN, NA-56
J. Estrada, SSO, MS 0184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412000
1452500
1452000
MWL-MW6
MWL-MW2
MWL-MW1
MWL-MW9
MWL-VZ-1
MWL-VW-1
MWL-MW3
MWL-MW8-NMED
MWL-VZ-3
MWL-BW2
MWL-MW8
MWL-VW-3
MWL-VZ-2
MWL-MW5
MWL-MW7-NMED
MWL-VW-2
MWL-MW7
MWL-BW1
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Legend
NMED Proposed Monitoring Well Location
Existing Monitoring Well Proposed for Plug and Abandonment
DOE / Sandia Proposed Monitoring Well Location
Soil-Moisture Monitoring Access Tube (showing horizontal extent of tube)
FLUTe™ Well
Existing Monitoring Well
Road
Proposed Fence
1-ft. Contour Intervals for Proposed Soil Cover
Toe of Landfill Cover
MWL Extent
Figure 1
Location of Existing and Proposed Groundwater Monitoring Wells at the Mixed Waste Landfill
0 100 200
Scale in Feet
0 24 48
Scale in Meters
Sandia National Laboratories, New Mexico
Environmental Geographic Information System

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Response to Notice of Approval: Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan; Decommissioning of Groundwater Monitoring Wells MWL-MW1 and MWL-MW3; Installation of Replacement Groundwater Monitoring Wells MWL-MW7 and MWL-MW8, July 2007 (HWB-SNL07-016) November 2007**

Document author: Stacy Griffith, Dept. 6765

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 11/13/07
Francis B. Nimick — Date
Deputy to the
Nuclear Energy and Global Security Technologies
Center 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ for 12/5/07
Patty Wagner — Date
Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Volume VIII

TAB 11

Location of Monitoring Wells MWL-MW7 and MWL-MW8

From: NMED/Bearzi
To: SNL/Wagner

Back of Tab 11

NEW MEXICO ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

February 12, 2008

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Securities Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: LOCATION OF MONITORING WELLS MWL-MW7 AND MW8
SANDIA NATIONAL LABORATORIES, EPA ID#NM5890110518
HWB-SNL-07-016

Dear Ms. Wagner and Mr. Nimick:

On October 30, 2007, the New Mexico Environment Department (NMED) conditionally approved the installation plan for the two subject replacement wells. These wells are to be located at the Sandia National Laboratories' Mixed Waste Landfill (MWL). In a letter dated December 5, 2007, the U.S. Department of Energy (DOE) requested that the NMED reconsider the conditions of approval dealing specifically with the locations of the two replacement wells. The DOE expressed several concerns related to structural integrity and performance of the cover and monitoring wells, access and security, and conflicts with the its proposed Long-Term Monitoring and Maintenance Plan (LTMMP).

Since then, DOE and Sandia Corporation (collectively, the Permittees) have provided additional technical details for the NMED's consideration. In addition, the Permittees proposed as a compromise a change in the locations of the two wells such that they would be located further east from where they are shown in the LTMMP, but not quite as far east as directed by the NMED's letter of October 30, 2007.

The NMED believes that the compromise locations balance the need for the wells to be close to the western perimeter of the MWL, with the need to assure long-term integrity of

the wells and the cover. NMED approves the Permittees' proposal to install three replacement wells (instead of two) west of the MWL; the third well is intended to replace existing well MW2. The wells shall be located in line with the existing MWL Soil-Moisture Monitoring Access Tubes. An installation plan for the third well shall be submitted to the NMED no later than March 31, 2008.

Because appreciable time has been expended to resolve this issue of well locations, the NMED is extending the due dates for well completion and reporting. The well installations shall now be concluded by June 30, 2008. The report documenting this work shall now be submitted to NMED by September 30, 2008.

If you have any questions regarding this matter, please contact William Moats of my staff at (505) 222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
P. Freshour, SNL MS 1089
J. Gould, DOE MS 0184
File: SNL 2008 and Reading

Volume VIII

TAB 12

Monitoring Well Plug and Abandonment Plan and
Well Construction Plan; Decommissioning of Well MWL-MW2
Installation of Well MWL-MW9

From: SNL/Wagner
To: NMED/Bearzi

Back of Tab 12

MWL ENTERED

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

MAR 0 6 2008

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. James Bearzi
Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East Building E
Santa Fe, New Mexico 87505

Dear Mr. Bearzi:

On behalf of Sandia Corporation and the Department of Energy (DOE), DOE is submitting a Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan Decommissioning of Groundwater Monitoring Well MWL-MW2 Installation of Replacement Groundwater Monitoring Well MWL-MW9, February 2008. This Plug and Abandonment Plan is required under Section VIII.C of the Compliance Order of Consent.

In addition, this plan includes a map showing the proposed locations for all three replacement wells MWL-MW7, MWL-MW8, and MWL-MW9. The DOE and SNL would like to invite the New Mexico Environmental Department for a site visit to verify the final locations of these wells prior to initiation of drilling activities.

We would like to expedite installation of these wells as soon as all requirements are met and would very much appreciate your review and approval as soon as possible.

If you have any questions regarding this submittal, please contact me at (505) 845-6036, or Dan Pellegrino of my staff, at (505) 845-5398.

Sincerely,

Patty Wagner
Manager

Enclosure

cc w/enclosure:
W. Moats, NMED (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB
B. Birch, NMED-OB

MAR 0 6 2008

Mr. Bearzi (2)

cc w/o enclosure:

A. Blumberg, SNL/NM, Org. 11100, MS 0141
D. Miller, SNL/NM, Org 6765, MS 0718
P. Freshour, SNL/NM, Org. 6765, MS 1089
M. Skelly, SNL/NM, Org. 6765, MS 1089
B. Langkopf, SNL/NM, Org. 6765, MS 1089
S. Griffith, SNL/NM, Org. 6765, MS 1089
M. Davis, SNL/NM, Org. 6765, MS 1089
Records Center, SNL/NM, Org.6765, MS 1089
J. Estrada, SSO, MS 0184
T. Longo, HQ/GTN, NA-56

AOP 95-45, 06

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan Decommissioning of Groundwater Monitoring Well MWL-MW2 Installation of Replacement Groundwater Monitoring Well MWL-MW9, February 2008.

Document author: Mike Skelly, Dept. 06765

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: Francis B Nimick 2/15/08
Date

Francis B. Nimick
Deputy to the
Nuclear Energy and Global Security Technologies
Center 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: Patty Wagner 3-6-08
Date

Patty Wagner
Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Sandia National Laboratories/New Mexico

Monitoring Well Plug and Abandonment Plan
and
Replacement Well Construction Plan

Decommissioning of
Groundwater Monitoring Well MWL-MW2

Installation of Replacement
Groundwater Monitoring Well MWL-MW9

Environmental Restoration Project

February 2008

United States Department of Energy
Albuquerque Operations Office

Sandia is a multiprogram laboratory managed and operated by Sandia Corporation, a wholly-owned subsidiary of Lockheed Martin Corporation, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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Attachment 2--Groundwater Well Abandonment Diagram
Attachment 3--Well Plugging and Abandonment Form
Attachment 4--Groundwater Monitoring Well Data Sheet

1 Project and Site Information

Task Description: Sandia National Laboratories/New Mexico (SNL/NM) decommissioning with plugging and abandonment of one groundwater monitoring well, and installation of one replacement groundwater monitoring well

Case No.: 98026.01.08

Project Leader/Department No.: Paul Freshour/6765

Scheduled Start Date: May 1, 2008

Estimated Completion Date: June 30, 2008

Operations/Technical Area: Mixed Waste Landfill/Technical Area III

2 Regulatory Criteria

This Plug and Abandonment (P&A) Plan outlines the activities and procedures to decommission existing groundwater monitoring well MWL-MW2, with the installation of replacement groundwater monitoring well MWL-MW9.

The U.S. Department of Energy (DOE) and Sandia Corporation (Sandia) received a specific request from the New Mexico Environment Department (NMED) on February 12, 2008 to install a new well (MWL-MW9) as a replacement for MWL-MW2.

Section VIII.C of the Compliance Order on Consent (the Consent Order) discusses well abandonment (NMED April 2004):

> *"Wells shall be abandoned when they are no longer required in the monitoring network, no longer provide representative groundwater samples because of falling water levels or insufficient productivity, or become damaged beyond repair. The goal of well abandonment is to seal the well in such a manner that it cannot act as a conduit for the migration of contaminants from either the ground surface to the saturated zone or between saturated zones. Respondents shall prepare an abandonment plan for any and all wells that are to be plugged and abandoned, and shall submit the plan to the Department for approval. Respondents shall not abandon any groundwater monitoring well without prior written approval of the Department."*

Further regulatory requirements for well P&A procedures can be found in the New Mexico Office of the State Engineer (OSE) "Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells" (OSE August 2005):

> *"To plug a well, the entire well shall be filled from the bottom upwards to land surface using a tremie pipe. The well shall be plugged with neat cement slurry, bentonite based plugging material, or other sealing material approved by the state engineer for use in the plugging of non-artesian wells"*

The OSE regulations also state that:

> "*Wells encountering contaminated water or soil may require coordination between the office of the state engineer and the New Mexico environment department (or other authorized agency or department) prior to the plugging of the well*."

And,

> "*A licensed well driller shall keep a record of each well plugged as the work progresses. The well driller shall file a complete plugging record with the state engineer and the permit holder no later than twenty (20) days after completion of the plugging. The plugging record shall be on a form prescribed by the state engineer . . ."*

To meet these regulatory requirements, the following tasks will be completed at SNL/NM:

- Submit this P&A Plan to the NMED/HWB and OSE requesting to decommission MWL-MW2 because it no longer provides representative groundwater samples due to declining water levels, insufficient productivity, and corrosion of the stainless-steel screen.
- Use a licensed well driller and approved materials to seal the well so that the well cannot act as a conduit for the migration of potential contaminants from the ground surface to the saturated zone.
- Upon completion of the P&A activities, submit a plugging record to the OSE and submit a P&A Report describing the field activities to the NMED/HWB.

3 Existing Well Information

Groundwater monitoring well MWL-MW2 is proposed for decommissioning in this P&A Plan. The monitoring well completion diagram is presented in Attachment 1, and the pertinent well completion information is summarized below.

MWL-MW2 is a groundwater monitoring well located at the Mixed Waste Landfill (Figure 1). This well was installed with mud rotary drilling techniques in July 1989 and is completed in the regional aquifer with the following well completion details:

- Total depth of the well – 477 feet (ft) below ground surface (bgs).
- Screened interval – 452 to 472 ft bgs.
- Construction materials – Polyvinyl chloride (PVC) riser pipe, stainless-steel screen, carbon-steel protective surface casing (conductor casing), and a concrete well pad.
- Current water level – approximately 464 ft bgs.
- Water-bearing strata – Groundwater occurs in unconsolidated silts and sands (alluvial fan facies) of the upper Santa Fe Group that have relatively low hydraulic conductivities.
- Reason for decommissioning – The stainless-steel screen is corroding, the well requires excessive time to recover between purging and sampling, and declining water levels in the regional aquifer. There is no evidence that suggests the annular seal is compromised.

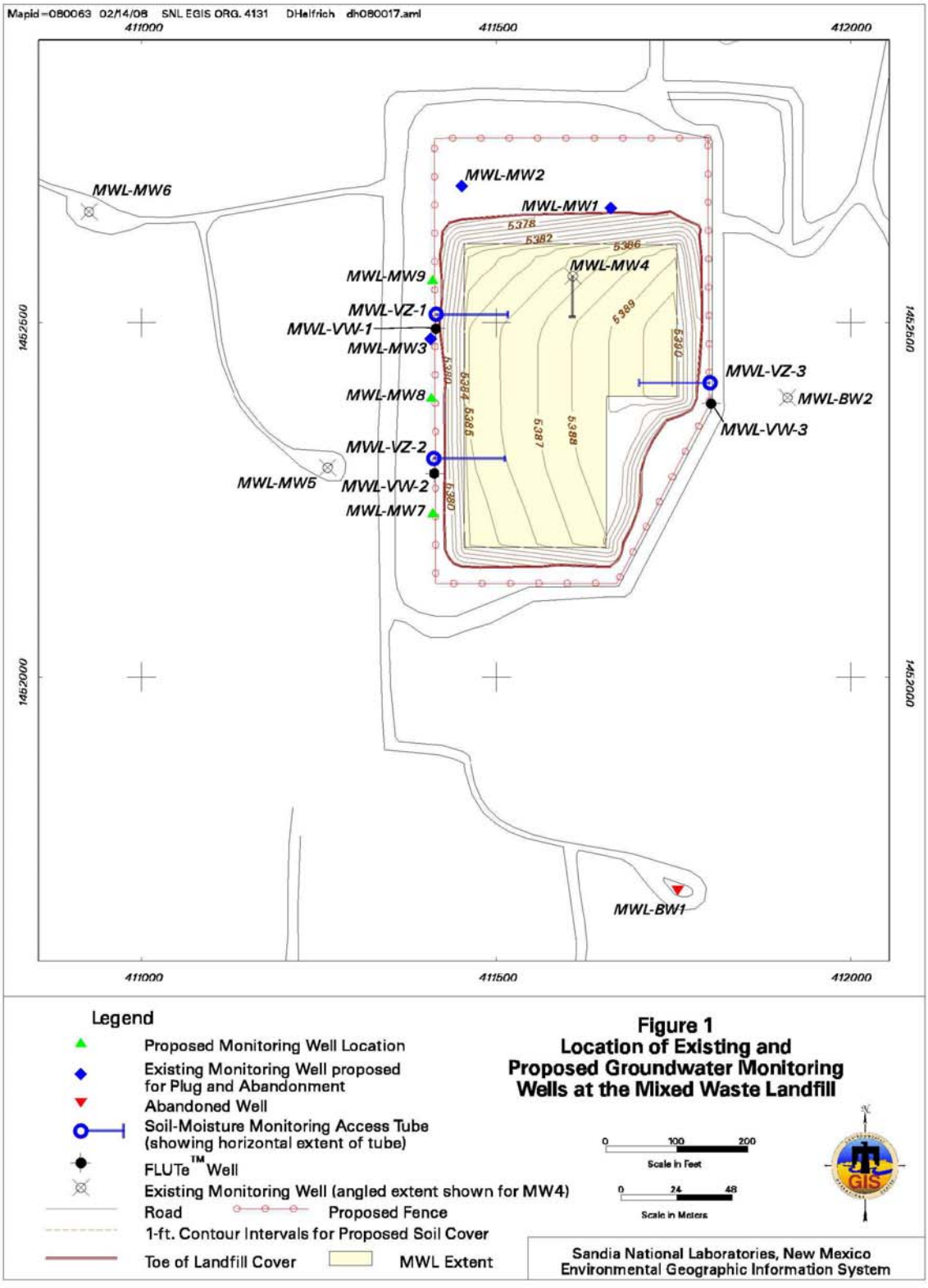
4 Plugging and Abandonment

Based on the requirements established by the NMED/HWB and OSE, groundwater monitoring well MWL-MW2 will be decommissioned. Applicable Field Operating Procedures (FOPs) and Administrative Operating Procedures (AOPs) are listed in Table 1; however, this site-specific P&A Plan should be used as the primary guidance in the field.

Table 1. Applicable Operating Procedures

Number of Procedure[a]	Title of Procedure
FOP 94-01	Safety Meetings, Inspections, and Pre-Entry Briefings Rev. 1, 12/16/96
FOP 94-05	Borehole Lithologic Logging, Rev. 0, 2/10/94
FOP 94-25	Documentation of Field Activities, Rev. 0, 11/4/94
FOP 94-26	General Equipment Decontamination, Rev. 1, 2/20/97
FOP 94-28	Health and Safety Monitoring of Organic Vapors (FID and PID), Rev. 2, 4/27/97
FOP 94-38	Drilling Methods and Drill Site Management, Rev. 0, 4/14/94
FOP 94-41	Well Development, Rev. 0, 11/21/94
FOP 94-42	Integration of the design, Installation, Rehabilitation, and Decommissioning of Environmental Restoration Wells, Rev. 1, 5/31/94
FOP 94-43	Decommissioning Of Wells, Rev 0, 5/31/94
FOP 94-45	Designing and Installing Groundwater Monitoring Wells, Rev. 0, 5/31/94
FOP 94-57	Decontaminating Drilling and Other Field Equipment, Rev. 0, 5/31/94
FOP 94-68	Field Change Control, Rev. 2 (in revision)
FOP 94-69	Personnel Decontamination (Level D, C, and B Protection), Rev. 1, 1/23/98
AOP 94-24	System and Performance Audits, Rev. 0, 1/12/95
AOP 94-25	Deficiency Reporting, Rev. 0, 1/12/95
AOP 95-16	Administrative Operating Procedure for Sample Management and Custody, Rev. 02, 3/28/07

Notes:
[a] The most current version will be used.
AOP = Administrative Operating Procedure.
FOP = Field Operating Procedure.
Rev. = Revision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Proposed Monitoring Well Location
Existing Monitoring Well proposed for Plug and Abandonment
Abandoned Well
Soil-Moisture Monitoring Access Tube (showing horizontal extent of tube)
FLUTe™ Well
Existing Monitoring Well (angled extent shown for MW4)
Road
Proposed Fence
1-ft. Contour Intervals for Proposed Soil Cover
Toe of Landfill Cover
MWL Extent
Figure 1
Location of Existing and Proposed Groundwater Monitoring Wells at the Mixed Waste Landfill
0 100 200
Scale in Feet
0 24 48
Scale in Meters
GIS
Sandia National Laboratories, New Mexico
Environmental Geographic Information System

4.1 Goal

The goal for decommissioning monitoring well MWL-MW2 is to eliminate the potential of this well to act as a conduit for the migration of potential contamination to groundwater. The well materials and annular seal are not believed to pose a threat to groundwater, and therefore will be backfilled in place with proper sealing materials.

4.2 Objective

The objective is to seal this monitoring well in such a manner that there is reasonable certainty that the abandonment has adequately eliminated the potential for cross-communication between the land surface and the aquifer, and the potential for downward migration of potential contaminants through the borehole annulus to the aquifer. All grouting techniques and grout mixtures used during decommissioning will minimize grout intrusion into the native formation.

4.3 Implementation

General activities for the implementation of the P&A include:

1) Remove all monitoring well surface completion features,
2) Backfill the casing with well-plugging materials, and
3) Construct a new surface pad/monument.

SNL/NM personnel and the selected drilling contractor will remove all surface completion features, such as guard posts, concrete well pads, and surface protective casing. Care will be taken to prevent materials from falling down the well casing and possibly causing a downhole obstruction. The well will be abandoned with casing left in place. The well was installed using mud rotary drilling methods and 20 ft of carbon steel conductor casing was left in place at the well head. The conductor casing (extending to approximately 19 ft bgs) cannot be removed and will remain in place following P&A activities. The PVC casing will be cut off flush with the top of the conductor casing (at approximately 8 to 10 inches above ground surface).

The well screen and blank well casing will be sealed by lowering a tremie pipe to the base of the well casing (below the base of the screen) and injecting the plug material (bentonite grout) using a diaphragm or equivalent pump system. The plug material will be filled to within 5 ft of the ground surface and allowed to set overnight. If the level of the plug material in the well casing drops overnight, additional bentonite grout will be added to again reach within 5 ft of ground level.

Once the well has been properly plugged, the decommissioning process will be completed by placing concrete in the upper 5 ft of the well/borehole and installing a concrete slab on the surface. The concrete pad will be approximately 1ft thick with a 2 ft by 2 ft area. A brass marker containing the well name and date of decommissioning will be set in the concrete pad.

5 Monitoring Well Installation

Replacement monitoring well MWL-MW9 will be installed after MWL-MW2 has been decommissioned.

5.1 Objective

Install a 5-inch nominal diameter PVC-casing replacement monitoring well to provide representative groundwater samples. The replacement monitoring well borehole will be drilled using Air-Rotary Casing-Hammer (ARCH) drilling methods.

Based on the NMED letter dated February 12, 2008, the replacement well shall be installed at a location west of the landfill in a line with the existing MWL Soil-Moisture Access Tubes. The proposed replacement well location on Figure 1 is shown schematically.

5.2 Implementation

Applicable FOPs and AOPs are listed in Table 1; however, this site-specific plan should be used as the primary guidance in the field.

5.2.1 Borehole Drilling

The ARCH drilling method will use environmentally-friendly lubricants and will be able to penetrate highly variable lithologies such as cobbles, boulders, gravel, sand, clay, and caliche while maintaining an open, competent borehole. The geology of the borehole will be logged during drilling. The total depth of the borehole will be determined by the SNL/NM field geologist, but the depth is anticipated to be approximately 17 ft deeper than the original well. The depth of the first encounter with regional groundwater and any perched groundwater will be logged during drilling. After reaching total depth, the cased borehole will be logged using natural gamma and neutron wire-line geophysical methods.

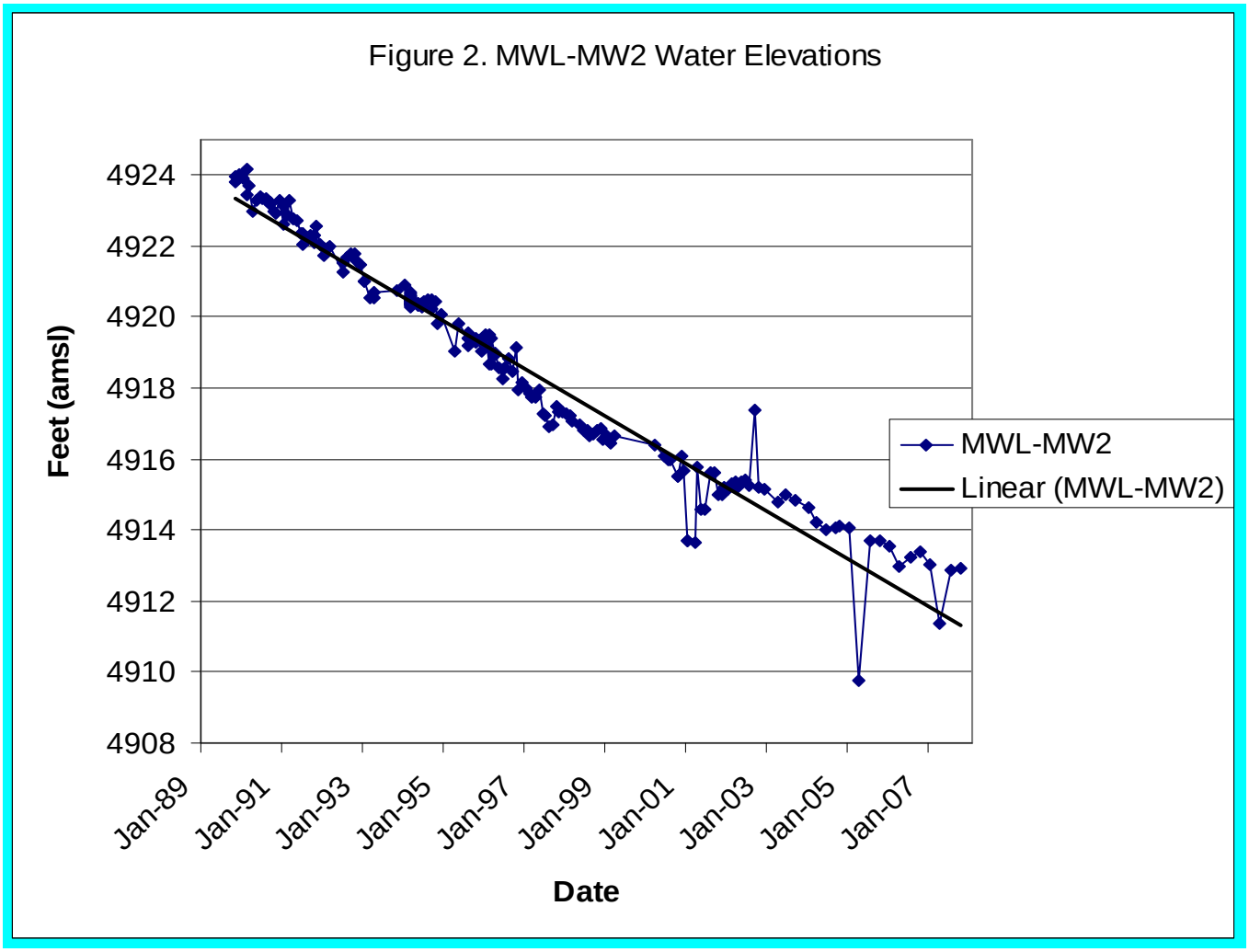
Minimal water (but no other foams/liquids) in the form of “mist” may be introduced into the borehole to aid in the removal of cuttings. Waste generation will be kept to a minimum. Borehole cuttings will be contained within an area adjacent to the well. Water produced from the well during drilling or development will be contained in 55-gallon drums and placed on spill control pallets.

Based on the most recent groundwater level measurements for the MWL Study Area (April 2007), monitoring well MWL-MW9 is anticipated to be drilled to approximately 494 ft bgs. The 30-ft well screen for MWL-MW2 will be set with approximately 5 ft of screen situated above the static water level. The anticipated depth to water at this location is approximately 464 ft bgs; therefore, the screen completion interval is expected to be approximately 459 to 489 ft bgs with a 5-ft sump placed below the screen.

5.2.2 Well Construction

The monitoring well will be completed as specified in this plan. The water-table monitoring well will be installed through the temporary steel drive casing (nominal 10-inch diameter), and completed using 5-inch nominal diameter, flush threaded, PVC Schedule-80 water well casing. No solvents, cleaners, or lubricants will be used for construction of the monitoring well. The casing will be delivered pre-cleaned and bagged, or steam-cleaned on site prior to installation. To preserve the integrity of the well materials, the well screen and riser pipe will be suspended in the borehole until the primary filter pack, bentonite pellet seal and annular seal are installed.

The regional aquifer in the area is being over-pumped and the water table at MWL-MW2 is declining at a rate of approximately 1 ft/year (Figure 2). Anonymously low water levels (below trend line) may have been taken following a purging event.



To accommodate the rapidly declining water table, a 30-ft length of PVC screen with a 0.010-inch or 0.020-inch slot size will be used for the replacement well. A 5-ft sump will be placed at the base of the screen and sealed with a threaded end cap. PVC centralizers will be placed at the base and top of the well screen and then at intervals not to exceed 100 ft up to the land surface. The screen for this water-table well will be placed so that the top of the screen is approximately 5 ft above the static water level.

The appropriate screen slot size and gradation of the filter pack material will be based on the gradation of the sediments in the screen interval as determined in the field by the geologist logging the borehole. If the predominant water-bearing interval consists mostly of clay and silt, a 0.010-inch screen slot and a primary filter pack of clean 20-40 silica sand will be placed in the annulus. However, if the predominant water-bearing interval consists mostly of silt and sand, a 0.020-inch screen slot and a primary filter pack of clean 10-20 silica will be placed in the annulus. The primary filter pack will extend from the bottom of the sump to at least 5 ft above the top of the screen. A 5-ft thick layer of clean 60 sand will be placed above the primary filter pack. Both sand packs will be tagged using a tag line to verify their depth. Preliminary well development using a surge block will be performed at this time to help settle the filter pack.

A 30-ft thick layer of 3/8-inch bentonite chips will be placed above the filter pack prior to emplacement of the bentonite-grout annular seal. Each 5-ft thickness of bentonite pellets/chips added will be hydrated before adding the next 5-ft thickness of bentonite pellets/chips. The final lift of bentonite pellets/chips will be allowed to set for a time adequate for hydration (at least I hour). The remaining annular space to ground surface will then be filled with bentonite grout. To prevent overloading, the bentonite grout will be installed in multiple lifts. Per NMED requirements (NMED June 2007), the first bentonite grout lift will be approximately 100 ft thick and will be allowed to set a minimum of 24 hours before installation of the

next lift. Subsequent bentonite grout lifts will each be approximately 200 ft thick. The bentonite grout will be topped off to within 6-inches to 1-ft bgs.

The well casing will extend approximately 30 inches above ground surface with a water-tight cap. The monitoring well will be completed with protective steel casing with a hinged locking cap. The protective casing will be primed and painted yellow. A 3-ft by 3-ft, sloped concrete pad will be constructed around the casing. The pad will contain a 3-in brass cap stamped with the well identification. Three, 4-inch diameter concrete-filled, steel guard posts (also primed and painted yellow) will be placed around the pad, equidistant from the well.

5.2.3 Well Development

Well development will be initiated after at least 48 hours following final grout placement. The well will be developed for approximately 10 hours, and will consist of pumping, surge-block, swabbing, and/or bailing techniques. During development, the groundwater field parameters (pH, specific conductivity, temperature, and turbidity) will be continuously monitored, and development will continue until parameters have stabilized. All development water will be contained in drums and will not be allowed to discharge to the ground surface. The method of development, the volume of water added or removed, the parameters measured, the results of the measurements, and the time these activities take place will be documented in writing during well development. If required, only potable water shall be added to the well during development.

During development of this water-table completion well, a minimum of five well bore volumes will be removed. After the minimum volume has been removed, development will continue until representative water is obtained. Representative water is assumed to be obtained when pH, temperature, turbidity, and specific conductivity readings stabilize (less than 10% variability over three consecutive well bore volumes) and the water is visually clear of suspended solids with a target turbidity of less than five Nephelometric Turbidity Units (NTUs).

6 Equipment Decontamination

The drilling rig and related equipment will be decontaminated at the decontamination pad in Technical Area III prior to the beginning of drilling operations and upon completion of the drilling program. Decontamination waste will be kept to a minimum and containerized in drums placed on spill control pallets at the decontamination pad.

7 Health and Safety

Level D personal protective equipment is required for all drilling operations. Health and Safety records associated with drilling and development personnel will be maintained on site and will be available at the commencement of drilling activities. All field personnel will operate under an SNL/NM Health and Safety Plan (HASP) and will have SNL/NM-required training including 40-Hr OSHA HAZWOPER and subsequent yearly refresher courses. An SNL/NM Subject Matter Expert will perform a safety inspection of the drill rig before drilling commences.

8 Pre-field activities

Pre-field activities that must be completed prior to drilling include:

- Preparation of the Statement of Work for drilling and monitoring well installation;
- SNL/NM digging permit request and approval;
- HASP preparation, review, and signatures;
- National Environmental Policy Act (NEPA) review and signatures;
- Sample bottle order for waste samples through Sample Management Office;
- Waste Management Plan preparation;
- Field checklist completion, review, and approval; and
- Readiness review meeting

9 Mobilization and Site Setup

SNL/NM personnel will ensure that containers for cuttings have been obtained and are ready for drilling operations. Roll-off bins supplied by SNL/NM will be used to collect drill cuttings for waste management purposes.

10 Reporting

Based on the requirements established by the NMED/HWB, OSE and SNL/NM FOPs, the field activities associated with decommissioning and installation of the monitoring wells will be documented.

10.1 Decommissioning Records

All decommissioning field activities will be documented in a field log book per guidance in FOP 94-25. Upon completion of decommissioning of the well, the P&A Report will document all site activities and provide final as-built Groundwater Well Abandonment Diagram (Attachment 2). The Well Plugging and Abandonment Form (Attachment 3) will be used to assure that all records are completed, approved, and submitted for proper records management. The following list of documents and records that are generated as part of the decommissioning process will be provided to the SNL/NM Well File Coordinator who, in turn, will submit them to the SNL/NM Customer-Funded Records Center:

- Monitoring Well Plugging and Abandonment Request
- Site-Specific Well Plugging and Abandonment Work Plan
- Site-Specific Well Plugging and Abandonment Report
- Plugging and Abandonment Documentation and Approval Checklist
- Waste Management Plan
- Field Log Book
- Detailed as-built Groundwater Well Abandonment Diagram (Attachment 2)
- Well Plugging and Abandonment Form (Attachment 3)

All decommissioning activities performed at SNL/NM will be accurately and concisely documented in a final P&A Report to be submitted to the NMED/HWB and the OSE. The P&A Report will contain a brief narrative describing actual work performed at the site and any variances to the site-specific P&A Plan. Information to be contained in the P&A Report include: (1) daily field activity notes, (2) all materials used, (3) a final "as-built" plugging and abandonment diagram, and (4) documentation of notification of SNL/NM GIS group and the appropriate regulatory agencies. The Well Plugging and Abandonment Form (Attachment 3) will be completed and included as part of the P&A Report.

Further P&A reporting elements are required by the OSE (OSE August 2005). SNL/NM personnel and the licensed well driller (contractor) will submit a plugging record with the OSE no later than twenty (20) days after completion of the plugging. The record will include the following elements:

- Name and address of the well owner
- Well driller’s name and license number
- Name of each drill rig supervisor that supervised the well plugging
- State engineer file number for the well (if available)
- Location of the well (reported in New Mexico state plane coordinates to ±0.01 ft)
- Dates when plugging began/concluded
- Plugging material(s) used
- Depth of the well
- Size and type of casing
- Location of perforations
- Location of the sanitary seal
- Completed well log with depth and thickness of all strata plugged, including whether each stratum was water bearing

10.2 Well Installation Records

All well installation field activities will be documented in a field log book per guidance in FOP 94-45. Upon completion of the well installation, the Field Report will document all site activities and provide the final as-built well completion diagram (Attachment 4). The Field Report will contain a brief narrative describing actual work performed at the site and any variances to the site-specific Well Construction Plan. Information to be contained in the Field Report include: (1) daily field activity notes, (2) all materials used, (3) a final "as-built" well completion diagram, and (4) documentation of notification of SNL/NM GIS group and the appropriate regulatory agencies. The documentation will also include the 37 information elements required in Section VIII.D of the Consent Order (NMED April 2004). The following list of documents and records that are generated as part of the well installation process will be provided to the SNL/NM Well File Coordinator who, in turn, will submit them to the SNL/NM Customer-Funded Records Center:

- Well permit agreement
- Well file contents checklist
- Well data summary sheet
- Statement of work for drilling the well
- Drilling permit
- Lithologic (boring) log
- Well construction diagram and completion parameters
- Well development data and groundwater parameters
- Copies of field logbook (geologist, driller)
- Surveyed elevations and location in New Mexico state plane coordinates (with a degree of accuracy of ± 0.01 ft)
- Location map
- Water level measurements
- Aquifer test data
- Analytical data
- Waste management documentation
- Photographs

11 References

New Mexico Environment Department (NMED) April 2004, “Compliance Order on Consent Pursuant to the New Mexico Hazardous Waste Act 74-4-10: Sandia National Laboratories Consent Order,” New Mexico Environment Department, April 24, 2004.

New Mexico Environment Department (NMED) June 2007, “Notice of Disapproval: Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan, Decommissioning of Groundwater Monitoring Well MWL-BW1, Installation of Replacement Groundwater Monitoring Well MWL-BW2, April 9, 2007, Sandia National Laboratories NM5890110518, HWB-SNL-07-014.” Letter to Patty Wagner (SSO/NNSA) and Francis Nimick (Sandia) from James Bearzi, June 19, 2007.

New Mexico Environment Department (NMED) February 2008, “Location of Monitoring Wells MWL-MW7 and MW8 Sandia National Laboratories, EPA ID#NM5890110518 HWB--016” Letter to Patty Wagner (SSO/NNSA) and Francis Nimick (Sandia) from James Bearzi, February 12, 2008.

New Mexico Office of the State Engineer (OSE) August 2005, “Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells” New Mexico Office of the State Engineer, August 2005.

Attachment 1

Monitoring Well Completion Diagram for MWL-MW2

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA III
ER ADS #:	1289	**Well Completion Date:**	01-AUG-1989
Well Name:	MWL-MW2	**Completion Zone:**	SAND
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE
Date Drilling Started:	21-JUL-1989	**Well Comment:**	WATER LEVEL MEASURED ON 5/14/90
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	MUD ROTARY		
Borehole Depth:	521		
Casing Depth:	477		

Survey Data

Survey Date: 12-APR-1990

Surveyed By: SANTIAGO ROMERO AND ASSOCIATES

State Plane Coordinates

(X) Easting: 411451.366

(Y) Northing: 1452692.592

Surveyed Elevations (FAMSL)

Protective Casing:	5378.18
Top of Inner Well Casing:	5377.26
Concrete Pad:	5376.49
Ground Surface:	5375.71

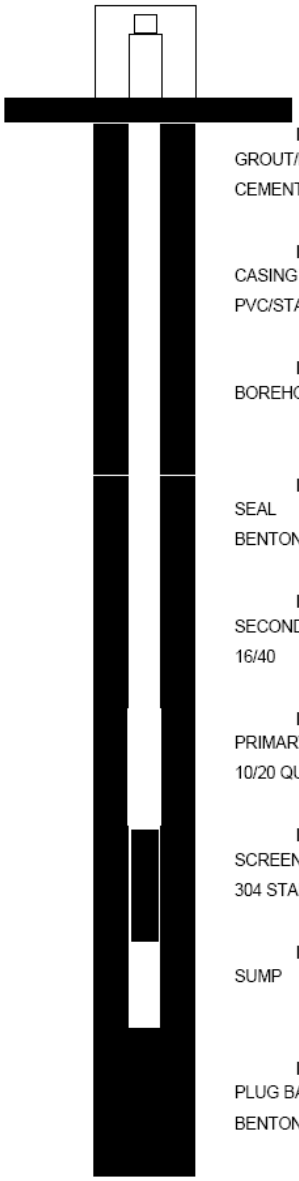
Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4923.27
Initial Depth To Water: (FBGS)	453.99

Last measured water level was 4912.85 **FASL**
measured on 12-JUL-2007

Date Updated: 14-MAR-00

Date Printed: 06-NOV-2007



Completion Data Measured Depths (FBGS)

Casing Stickup: .77

Interval	Start	Stop
GROUT/BACKFILL	0'	430'
CEMENT/BENTONITE		

Interval	Start	Stop
CASING	0'	477'
PVC/STAINLESS STEEL	I.D. 5"	

Interval	Start	Stop
BOREHOLE	0'	521'
	O.D. 12.25"	

Interval	Start	Stop
SEAL	430'	442'
BENTONITE		

Interval	Start	Stop
SECONDARY PACK	442'	444'
16/40		

Interval	Start	Stop
PRIMARY PACK	444'	477'
10/20 QUARTZ SAND		

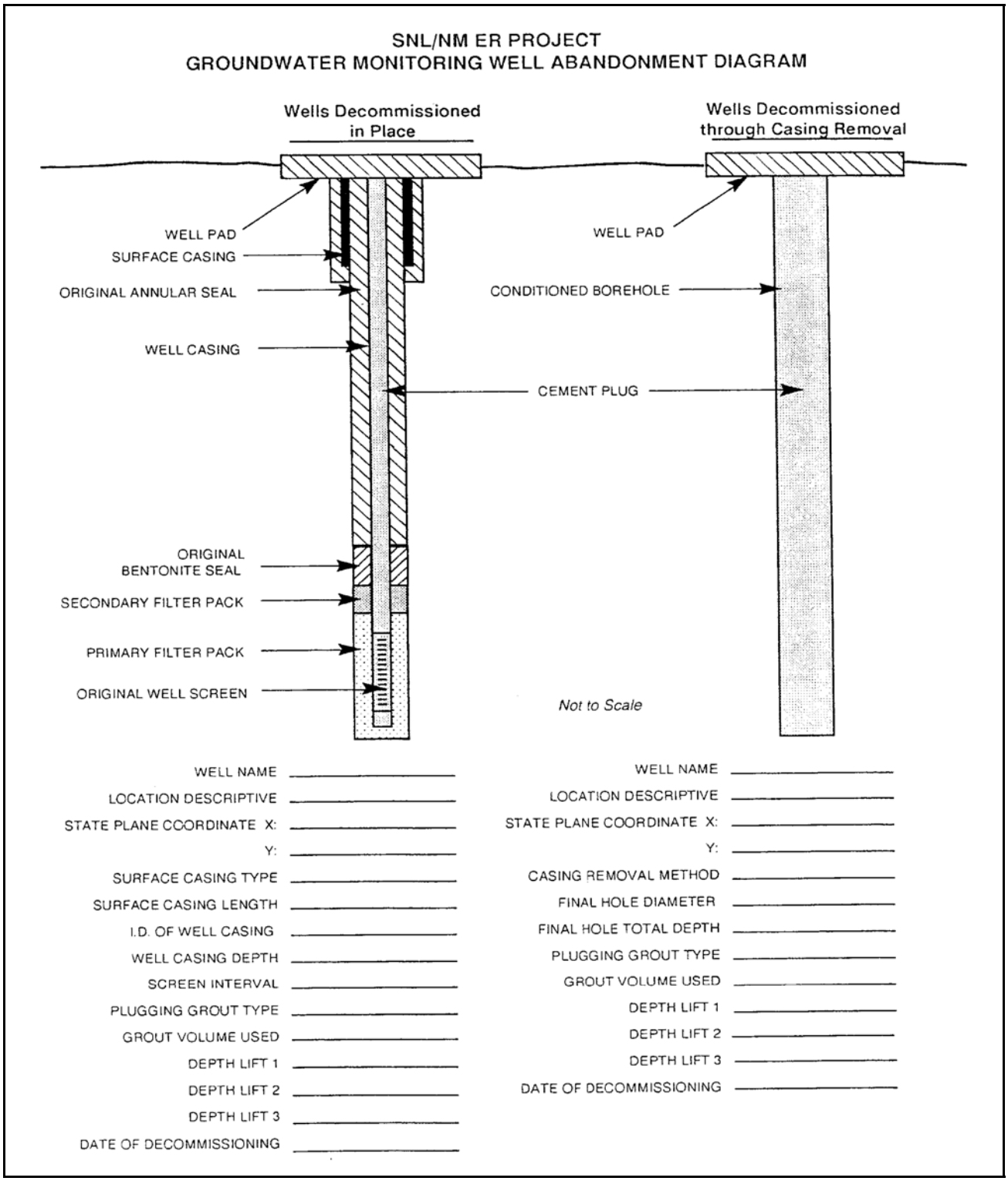
Interval	Start	Stop
SCREEN	452'	472'
304 STAINLESS STEEL		
	Slot Size .01"	

Interval	Start	Stop
SUMP	472'	477'

Interval	Start	Stop
PLUG BACK	477'	521'
BENTONITE		

Attachment 2

Groundwater Well Abandonment Diagram



Attachment 3

Well Plugging and Abandonment Form

SNL/NM ER PROJECT
WELL PLUGGING AND ABANDONMENT FORM

1. Preabandonment Well Specifics:
   - a. Well Identification _____
   - b. Location (geographic description and state plane coordinates) _____
   - c. Reported Well Depth (feet) _____
   - d. Field Well Depth (feet) _____
   - e. Screened Intervals(s) (feet) _____
   - f. Screen Diameter(s) (inches) _____
   - g. Screen Type(s) (SS or PVC, etc.) _____
   - h. Casing Diameter(s) (inches) _____
   - i. Casing Type (PVC, steel, etc.) _____
   - j. Artesian or Nonartesian Aquifer _____

2. Reason for Abandonment:
   _____
   _____

3. Abandonment Specifics:
   - a. Date Abandonment Started _____
   - b. Date Abandonment Completed _____
   - c. ID Number of Field Log Book Used _____
   - d. Site Personnel _____
   - e. Drilling Method Used _____
   - f. Grout Used _____
   - g. Casing Removed (Y or N) _____
   - h. Concrete Pad Inscription _____

   j. Briefly Describe Abandonment Method:
   _____
   _____
   _____

   k. Disposition of Materials Removed From Well: _____
   _____
   _____

4. Comments or Problems Encountered: _____
   _____

Completed by: _____
Printed Name Signature Date

Subcontractor: _____

Drilling Contractor: _____ License No.: _____

Attachment 4
Groundwater Monitoring Well Data Sheet

WELL REGISTRY DATA SHEET

PROJECT NAME: _____
ER ADS #: _____
WELL NAME: _____
OWNER: _____
DATE DRILLING BEGAN: _____
DRILLING CONTRACTOR: _____
DRILLING METHOD: _____
BOREHOLE DEPTH: _____
BOREHOLE DIAMETERS: _____

GEOGRAPHIC LOCATION: _____
WELL COMPLETION DATE: _____
COMPLETION ZONE: _____
FORMATION OF COMPLETION: _____
COMMENTS: _____

Survey Data

Survey Date: _____
Surveyed by: _____
State Plane Coordinates
(X) Easting = _____
(Y) Northing = _____

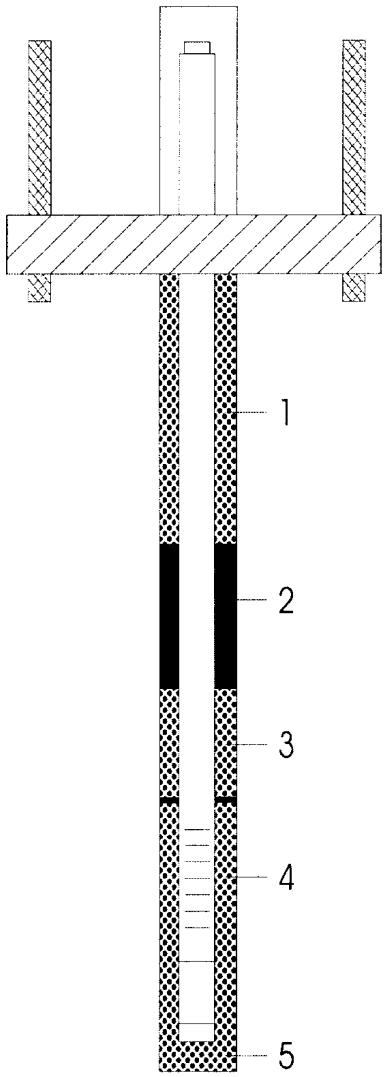
Surveyed Elevations
(feet above sea level)

Protective Casing: _____
(Elev. D - FOP 94-71)
Top of Inner Well Casing: _____
(Elev. C - FOP 94-71)
Concrete Pad: _____
(Elev. B - FOP 94-71)
Ground Surface: _____
(Elev. A - FOP 94-71)

Calculated Elevations
(feet above sea level)

Initial Water Level: _____
Other: _____
Comments: _____

Form Completed by: _____
Verified by: _____



Completion Data

Measured Depths

Depth to Water: _____
(below top of casing)
Casing Stickup: _____
(above ground level)
Casing OD (in.): _____
Casing ID (in.): _____
(Items 1-5 feet below ground surface)

1. Grout/Backfill Interval: _____
   Material: _____
2. Seal Interval: _____
   Material: _____
3. Secondary Pack Interval: _____
   Secondary Pack Size: _____
4. Primary Pack Interval: _____
   Primary Pack Size: _____
   Screen Interval: _____
   Slot Size: _____
   Material: _____
   Sump Interval: _____
   Casing Depth: _____
   Material: _____
5. Plug Back Interval (if used): _____
   Plug Material (if used): _____

Volume VIII

TAB 13

Notice of Approval: Monitoring Well Plug and Abandonment Plan and Well Construction Plan; Decommissioning of Well MWL-MW2, Installation of Well MWL-MW9

From: NMED/Bearzi
To: SNL/Wagner

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NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

March 21, 2008

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Securities Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: NOTICE OF APPROVAL: MONITORING WELL PLUG AND ABANDONMENT PLAN AND REPLACEMENT WELL CONSTRUCTION PLAN; DECOMMISIONING OF GROUNDWATER MONITORING WELL MWL-MW2, INSTALLATION OF REPLACEMENT GROUNDWATER MONITORING WELL MWL-MW9, FEBRUARY 2008
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-08-002

Dear Ms. Wagner and Mr. Nimick:

The New Mexico Environment Department (NMED) has reviewed the subject document dated February 2008 (with transmittal letter dated March 6, 2008). NMED approves the subject plan. If you have any questions regarding this matter, please contact Mr. William Moats of my staff at (505) 222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
P. Freshour, SNL MS 1089
J. Gould, DOE, MS 0184
File: SNL 2008 and Reading
SNL-08-002

Volume VIII

TAB 14

Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2

From: SNL/Wagner
To: NMED/Bearzi

Back of Tab 14

ENTERED

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

APR 2 3 2008

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

James Bearzi
Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Bldg. 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

On behalf of Sandia Corporation (Sandia) and the Department of Energy (DOE), DOE is submitting the Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation: Decommissioning of Groundwater Monitoring Well MWL-BW1 and Installation of Groundwater Monitoring Well MWL-BW2.

If you have any questions regarding this report, please contact me at (505) 845-6036, or Dan Pellegrino of my staff at (505) 845-5398.

Sincerely,

Kimberly A Davis for

Patty Wagner
Manager

Enclosure

cc w/enclosure:
W. Moats, NMED (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB
B. Birch, NMED-OB

APR 2 3 2008

cc w/o enclosure:
A. Blumberg, SNL/NM, Org. 11100, MS 0141
D. Miller, SNL/NM, Org 6765, MS 0718
P. Freshour, SNL/NM, Org. 6765, MS 1089
S. Griffith, SNL/NM, Org. 6765, MS 1089
M. Skelly, SNL/NM, Org. 6765, MS 1089
B. Langkopf, SNL/NM, Org. 6765, MS 1089
M. Davis, SNL/NM, Org. 6765, MS 1089
Records Center, SNL/NM, Org.6765, MS 1089
T. Longo, HQ/GTN, NA-56
J. Estrada, SSO, MS 0184

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation: Decommissioning of Groundwater Monitoring Well MWL-BW1 and Installation of Groundwater Monitoring Well MWL-BW2

Document author: Stacy Griffith, Department 06765

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 4/11/08

Francis B. Nimick
Deputy to the
Nuclear Energy and Global Security Technologies
Center 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ 4/23/08
for

Patty Wagner
Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Sandia National Laboratories/New Mexico

SUMMARY REPORT FOR MIXED WASTE LANDFILL MONITORING WELL PLUG AND ABANDONMENT AND INSTALLATION
Decommissioning of Groundwater Monitoring Well MWL-BW1
Installation of Groundwater Monitoring Well MWL-BW2

April 2008

Environmental
Restoration
Project

United States Department of Energy
Albuquerque Operations Office

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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B Field Notes for Activities at MWL-BW1 and MWL-BW2

C Combination Lithologic and Geophysical Logs with Well Construction Details for MWL-BW2

D Well Construction Diagram for MWL-BW2

E Groundwater Well Abandonment Diagram for MWL-BW1

F Well Development Forms for MWL-BW2

ACRONYMS AND ABBREVIATIONS

AOP	administrative operating procedure
ARCH	air rotary casing hammer
bgs	below ground surface
cm	centimeter(s)
°C	degrees Celsius
DOE	U.S. Department of Energy
ER	Environmental Restoration
ft	feet
FOP	field operating procedure
ID	inside diameter
Jet West	Jet West Geophysical Services
μmhos	micromhos
NNSA	National Nuclear Safety Administration
NTU	nephelometric turbidity unit
NMED	New Mexico Environment Department
NMOSE	New Mexico Office of State Engineer
NOD	Notice of Deficiency
MWL	Mixed Waste Landfill
OD	outside diameter
pH	potential of hydrogen
P&A	plug and abandon
PVC	polyvinyl chloride
Sandia	Sandia Corporation
SNL/NM	Sandia National Laboratories/New Mexico
TD	total depth
WDC	Water Development Corporation, Incorporated.

1.0 INTRODUCTION

This report documents the activities for the plugging and abandoning (P&A) and the installation of groundwater monitoring wells at the Mixed Waste Land (MWL) at Sandia National Laboratories/New Mexico (SNL/NM). The activities were performed in January through March 2008 by the SNL/NM Environmental Restoration (ER) Project personnel and the drilling contractor Water Development Corporation, Incorporated. (WDC).

1.1 Regulatory Action

On March 23, 2007, the New Mexico Environment Department (NMED) required that the U. S. Department of Energy (DOE) National Nuclear Security Administration (NNSA) and Sandia Corporation (Sandia) replace monitoring well MWL-BW1 (Bearzi March 2007). In April 2007, the NNSA/Sandia submitted a Plug and Abandonment/Replacement Plan for MWL-BW1 (SNL/NM April 2007).

However, in June 2007, the NMED issued a Notice of Disapproval (NOD) regarding this plan (Bearzi June 2007). The NOD listed 13 items that needed to be addressed in a revised plan. In July 2007, NNSA/Sandia submitted the revised *Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan: Decommissioning of Groundwater Monitoring Well MWL-BW1 and Installation of Replacement Groundwater Monitoring Well MWL-BW2* (the Plan) to the NMED (SNL/NM July 2007). The revised plan addressed the issues listed in the NOD. The NMED issued a Notice of Approval on October 10, 2007 (Bearzi October 2007a) followed by a date correction to the Notice of Approval on October 12, 2007 (Bearzi October 2007b).

1.2 Site Description and History

The MWL is an inactive landfill, designated as a Solid Waste Management Unit, at SNL/NM. The SNL facility is owned by the DOE/NNSA. The MWL is located in Technical Area III of SNL/NM which is within the boundaries of the federally-owned Kirtland Air Force Base, south of the city of Albuquerque (Figure 1-1).

The MWL groundwater monitoring well network consists of seven wells completed within interfingering alluvial fan deposits of the Santa Fe Group (Goering et al. 2002). The network (Figure 1-2) included one background well (MWL-BW1), one on-site well (MWL-MW4), and five downgradient or cross-gradient wells (MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW5, and MWL-MW6). All seven wells are constructed of nominal 5-inch, Schedule 80 polyvinyl chloride (PVC) casing. Wells MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3 have screens composed of slotted Type 304 stainless steel. Wells MWL-MW4, MWL-MW5, and MWL-MW6 have screens composed of slotted Schedule 80 PVC.

Groundwater levels have been declining in the regional aquifer and monitoring well MWL-BW1, installed in 1989, was no longer useful for sampling. At the time for annual groundwater sampling (April 2007), there was approximately 1 foot of water within the well screen of MWL-BW1, and the well could not be sampled.

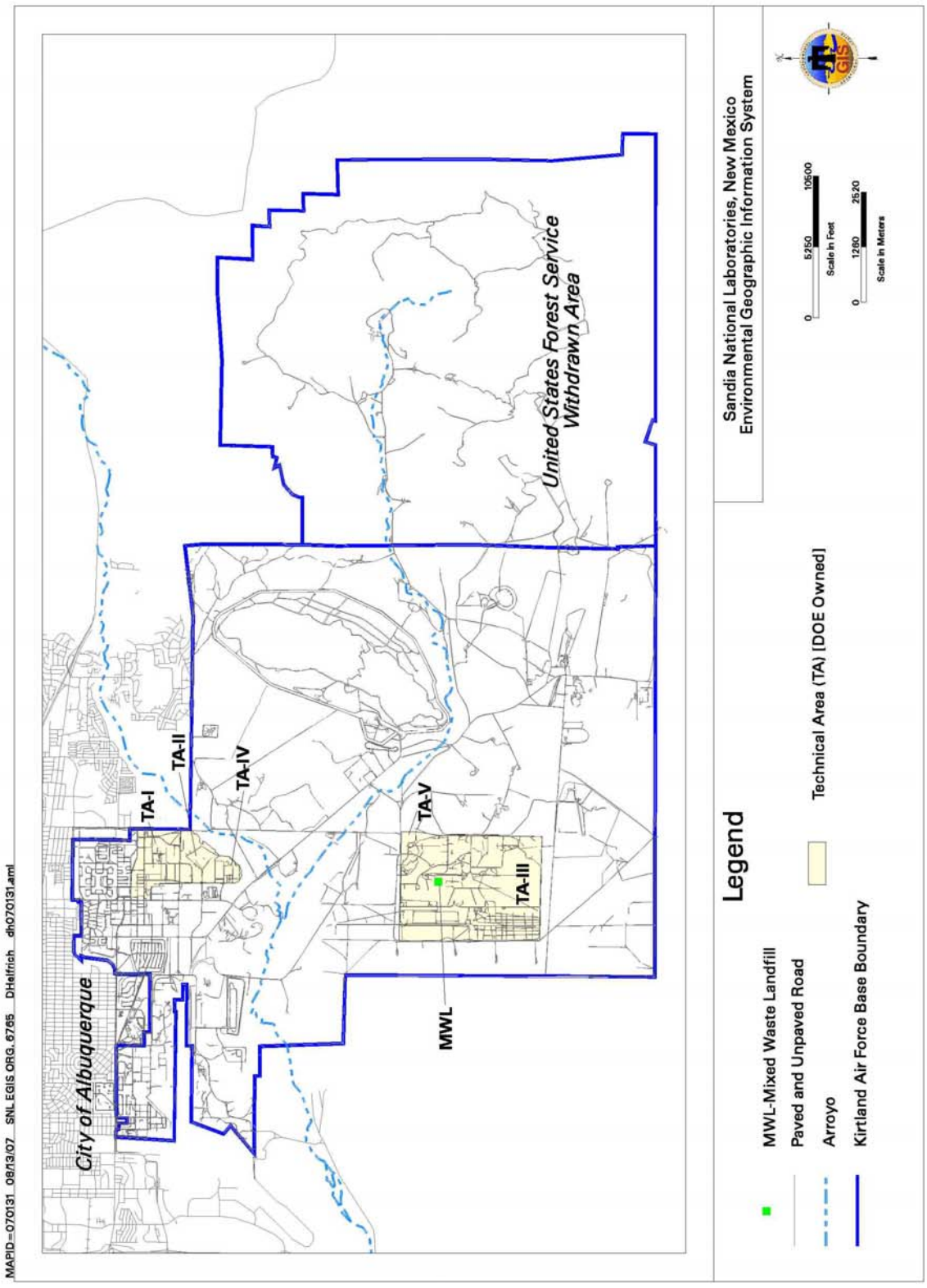

Figure 1-1. Location Map

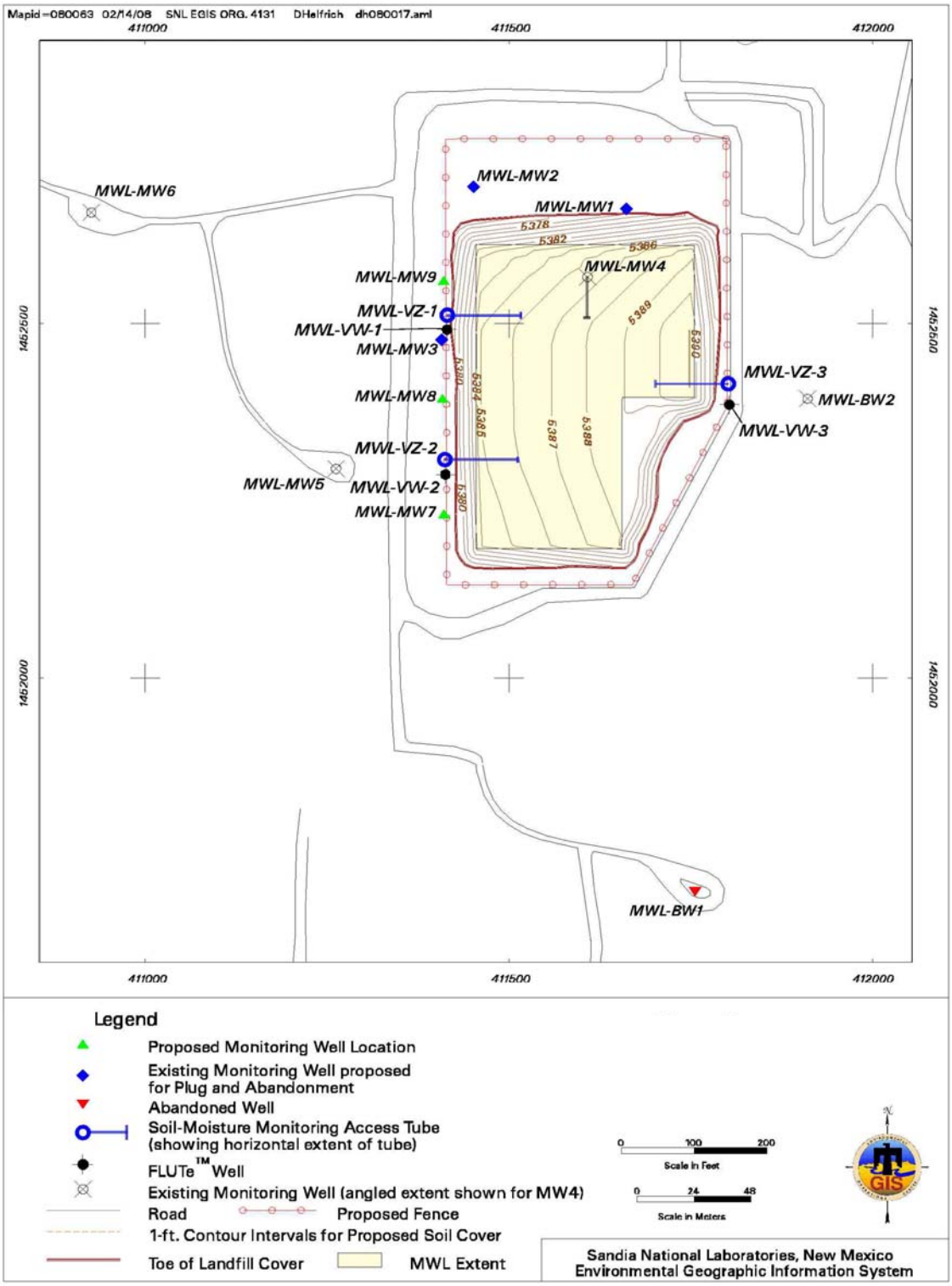

Figure 1-2. Location of Existing and Proposed Groundwater Monitoring Wells at the Mixed Waste Landfill

1.3 Objective

The objective of this project was to successfully P&A MWL-BW1 by grouting the well in situ and to install a new background well, MWL-BW2. This report is organized in chronologic order of activities; the drilling and installation of MWL-BW2, the P&A of MWL-BW1, and the development of MWL-BW2.

The report meets the reporting requirements of the NMED and the New Mexico Office of the State Engineer (NMOSE). The NMED Compliance Order on Consent (the Order) specifies the required elements for reporting on installation of monitoring wells (NMED April 2004) (Attachment A). The NMOSE requirements and guidance can be found in *Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells* (NMOSE August 2005).

2.0 DRILLING AND WELL INSTALLATION

All drilling, well installation, and well development operations were performed by WDC and were supervised by SNL/NM ER Project personnel. Geophysical logging services were performed by Jet West Geophysical Services (Jet West). The borehole for MWL-BW2 was drilled using the air rotary casing hammer (ARCH) method.

The following sections describe the borehole drilling, lithologic and geophysical logging, and well construction. Complete field documentation, field forms, daily driller reports, and lithologic and geophysical logs, are on file at the SNL/NM Customer-Funded Records Center.

2.1 Drilling Operations

The WDC equipment and crew arrived at SNL/NM on January 7, 2008. The drilling equipment (a Speedstar 50K drilling rig and associated equipment) was decontaminated at the ER Project decontamination pad in TA-III prior to the start of drilling operations. Drilling of the borehole for well MWL-BW2, located east of the MWL (Figure 1-2), commenced on January 14, 2008. The first 300 feet (ft) of borehole was advanced with a tricone bit and with 11 3/4-inch outside diameter (OD) drive casing to accommodate drilling through caliche and gravel zones. At 300 ft below ground surface (bgs), the bit and drive casing was switched to 9 5/8-inch OD and the smaller drive casing was telescoped into the borehole. The borehole was initially advanced to a depth of 509 ft. The drilling was suspended at 509 ft bgs to allow for geophysical logging of the borehole (Section 2.3). Following the geophysical logging, the borehole was advanced to a total depth (TD) of 519 ft bgs on January 16, 2008. Field notes are included as Attachment B.

2.2 Lithologic Logging

A lithologic log based on the cuttings returned from the borehole was generated by the ER Project geologist. A combination diagram showing lithologic and geophysical logs, and well construction details is included as Attachment C.

The lithology of the borehole consisted of unconsolidated alluvial and fluvial deposits of the late Pleistocene post-Santa Fe Group alluvium and late Pliocene to Pleistocene upper Santa Fe Group (Goering et al. 2002). The upper Santa Fe Group consists of two first-order sediment types: an alluvial fan sequence derived from uplifts on the basin flanks, and a fluvial sequence derived from the north and deposited by an axial river, the ancestral Rio Grande. The alluvial fan deposits consist of poorly-sorted, weakly-stratified, discontinuous layers of sand with a silt/clay matrix. The lower ancestral Rio Grande sequence was not encountered in this borehole.

From the surface to 80 ft bgs, a sand and gravel mixture of the late Pleistocene post-Santa Fe Group alluvium was encountered. From 80 to 420 ft bgs there was a heterogeneous mixture of silt, sand, and gravel of the upper Santa Fe Group. In general, the sediments were fining downward to 420 ft bgs. A clayey-silt was encountered from 420 to 435 ft bgs. Below that, to the total depth of the borehole (519 ft bgs), there were interfingering units of silty sand with some gravel and silts and clays.

2.3 Downhole Geophysical Logging

On January 15, 2008 the cased borehole was logged with downhole wireline geophysical tools supplied by Jet West to help determine the lithologic characteristics of sediments penetrated in the borehole. Geophysical logs run in the borehole included combination natural gamma ray, thermal neutron, and 1-arm caliper. Although the caliper instrument is located on the same tool, the caliper log is not informative as the logging was completed within the steel drive casing. The geophysical log is provided in Attachment C. The Jet West report and logs are on file in the SNL/NM Customer-Funded Records Center.

The neutron log reveals the telescoped drill casing with a significant signal increase at 300 ft bgs. The gamma ray and neutron readings are attenuated approximately 30 percent by the steel casing and approximately 50-60 percent in dual casing. A notable shift in the neutron signal occurs at 494 ft bgs indicating the level of groundwater in the borehole at the time of the logging. This represents a temporarily depressed water level, due to the drilling activities earlier in the day. The neutron logging continued another 12 ft below the water. The gamma signal is unaffected by the presence of water in the borehole. Due to the position of the gamma detector on the logging tool, the gamma signal ends at approximately 496 ft bgs.

The log indicated that the formation is composed of interbedded clays, silts, and sands. The region of concern, from the groundwater level (approximately 472 ft bgs) downward, was comprised predominately of “dirty” sands with silts and clays (Jet West January 2008). Dirty sand refers to sediment with relatively coarse sand grains mixed with silt and clay that have relatively low hydraulic conductivity and low transmissivity.

2.4 Initial Groundwater Level and Well Construction

On January 15, 2008 the cased borehole had been advanced to 509 ft bgs and initial groundwater was encountered during drilling at approximately 472 ft bgs. During the geophysical logging (occurring later that same day), the groundwater level was at approximately 494 ft bgs within the steel drive casing. The following morning, the groundwater level had risen to approximately 485 ft bgs within the steel drive casing. The water level had not risen to the expected level (472 ft bgs) after allowing the well to recover overnight. The borehole was advanced another 10 ft to approximately 519 ft bgs in an effort to access more transmissive units of sand and/or gravel. It did not appear that any such units were encountered. The sands with silts and clays encountered in the lower portion of the borehole below the static water level are indicative of relatively low-water volume producing units.

Following a telephone consultation with NMED concerning the well construction, it was determined to build the well at the depth proposed in the Plan, assuming the water level would eventually equilibrate to the anticipated level of 472 ft bgs.

Well installation began on January 16, 2008 and was completed on January 18, 2008. The well was constructed of nominal 5-inch diameter (inside diameter of 4.767 inches and OD of 5.563 inches) Schedule 80 PVC flush-threaded blank casing and a 30-foot length of 0.010-inch slot schedule-80 PVC screen. This screen slot size was specified in the Plan to accommodate the low transmissive sand, silts, and clays encountered in the borehole. The sump consisted of a 5-ft length of nominal 5-inch diameter Schedule 80 PVC flush-threaded blank casing with a threaded end cap placed at the bottom. A volclay coarse chip product was used to backfill the

borehole from 510 to 519 ft bgs. Approximately 8 ft of #20-40 sand (Colorado Silica Sand) was used to backfill the borehole from 502 to 510 ft bgs.

The bottom of the well MWL-BW2 was placed at 502 ft bgs and the 30-ft screen section was placed from 467 to 497 ft bgs. The #20-40 sand was used as the primary sand pack in the annulus around the screen and extended approximately 5.5 ft above the top of the screen to 461.5 ft bgs. A secondary sand pack using #60 Colorado Silica sand was placed from 456 to 461.5 ft bgs (the #40-60 sand specified in the Plan is no longer commercially available). A 30-ft volclay coarse chip plug was placed from 426 to 456 ft bgs. The first 18 ft of chips were hydrated and allowed to set overnight. The next day, chips were added up to 426 ft bgs, hydrated, and allowed to set for approximately 2 hours. The Well Construction Diagram is provided in Attachment D.

A bentonite grout (SmoothGrout20™ One Step Grouting System) mixture was used to fill the remainder of the annulus (12 to 426 ft bgs). The first lift of 121 ft of grout was placed and allowed to set for 24 hours. The subsequent lifts of grout were placed in approximately 100-ft lifts and allowed to set for one hour. The final grout lift was brought to 12 ft bgs.

2.5 Wellhead Construction

A 10-ft length of nominal 12-inch diameter steel casing was used as the protective casing at the surface. The casing was placed approximately 7-ft below ground and 3-ft above and was equipped with a hinged locking cap. A fitted locking well cap was also placed on the PVC casing. Concrete was placed in the annulus from the top of the grout at 12 ft bgs to the surface. A 3-ft by 3-ft pad was built around the casing and a brass marker cap was placed in the pad denoting the well name. Three steel guard posts were placed around the pad, and the posts and the protective casing were painted yellow.

3.0 PLUG AND ABANDONMENT

The monitoring well MWL-BW1 was plugged in situ on January 23 and 24, 2008. A Groundwater Well Abandonment Diagram is included as Attachment E. A grout mix (Quick-Grout™) was placed in the well with a portable grout plant (grout was pumped through tubing placed at the bottom of the well and pulled up as well was filled). The well was grouted from 477 ft bgs (bottom of the well) to the surface and allowed to set overnight. The next morning, the grout plug had settled to approximately 12 ft bgs. The concrete pad and steel guard posts were removed from the surface of the well head.

The protective casing consisted of approximately 3 feet of steel casing that was welded to a length of conductor casing that extended below ground. The conductor casing was required for the mud-rotary drilling technique used to advance the borehole and was left in place during the installation of the well to serve as the protective casing. As the annulus between the conductor casing and the PVC well casing was firmly cemented, it was not possible to remove the 20-ft length of conductor casing. There was approximately 14 inches of the casing above ground and the PVC well casing extended a foot above that. The PVC casing was cut flush with the steel casing. A concrete plug was placed from the top of the grout plug (approximately 12 ft bgs) to the top of the two casings (approximately 14 inches above ground). The well monument was built over the two casings and a brass marker was placed in the monument. The marker denotes the well name, date of P&A, and well depth.

4.0 WELL DEVELOPMENT

Well development of MWL-BW2 was conducted March 10 through 13, 2008, according to the Well Development Field Operating Procedure (FOP) 94-41 (SNL/NM 1994). The well was developed with the WDC development rig. The initial water level reading taken on March 10, 2008, was 474.55 ft bgs. The calculated saturated wellbore volume (includes pore spaces in the annular sand pack) was approximately 42 gallons. The volume was originally overestimated (in the field notes – Attachment A) at 68 gallons, as it included the saturated casing and bore volume below the screen section.

The development began by evacuating the well with a stainless steel bailer. Approximately 40 gallons of water was bailed before the well went dry. The water was turbid, but did not contain much sediment. The well screen was swabbed and the well was allowed to recover for approximately 30 minutes. Another 25 gallons of water was bailed before the well went dry again. The following day, the well was repeatedly swabbed, bailed dry, and allowed to recover. A total of approximately 340 gallons (approximately 8 bore volumes) was removed from the well with the bailer.

Water quality parameters were measured and recorded during the well development, including:

- Temperature (degrees Celsius [°C])
- Specific Conductivity (micromhos/centimeter [µmho/cm])
- pH (potential of hydrogen), and
- Turbidity (measured in nephelometric turbidity units [NTUs]).

Water quality parameters were not stable during the bailing and swabbing of the well. The well was then purged with a submersible pump (Bennett™) at approximately 1/3 gallon per minute (lowest possible flow rate). The pump was set at the bottom of the screen section (497 ft bgs). Water quality parameters were stable during the pumping of approximately 150 gallons (approximately 3.5 bore volumes). A summary of the water quality parameters measured during pumping are presented in Table 4-1. The Well Development Forms are provided as Attachment F.

Table 4-1. Summary of Water Quality Parameters during Well Development, March 13, 2008

Time	Gallons pumped[a]	Water Level (ft bgs)	Temperature (°C)	Specific Conductivity (µmho/cm)	pH	Turbidity (NTUs)
0802	5	480.18	15.47	693	6.80	0.94
0916	25	482.91	18.37	700	7.22	4.18
1041	50	483.94	18.60	706	7.22	1.00
1213	75	484.21	18.37	706	7.20	0.68
1317[b]	100	488.10	19.54	703	7.13	2.94
1436	125	485.92	19.36	705	7.17	2.89
1558	150	485.42	19.86	708	7.11	3.39

[a] Pumping followed the evacuation of approximately 340 gallons with the bailer on March 10 and 11, 2008. Water quality parameters were not stable during the bailing.
[b] Pump rate was increased to approximately ¾ gallon per minute at 1259 and water level dropped significantly. Rate was returned to approximately 1/3 gallon per minute and water level recovered. Turbidity remained below 5 NTUs (as specified in FOP).

ft = Feet
bgs = Below ground surface
°C = Degrees Celsius
FOP = Field operating procedure
µmho/cm = Micromhos/centimeter
NTUs = Nephlemetric turbidity units
pH = Potential of hydrogen

5.0 VARIANCES

All FOPs and Administrative Operating Procedures (AOPs) cited in the Plan (SNL/NM August 2007) were followed. There were no instances of variance from either the Plan or the FOPs/AOPs during these activities.

6.0 REFERENCES

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Sandia National Laboratories/New Mexico (SNL/NM), July 2007. "DOE/SNL Response to NMED's Notice of Disapproval: Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan; Decommissioning of Groundwater Monitoring Well MWL-BW1, Installation of Replacement Groundwater Monitoring Well MWL-BW2, April 9 2007; and Revised Plan, July 2007," Environmental Restoration Project, Sandia National Laboratories, Albuquerque, New Mexico.

ATTACHMENT A
Well Data for MWL-BW2

Table A-1. Well Data for MWL-BW2

Items Required by the Order[a] Section VIII.D	Comments
1. Well name/number	MWL-BW2
2. Date of well construction	January 22, 2008 (completion)
3. Drilling method	Air rotary casing hammer
4. Drilling contractor and name of driller	Water Development Corporation, Mark Green
5. Borehole diameter and well casing diameter	Borehole: 11 3/4 inches 0 to 300 ft bgs, 9 5/8 inches to 300 to 519 ft bgs
	Well casing: 5.563 inches OD, 4.767 inches ID
6. Well depth	502 ft bgs (borehole depth 519 ft bgs)
7. Casing length	504.35 ft total (bgs 2.35 ft above ground)
8. Casing materials	Schedule 80 PVC
9. Casing and screen joint type	Flush thread
10. Screened interval(s)	467 to 497 ft bgs
11. Screen materials	Schedule 80 PVC
12. Screen slot size and design	0.010-inch slotted screen
13. Filter pack material and gradation	Primary: #20-40 silica sand
	Secondary: #60 silica sand
14. Filter pack volume (calculated and actual)	Calculated: 18.2 ft^3, 36.4 50-lb bags
	Actual: 40 bags
15. Filter pack placement method	Gravity feed through drive casing
16. Filter pack interval(s)	Primary: 461.5 to 510 ft bgs
	Secondary: 456 to 461.5 ft bgs
17. Annular sealant composition	Volclay chip plug, bentonite grout
18. Annular sealant placement method	Gravity feed through drive casing
19. Annular sealant volume (calculated and actual)	Calculated: Plug 11.4 ft^3, 12.7 50-lb bags Grout 1st 121-ft lift 46 ft^3, 345 gallons Grout 2nd through 4th 100-ft lifts 63 ft^3, 472 gallons each
	Actual: Plug 14 bags Grout 1st 121-ft lift 380 gallons Grout 2nd through 4th 100-ft lifts 400 gallons each (brought to 12 ft bgs)
20. Annular sealant interval(s)	Plug: 426 to 456 ft bgs
	Grout: 12 to 426 ft bgs
21. Surface sealant composition	Concrete
22. Surface seal placement method	Gravity feed through drive casing
23. Surface sealant volume (calculated and actual)	7.56 ft^3
	Not recorded, placed concrete 0 to 12 ft bgs
24. Surface sealant interval	0 to 12 ft bgs
25. Surface seal and well apron design and construction	3-ft by 3-ft by approximately 8-inch deep concrete pad
26. Well development procedure and turbidity measurements	Stainless steel bailer and submersible pump (see Table 4-1 for turbidity measurements)
27. Well development purge volume(s) and stabilization parameter measurements	Total of 490 gallons (see Table 4.1 for parameter measurements)
28. Type and design and construction of protective casing	10-ft length of 12-inch diameter steel casing with hinged cap (7 ft bgs and 3 ft above ground)
29. Well cap and lock	Hinged cap on protective casing with padlock and locking well cap with padlock on well casing
30. Ground surface elevation	5386 ft amsl
31. Survey reference point elevation on well casing	5388.35 ft amsl
32. Top of monitoring well casing elevation	5388.35 ft amsl

Refer to footnotes at end of table.

Table A-1. Well Data for MWL-BW2 (concluded)

Items Required by the Order[a] Section VIII.D	Comments
33. Top of protective steel casing elevation	5388.95 ft amsl
34. Name of geologist	Stacy Griffith
35. Initial water level	472.5 ft bgs (estimated by diminished cuttings return during drilling)
36. Final water level	474.46 ft bgs January 22, 2008 (475.27 ft bgs on April 3, 2008)
37. Date of well development	March 13, 2008 (completed)

[a] New Mexico Environment Department, April 2004. "Compliance Order on Consent Pursuant to the New Mexico Hazardous Waste Act," § 74-4-10, New Mexico Environment Department.

amsl = above mean seal level
bgs = below ground surface
ft = feet
ft^3 = cubic feet
ID = inside diameter
OD = outside diameter
PVC = polyvinyl chloride

ATTACHMENT B
Field Notes for Activities at MWL-BW1 and MWL-BW2

1-7-08
Drilling @ MWL
kick-off Meeting w/ training

1344: Arrive ERFO for meeting
Mike Skelly (CT32165)
Stacy Griffith > SNL/NM (CT32215)
Mike Sanders

Clint
Mark Green > Water Development Corp.
Dustin
Richard

Watch all training videos @ ERFO. Discuss SAW, HASP, site access, security, etc.
1530: All personnel leave site.

1-8-08
Drilling @ MWL
Task: Set up @ site
Personnel: SRG -SNL/GRAM
Mark Green
~~Chad~~ Dustin Cra } WDC
Richard Bare

0930: Arrive @ site, mob equipment from decon pad. All equipment decond prior to arriving @ drill site.
Mike Skelly arrives
1000: Franz Lauffer arrives
1045: Craig Hawker arrives to conduct safety inspection
1115: Safety inspection complete & approval from Hawker to proceed w/ work.
1130: All personnel off-site. WDC needs new filters for rig. Must go off-site.
Return to ERMO

1-14-08 Monday
Task: MWL Drilling
Weather: Cold, clear. 26°F @ 0700.
Personnel: SRG - SNL/GRAM
Mark Green
Richard Bare > WDC

0646: SRG @ ERMO, mob to site.
0700: On-site all personnel. Conduct daily H&S mtg.
Dustin Crow not on site. New crew member (363-2396)
waiting @ badge office. Rig Type STAR 30K
0736: Setting up @ location.
0750: Bill Gibson & Alfred S. on-site to deliver eye wash station.
0810: Bill & Alfred off site
Drill string - 1' shoe then 20' of 11 3/4" drill casing
1st length of casing 20'
0830: 2nd 20' → 40' total
0850: 3 x 20' → 60' "
0920: 4 x 20' → 80' "
0930: 5 x 20' → 100 " no grab sample
0940: 6 x 20' → 120'
0945: 7 x 20' → 140' 145' no grab sample
1003: 8 x 20' → 160' sample @ 155'
1021: 9 x 20' → 180'
1033: 10 x 20' → 200'
1050: 11 x 20' → 220'
1105 12 x 20' → 240'
1130 13 x 20' → 260'

1-14-08 cont'

1140: 14 X 20' → 280' total drill pipe casing in hole.
1201: 15 X 20' → 300'
1220: Reached 300' bgs w/ 11¾" casing. Pull drill stem x1
1230: All personnel off-site for lunch, badge office, decon pad.
1350: All personnel back on-site including Dustin Crow & ERFO (Lynch, Gibson, Santillanes to set up site perimeter zone.
1435: Set up w/ 9⅝" drill casing, trip back in all drill stem. 520' of casing on pipe truck.
1500: Site visitors: Casey Heath (WDC, new crew) Danielle Nieto (SNL), Daniel Kurtz (SNL) Lynch, Gibson, Santillanes (ERFO) - set up exclusion zone perimeter.
Cover HASP & training forms w/ Heath.
1540: Heath, Nieto, Kurtz → off-site
1550: Mike Skelly on-site for ~~SRGriffith~~. SRG off-site @ 1605.
1629: Gibson/Lynch/Santillanes finish setting up perimeter fence/caution barrier; they leave for ERFO.
1647: Drill rig off, secure site, drill crew off site
1653 Secure Trailer, Skelly offsite.

Michael F. Skelly

1-15-08 Tuesday
Task: MWL Drilling
Weather: Cold, clear
Personnel: SRG - SNL/GRAM
Mark Green
Richard Bare → WOC

0645: SRG @ ERMO, mob to site
0700: Personnel on-site. Conduct H+S mtgs.
0732: Prepare to resume drilling @ 300'. 220' of casing on pipe truck.

			on truck
0740:	casing 1 X 20'	→ 320'	200'
0802:	2 x 20'	→ 340'	180'
0818:	3 x 20'	→ 360'	160'
0840:	4 x 20'	→ 380'	140'
0902:	5 x 20'	→ 400'	120'
0917:	6 x 20'	→ 420'	100'

0930: Casey Heath on-site, Badge # CT42053 Temp
Mark Green CT41780
Richard Bare CT41975

0935:	7 x 20'	→ 440'	80'
0950:	8 x 20'	→ 460'	60'
1017:	9 x 20'	→ 480'	40' expect WT ~ 472'
1050:	10 x 20'	→ 500'	20' + 10' on truck

1100: Cyclone & tube blocked after encountering material below WT

1-15-08 cont

1140: Add 10' casing → total 510'
1210: Total Depth ~509'. Added ~100-150 gallons water to clean out. Will evacuate all added water.
1245: Start tripping out drill stem.
1315: All drill stem out of hole.
1330: Drill crew prep well materials. SRG offsite to ERMO
1400: Skelly, SRG & JetWest Geophysical Services onsite. Neutron probe & resistivity logging of well w/in drive casing. (JetWest personnel - Al Henderson
1445: Start logging borehole.
1700: JetWest finished. Skelly offsite.
1720: Secure site. SRG w/ JetWest to Eubank Gate.

1-16-08 Wednesday
Task: MWL Drilling
Weather: Very cold, windy.
Personnel: SRG SNL/GRAM
Mark Green
Richard Bare > WOC
Casey Heath

0645: SRG @ ERMO, mob to site.
0700: All personnel on site. Conduct H+S mtg
0740: Water level 485' bgs. (measurement 489' - 3.8' stick up)
WL has not reached anticipated ~472' bgs.
0800: SRG offsite to ERMO to discuss situation.
0930: Call Mark Green → trip drill stem back in hole & drill an additional 10'.
1000: SRG on site, drill crew tripping into borehole
1030: Mike Skelly on site. Begin drilling @ 509'
gravel layer only few inches thick. Back into some gravel but w/ clay.
1120: Not much difference in lithologies → intermittent sands, clay, very few gravel lenses. TD = 519' bgs.
1145: Trip out drill stem.
1220: All drill stem out
1300: SRG off-site to ERMO.

1-17-08 Thursday
Task: MWL Drilling
Weather: Very, very cold → 1°F w/ wind chill
Personnel: SRG /SNL/GRAM
Mark Green
Casey Heath
Richard Bare
} WDC

0630: SRG @ ERMO mob to site.
0655: SRG Green + Heath on site. Very cold conditions. -
0720: Conduct H+S mtgs.
0730: Tag water level. 502.3' - 3.8' stick up = 498.5'
Tag bottom of borehole ~ 523' - 3.8' " = 519'
Borehole stayed open, water level has not come up to expected level (~ 472')
There is ~20.7' of water in borehole.
Expect ~ 47' of water in borehole.
0945: Mike Skelly called Will Moats (NMED) to discuss situation. Moats agreed to set the well as proposed w/ an anticipated water level of 472'.
1000: Begin to build well. Brand new tape measure for tag.
1030: Add Volclay coarse chips to bottom of hole.
50 lb bags → HHH II
pulled 10' casing left in hole 510'
added plug to 509.2' bgs.
Build well - 5" cap, sump, 30' 0.010 slot screen
centralizer @ base of screen + at top

1-17-08 CMA

1400 Set well → 504.66' of PVC set bottom @ 502' add 5' of stick up for building well (7.66' of stick up w/ addition)

1420: Start adding 20-40 sand 50lb bags |||| |||| bringing sand up to 462' (need ~37 bags 20-40 sand) Clint on-site to deliver more 20-40 sand

1440: Pull casing 1 x 10' → 500' in hole adding 20-40 sand |||| ||||

1500: pull casing 1 x ~~20~~ 10 → 480' in hole add sand @ ~489' |||| ||||

1515: pull 1 x ~~20~~ 10' 480' in hole add sand to ~469' |||| ||||

1530: pull 1 x 10' 470' tag sand @ 460', swab the well to settle sand around screen. Used 40 bags 20-40 sand

1600: pull 1 x 10' casing 460' tag sand @ 461.5', add 60 sand (40-60 sand is no longer available) 100 lb bags → II (2 total) tag top of 60 sand @ 456' pull 1 x 20' casing (440' in hole)

1630: Adding volclay chips 50 lb. bags |||| || (calc. 9, use 7) pull 1 x 10' casing (430' in hole) chips @ 438' will hydrate & let sit overnight

1715: add ~ 100 gallons water

1730: Secure site. SRG to ERMO

1-18-08 Friday

Task: MWL Drilling

Weather: Cold & clear

Personnel: SRG SNL/GRAM
Mark Green
Richard Bare } WDC
Casey Heath

0700: SRG @ ERMO, mob to site

0750: All personnel @ site. Conduct H&S mtgs.

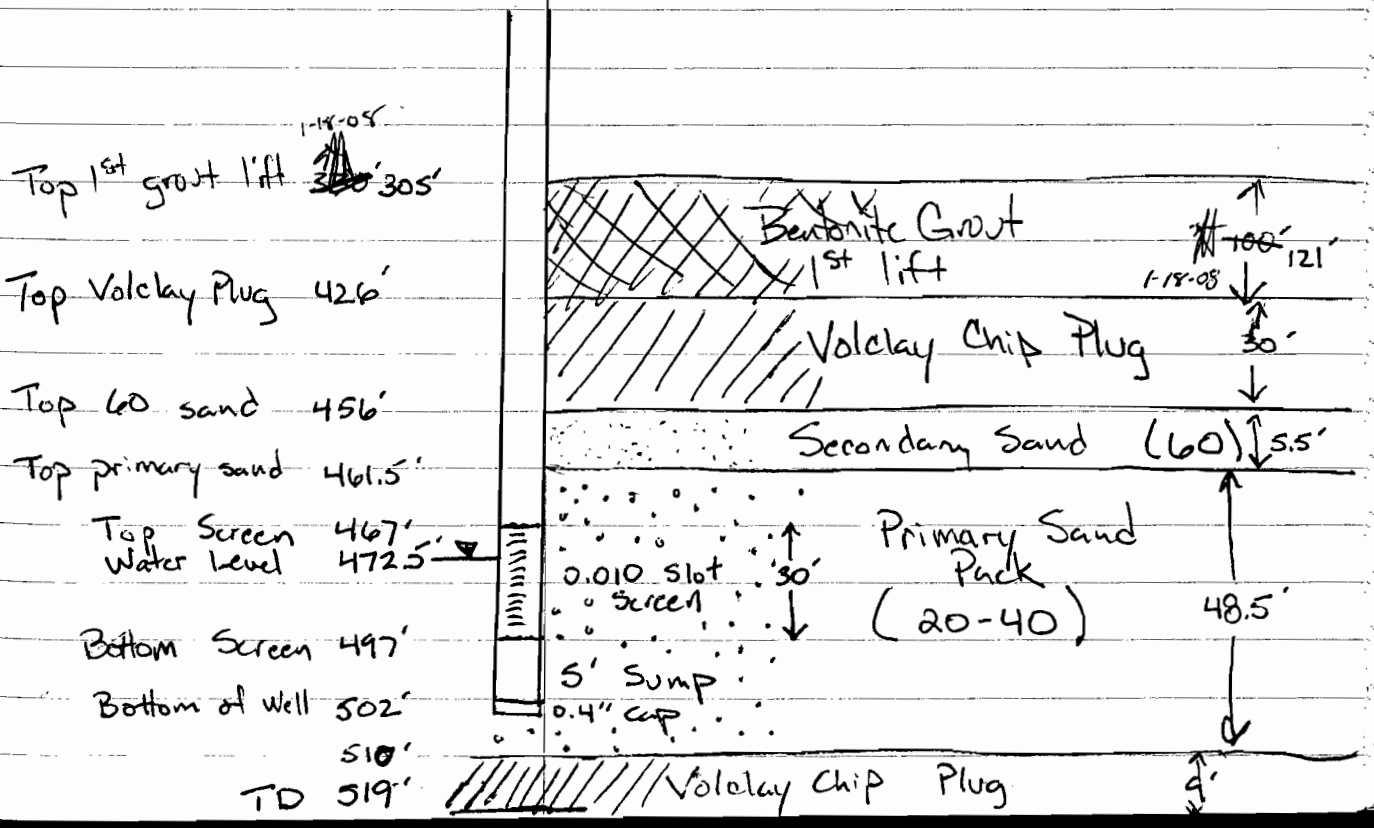
0754: Adding Volclay chips to 426' need 4 → IIII (4) used

0820: Water level 472.5' → Yeah.

0830: Hydrate last 10' of chips w/ 140 gallons

0850: Pull 1x20' casing (410' in hole)

Well Construction Diagram



1-18-08 cont'd

0900: Mark Green offsite to Home Depot
Richard + Casey to decon pad w/ casing

0930: Richard + Casey back.

0945: Mark back onsite. Prepare to mix 1st lift of grout.

1020: Pump in 1st tank (~380 gallons) of grout. SmoothGrout20 One Step Grouting System (powdered) 50 lb. bags Wyoming Bentonite

1030: Pull 4 x 20' casing (330' casing in borehole)

1045: Cut off upper portion of well casing.
Pull 5 x 20' casing (230' casing)

1105: Pull all remaining 9 5/8" casing. Leave in 11 3/4" (300' in borehole).

1205: All 9 5/8" casing pulled. ~5' open hole b/w bottom of 11 3/4" casing @ 300' & top of grout ~305'
WDC crew to decon pad to clean drill casing. Will go to standby later this afternoon.

1300: Secure site. SRG to ERM.

1-21-08 Monday
Task: MWL Drilling
Weather: Cold clear, high winds expected
Personnel: SRG SNYGRAM
Mark Green
Richard Bare > WDC

0645: SRG @ ERMO, mob to site
0700: All personnel on site. Casey Heath not on site today.
0720: Water level @ 474.32. No grout on water level probe. Conduct H&S mtgs.
0751: Tagged top of grout @ 308'. ~100'
0900: Mixed batch of grout ~400 gallons. Pumped in. Pull 20' casing → ~~HH~~ = 100'
0950: Mix ~400 gallons grout ~100', pump in.
1000: Pull 100' casing, let grout sit 1 hour.
1200: Mix last batch of grout to bring up to near surface
1236: Grout up to ~12' bgs. Let set up & top off tomorrow. SRG off-site to ERMO, WDC site clean up & decon.
1300 - 1700 - Stand by → 4 hours

1-22-08 Tues
Task: MWL Drilling - Official date of Completion BW2
Weather; Overcast, cold
Personnel; SRG SNL/GRAM

0800: SRG on-site,
Mark Green & Richard Bare (WOC) on site.
Prepare to complete well pad @ BW2.
Casey Heath on site (WOC).
0858: Water level 474.46'
1000: WOC crew to finish well pad w/ bollards.
SRG back to ERMO.
Casey Heath picked up new badge CT42669
10:30 - 5:30 Stand by hours - 7hr

1-23-08 Wed
Task: P+A @ MWL-BW2
Weather: Clear, cold
Personnel: SRG SNL/GRAM
Mark Green
Richard Bare > WDC
Casey Heath

0800: Mob to BW1 to prepare to P+A the well.
0830: Run tubing to bottom of well for grouting. Conduct HAS mtg.
Grout product: Quick-Grout™ Baroid

Placement of grout w/ portable grout plant on trailer. Mixes grout & water in small tank & pumps into well from bottom up w/ flexible hose.

1030: Start grouting well.
1245: Grout to surface. All personnel off-site. WDC crew to decon grout equipment. Will check grout level in morning. SRG to ERMO.
5 hours standby

1-24-08 Thur
Task: MWL Drilling - P&A MWL-BW1
Weather: Overcast, cold
Personnel: SRG SNL/GRAM
Mark Green
Richard Bove > WDC
Casey Heath

0645: SRG @ ERMO, mob to site.
0700: SRG on site trailer. H&S mtg.
0740: David Miller and Mike Sanders on site for discussion of TA-V next week.
0830: Miller & Sanders offsite.
0900: Grout sunk to 12' bgs in well casing @ BW1. Use forklift to pull up concrete pad & bollards. The protective casing (above pad portion) was welded to ~~&~~ conductor casing. This was not indicated on the well construction diagram. The lithology log show 14" butt welded casing to 20' bgs. There is ~ 10" of the casing above ground & another 1' of the PVC well casing above that. Cannot pull that ~~14~~ 20' steel casing. In order to abandon the well, cut off the PVC level w/ the steel casing. Fill to surface w/ quickcrete & mound around steel casing. Place tagger in concrete monument to be marked as P&A by ERFO later
1130: All personnel off-site to 6585 to watch TA-V security video.

MW-BW2 DEVELOPMENT 3/10/08 MON

PERSONNEL: MIKE SANDERS (6765/GRAM INC.)
NICHOLAS (NICK) COOPER (WDC)

WEATHER: CLEAR, CALM, MID-50s

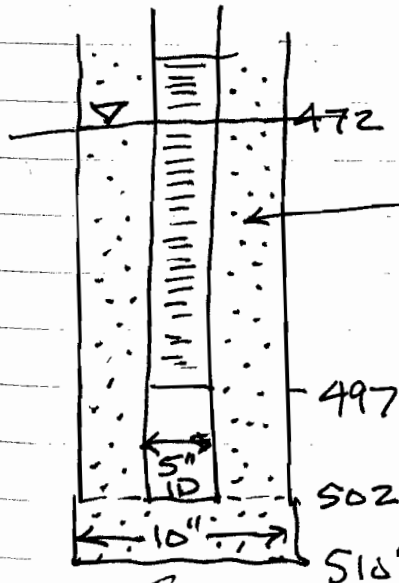
TASK: START MW-BW2 WELL DEVELOPMENT.

0800 ARRIVE @ BADGE OFFICE (CIPC BLDG). COOPER HAS TEMP. BADGE, HEAD TO B. 9925 FOR VIDEO ~~TRAINING~~ MRS TRAINING.

1054 ARRIVED @ TA-II DECON PAD AFTER COMPLETING VIDEO TRAINING + FILLING 70 GAL WATER TANK @ B. 9925.

1340 STILL @ DECON PAD. HAD TO RUN DOWN REPAIR PART FOR STEAM CLEANER

BORE VOL CALCS: Please see recalculation p.188 3-11-08



GRAVEL PACK:

10" DIAM: 0.5454 FT³/FT (472'-502')
5" DIAM: 0.1364 FT³/FT
NET: 0.5454 - 0.1364 = 0.409 FT³/FT
.502'-510': 0.5454 × 8' = 4.4 FT³

→ 0.409 × 30' (472'-502') = 12.3 FT³

Σ: VOL IN GRAVEL PACK FROM 472'-510':
12.3 + 4.4 = 16.7 FT³ × 7.48 GALS/FT
× 30% POROSITY = 37.5 GALS

CASING (5" ID): 1.02 GALS/FT × 30' = 30.6 GALS

TOTAL: 37.5 + 30.6 = 68.1 GALS PER BORE VOL

MR Sanders 3/10/08

MW-BW2 DEVELOPMENT 3/10/08, MON

1407 HEAD TO BW2, DECON DANIE. DAILY GEN.
2-3 GALS WATER TO DECON PAD.

1435 477.55 (TO TOP OF STOVE PIPE [PROT. CASING]) -/~3.0' STICKUP ABOVE GROUND SURFACE.
474.55' TO WATER BGS. ~7.5' OF SCREEN IS DRY.

1440 COMPLETED HASP REVIEW, TAILGATE H&S BRIEF, DISCUSSED LAYNE LIFTING HOOK ACCIDENT ~2 YRS AGO.

1520 BAILED ~40 GALS FROM WELL - MUDDY WATER, NOT MUCH SEDIMENT IN SUMP. BAILED DRY.

1542 START SWABBING WELL

1625 FINISH SWABBING, RUN BAILER AGAIN.

1700 BAILED ~25 GALLONS (~75 TOTAL NOW), WATER LEVEL DROPPING FAIRLY QUICKLY (LOW PRODUCER). LOCK UP WELL, WILL SWAB AGAIN IN AM.

1718 DEPART SITE, CALL STACY GRIFFITH STATUS REPORT.

MR Sumner 3/10/08

MWL-BWZ Development 11 MAR08 Tues.
Michael Shelby taking over for Michael Sanders.
0648 at ER MO+ pick up gear + truck head to MWL
0703 Onsite at MWL-BWZ
0711 Nick Cooper onsite, set up over well, discuss daily plan, review tailgate H&S plan.
0732 Tag Water level 478.1 top of protective casing (stove pipe).
0738 Begin swabbing well screen
0802 Finish swabbing, run bailer.
0815 Removed ~95 gal (total: 45 today) water sample very muddy/silty (see field log for parameter readings).
0832 Bailed dry at ~120 gal (total) allow well to recover
0848 Resume bailing.
0904 Bailed dry at ~140 gal (total) allow well to recover
0921 Resume bailing; transfer water to drum #3 (1506).
0947 Bailed dry at ~160 bal.
1010 Resume bailing.
1021 Bailed dry at ~175 bal
1044 Resume bailing
1055 Bailed dry at ~185 bal
1126 Resume bailing
1139 Bailed dry at ~200 bal, allow well to set before swabbing. Leave site for ER MOs.
1156 at ER MOs tag off with Stacy.

3-11-08 cont

1250: S. Griffith on site.
WDC swabbing well again.
1300: Bailed ~ 25 gal, well nearly dry, allow recovery
1340: Resume bailing. Bailed ~20 gal → dry
1430: "
1455: ~250 gallons total purged from well
parameters not stable, see log
1500: Able to purge ~ 20 gal every 20-25 minutes
1530: Mike Skelly on-site. Continue purge & recovery
1700: Total purge volume @ ~~300~~ 340 gal, parameters did not stabalized w/ bailing method alone. Well recovery too slow to pump w/ WDC development rig. Will continue to develop w/ ERFO. Skelly offsite.
1715: Secure site. WDC & Griffith offsite

Recalculation of Well Bore Volume:

R_1 = well ID = 0.40 ft
R_2 = bore ID = 0.83 ft ~from 3-10-08
saturated screen height (497 - 474.55) = 22.45 ft
V_1 = saturated casing volume = $\left(\frac{R_1}{2}\right)^2 \pi (22.45)(7.48\ gal/ft^3)$ = 21 gal
V_2 = saturated bore volume = $\left(\frac{R_2}{2}\right)^2 \pi (22.45)(7.48)$ = 91 gal
V_3 = sand pack = $(V_2 - V_1)(0.30)$ = 21 gal
Well Bore Volume = $V_3 + V_1$ = 42 gal

3-13-08
Task: Continued Development MWL-BWZ
Weather: Clear, expected very high winds
Personnel: S. Griffith / GRAM
Robert Lynch
Bill Gibson
Alfred Santillanes
> ERFO

0730: Prepare to pump well w/ Bennett pump
Water level 477.35' BTC
Set pump @ bottom of screen section ~497'

0802: Set pump @ bottom of screen.
Start pumping @ ~ 1/3 gal/minute.
Parameters recorded on log.
Water is only slightly cloudy.

0830: After 10 gals → turbidity 1.28 NTU
0900: 20 gals → " 6.34 NTU
Water level drops to 483 and then only drops slightly w/ continued pumping.

1116: WL 483.73' BTC, turb 1.01 NTU
60 gals purged

3-13-08 con't

1300: Pump rate @ ~ ½ gal/minute.
WL in well ~ 483
Parameters remain stable.
Turbidity below 1 NTV.
Increase pump flow rate to approximately ¾ gal/min.
WL drops ~ 4 ft & turb increases. (max 25.2 NTV)

1330: Reduce flow rate to ~⅓ gal/min.
Parameters stabalize turb returns to <1 NTV

1400: Continue pumping @ lower rate.
Total gallons pumped 115.

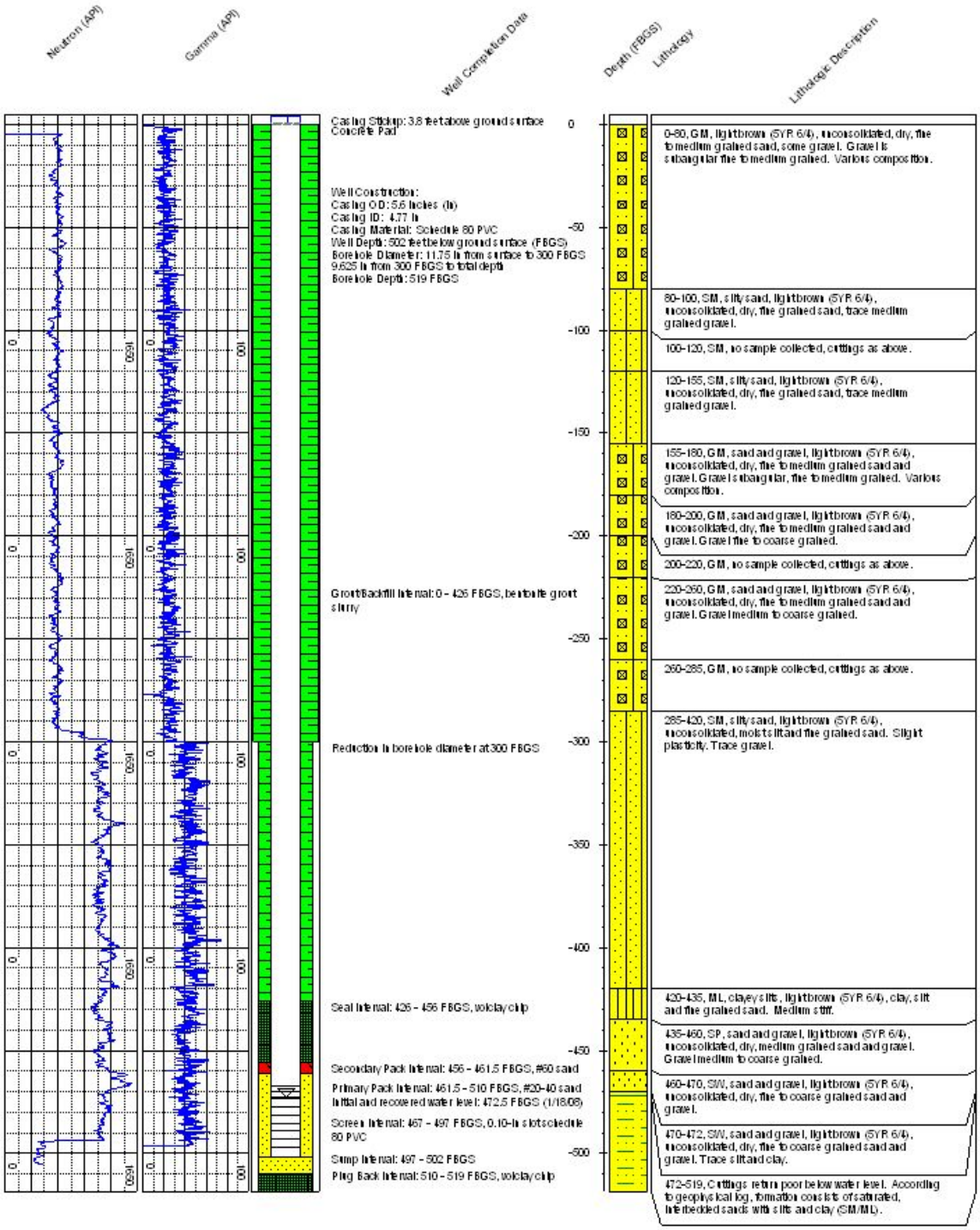
1558: Total gallons @ 150 for day. Gallons bailed previously this week ~340 gallons.
Parameters stabilized. End of development
Pull pump, secure well head, leave site.
See field logs for MWL-3W2.

ATTACHMENT C

Combination Lithologic and Geophysical Logs with Well Construction Details for MWL-BW2

Sandia National Laboratories/New Mexico
Environmental Restoration Department
MWL-BW2

Geologist: *Stacy Griffith*
Drilling Date: *January 14-15, 2008*
Well Installation Date: *January 22, 2008*



Water level during geophysical logging (~494 FBGS) was not static.

ATTACHMENT D
Well Construction Diagram for MWL-BW2

WELL DATABASE SUMMARY SHEET

Project Name:	ENVIRONMENTAL RESTOR	**Geo Location:**	TA-III
ER ADS #:	1289	**Well Completion Date:**	22-JAN-2008
Well Name:	MWL-BW2	**Completion Zone:**	ALLUVIAL MATERIAL
Owner Name:	U.S. DEPT. OF ENERGY	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	14-JAN-2008	**Well Comment:**	INITIAL WATER LEVEL APPROX BASED ON CONDITIONS ENCOUNTED DURING DRILLING. CUTTINGS RETURN DIMINISHED DUE TO SATURATION.
Drilling Contractor:	WATER DEVELOPMENT CORP.		
Drilling Method:	AIR ROTARY CASING HAMMER		BOREHOLE DIAMETER IS 11 3/4 IN. TO 300 FT. AND 9 5/8 IN. TO TD.
Borehole Depth:	519		
Casing Depth:	502		

Survey Data

Survey Date: 23-MAR-2008

Surveyed By: SNL/NM

State Plane Coordinates

(X) Easting: 411947.89

(Y) Northing: 1452389.85

Surveyed Elevations (FAMSL)

Protective Casing: 5388.95

Top of Inner Well Casing: 5388.35

Concrete Pad: 5386.01

Ground Surface: 5386

Calculated Depths and Elevations

Initial Water Elevation: (FAMSL) 4915.85

Initial Depth To Water: (FBGS) 472.5

Last measured water level was 4913.5 **FASL**

measured on 22-JAN-2008

Date Updated: 03-APR-08

Date Printed: 07-APR-2008

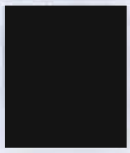
Completion Data Measured Depths (FBGS)

Casing Stickup: 2.34

Interval	**Start**	**Stop**			
BOREHOLE	0'	300'			
	I.D.	11.75"			
Interval	**Start**	**Stop**			
GROUT/BACKFILL	0'	426'			
BENTONITE GROUT					
Interval	**Start**	**Stop**			
CASING	0'	502'			
SCHEDULE 80 PVC	**I.D.**	4.767"	**O.D.**	5.563"	
			Slot Size	5.56"	
Interval	**Start**	**Stop**			
BOREHOLE	300'	519'			
	I.D.	9.625"			
Interval	**Start**	**Stop**			
SEAL	426'	456'			
VOLCLAY CHIP					
Interval	**Start**	**Stop**			
SECONDARY PACK	456'	461.5'			
#60 SAND					
Interval	**Start**	**Stop**			
PRIMARY PACK	461.5'	510'			
#20-40 SAND					
Interval	**Start**	**Stop**			
SCREEN	467'	497'			
SCHEDULE 80 PVC					
			Slot Size	.01"	
Interval	**Start**	**Stop**			
SUMP	497'	502'			

WELL DATABASE SUMMARY SHEET

Project Name:	ENVIRONMENTAL RESTOR	**Geo Location:**	TA-III
ER ADS #:	1289	**Well Completion Date:**	22-JAN-2008
Well Name:	MWL-BW2	**Completion Zone:**	ALLUVIAL MATERIAL
Owner Name:	U.S. DEPT. OF ENERGY	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	14-JAN-2008	**Well Comment:**	INITIAL WATER LEVEL APPROX BASED ON CONDITIONS ENCOUNTED DURING DRILLING. CUTTINGS RETURN DIMINISHED DUE TO SATURATION. BOREHOLE DIAMETER IS 11 3/4 IN. TO 300 FT. AND 9 5/8 IN. TO TD.
Drilling Contractor:	WATER DEVELOPMENT CORP.		
Drilling Method:	AIR ROTARY CASING HAMMER		
Borehole Depth:	519		
Casing Depth:	502		

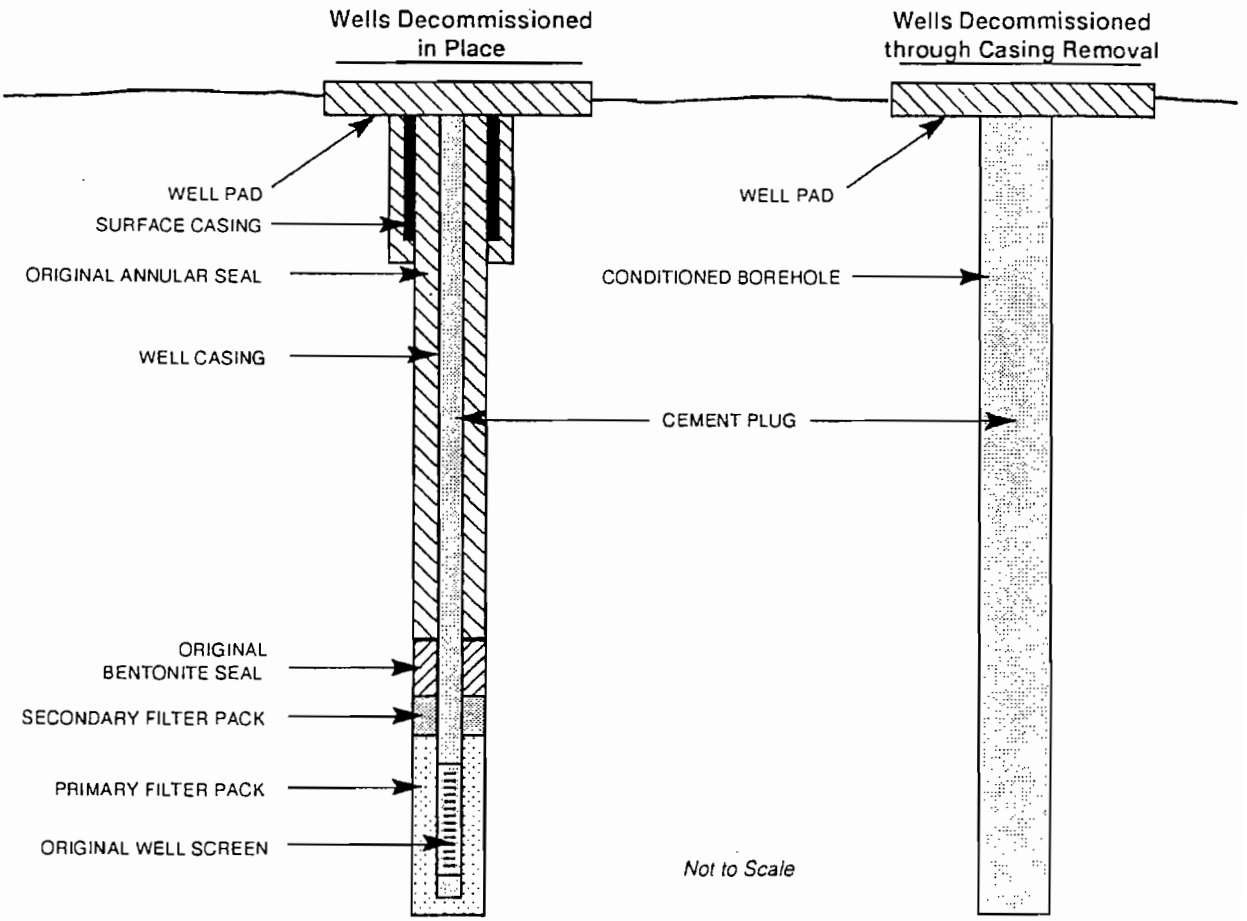


Interval	Start	Stop
PLUG BACK	510'	519'
VOLCLAY CHIP		

Additional Comments

ATTACHMENT E
Groundwater Well Abandonment Diagram for MWL-BW1

SNL/NM ER PROJECT
GROUNDWATER MONITORING WELL ABANDONMENT DIAGRAM



Well Name	MWL-BW1
Location	Mixed Waste Landfill
State Plane Coordinate X	411756.001
Y	1451698.73
Surface Casing Type	steel conductor casing
Surface Casing Length	20 feet
ID Well Casing	4.75 inches
Well Casing Depth	477.17 feet
Screen Interval	452.17 to 472.17 feet
Plugging Grout Type	Quick-Crete™ (bentonite grout)
Grout Volume Used	approximately 450 gallons
Date of Decommissioning	24-Jan-08

ATTACHMENT F
Well Development Forms for MWL-BW2

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: Mixed Waste Landfill	Project No.: p 1/4
Well I.D.: MWL-BW2	Date: 3/10/08/11MAR08
Weather CLEAR, CALM, 50s-60s	
Method: Bailer ~~Portable pump~~ ~~Dedicated pump~~ ~~Pump depth:~~	

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L gls	Temp °C	mS/cm³	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
~~865~~ 474.55	1543	40 G	20.25	0.637	180.2	6.84		191	51.0	4.60
~475	0806	~~95~~	19.64	0.636	142.8	7.30		>1000	35.4	3.22
	0819	110	19.90	0.627	145.3	7.31		>1000	56.4	5.10
	0850	125	19.76	0.619	123.8	7.45		>1000	62.0	5.62
	0902	140	19.45	0.650	69.8	7.41		>1000	84.1	7.72
	0943	155	19.61	0.626	141.2	7.73		>1000	95.7	8.77
	1044	180	19.85	0.625	153.0	7.44		51.8	61.2	5.56
	1126	190	20.36	0.628	179.2	7.44		59.7	30.2	2.72
	1309	220	20.74	0.635	123.0	8.09		>1000	—	—
	1345	240	20.8	0.631	149.4	7.59		>1000	—	—
	1435	260	20.46	0.633	148.6	7.66		728	—	—
	1515	280	20.84	0.637	142.6	7.81		443	—	—
	1550	300	20.84	0.631	163.0	7.82		455	—	—
	1620	320	20.51	0.632	189.2	7.64		160	—	—
COC number(s): 1656			20.27	0.628	211.5	7.56		316	—	—
Sample number(s):										

(*) sample after swabbing

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ millileters
1/2" ODl: 2 1.6 ml/ft X____ (length of tubing)) = _____ millileters

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: MWL	Project No.: P 2/4
Well I.D.: BW2	Date: 3-13-08
Weather: Clear & Cold	
Method: ✓ Portable pump _____ Dedicated pump	Pump depth: 497'

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L gls	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
477.35	0802		START							
480.18	0820		15.47	693	304.1	6.80		0.94	20.7	2.02
480.97	0830	10	17.15	700	261.2	7.24		1.28	12.0	1.16
481.93	0846	15	17.89	696	231.1	7.22		4.91	13.5	1.27
482.58	0900	20	18.21	696	216.7	7.24		6.36	17.6	1.65
482.91	0916	25	18.37	700	209.2	7.22		4.18	16.5	1.54
483.08	0933	30	18.61	704	199.6	7.23		2.52	14.3	1.35
483.32	0952	35	18.72	705	192.0	7.19		1.53	13.3	1.23
483.51	1008	40	18.74	706	183.0	7.21		1.23	11.3	1.07
483.74	1025	45	18.54	705	178.1	7.20		1.00	10.3	0.97
483.94	1041	50	18.60	706	168.9	7.22		1.00	10.0	0.94
484.18	1057	55	18.71	705	163.5	7.21		0.78	9.8	0.91
483.73	1116	60	18.08	705	161.3	7.20		1.01	10.7	0.95
483.88	1138	65	18.12	705	157.4	7.23		0.78	8.7	0.79
COC number(s):										
Sample number(s):										

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ millileters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ millileters
1/2" OD: 2 1.6 ml/ft X____ (length of tubing) = _____ millileters

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

CONT.

Project Name:	Project No.: p 3/4
Well I.D.: MWL-BW2	Date: 3-13-08
Weather	
Method: _____ Portable pump _____ Dedicated pump	Pump depth: 497'

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L (gls)	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~	
484.08	1156	70	18.35	707	152.6	7.23		0.65	7.6	0.74	
484.21	1213	75	18.37	706	150.0	7.20		0.68	7.2	0.68	
484.31	1233	80	18.46	705	155.5	7.15		0.59	9.6	0.90	inc.
484.31	1249	85	18.46	705	149.5	7.14		0.62	8.9	0.83	
485.42	1259	90	19.17	706	141.1	7.19		0.65	8.2	0.76	
486.67	1309	95	19.48	707	138.4	7.13		0.61	7.5	0.69	
488.10	1317	100	19.54	703	136.8	7.13		2.94	7.7	0.71	
489.44	1327	105	19.44	702	138.9	7.12		8.36	9.2	0.84	
488.52	1343	110	18.99	698	145.9	7.13		25.2	11.9	1.10	dec
487.41	1401	115	19.10	703	122.3	7.15		6.25	14.6	1.35	
485.95	1421	120	19.33	704	147.5	7.14		3.57	29.3	2.70	
485.92	1436	125	19.36	705	174.7	7.17		2.89	35.5	3.25	
485.71	1452	130	19.55	707	195.5	7.14		4.69	35.1	3.21	
485.35	1509	135	19.78	708	205.2	7.14		2.69	35.7	3.19	
COC number(s):											
Sample number(s):											

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliliters
1/2" OD: 2.16 ml/ft X____ (length of tubing)) = _____ milliliters

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name:	Project No.:
Well I.D.: MWL-BW2	Date: 3-13-08
Weather	
Method: X Portable pump _____ Dedicated pump	Pump depth:

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol L gls	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
485.02	1528	140	19.55	708	212.7	7.11		2.07	28.1	2.57
485.27	1543	145	19.83	708	213.5	7.12		3.87	28.1	2.56
485.42	1558	150	19.86	708	217.8	7.11		3.39	29.2	2.66
COC number(s):										
Sample number(s):										

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ millileters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ millileters
1/2" OD: 2.16 ml/ft X____ (length of tubing) = _____ millileters

Volume VIII

TAB 15

Notice of Disapproval: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2

From: NMED/Bearzi
To: SNL/Wagner

Back of Tab 15

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

August 25, 2008

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400 MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Securities Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: NOTICE OF DISAPPROVAL: SUMMARY REPORT FOR MIXED WASTE LANDFILL MONITORING WELL PLUG AND ABANDONMENT AND INSTALLATION -- DECOMMISSIONING OF GROUNDWATER MONITORING WELL MWL-BW1 INSTALLATION OF GROUNDWATER MONITORING WELL MWL-BW-2, APRIL, 2008
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-08-015

Dear Ms. Wagner and Mr. Nimick:

The New Mexico Environment Department (NMED) has reviewed the subject document submitted in April, 2008 and has identified several deficiencies. Within 60 days of receipt of this letter, the U.S. Department of Energy and Sandia Corporation must submit additional information to correct these deficiencies which are noted in the following five comments.

1. Section 2.4, Initial Groundwater Level and Well Construction, 4th paragraph states "A 30-ft volclay coarse chip plug was placed from 426 to 456 ft bgs. The first 18 ft of chips were hydrated and allowed to set overnight. The next day, chips were added up to 426 ft bgs, hydrated, and allowed to set for approximately 2 hours." Apparently based on this information two separate lifts were placed, followed by hydration of the chips. However, the work plan calls for 5-ft lifts with hydration done between each lift, or placing 6 separate lifts. Clarify how many lifts were emplaced.

Also associated with the above paragraph, the response of SNL to item 8 in NMED's Notice of Deficiency dated June, 2007, includes "also, please note that the first sentence of the fourth paragraph in Section 5.2.2 of plan has been changed from "A 30-ft thick layer of ¼-inch bentonite pellets or 3/8-inch bentonite chips will be placed above the filter pack…." to now read "A 10-ft thick layer of ¼-inch bentonite pellets or 3/8-inch bentonite chips…". This change was made based on consultations with experienced well drillers who pointed out that a 30-ft thick layer of bentonite pellets/chips would be difficult to confidently install inside drive casing." Clarify why SNL chose to stay with the 30-ft layer after requesting and getting approval for a 10-ft layer.

2. The work plan calls for use of centralizers and has spacing specifications. Discuss the installation of centralizers and their spacing.

3. The work plan, Section 5.2.3, Well Development, states "representative water is assumed to be obtained when pH, temperature, turbidity, and specific conductivity readings stabilize (less than 10% variability over three consecutive well bore volumes) and the water is visually clear of suspended solids with a target turbidity of less than five Nephelometric Turbidity Units (NTUs)". The field data submitted in the report shows that these conditions were met except for turbidity, which did not stabilized to within 10% variability. However, NMED does accept that the well was adequately developed and that representative groundwater samples can be obtained. However, rewording of the above criteria should be considered in any future work plans to avoid confusion as to what situations are applicable for the two different criteria for turbidity.

4. Section 5.0 Variances, states "there were no instances of variance from either the Plan or the FOPs/AOPs during these activities". However, NMED notes at least two instances of variance. One is stated in Section 2.4, Initial Groundwater Level and Well Construction, 4th paragraph, where the use of #60 sand instead of #40-60 sand is acceptable for the reason stated, but such a change is a variance from the plan. Another example, is that the plan calls for cutting off the casing at approximately 5 ft. bgs. As discussed in Section 3.0, Plug and Abandonment, 2nd paragraph in the report, the casing was cut off at about 14 inches above ground. Again, this is acceptable for the reason stated, but it is still a variance. There may be other variances depending upon the answers to the above items. List and discuss each variance.

5. Much of the Combination Lithologic and Geophysical Logs with Well Construction Details for MWL-BW2 submitted in Attachment C is difficult to read. Submit a readable version. Also, submit an electronic version of the geophysical log data, preferably in depth/value spreadsheet format.

If you have any questions regarding this matter, please contact Mr. Sid Brandwein of my staff at (505) 222-9504.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

JPB:sb

Cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
S. Brandwein, NMED HWB
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J. Cochran, SNL, MS 0719

File: SNL 2008 and Reading

Volume VIII

TAB 16

Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Wells MWL-MW1, MWL-MW2, MWL-MW3, Installation of Wells MWL-MW7, MWL-MW8, MWL-MW9

From: SNL/Davis
To: NMED/Bearzi

Back of Tab 16

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

SEP 23 2008

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. James Bearzi,
Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Bldg. 1
Santa Fe, New Mexico 87505

Dear Mr. Bearzi:

On behalf of Sandia Corporation (Sandia) and the Department of Energy (DOE), DOE is submitting a Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation, Decommissioning of Groundwater Monitoring Wells MWL-MW1, MWL-MW2, and MWL-MW3, Installation of Groundwater Monitoring Wells MWL-MW7, MWL-MW8, MWL-MW9 September 2008.

If you have any questions regarding this submission, please contact me at (505) 845-6036, or John Gould of my staff at (505) 845-6089.

Sincerely,

Kimberly A. Davis
Acting Manager

Enclosure

cc w/enclosure:
W. Moats, NMED (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB
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cc w/o enclosure:
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D. Miller, SNL/NM, Org 6765, MS 0718
J. Cochran, SNL/NM, Org 6765, MS 0719
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Records Center, SNL/NM, Org.6765, MS 1089
J. Estrada, SSO, MS 0184
T. Longo, HQ/GTN, NA-56

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation Decommissioning of Groundwater Monitoring Wells MWL-MW1, MWL-MW2, and MWL-MW3 Installation of Groundwater Monitoring Wells MWL-MW7, MWL-MW8, MWL-MW9 September 2008

Document author: Stacy Griffith, Department 06765

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: Francis B. Nimick 9/17/08
Francis B. Nimick Date
Deputy to the
Nuclear Energy and Global Security Technologies
Center 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: Kimberly A Davis 9/23/08
Kimberly A. Davis Date
Acting Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Sandia National Laboratories/New Mexico Environmental Restoration Project

SUMMARY REPORT FOR MIXED WASTE LANDFILL MONITORING WELL PLUG AND ABANDONMENT AND INSTALLATION

Decommissioning of Groundwater Monitoring Wells MWL-MW1, MWL-MW2, and MWL-MW3

Installation of Groundwater Monitoring Wells MWL-MW7, MWL-MW8, and MWL-MW9

September 2008

United States Department of Energy
Sandia Site Office

Sandia is a multiprogram laboratory managed and operated by Sandia Corporation, a wholly-owned subsidiary of Lockheed Martin Corporation, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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ACRONYMS AND ABBREVIATIONS

ARG	ancestral Rio Grande
bgs	below ground surface
DOE	U.S. Department of Energy
ER	Environmental Restoration
FOP	field operating procedure
ID	inside diameter
Jet West	Jet West Geophysical Services
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
NMOSE	New Mexico Office of the State Engineer
NTU	nephelometric turbidity unit
OD	outside diameter
P&A	plug and abandonment
PVC	polyvinyl chloride
Sandia	Sandia Corporation
SNL/NM	Sandia National Laboratories/New Mexico
TA	Technical Area
TD	total depth
WDC	WDC Exploration and Wells

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1.0 INTRODUCTION

This report documents the activities for plug and abandonment (P&A) and installation of groundwater monitoring wells at the Mixed Waste Landfill (MWL) at Sandia National Laboratories/New Mexico (SNL/NM). SNL/NM is managed and operated by Sandia Corporation (Sandia), a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy (DOE).

The activities were performed from April through June 2008 by SNL/NM Environmental Restoration (ER) Project personnel and the SNL/NM drilling contractor WDC Exploration and Wells (WDC).

1.1 Regulatory Action

On July 2, 2007, the DOE/Sandia received a letter from the New Mexico Environment Department (NMED)/Hazardous Waste Bureau entitled, "Replacement of Mixed Waste Landfill Groundwater Monitoring Wells MWL-MW1 and MWL-MW3" (Bearzi July 2007). The NMED letter required that DOE/Sandia replace these two groundwater monitoring wells. The letter also stated that DOE/Sandia shall submit to the NMED within 60 days a plan for approval describing how the wells are to be replaced and a schedule for implementation of this work. On July 31, 2007, the DOE/Sandia submitted the work plan to the NMED entitled, "Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan; Decommissioning of Groundwater Monitoring Wells MWL-MW1 and MWL-MW3; Installation of Replacement Groundwater Monitoring Wells MWL-MW7 and MWL-MW8" (SNL/NM July 2007).

On October 30, 2007, the NMED issued a Notice of Approval of the work plan with conditions on the well locations (Bearzi October 2007). The well locations were negotiated over the next several months, and on February 12, 2008, the NMED issued a letter approving the plan and the negotiated locations (Bearzi February 2008).

Also included in the February 2008 NMED letter was a request for a work plan for P&A of MWL-MW2 and installation of a third well (MWL-MW9). The DOE/Sandia submitted the work plan to the NMED entitled, "Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan; Decommissioning of Groundwater Monitoring Well MWL-MW2; Installation of Replacement Groundwater Monitoring Well MWL-MW9," (SNL/NM February 2008). The NMED approved the work plan in March 2008 (Bearzi March 2008).

The two work plans (SNL/NM July 2007 and SNL/NM February 2008) will be referred to collectively as the Plan in subsequent sections of this report.

The installation of groundwater monitoring wells MWL-MW7, MWL-MW8, and MWL-MW9 constitutes the installation of new wells, as defined during a meeting held on August 16, 2007 (SNL/NM August 2007) between NMED and DOE/Sandia representatives. A new well is defined as a well installed at a distance of greater than 30 feet from an existing well. As the newly installed wells described in this report are considered new wells, they will be sampled accordingly (eight consecutive quarters for a defined suite of parameters) as required by the NMED Compliance Order on Consent (the Order) (NMED April 2004).

1.2 Site Description and History

The MWL is designated as a Solid Waste Management Unit at SNL/NM. SNL/NM is located within the boundaries of Kirtland Air Force Base, immediately south of the city of Albuquerque in Bernalillo County, New Mexico (Figure 1-1).

The MWL is located approximately 4 miles south of SNL/NM central facilities and approximately 5 miles southeast of Albuquerque International Sunport. The landfill is a fenced, 2.6-acre site in the north-central portion of Technical Area (TA)-III. The MWL was established in 1959 as a disposal area for low-level radioactive waste generated by SNL/NM research facilities. Low-level radioactive and minor amounts of mixed waste were disposed of at the MWL from March 1959 through December 1988. Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies of activity (at the time of disposal) were disposed of in the landfill.

Currently, the MWL groundwater monitoring well network consists of seven wells completed within interfingering alluvial fan deposits of the Santa Fe Group (Goering et al. 2002). The network (Figure 1-2) includes one background well (MWL-BW2), one on-site well (MWL-MW4), and five downgradient monitoring wells (MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9). All seven wells are constructed of nominal 5-inch, Schedule 80 polyvinyl chloride (PVC) casing and have screens composed of slotted Schedule 80 PVC. Because of declining groundwater levels in the regional aquifer, the three monitoring wells that were plugged and abandoned (MWL-MW1, MWL-MW2, and MWL-MW3) were no longer useful for sampling purposes.

1.3 Geologic Setting

The MWL is located within the eastern flank of the Albuquerque basin and the uplifted basin margins comprising the Rio Grande rift (SNL/NM September 2002). The basin is a complex trough 90 miles long and 30 miles wide, bordered by the major uplifted fault blocks to the west. The eastern boundary is marked by the Sandia, Manzanita, and Manzano mountains. The western boundary is marked by the Lucero uplift, with the Ladron Mountains to the south and the Nacimiento Mountains to the northwest.

Erosion and sediment transport from the surrounding uplifts has filled the Albuquerque basin with up to 14,000 feet of deposits that comprise the late Pliocene to Pleistocene Santa Fe Group. The Santa Fe Group thins toward the basin edges and is truncated by the bounding uplifts. The Santa Fe Group is a diverse suite of alluvial gravel, sand, and silt, as well as fluvial sand, silt, and clay. The upper Santa Fe Group consists of two first-order sediment types: (1) an alluvial fan sequence derived from uplifts on the basin flanks, and (2) a fluvial sequence derived from the north and deposited by an axial river, the ancestral Rio Grande (ARG). The alluvial fan deposits are characterized by poorly sorted conglomerates and coarse sand at the top of the sequence that are underlain by silty and clayey sand. The upper ARG lithofacies of the Santa Fe Group is characterized by coarse- to fine-grained sand, generally poor in silt and clay, and locally rich in clasts (occasionally volcanic pumice).

The MWL is underlain by approximately 50 feet of late Pleistocene post-Santa Fe Group alluvial gravel, sand, and silt followed by the Santa Fe Group deposits at depth (SNL/NM September 2002). These collective deposits are characterized by great internal variability. A detailed

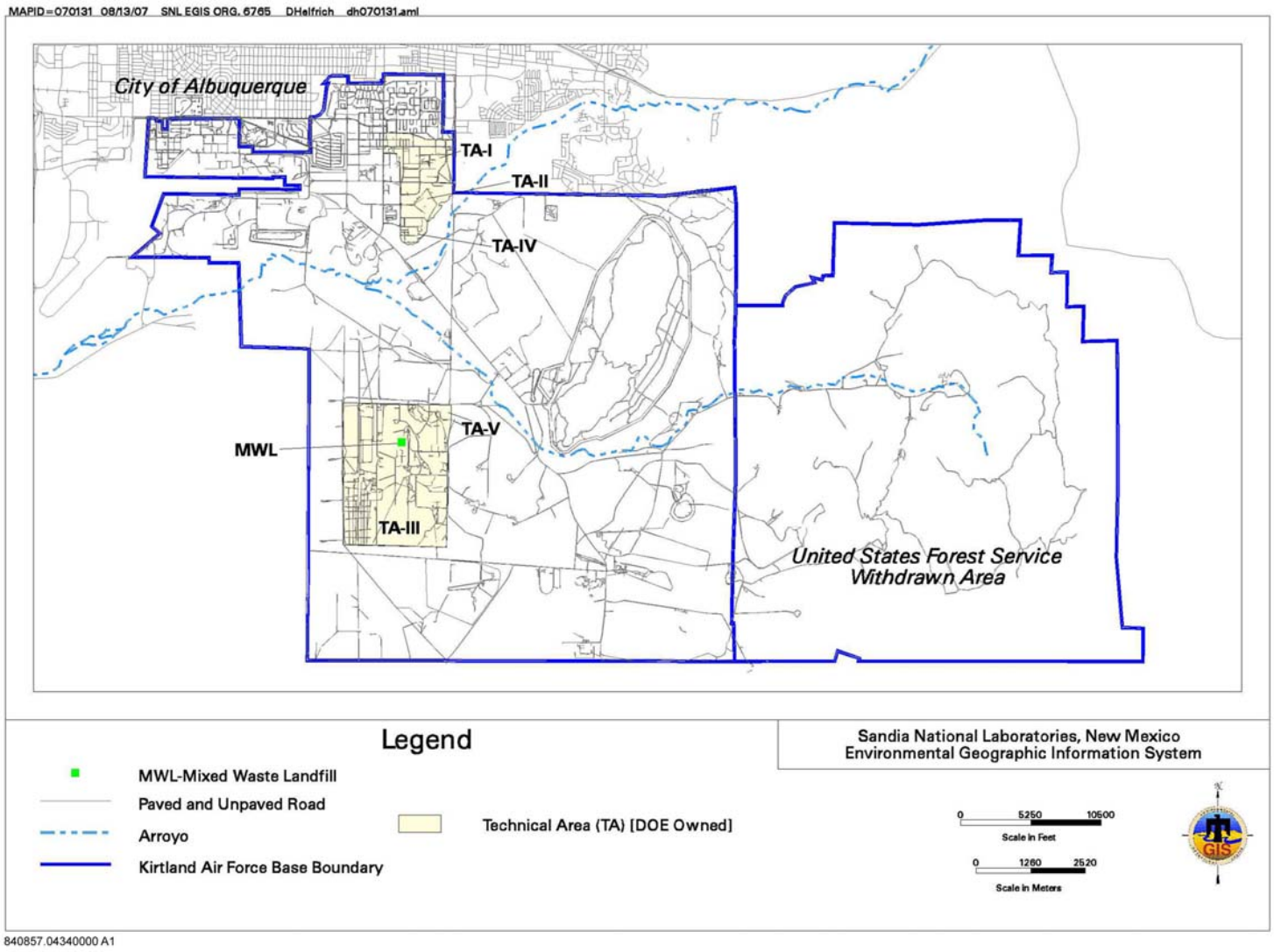

Figure 1-1
Location Map of the Mixed Waste Landfill, Technical Area III
Sandia National Laboratories, New Mexico

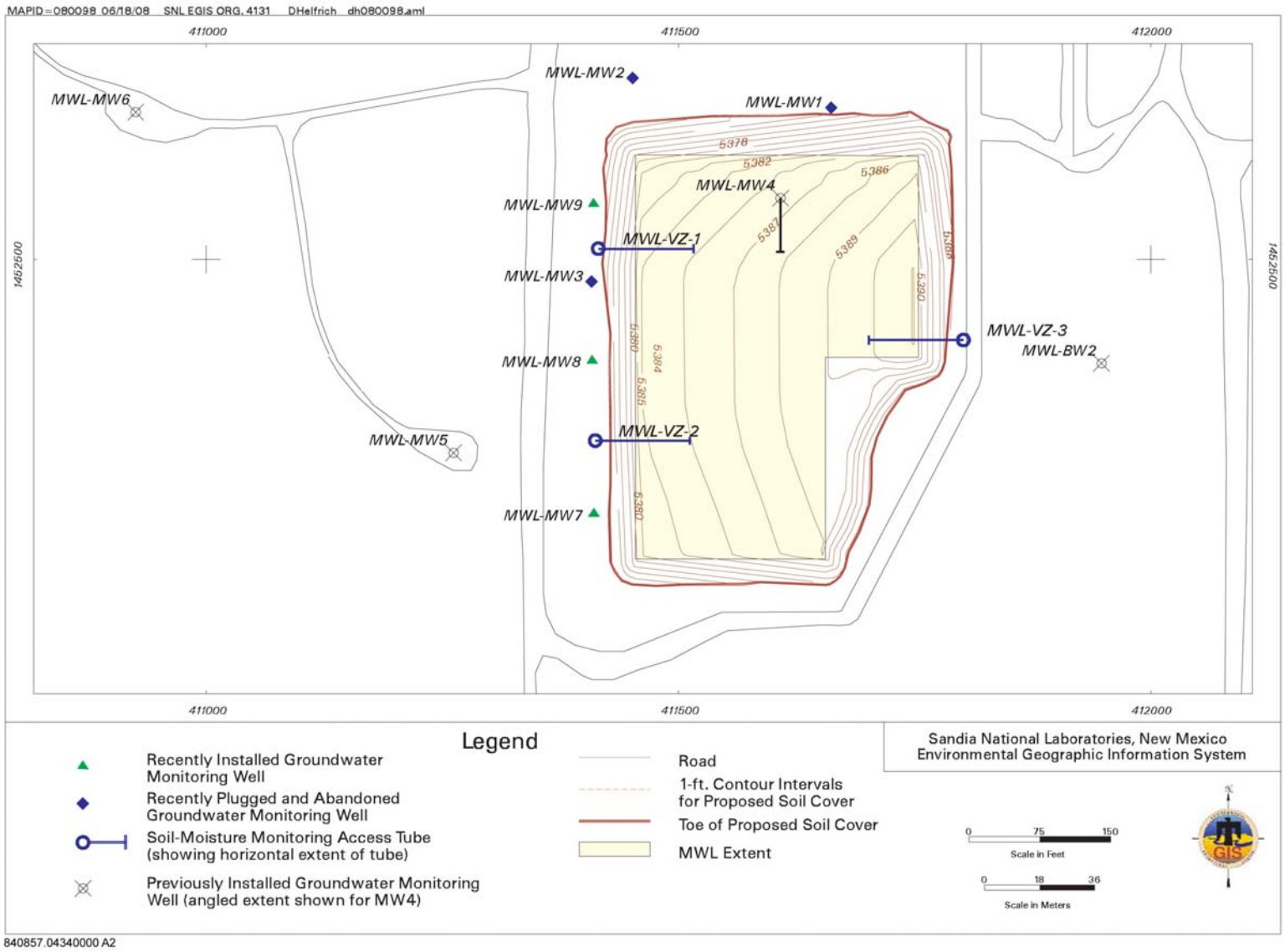

Figure 1-2
Location of Recently Plugged and Abandoned Groundwater Monitoring Wells and Recently Installed Groundwater Monitoring Wells at the Mixed Waste Landfill

correlation of individual lithologic units within and between boreholes is difficult (SNL/NM September 2002). The coarse and fine alluvial fan deposits of the upper Santa Fe Group have been identified at the MWL. Over the past 10 to 15 years, the presence of upper ARG fluvial deposits at the MWL has been questioned. Most recently, the ARG fluvial deposits have been interpreted as being present at the MWL based upon a reinterpretation of the geophysical log of MWL-MW2 (SNL/NM June 2003).

1.4 Objective

The objectives of this project were to perform successful P&A of three groundwater monitoring wells (MWL-MW1, MWL-MW2, and MWL-MW3) by grouting the wells in situ and to install three new, downgradient, groundwater monitoring wells (MWL-MW7, MWL-MW8, and MWL-MW9). This report is organized in chronological order of the activities conducted as follows: (1) the P&A of MWL-MW1, MWL-MW2, and MWL-MW3; (2) drilling and installation of MWL-MW7, MWL-MW8, and MWL-MW9; and (3) development of MWL-MW7, MWL-MW8, and MWL-MW9.

This report meets the reporting requirements of both the NMED and New Mexico Office of the State Engineer (NMOSE). The Order specifies the required elements for reporting installation of monitoring wells (NMED April 2004). The NMOSE requirements and guidance are provided in "Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells" (NMOSE August 2005). Appendix A presents the required NMED well data for the newly installed MWL groundwater monitoring wells.

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2.0 MONITORING WELL PLUGGING AND ABANDONMENT

Monitoring Wells MWL-MW1, MWL-MW2, and MWL-MW3 were plugged in situ on April 23 and April 24, 2008. All P&A activities were performed by WDC and supervised by SNL/NM ER Project personnel. Groundwater well abandonment diagrams are presented in Appendix B, and the field notes for the P&A are provided in Appendix C.

A bentonite grout (Quick-Grout™) was placed in the well with a portable grout plant (i.e., the grout was pumped through tubing placed at the bottom of the well and pulled up as the well was filled). Each well was grouted from the bottom of the well to the surface and allowed to set overnight. The concrete pad and steel guard posts were removed from the surface of the wellhead.

At MWL-MW2 and MWL-MW3, the protective casing consisted of approximately 3 feet of steel casing that was welded to a length of conductor casing that extended below ground. The conductor casing was required for the mud-rotary drilling technique used to advance the borehole and was left in place during the installation of the wells to serve as the protective casing. As the annulus between the conductor casing and the PVC well casing was firmly cemented during well installation, it was not possible to remove the 20-foot length of conductor casing. Approximately 14 inches of the steel casing protruded aboveground, and the PVC well casing extended another foot above it. The PVC casing was cut flush with the steel casing. A concrete plug was placed from the top of the grout plug (approximately 12 feet below ground surface [bgs]) to the top of the two casings (approximately 14 inches aboveground). The well monument was built over the two casings.

At MWL-MW1, the well and open portion of the annulus were filled to near the surface by mixing bentonite grout in a tub and pumping it into the well. The existing 5-foot length of protective conductor casing, concrete well pad, and steel guard posts were then removed from the surface of the wellhead at that time. The well and annulus were filled to within approximately 5 feet of the surface with coarse bentonite chips. The final 5 feet of the well and annulus were then filled with concrete, and a 3- by 3-foot concrete well monument was constructed over the location of the former well.

For all three P&A wells, a brass marker was placed in the monument. The marker was stamped with the abandoned well name, date of P&A, and well depth.

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3.0 DRILLING AND MONITORING WELL INSTALLATION

All drilling and monitoring well installation operations were performed by WDC and supervised by SNL/NM ER Project personnel. Geophysical logging services were performed by Jet West Geophysical Services (Jet West). The boreholes for all three wells were drilled using the air-rotary casing hammer method with a Speedstar 50K drilling rig and associated equipment.

The following sections describe the borehole drilling, lithologic and geophysical logging, and well construction. Field notes are provided in Appendix C. Lithologic logs based upon the cuttings returned from the boreholes were generated by the ER Project geologists. Appendix D presents the lithologic logs, and Appendix E presents combination diagrams showing lithologic and geophysical logs and well construction details. The well construction diagrams are provided in Appendix F. Complete field documentation, field forms, daily driller reports, and lithologic and geophysical logs, as well as the Jet West reports (Jet West April 2008 and May 2008a and b) are on file at the SNL/NM Customer-Funded Records Center.

3.1 Well MWL-MW7

Drilling of the borehole for MWL-MW7, located west of the MWL (Figure 1-2), commenced on April 24, 2008.

3.1.1 Drilling Operations

The drilling equipment was decontaminated at the ER Project decontamination pad in TA-III prior to the start of drilling operations. The first 200 feet of borehole was advanced with a tricone bit and 11 3/4-inch outside diameter (OD) drive casing to accommodate drilling through caliche and gravel zones. At 200 feet bgs, the bit and drive casing were switched to 9 5/8-inch OD and the smaller drive casing was telescoped into the borehole. The borehole was advanced to a total depth (TD) of 498.8 feet bgs on April 28, 2008. The drilling was suspended at 498.8 feet bgs to allow for geophysical logging of the borehole (Section 3.1.3).

3.1.2 Lithologic Logging

The lithology of the borehole consisted of unconsolidated deposits of sand and gravel. From the surface to approximately 250 feet bgs, a heterogeneous mixture of sand and gravel of the upper Santa Fe Group alluvium was encountered. From approximately 250 to 420 feet bgs, the sediment decreased in average particle size with depth. Intermittent layers of sand (sometimes with a trace of gravel) and silt (also with some sand and gravel) were present. At approximately 420 to 460 feet bgs, a significant change in lithology occurred, characterized by sand and coarse gravel of varied lithologies that may represent fluvial deposits of the upper ARG. At approximately 460 to 498.8 feet bgs (borehole TD), a silt and sand unit was encountered.

3.1.3 Downhole Geophysical Logging

On April 29, 2008, the cased borehole was logged with downhole wireline geophysical tools supplied by Jet West to help determine the lithologic characteristics of sediments penetrated by the borehole. Geophysical logs run in the borehole included combination natural gamma ray, thermal neutron, and 1-arm caliper. Although the caliper instrument is located on the same tool, the caliper log is not informative as the logging was completed within the steel drive casing.

The neutron log shows a significant signal increase at 200 feet bgs for the telescoped drill casing. The gamma ray and neutron readings are attenuated approximately 30 percent by the steel casing and approximately 50 to 60 percent in dual casing. A notable shift in the neutron signal occurs at 484 feet bgs, indicating the level of groundwater in the borehole at the time of the logging. The neutron logging continued another 12 feet below the water. (The gamma signal is unaffected by the presence of water in the borehole.)

The interpretation of the log indicates that the formation is composed of interbedded clay, silt, and sand. The lithology from 200 feet bgs to TD consisted of "dirty" sand bounded by clay layers and silt (Jet West April 2008). Dirty sand refers to sediment with relatively coarse sand grains mixed with silt and clay that have relatively low hydraulic conductivity and low transmissivity. Sand lenses were present at 200 to 345, 429 to 436, and 456 to 496 feet bgs. Clay and silt were encountered from 345 to 429 and 436 to 456 feet bgs. The region of concern, from the groundwater level (approximately 484 feet bgs) downward, is predominately comprised of saturated sand with interbedded silt and clay.

3.1.4 Initial Groundwater Level and Well Construction

On April 29, 2008, the initial groundwater level in the cased borehole was approximately 487 feet bgs. During the geophysical logging (occurring later that same day), the groundwater level was measured at approximately 484 feet bgs within the steel drive casing.

Well installation began on April 29, 2008, and was completed on May 1, 2008. The well was constructed of nominal 5-inch-diameter (inside diameter [ID] of 4.767 inches and OD of 5.563 inches); Schedule 80 PVC, flush-threaded, blank casing; and a 30-foot length of 0.010-inch slot, Schedule-80 PVC screen. This screen slot size was specified in the Plan to accommodate the fine-grained sand, silt, and clay encountered in the borehole. The sump consisted of a 5-foot length of nominal 5-inch-diameter, Schedule 80 PVC, flush-threaded, blank casing with a threaded end cap placed at the bottom. PVC centralizers were placed above and below the screen section and subsequently every 100 feet along the blank casing (Figure 3-1).

The bottom of MWL-MW7 was placed at approximately 498.75 feet bgs, and the nominal 30-foot screen section was placed from 464.65 to 493.99 feet bgs. Colorado Silica Sand (#20-40) was used as the primary sand pack in the annulus around the screen and extended approximately 10.85 feet above the top of the screen to 453.8 feet bgs. A secondary sand pack using #60 Colorado Silica Sand was placed from 448.6 to 453.8 feet bgs (the #40-60 sand specified in the Plan is no longer commercially available). A 31.2-foot volclay coarse chip (3/8-inch) plug was placed from 417.4 to 448.6 feet bgs. The chips were hydrated with 20 gallons of water three times during the chip placement and then with 100 gallons of water and allowed to set approximately 30 minutes.

Figure 3-1
Installation of a Groundwater Monitoring Well with a PVC Centralizer

A bentonite grout (SmoothGrout20™ One Step Grouting System) mixture was used to fill the remainder of the annulus (12 to 417 feet bgs). The first lift of approximately 110 feet of grout was placed and allowed to set for 24 hours. The subsequent lifts of grout were placed in approximate 100-foot lifts and allowed to set for one hour. The final grout lift was brought to approximately 12 feet bgs. The water level in the well on May 1, 2008 (following installation) was approximately 489.5 feet bgs.

3.1.5 Discussion with the NMED

Following the installation of MWL-MW7, DOE/Sandia and NMED personnel discussed the anomalously low groundwater elevations. It was anticipated that the static water level in MWL-MW7 would have been approximately 467 feet bgs (based upon the water level from MWL-MW3 approximately 250 feet away). The actual water level of approximately 498 feet bgs may reflect the strong downward vertical gradient in the Santa Fe Group units in the area. Although it was known that a gradient in this area existed, the magnitude of the gradient was not anticipated. The 30-foot screen section in MWL-MW7 was set to the depth proposed in the Plan; therefore, only approximately 4 to 5 feet of water-bearing strata is exposed in the screen section.

DOE/Sandia discussed this situation with the NMED, and the NMED directed DOE/Sandia to set the two remaining wells (MWL-MW8 and MWL-MW9) as proposed in the Plan regardless of the water level encountered during drilling and installation.

3.2 Well MWL-MW8

Drilling of the borehole for MWL-MW8, located west of the MWL (Figure 1-2), commenced on May 2, 2008.

3.2.1 Drilling Operations

The drilling equipment was decontaminated at the ER Project decontamination pad in TA-III following the installation of MWL-MW7 and prior to the start of drilling operations at MWL-MW8. The first 200 feet of borehole was advanced with a tricone bit and 11 3/4-inch OD drive casing. At 200 feet bgs, the bit and drive casing were switched to 9 5/8-inch OD and the smaller drive casing was telescoped into the borehole. The borehole was advanced to a TD of 535 feet bgs on May 7, 2008. The drilling was suspended at 535 feet bgs to allow for geophysical logging of the borehole (Section 3.2.3).

3.2.2 Lithologic Logging

The lithology of the borehole consisted of unconsolidated alluvial deposits of the late Pleistocene post-Santa Fe Group alluvium and late Pliocene to Pleistocene upper Santa Fe Group.

From the surface to approximately 38 feet bgs, a sand and gravel mixture of the late Pleistocene post-Santa Fe Group alluvium was encountered. From approximately 38 to

370 feet bgs, a heterogeneous mixture of silt, sand, and gravel of the upper Santa Fe Group was present. From approximately 370 to 518 bgs, the sediments decreased in average particle size with depth. Intermittent layers of sand (sometimes with a trace of gravel) and clayey sand and silt were encountered. At approximately 518 to 535 feet bgs, a significant change in lithology occurred, characterized by sand and coarse gravel of varied lithologies that may represent fluvial deposits of the upper ARG. A silt and clay unit was encountered at approximately 535 feet bgs (borehole TD).

3.2.3 Downhole Geophysical Logging

On May 8, 2008, the cased borehole was logged with downhole wireline geophysical tools supplied by Jet West to help determine the lithologic characteristics of sediments penetrated by the borehole. Geophysical logs run in the borehole included combination natural gamma ray, thermal neutron, and 1-arm caliper. Although the caliper instrument is located on the same tool, the caliper log is not informative as the logging was completed within the steel drive casing.

The neutron log reveals a significant signal increase at 200 feet bgs for the telescoped drill casing. A notable shift in the neutron signal occurs at 521.5 feet bgs indicating the level of groundwater in the borehole at the time of the logging. The neutron logging continued another 11 feet below the water. (The gamma signal is unaffected by the presence of water in the borehole.)

The interpretation of the log indicates that the formation is composed of interbedded clay, silt, and sand. The lithology from 200 feet bgs to TD consisted of dirty sand bounded by clay layers and silt (Jet West May 2008a). Sand lenses were predominant at 200 to 367, 413 to 430, 438 to 443, 487 to 497, and 508 to 535 feet bgs. Clay and silt were encountered from 367 to 413, 430 to 438, 443 to 487, and 497 to 508 feet bgs. From the groundwater level at the time of logging (approximately 521 feet bgs) downward, the formation is predominately comprised of saturated sand with interbedded clay.

3.2.4 Initial Groundwater Level and Well Construction

On May 8, 2008, the initial groundwater level in the cased borehole was approximately 530 feet bgs. During the geophysical logging (occurring later that same day), the groundwater level was measured at approximately 521 feet bgs within the steel drive casing. These preliminary water levels do not reflect equilibrium conditions, as the expected static groundwater level was approximately 20 to 30 feet higher. However, the low transmissivity of the local aquifer material and steel casing prevented equilibrium conditions from being achieved until after the well materials were installed.

Well installation began on May 8, 2008, and was completed on May 12, 2008. The well was constructed of nominal 5-inch-diameter (ID of 4.767 inches and OD of 5.563 inches), Schedule 80 PVC, flush-threaded, blank casing and a 30-foot length of 0.010-inch slot, Schedule-80 PVC screen. This screen slot size was specified in the Plan to accommodate the fine-grained sand, silt, and clay encountered in the borehole. The sump consisted of a 5-foot length of nominal 5-inch-diameter, Schedule 80 PVC, flush-threaded, blank casing with a threaded end cap placed at the bottom. PVC centralizers were placed above and below the screen section and subsequently every 100 feet along the blank casing (Figure 3-1).

A volclay coarse chip (3/8-inch) plug was used to backfill the borehole from 506.5 to 535 feet bgs. Colorado Silica Sand (#20-40) was used to backfill the borehole from 500 to 506.5 feet bgs.

The bottom of MWL-MW8 was placed at approximately 500 feet bgs, and the nominal 30-foot screen section was placed from 465 to 495 feet bgs. The #20-40 Colorado Silica Sand was used as the primary sand pack in the annulus around the screen and extended approximately 7 feet above the top of the screen to 458 feet bgs. A secondary sand pack using #60 Colorado Silica Sand was placed from 453 to 458 feet bgs (the #40-60 sand specified in the Plan is no longer commercially available). A 28.8-foot volclay coarse chip (3/8-inch) plug was placed from 424.2 to 453 feet bgs. The chips were hydrated with water continuously during the chip placement and then allowed to set overnight.

A bentonite grout (SmoothGrout20™ One Step Grouting System) mixture was used to fill the remainder of the annulus (12 to 424 feet bgs). The first lift of approximately 100 feet of grout was placed and allowed to set for 24 hours. The subsequent lifts of grout were placed in approximate 100-foot lifts and allowed to set for one hour. The final grout lift was brought to approximately 12 feet bgs.

3.3 Well MWL-MW9

Drilling of the borehole for MWL-MW9, located west of the MWL (Figure 1-2), commenced on May 13, 2008.

3.3.1 Drilling Operations

The drilling equipment was decontaminated at the ER Project decontamination pad in TA-III following the installation of MWL-MW8 and prior to the start of drilling operations at MWL-MW9. The first 200 feet of borehole was advanced with a tricone bit and 11 3/4-inch OD drive casing. At 200 feet bgs, the bit and drive casing were switched to 9 5/8-inch OD and the smaller drive casing was telescoped into the borehole. The borehole was advanced to a TD of 535 feet bgs on May 14, 2008. The drilling was suspended at 535 feet bgs to allow for geophysical logging of the borehole (Section 3.3.3).

3.3.2 Lithologic Logging

The lithology of the borehole consisted of unconsolidated deposits of sand and gravel. From the surface to approximately 240 feet bgs, a heterogeneous mixture of sand and gravel of the upper Santa Fe Group alluvium was encountered. From approximately 240 to 416 feet bgs, the sediments decreased in average particle size with depth. Intermittent layers of sand (sometimes with a trace of gravel) and silt (also with some sand and gravel) were present. At approximately 416 to 440 feet bgs, a significant change in lithology occurred, characterized by sand and coarse gravel of varied lithologies that may represent fluvial deposits of the upper ARG. At approximately 440 to 515 feet bgs, silt, sand, and clay units were encountered. From approximately 515 to 535 bgs (borehole TD), a sand and gravel unit was again encountered, with a thin silt and clay unit at approximately 528 feet bgs.

3.3.3 Downhole Geophysical Logging

On May 15, 2008, the cased borehole was logged with downhole wireline geophysical tools supplied by Jet West to help determine the lithologic characteristics of sediments penetrated in the borehole. Geophysical logs run in the borehole included combination natural gamma ray, thermal neutron, and 1-arm caliper. Although the caliper instrument is located on the same tool, the caliper log is not informative as the logging was completed within the steel drive casing.

The neutron log reveals a significant signal increase at 200 feet bgs for the telescoped drill casing. A notable shift in the neutron signal occurs at 494 feet bgs indicating the level of groundwater in the borehole at the time of the logging. The neutron logging continued another 41 feet below the water. (The gamma signal is unaffected by the presence of water in the borehole.)

The interpretation of the log indicates that the formation is composed of interbedded clay, silt, and sand. The lithology from 200 feet bgs to TD consisted of dirty sand bounded by clay layers and silt (Jet West May 2008b). Sand lenses with interbedded clay layers were present at 200 to 362, 410 to 427, 435 to 444, 488 to 495, and 502 to 535 feet bgs. Clay and silt with interbedded sand were present from 362 to 410, 427 to 435, 444 to 488, and 495 to 502 feet bgs. From the groundwater level at the time of logging (approximately 494 feet bgs) downward, the formation is predominately comprised of saturated sand with interbedded clay.

3.3.4 Initial Groundwater Level and Well Construction

On May 15, 2008, the initial groundwater level in the cased borehole was approximately 499 feet bgs. During the geophysical logging (occurring later that same day), the groundwater level was measured at approximately 494 feet bgs within the steel drive casing.

Well installation began on May 15, 2008, and was completed on May 19, 2008. The well was constructed of nominal 5-inch-diameter (ID of 4.767 inches and OD of 5.563 inches), Schedule 80 PVC, flush-threaded, blank casing and a 30-foot length of 0.010-inch slot, Schedule-80 PVC screen. This screen slot size was specified in the Plan to accommodate the low transmissive sand, silt, and clay encountered in the borehole. The sump consisted of a 5-foot length of nominal 5-inch-diameter, Schedule 80 PVC, flush-threaded, blank casing with a threaded end cap placed at the bottom. PVC centralizers were placed above and below the screen section and subsequently every 100 feet along the blank casing (Figure 3-1).

A volclay coarse chip (3/8-inch) plug was used to backfill the borehole from 500.5 to 535 feet bgs. Colorado Silica Sand (#20-40) was used to backfill the borehole from 500 to 500.5 feet bgs.

The bottom of MWL-MW9 was placed at approximately 500 feet bgs, and the nominal 30-foot screen section was placed from 465 to 495 feet bgs. The #20-40 Colorado Silica Sand was used as the primary sand pack in the annulus around the screen and extended approximately 6.3 feet above the top of the screen to 458.7 feet bgs. A secondary sand pack using #60 Colorado Silica Sand was placed from 452.5 to 458.7 feet bgs (the #40-60 sand specified in the Plan is no longer commercially available). A 32.9-foot volclay coarse chip (3/8-inch) plug was placed from 419.6 to 452.5 feet bgs. The chips were hydrated with water continuously during the chip placement and then allowed to set overnight.

A bentonite grout (SmoothGrout20™ One Step Grouting System) mixture was used to fill the remainder of the annulus (12 to 419.6 feet bgs). The first lift of approximately 100 feet of grout was placed and allowed to set for 24 hours. The subsequent lifts of grout were placed in approximate 100-foot lifts and allowed to set for one hour. The final grout lift was brought to approximately 12 feet bgs.

3.4 Wellhead Construction

The wellhead construction for all three groundwater monitoring wells (MWL-MW7, MWL-MW8, and MWL-MW9) was similar and followed procedures proposed in the Plan. A 10-foot length of nominal 12-inch-diameter steel casing was used as the protective casing at the surface. The casing, equipped with a hinged locking cap, was placed approximately 7 feet bgs and 3 feet aboveground. A fitted locking well cap was also placed on the PVC casing. Concrete was poured into the annulus from the top of the grout (approximately 12 feet bgs in each borehole) to the surface. A 3- by 3-foot pad was built around the casing, and a brass marker cap was placed in the pad denoting the well name. Three steel guard posts were placed around the pad, and the posts and protective casing were painted yellow.

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4.0 WELL DEVELOPMENT

From May 27 through June 30, 2008, well development of MWL-MW7, MWL-MW8, and MWL-MW9 was performed in accordance with the Well Development Field Operating Procedure (FOP) 94-41 (SNL/NM November 1994). Due to the low water yield of the wells, two phases of development were required. Initially, the wells were developed with the WDC development rig. ER Project personnel performed the second phase of development by purging the wells with a submersible pump.

The following water quality parameters were measured and recorded during well development:

- Temperature (degrees Celsius)
- Specific Conductivity (micromhos/centimeter)
- pH
- Turbidity (measured in nephelometric turbidity units [NTUs])

The Well Development Forms are provided in Appendix G.

4.1 Phase 1 Well Development

The predevelopment water level readings and the calculated saturated wellbore volumes, which includes pore spaces in the annular sand pack, are presented in Table 4-1. Because the wellheads had not been surveyed at the time of development, all measurements and volumes are estimated and rounded to the nearest tenth of a foot and whole gallon, respectively. A minimum of 5 saturated wellbore volumes (also shown in Table 4-1) represents the target volume to be removed from a borehole drilled without mud or water, as defined in the FOP (SNL/NM November 1994). The FOP defines the completion of well development at the point where the minimum wellbore volumes have been removed and representative water is obtained (representative water is obtained when pH, temperature, turbidity, and specific conductivity measurements are within 10 percent for three consecutive wellbore volumes).

Well development at MWL-MW7 began by swabbing the well screen with the surge block. A stainless steel bailer was used to begin evacuating the well. Although turbid, the water did not contain much coarse sediment. The well was dry after bailing approximately 5 to 10 gallons of water. The well was bailed throughout the day, allowing time for recovery. Approximately 10 saturated wellbore volumes (a total of 140 gallons of water) were removed from the well with the bailer. Stable water quality parameters were not achieved for MWL-MW7 during Phase 1 well development activities.

Well development of MWL-MW8 began by swabbing the well screen followed by evacuating the well with a stainless steel bailer. Although turbid, the water did not contain much coarse sediment. Approximately 5 to 10 gallons of water were bailed before the well was dry. Another 15 gallons of water were bailed before the well was dry again. The following day, the well was repeatedly swabbed, bailed dry, and allowed to recover. Approximately 11 wellbore volumes (a total of 138 gallons of water) were removed from the well with the bailer. Stable water quality parameters were not achieved for MWL-MW8 during Phase 1 well development activities.

Table 4-1
Calculated Saturated Wellbore Volumes
MWL-MW7, MWL-MW8, and MWL-MW9 Well Development

Well	Date	Water Level (ft BTOC)	Saturated Wellbore Volume (gal.)	Target Volume
Phase 1				5 Saturated Wellbore Volumes (gal.)
MWL-MW7	05-27-08	488.9	13	46
MWL-MW8	05-28-08	490.4	12	63
MWL-MW9	05-28-08	490.6	12	62
Phase 2				3 Saturated Wellbore Volumes (gal.)
MWL-MW7	06-24-08	489.9	12	35
MWL-MW8	06-25-08	490.6	12	36
MWL-MW9	06-26-08	491.4	11	33

BTOC = Below top of casing.
ft = Foot (feet).
gal. = Gallons.

Well development at MWL-MW9 began by swabbing the well followed by evacuating the well with a stainless steel bailer. Although turbid, the water did not contain much coarse sediment. Approximately 12 gallons of water were bailed before the well was dry. The following day, the well was repeatedly swabbed, bailed dry, and allowed to recover. Approximately 7 wellbore volumes (a total of 89 gallons of water) were removed from the well with the bailer. Stable water quality parameters were not achieved for MWL-MW9 during Phase 1 well development activities.

4.2 Phase 2 Well Development

Water quality parameters did not stabilize during Phase 1 well development (bailing and swabbing). ER Project personnel continued well development activities during Phase 2 by purging each well with a submersible pump (Bennett™) at approximately 1/3 gallon per minute (lowest possible flow rate). The pump was set at the bottom of the screen section in each well. Each well was purged with the pump for an additional three consecutive, saturated wellbore volumes, as specified in the FOP (SNL/NM November 1994). Table 4-2 summarizes the water quality parameters measured during Phase 2 of well development.

Well development continued in MWL-MW7 on June 24, 2008. Approximately 14 gallons of water were purged before the water level in the well was too low to continue pumping. The well was allowed to recover, repeatedly pumped throughout the day, and allowed to recover. Approximately 4 wellbore volumes (52 gallons of water) were pumped from the well, in addition to the 10 wellbore volumes removed during Phase 1. Specific conductivity and pH were stable within 10 percent in the last three wellbore volumes. Temperature and turbidity fluctuated each time the well was pumped to a low level. Turbidity was generally less than 5 NTUs.

Table 4-2
Summary of Water Quality Parameters for MWL-MW7, MWL-MW8, and MWL-MW9
During Phase 2 Well Development, June 2008

Time	Gallons Pumped[a]	Water Level (BTOC)	Temperature (°C)	Specific Conductivity (μmho/cm)	pH	Turbidity (NTU)
MWL-MW7 (June 24, 2008)						
0840	0	489.9	--	--	--	--
0901	2	491.4	23.87	586	7.16	2.11
0906	4	492.0	22.66	592	7.29	2.22
0911	6	492.7	22.48	586	7.31	1.47
0917	8	492.8	22.61	595	7.36	2.14
0924	10	492.8	22.93	594	7.36	1.41
0931	12	492.8	23.19	593	7.43	1.66
0936	14	493.4[b]	22.31	588	7.40	0.89
1017	--	490.5	--	--	--	--
1027	18	492.5	22.50	586	7.30	0.54
1032	20	493.2	22.82	586	7.36	7.36
1034	21	493.5[b]	22.96	587	7.39	6.40
1112	--	490.6	--	--	--	--
1121	25	492.3	23.53	592	7.31	1.69
1126	27	492.9	23.72	589	7.38	1.57
1131	29	493.3	23.92	589	7.39	6.34
1134	30	493.4[b]	23.87	588	7.38	9.16
1258	--	489.5	--	--	--	--
1310	34	491.3	25.85	592	7.31	0.84
1319	36	491.7	26.44	590	7.29	3.57
1326	38	492.0	26.51	590	7.36	4.25
1334	40	492.3	25.91	589	7.36	2.35
1341	42	492.6	25.84	589	7.37	1.61
1349	44	492.8	25.73	589	7.36	1.36
1356	46	492.9	25.67	589	7.36	1.02
1404	48	493.1	25.67	589	7.34	0.39
1411	50	493.3	25.47	590	7.34	0.30
1415	51	493.4	25.36	589	7.34	0.40
1419	52	493.4[b]	25.39	590	7.34	0.33
MWL-MW8 (June 25 through June 26, 2008)						
0851	0	490.6	--	--	--	--
0907	2	494.6	23.57	606	7.13	0.81
0912	4	495.8	22.94	604	7.30	1.65
0915	5	496.3	22.78	611	7.34	1.97
0918	6	496.9	22.68	615	7.36	1.69
0921	7	497.4[b]	22.71	621	7.37	1.59
1133	--	491.9	--	--	--	--
1142	11	494.8	23.90	623	7.30	4.05
1144	12	495.5	23.53	615	7.32	1.86
1146	13	496.1	23.48	614	7.24	1.45
1148	14	496.7	23.41	614	7.24	6.57
1150	15	497.4[b]	23.41	613	7.26	15.6
1348	--	492.2	--	--	--	--

Refer to footnotes at end of table.

Table 4-2 (Continued)
Summary of Water Quality Parameters for MWL-MW7, MWL-MW8, and MWL-MW9
During Phase 2 Well Development, June 2008

Time	Gallons Pumped[a]	Water Level (BTOC)	Temperature (°C)	Specific Conductivity (μmho/cm)	pH	Turbidity (NTU)
MWL-MW8 (June 25 through June 26, 2008) (Continued)						
1401	19	494.8	25.69	619	7.28	14.0
1403	20	495.4	25.24	619	7.22	2.30
1406	21	496.1	25.06	618	7.24	2.24
1409	22	496.6	25.11	617	7.25	9.37
1412	23	497.1	25.18	615	7.28	19.4
1415	24	497.5[b]	25.14	615	7.30	22.4
0810	--	490.6	--	--	--	--
0823	28	493.7	21.32	610	7.42	7.25
0825	29	494.1	21.42	612	7.37	3.26
0828	30	494.8	21.74	613	7.35	2.24
0830	31	495.4	21.90	613	7.36	5.05
0833	32	496.0	21.95	613	7.37	12.1
0835	33	496.7	22.02	613	7.38	19.1
0837	34	497.4[b]	22.04	613	7.38	21.4
MWL-MW9 (June 26 through June 30, 2008)						
0928	0	491.4	--	--	--	--
0946	1	495.5	26.82	579	6.63	1.11
0949	2	496.1	26.12	571	6.96	0.93
0952	3	496.8	25.33	562	7.17	1.44
0954	4	497.2	24.98	558	7.27	1.26
0955	4	497.5	24.74	559	7.29	1.33
0957	5	497.7[b]	24.56	557	7.32	1.81
1252	--	491.7	--	--	--	--
1301	9	495.6	25.22	576	7.20	6.78
1303	10	496.3	24.69	580	7.17	1.87
1305	11	497.1	24.56	579	7.17	2.09
1307	12	497.7[b]	24.39	579	7.18	2.57
0819	--	491.4	--	--	--	--
0828	16	495.2	19.95	574	7.35	10.9
0831	17	496.0	20.35	577	7.30	1.28
0834	18	496.6	20.80	578	7.30	0.90
0837	19	497.3	20.95	578	7.31	0.87
0840	20	497.8[b]	21.07	578	7.32	1.09
1250	--	491.5	--	--	--	--
1300	24	495.1	22.52	575	7.31	8.07
1303	25	495.8	22.31	578	7.28	1.74
1305	26	496.5	22.38	578	7.26	2.58
1308	27	497.4	22.42	578	7.27	2.26
1310	28	497.7[b]	22.47	578	7.28	2.25
0814	--	491.6	--	--	--	--
0823	32	495.6	19.88	575	7.41	5.75
0825	33	496.3	20.34	575	7.34	0.91
0827	34	497.1	20.74	569	7.33	1.02

Table 4-2 (Concluded)
Summary of Water Quality Parameters for MWL-MW7, MWL-MW8, and MWL-MW9
During Phase 2 Well Development, June 2008

Time	Gallons Pumped[a]	Water Level (BTOC)	Temperature (°C)	Specific Conductivity (μmho/cm)	pH	Turbidity (NTU)
MWL-MW9 (June 26 through June 30, 2008) (Continued)						
0829	35	497.8[b]	20.94	559	7.34	1.07
1245	--	491.7	--	--	--	--
1258	39	495.1	23.84	565	7.35	6.25
1300	40	495.9	23.20	578	7.25	2.30
1303	41	496.5	23.13	578	7.25	1.14
1306	42	497.3	22.98	579	7.26	1.30
1309	43	497.8	22.86	577	7.29	1.93

[a]Phase 2 pumping followed the Phase 1 evacuation by bailing. Stable water quality parameters were not achieved during Phase 1.
[b]Well purged dry then allowed to recover to approximately 80% of the initial Phase 2 water level before development continued.
BTOC = Below top of casing.
°C = Degrees Celsius.
μmho/cm = Micromho(s)/centimeter.
NTU = Nephelometric turbidity unit.
-- = Parameter not measured during well recovery.

Development of MWL-MW8 continued on June 25, 2008. The well was repeatedly pumped dry and allowed to recover. Approximately 3 wellbore volumes (34 gallons of water) were pumped from the well, in addition to the 11 wellbore volumes removed during Phase 1. Specific conductivity and pH were stable within 10 percent in the last three wellbore volumes. Temperature and turbidity fluctuated each time the well was pumped to a low level.

Development of MWL-MW9 continued on June 26, 2008. The well was repeatedly pumped dry and allowed to recover. Approximately 4 wellbore volumes (43 gallons of water) were pumped from the well, in addition to the 7 wellbore volumes removed during Phase 1. Stable water quality parameters were achieved during pumping of the last three saturated wellbore volumes. Specific conductivity and pH were stable within 10 percent in the last three wellbore volumes. Temperature and turbidity fluctuated each time the well was pumped to a low level. Turbidity was generally below 5 NTUs.

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5.0 VARIANCES

All FOPs and administrative operating procedures cited in the Plan were followed. Several variances from the Plan occurred during the 2008 P&A, drilling, installation, and well development activities.

Variance 1 occurred during the P&A of groundwater monitoring well MWL-MW3. The Plan specified removing the surface protective casing to approximately 5 feet bgs. This was not possible as MWL-MW3 had been installed with mud-rotary drilling techniques, and a 20-foot length of conductor casing had been left in place at the wellhead. This construction method had not been identified in the Plan. The well was abandoned as described in Chapter 2.0.

Variance 2 occurred during the drilling of the boreholes for MWL-MW8 and MWL-MW9. The Plan specified that the boreholes would be drilled to approximately 500 feet bgs. The boreholes were each advanced to 535 feet bgs in order to observe the lithology (recorded on the lithology logs provided in Appendices D and E). The boreholes were then backfilled with bentonite pellet plugs to approximately 500 feet bgs.

Variance 3 occurred in the installation of the well casing. The Plan specified that the 30-foot screen sections be placed such that approximately 5 feet of screen is above the static groundwater level and 25 feet of screen is submerged. This varied for each of the wells and the screens were set as described in Chapter 3.0. Each well was set to the depth specified in the Plan, yet the static groundwater elevation was lower than anticipated. This condition was discussed with the NMED following the installation of MWL-MW7, and the NMED specified that DOE/Sandia should set the wells to the depth as described in the Plan.

Variance 4 occurred in the installation of the bentonite plug above the secondary sand filter pack for each of the three wells. The Plan specified a 10-foot seal to be placed above the sand pack. WDC, the drilling contractor, preferred to place a 30-foot seal. Previously, DOE/Sandia had consulted with a different contractor who preferred a 10-foot seal. The placement of the seal also varied from what was specified in the Plan. The seal was to be placed in 5-foot lifts, hydrating between the lifts. The plug in each well was installed as described in Chapter 3.0.

Variance 5 occurred in the installation of the secondary sand filter pack (placed above the primary filter pack) in groundwater monitoring wells MWL-MW7 and MWL-MW8. The Plan specified the use of #40-60 sand. This combination of screen size fractions is no longer commercially available. A sand filter pack of single size fraction 60 was used.

Variance 6 occurred during the development of each of the wells. The required volumes were achieved, yet the primary target of field parameter agreement within 10 percent was not achieved for turbidity and temperature. This may be due to the low water levels and low-yielding nature of the units within the Santa Fe Group at these depths. Each of the wells was repeatedly bailed/pumped to the lowest level possible and then required a recovery period. Water quality parameters fluctuated during these cycles (Table 4-2). The secondary target for turbidity (less than 5 NTUs) was achieved during development for each of the wells.

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APPENDIX A
Well Data for MWL-MW7, MWL-MW8, and MWL-MW9

Table A-1
Well Data for MWL-MW7
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
1. Well name/number	MWL-MW7
2. Date of well construction	June 24, 2008 (construction and development done)
3. Drilling method	Air-rotary casing hammer
4. Drilling contractor and name of driller	WDC Exploration and Wells, Mark Green
5. Borehole diameter and well casing diameter	Borehole: 11 3/4 inches, 0 to 200 ft bgs; 9 5/8 inches, 200 to 498.8 ft bgs
	Well casing: 5.563 inches OD, 4.767 inches ID
6. Well depth	498.8 ft bgs
7. Casing length	501.2 ft total (498.8 ft bgs, 2.40 ft aboveground)
8. Casing materials	Schedule 80 PVC
9. Casing and screen joint type	Flush thread
10. Screened interval(s)	464.7 to 494 ft bgs
11. Screen materials	Schedule 80 PVC
12. Screen slot size and design	0.010-inch slotted screen
13. Filter pack material and gradation	Primary: #20-40 Colorado Silica Sand
	Secondary: #60 Colorado Silica Sand
14. Filter pack volume (calculated and actual)[b]	Calculated: 17.1 ft^3, 34 bags (50-lb)
	Actual: 18.5 ft^3, 37 bags (50-lb)
15. Filter pack placement method	Gravity feed through drive casing
16. Filter pack interval(s)	Primary: 453.8 to 498.8 ft bgs
	Secondary: 448.6 to 453.8 ft bgs
17. Annular sealant composition	Volclay (bentonite) chip plug, bentonite grout
18. Annular sealant placement method	Gravity feed through drive casing
19. Annular sealant volume (calculated and actual)	Calculated: Plug 11.9 ft^3, (16 bags [50-lb] bentonite chips) Grout 1st 100-ft lift, 38 ft^3, 284 gallons Grout 2nd through 4th ~100-ft lifts, ~883 gallons total (brought to ~12 ft bgs)
	Actual: Plug: 8.7 ft^3, (13 buckets [5-gallon] of chips) Grout 1st 100-ft lift (not tagged), 38 ft^3, 284 gallons Grout 2nd through 4th ~100-ft lifts, ~1,186 gallons total (brought to ~12 ft bgs)
20. Annular sealant interval(s)	Plug: 417.4 to 448.6 ft bgs
	Grout: 7 to 417.4 ft bgs
21. Surface sealant composition	Concrete
22. Surface seal placement method	Gravity fed into annulus
23. Surface sealant volume (calculated and actual)	Calculated: 5.25 ft^3
	Actual: not recorded, placed concrete 0 to 12 ft bgs
24. Surface sealant interval	0 to 12 ft bgs
25. Surface seal and well apron design and construction	3- by 3-ft by ~4-inch-deep concrete pad
26. Well development procedure and turbidity measurements	Bennett™ pump (see Table 4-2 for turbidity measurements)
27. Well development purge volume(s) and stabilization parameter measurements	Total of 192 gallons (see Table 4.2 for parameter measurements)

Refer to footnotes at end of table.

Table A-1 (Concluded)
Well Data for MWL-MW7
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
28. Type and design and construction of protective casing	10-ft length of 12-inch-diameter steel casing with hinged cap (7 ft bgs and 3 ft aboveground)
29. Well cap and lock	Hinged cap on protective casing with padlock and locking well cap with padlock on well casing
30. Ground surface elevation	5378.23 ft amsl
31. Survey reference point elevation on well casing	5380.63 ft amsl
32. Top of monitoring well casing elevation	5380.63 ft amsl
33. Top of protective steel casing elevation	5380.95 ft amsl (locking cover removed)
34. Name of geologist	Mike Skelly
35. Initial water level	485.9 ft bgs (predevelopment water level, May 1, 2008)
36. Final water level	488.89 ft bgs (postdevelopment water level, May 27, 2008)
37. Date of well development	May 27 to June 24, 2008

[a]New Mexico Environment Department, April 2004. "Compliance Order on Consent Pursuant to the New Mexico Hazardous Waste Act," § 74-4-10, New Mexico Environment Department, Santa Fe, New Mexico.
[b]Filter pack volume defined as the total volume of filter pack sand placed in well, both adjacent to the well casing, screen, and sump and below the sump (if applicable).
amsl = Above mean sea level.
bgs = Below ground surface.
ft = Foot (feet).
ft^3 = Cubic feet.
ID = Inside diameter.
lb = Pound(s).
MWL = Mixed Waste Landfill
OD = Outside diameter.
PVC = Polyvinyl chloride.

Table A-2
Well Data for MWL-MW8
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
1. Well name/number	MWL-MW8
2. Date of well construction	June 26, 2008 (construction and development done)
3. Drilling method	Air-rotary casing hammer
4. Drilling contractor and name of driller	WDC Exploration and Wells, Mark Green
5. Borehole diameter and well casing diameter	Borehole: 11 3/4 inches, 0 to 200 ft bgs; 9 5/8 inches, 200 to 535 ft bgs
	Well casing: 5.563 inches OD, 4.767 inches ID
6. Well depth	500 ft bgs
7. Casing length	502.28 ft total (500 ft bgs, 2.28 ft aboveground)
8. Casing materials	Schedule 80 PVC
9. Casing and screen joint type	Flush thread
10. Screened interval(s)	465 to 495 ft bgs
11. Screen materials	Schedule 80 PVC
12. Screen slot size and design	0.010-inch slotted screen
13. Filter pack material and gradation	Primary: #20-40 Colorado Silica Sand
	Secondary: #60 Colorado Silica Sand
14. Filter pack volume (calculated and actual)[b]	Calculated: 19.5 ft^3, 39 bags (50-lb)
	Actual: 18 ft^3, 36 bags (50-lb)
15. Filter pack placement method	Gravity feed through drive casing
16. Filter pack interval(s)	Primary: 458 to 506.5 ft bgs
	Secondary: 453 to 458 ft bgs
17. Annular sealant composition	Volclay (bentonite) chip plug, bentonite grout
18. Annular sealant placement method	Gravity feed through drive casing
19. Annular sealant volume (calculated and actual)	Calculated: Plug 10.9 ft^3, (14.5 bags [50-lb] bentonite chips) Grout 1st 100-ft lift, 38 ft^3, 284 gallons Grout 2nd through 4th ~100-ft lifts, ~1,205 gallons total (brought to ~12 ft bgs)
	Actual: Plug: 12.8 ft^3, (17 bags [50-lb] of bentonite chips) Grout 1st 100-ft lift (not tagged), 38 ft^3, 284 gallons Grout 2nd through 4th ~100-ft lifts, ~1,205 gallons total (brought to ~12 ft bgs)
20. Annular sealant interval(s)	Plug: 424.2 to 453 ft bgs
	Grout: 12 to 424.2 ft bgs
21. Surface sealant composition	Concrete
22. Surface seal placement method	Gravity fed into annulus
23. Surface sealant volume (calculated and actual)	Calculated: 5.25 ft^3
	Actual: not recorded, placed concrete 0 to 12 ft bgs
24. Surface sealant interval	0 to 12 ft bgs
25. Surface seal and well apron design and construction	3- by 3-ft by ~4-inch-deep concrete pad
26. Well development procedure and turbidity measurements	Bailer, Bennett™ pump (see Table 4-2 for turbidity measurements)
27. Well development purge volume(s) and stabilization parameter measurements	Total of 171.5 gallons (see Table 4.2 for parameter measurements)

Refer to footnotes at end of table.

Table A-2 (Concluded)
Well Data for MWL-MW8
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
28. Type and design and construction of protective casing	10-ft length of 12-inch-diameter steel casing with hinged cap (7 ft bgs and 3 ft aboveground)
29. Well cap and lock	Hinged cap on protective casing with padlock and locking well cap with padlock on well casing
30. Ground surface elevation	5379.72 ft amsl
31. Survey reference point elevation on well casing	5382.0 ft amsl
32. Top of monitoring well casing elevation	5382.0 ft amsl
33. Top of protective steel casing elevation	5382.76 ft amsl (locking cover removed)
34. Name of geologist	Stacy Griffith
35. Initial water level	486.7 ft bgs (predevelopment water level, May 9, 2008)
36. Final water level	490.4 ft bgs (postdevelopment water level, May 28, 2008)
37. Date of well development	May 28 to June 26, 2008

[a]New Mexico Environment Department, April 2004. "Compliance Order on Consent Pursuant to the New Mexico Hazardous Waste Act," § 74-4-10, New Mexico Environment Department, Santa Fe, New Mexico.
[b]Filter pack volume defined as the total volume of filter pack sand placed in well, both adjacent to the well casing, screen, and sump and below the sump (if applicable).
amsl = Above mean sea level.
bgs = Below ground surface.
ft = Foot (feet).
ft^3 = Cubic feet.
ID = Inside diameter.
lb = Pound(s).
MWL = Mixed Waste Landfill.
OD = Outside diameter.
PVC = Polyvinyl chloride.

Table A-3
Well Data for MWL-MW9
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
1. Well name/number	MWL-MW9
2. Date of well construction	June 30, 2008 (completion)
3. Drilling method	Air-rotary casing hammer
4. Drilling contractor and name of driller	WDC Exploration and Wells, Mark Green
5. Borehole diameter and well casing diameter	Borehole: 11 3/4 inches, 0 to 200 ft bgs; 9 5/8 inches, 200 to 535 ft bgs
	Well casing: 5.563 inches OD, 4.767 inches ID
6. Well depth	500 ft bgs
7. Casing length	502.60 ft total (500 ft bgs, 2.60 ft aboveground)
8. Casing materials	Schedule 80 PVC
9. Casing and screen joint type	Flush thread
10. Screened interval(s)	465 to 495 ft bgs
11. Screen materials	Schedule 80 PVC
12. Screen slot size and design	0.010-inch slotted screen
13. Filter pack material and gradation	Primary: #20-40 Colorado Silica Sand
	Secondary: #60 Colorado Silica Sand
14. Filter pack volume (calculated and actual)[b]	Calculated: 16.0 ft^3, 32 bags (50-lb)
	Actual: 22 ft^3, 44 bags (50-lb)
15. Filter pack placement method	Gravity feed through drive casing
16. Filter pack interval(s)	Primary: 458.7 to 500.5 ft bgs
	Secondary: 452.5 to 458.7 ft bgs
17. Annular sealant composition	Volclay (bentonite) chip plug, bentonite grout
18. Annular sealant placement method	Gravity feed through drive casing
19. Annular sealant volume (calculated and actual)	Calculated: Plug 12.5 ft^3, (16.7 bags [50-lb] bentonite chips) Grout 1st 100-ft lift, 38 ft^3, 284 gallons Grout 2nd through 4th ~100-ft lifts, ~1,192 gallons total (brought to ~12 ft bgs)
	Actual: Plug: 13.5 ft^3, (18 bags [50-lb] of bentonite chips) Grout 1st 100-ft lift (not tagged), 38 ft^3, 284 gallons Grout 2nd through 4th ~100-ft lifts, ~1,192 gallons total (brought to ~12 ft bgs)
20. Annular sealant interval(s)	Plug: 419.6 to 452.5 ft bgs
	Grout: 12 to 419.6 ft bgs
21. Surface sealant composition	Concrete
22. Surface seal placement method	Gravity fed into annulus
23. Surface sealant volume (calculated and actual)	Calculated: 5.25 ft^3
	Actual: not recorded, placed concrete 0 to 12 ft bgs
24. Surface sealant interval	0 to 12 ft bgs
25. Surface seal and well apron design and construction	3- by 3-ft by ~4-inch-deep concrete pad
26. Well development procedure and turbidity measurements	Bailer, Bennett™ pump (see Table 4-2 for turbidity measurements)

Refer to footnotes at end of table.

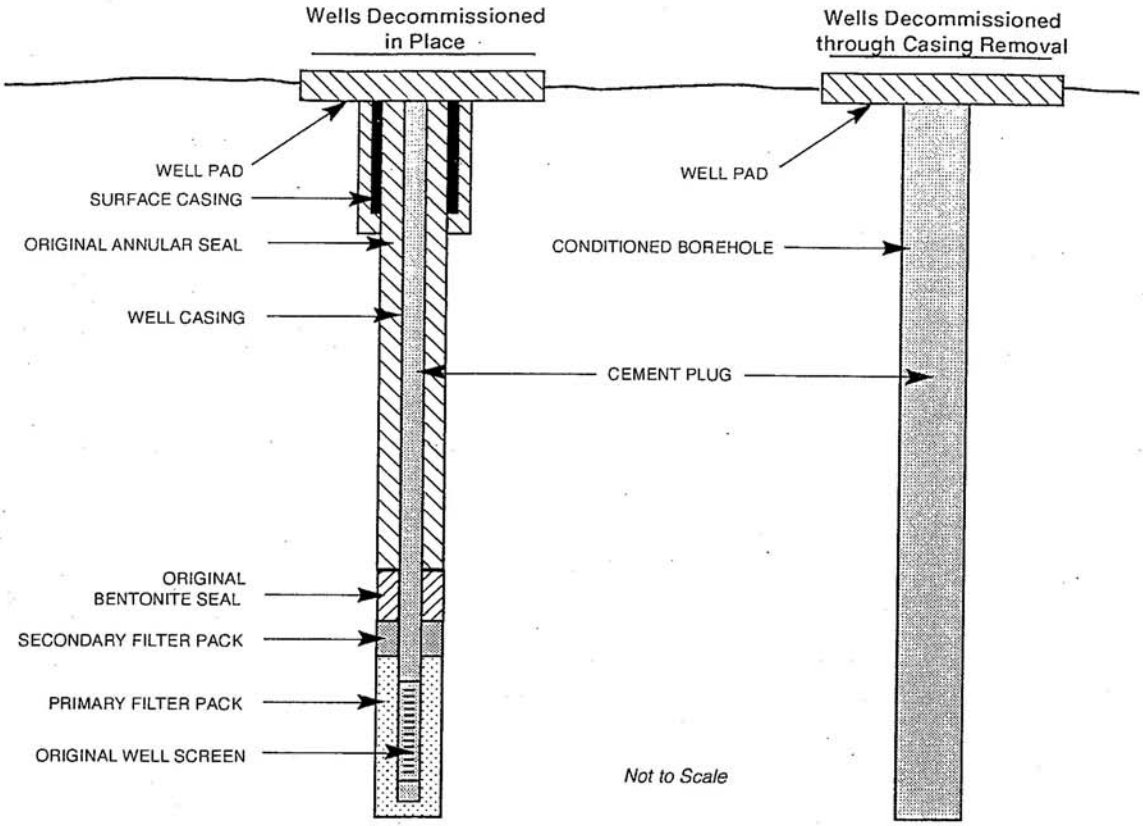
Table A-3 (Concluded)
Well Data for MWL-MW9
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
27. Well development purge volume(s) and stabilization parameter measurements	Total of 131.5 gallons (see Table 4.2 for parameter measurements)
28. Type and design and construction of protective casing	10-ft length of 12-inch-diameter steel casing with hinged cap (7 ft bgs and 3 ft aboveground)
29. Well cap and lock	Hinged cap on protective casing with padlock and locking well cap with padlock on well casing
30. Ground surface elevation	5376.64 ft amsl
31. Survey reference point elevation on well casing	5379.24 ft amsl
32. Top of monitoring well casing elevation	5379.24 ft amsl
33. Top of protective steel casing elevation	5379.83 ft amsl (locking cover removed)
34. Name of geologist	Mike Skelly
35. Initial water level	489.5 ft bgs (predevelopment water level, May 19, 2008)
36. Final water level	490.4 ft bgs (postdevelopment water level, May 28, 2008)
37. Date of well development	May 28 to June 30, 2008

[a]New Mexico Environment Department, April 2004. "Compliance Order on Consent Pursuant to the New Mexico Hazardous Waste Act," § 74-4-10, New Mexico Environment Department, Santa Fe, New Mexico.
[b]Filter pack volume defined as the total volume of filter pack sand placed in well, both adjacent to the well casing, screen, and sump and below the sump (if applicable).
amsl = Above mean sea level.
bgs = Below ground surface.
ft = Foot (feet).
ft^3 = Cubic feet.
ID = Inside diameter.
lb = Pound(s).
MWL = Mixed Waste Landfill.
OD = Outside diameter.
PVC = Polyvinyl chloride.

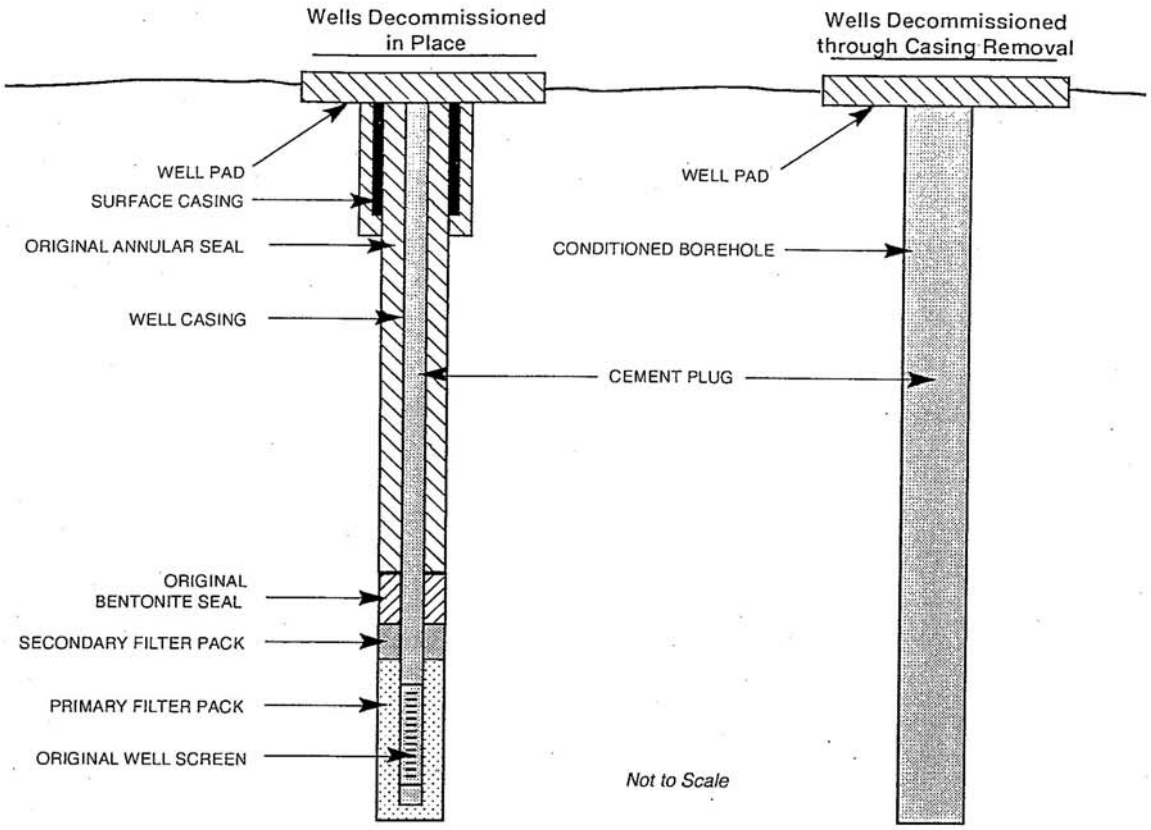
APPENDIX B
Groundwater Well Abandonment Diagrams for
MWL-MW1, MWL-MW2, and MWL-MW3

SNL/NM ER PROJECT
GROUNDWATER MONITORING WELL ABANDONMENT DIAGRAM



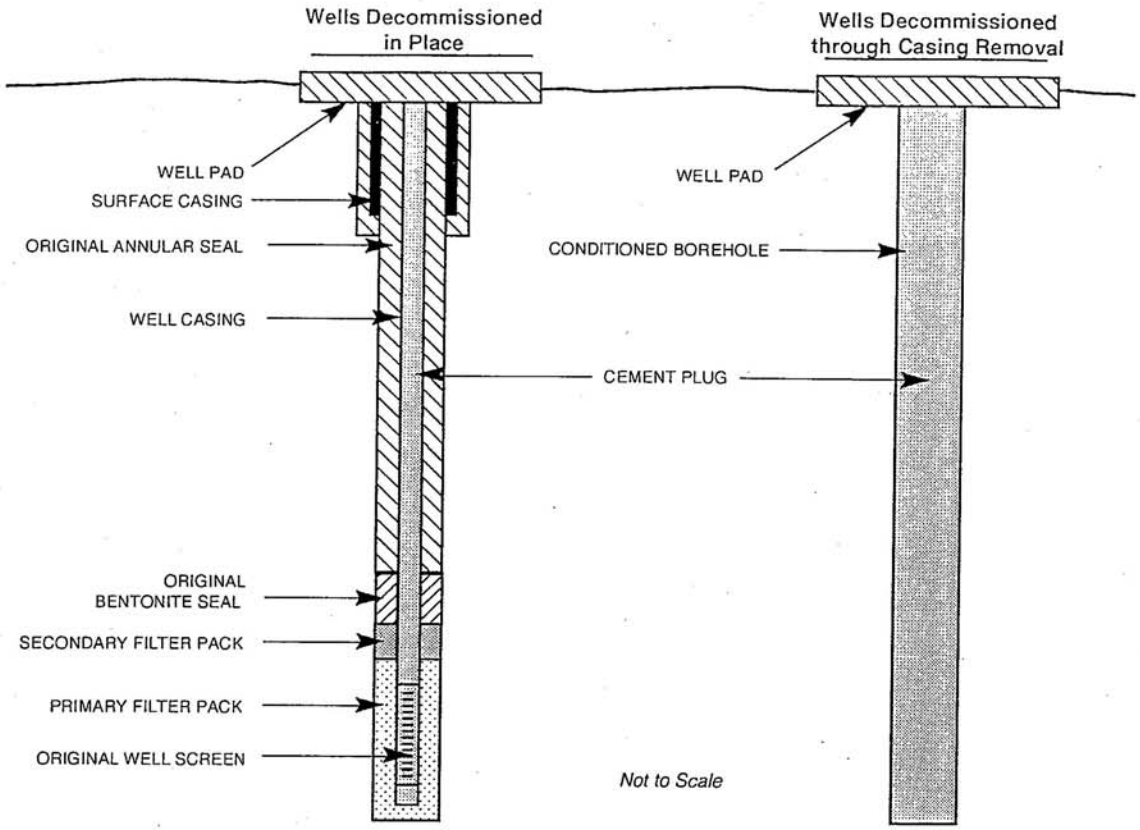
Well Name	MWL-MW1
Location	Mixed Waste Landfill
N.M. State Plane Coordinate X	411661.747
N.M. State Plane Coordinate Y	1452661.099
Surface Casing Type	steel conductor casing
Surface Casing Length	5 feet
ID Well Casing	4.75 inches
Well Casing Depth	478 feet below ground surface
Screen Interval	456 to 476 feet below ground surface
Plugging Grout Type	Quick-Grout™ (bentonite grout)
Grout Volume Used	approximately 550 gallons
Date of Decommissioning	23-Apr-08

SNL/NM ER PROJECT
GROUNDWATER MONITORING WELL ABANDONMENT DIAGRAM



Well Name	MWL-MW2
Location	Mixed Waste Landfill
N.M. State Plane Coordinate X	411451.366
N.M. State Plane Coordinate Y	1452692.592
Surface Casing Type	steel conductor casing
Surface Casing Length	20 feet
ID Well Casing	4.75 inches
Well Casing Depth	477 feet below ground surface
Screen Interval	452 to 472 feet below ground surface
Plugging Grout Type	Quick-Grout™ (bentonite grout)
Grout Volume Used	approximately 500 gallons
Date of Decommissioning	24-Apr-08

SNL/NM ER PROJECT
GROUNDWATER MONITORING WELL ABANDONMENT DIAGRAM



Well Name	MWL-MW3
Location	Mixed Waste Landfill
N.M. State Plane Coordinate X	411407.995
N.M. State Plane Coordinate Y	1452476.617
Surface Casing Type	steel conductor casing
Surface Casing Length	20 feet
ID Well Casing	4.75 inches
Well Casing Depth	476.3 feet below ground surface
Screen Interval	451.3 to 471.3 feet below ground surface
Plugging Grout Type	Quick-Grout™ (bentonite grout)
Grout Volume Used	approximately 500 gallons
Date of Decommissioning	24-Apr-08

APPENDIX C
Field Notes for 2008 Activities at the Mixed Waste Landfill

Well Plug and Abandonment

P+A MW1, 2, 3

Michael Skelly 16APR08

1044 Travel with Don Helpick + Stacy Griffith to MWL to stake locations of MWL - MW7, MW8, + MW9.

1105 at MWL, place large wood stakes at each of the proposed well locations. Locations based on the coordinates used by ERGIS to generate Figure 1 of the NMED - approved Plug and abandonment/Replacement plan for MWL - MW2/9.

1146 Back at E.R. Office.

22APR08

1015 Gather equipment into red truck.

1142 Go to IPOC/Badge Office to meet drillers.

1204 add Badge Office

Mark A Olsen	CT51602
Hector M Leon	CT51603
Tavricio J Leon	CT51604
Casey G Heath	CT51605

1227 Email Frank Stibeck badge numbers for RA-III access for 84 crew members

1250 At ERFO, discuss scope of work, H+S training requirements, logistics, minimizing impact to surface soils/vegetation, watch out for migratory birds (mourning dove nests), clearing well pad areas, volume calculations, bag counts, HotWork/Welding Permits.

1317 New crew (Hector + Javier) watch Video training. Go to decon pad with Mark and Casey to offload equipment

1425 Review SNL HASP with crew, get signatures on HASP

1444 Crew leaves ERFO to go to WDS yard for more gear.

1515 Fax Badge Requests (4) to badge office.

P+A MW1, 2, 3

Michael Skelly 22 April 08

1609 Call Mark Green, the drill rig is on its way to Bldg. He's still gathering equipment in the yard. He'll continue mobilizing equipment tomorrow morning.

1640 at ERMO, secure gear for the evening.

---

23 April 08

0709 at ERMO, pack gear, head to MWL
Weather: clear, cool, calm, pred hi ~80 w/ high wind

0733 at MWL, prepare trailer/gear WDC crew mobilizing equipment from yard to TA-III decon pad staging area. Pipe truck/trailer got stuck between the gates at entrance to TA-III. Security was called to override the gates.

0911 Leave decon pad to get another load of equipment at WDC yard. Talk to Mark Green about completions: protective casing = 10" (ID) Steel, 3 Bollards. Also, pick P+A Debris for pick up by ERFO.

1203 at ERFO pick up caution tape, drinking water and other supplies

1225 at Decon pad, WDC finishing up unloading gear. Take Mark Green to drill site locations and discuss logistics P+A MWL-MW1, MW2, MW3 then start drilling MWL-MW7. Some site prep work required at MW7.

1258 at MWL, flag roped area with Caution Streamers. WDC water truck goes for a load.

1339 Open Well MWL-MW1, WDC crew onsite give Tailgate safety briefing. Prep to insert Tremie (black plastic for tupping) mix + pump grout.

1408 Mike Sanders onsite to discuss operations.

Michael Shell 23 April 08
1424 Miles Sanders offsite.
Calculate volume of grout for 478 ft hole (4.7" ID) at 430 gallons
1452 Pumped ~550 gals of grout (20 bags) clean out pump/hose. WDC crew needs to replace hose. Ready site for leaving.
1507 Secure Trailer, head to ERMO.
1610 Mark Green calls, still fetching part. Will Resume operations in morning
1715 Go to site for ER Checklist, make copy for Franz Lauffer and Ship.
1751 Finish for the day.

0750 at ERMO Gather equipment 24 April 08
head to the site
0811 On site, drill crew readying equipment
Onsite personel:
Mike Shell
Mark Green
Casey Heath
Hector Leon
Javier Leon
Give tailgate safety briefing, WDC swaps out battery in fork left. Prepare to grout (top off MW1 then MW2)
0941 Finish topping off MW1 using ~50 gals and 2 bags of bentonite
0950 Set up on MW1 - MW2, prep to grout
1034 Plug MW1 - MW2 to within a few feet of the top of casing
Calculate volume of grout for 477 ft hole (4.7" ID) at 500 gallons. Pumped ~500 gals of grout (18 bags). Clean out pump house, mobilize to MW1 - MW3
1056 Call Craig Hauber, leave message re: inspection.

P+A MW1, 2, 3

4

Michael Shelby 24 April 08

1057 Lower pipe down MWL-MW3 mix and pump grout. Calculated volume = 500 gal.

1131 Topped off MW3, clean out hose and grout plant. Placed ~500 gals (18 bags) grout.

1142 Pull grout plant + water truck off of MW3 WDC crew goes to decon pad to decon equipment/pipe, stab pipe, etc. Go to ERMO, check on WLD100, rig inspection, etc.

1219 Retrieved call from Craig Hauber. He'll come out monday to perform rig inspection. He said we don't have to wait on his inspection to start our drilling.

1250 Call Debra Gallegos re: WLD100 certs, go to site. WDC stall decon/stabbing pipe. Remove rope fence from MWL-BW1 drill site to use at MWL-MW7 drill site.

1433 Drill rig is decon'ed, moved to MW7 location.

1619 Spud @ MWL-MW7 with 11 3/4" Drive Casing hammered in casing seved pat to set bit.

1633 Set up exclusion zone around drill site with posts + rope from BW2 well site.

1721 Secure site. WDC crew off site.

1802 Leave ERMOs for day.

Well Installation and Development

Michael Stelle 25 April 08

0711 at ERMO, pack gear

0729 at MW1, WDC crew onsite warming up equipment. Give tailgate safety briefing. Top off MW1, 2, 3 with grout, pull bollards

0846 All bollards + Steve pipes removed, stashed on pallets near MW1 - MW2

0857 Begin drilling to 20' on MW1 - MW7

0913 With bit at ~ 17 ft bgs add another joint.

0928 Bit at ~ 37 ft bgs add another joint.

0944 Bit at ~ 57 ft bgs add another joint.

1012 Mike Sanders + Brenda Langkopf on site.

1017 Bit at ~ 77 ft bgs, add another joint.

1028 Sanders and Langkopf offsite.

1045 Bit at ~ 97 ft bgs, add another joint.

1059 Bit at ~ 117 ft bgs, add another joint.

1113 Bit at ~ 137 ft bgs, add another joint.

1130 Bit at ~ 157 ft bgs, add another joint.

1145 Bit at ~ 177 ft bgs, add another joint.

1209 Bit at ~ 197 ft bgs, or deeper (drilled ahead of the drive casing. Crew to lunch Go to ERFO.

1240 Crew onsite, trip drill Stem + bit, attach 4' length of 11 3/4" drive casing. Drive 11 3/4" Casing to a depth of 200 ft (drive shoe) with ~ 1 ft of stick up above ground surface after removal of 4' length. Crew to decon pad to load more drive Casing (smaller diameter)

1441 WDC Crew back on site with 9 5/8" drive casing. Prepare to double trip casing/ drill Stem.

1508 Trip 9 5/8" inside of 11 3/4" drive casing

1600 Finish installing 9 5/8", Trip bit and drill Stem.

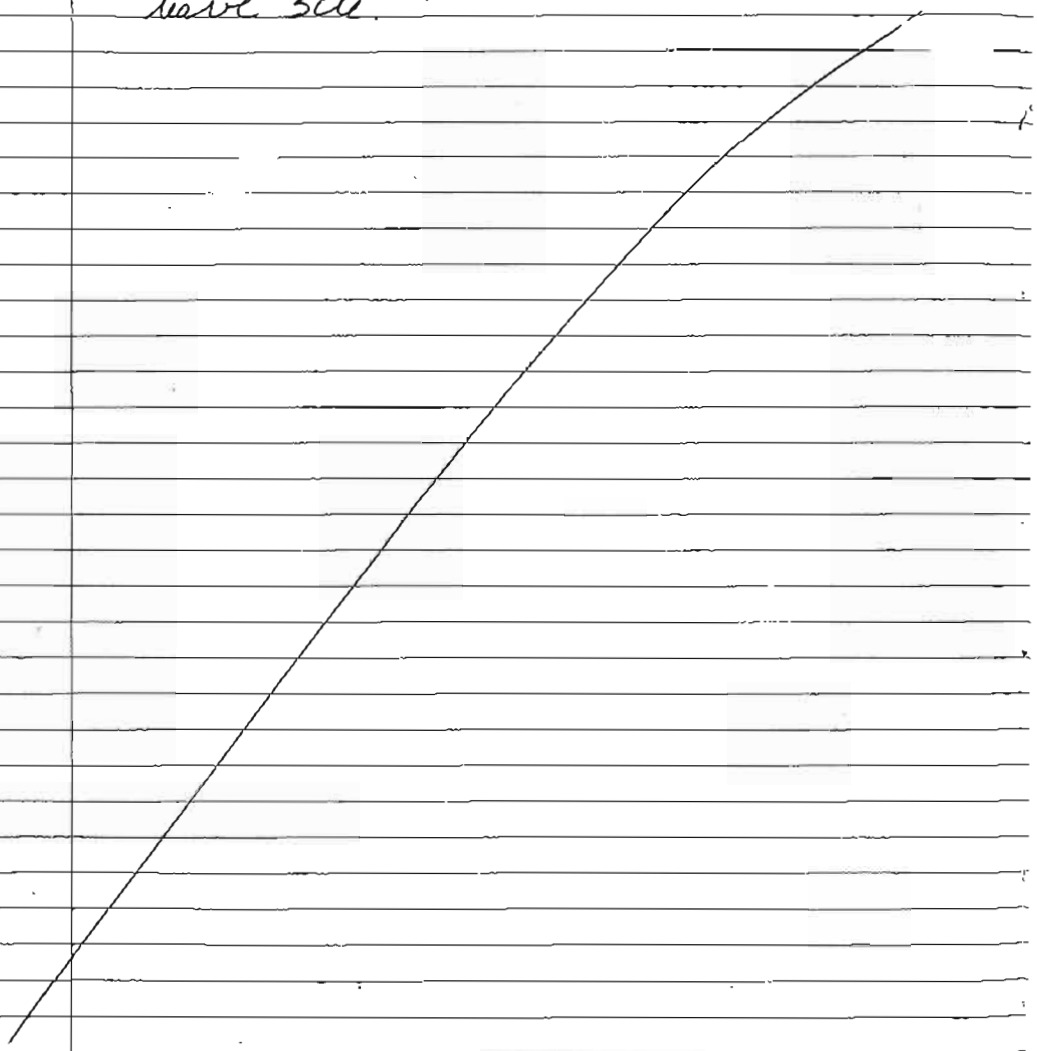
6

MWL - MW7

Michael Shelby 25April08

1652 Finish installing drill stem. WDC crew fuels rig, loads/unloads equip., and secures site. Secure trailer head to EKMO.

1728 Provided update to ER Folks, leave site.



Michael Shelby 28 April 08

0715 at ERM-MO, send email to Mick Peterson (Bat Wood) re: Health and Safety documents. Pack gear head to site

0735 Onsite, crew is warming up equipment and preparing to drill. Tailgate Safety briefing

0753 Begin drilling 200-220 ft w/ 9 5/8" drive casing

0808 Bit at ~217' bgs, add another joint.

0829 Bit at ~237' bgs, add another joint.

0852 Bit at ~257' bgs, add another joint.

0917 Bit at ~277' bgs, add another joint; Honey dipper on site to service port-o-let.

0924 Talked to Schofield - Facilities crew is supposed to do some dirt work on the berm.

0936 Bit @ ~297' bgs, add another joint.

1002 Bit @ ~317' bgs, add another joint; Schofield on site w/ bird survey. Road grader crew onsite.

1022 Bit @ ~337' bgs, add another joint.

1043 Bit @ ~357' bgs, add another joint.

1105 Bit @ ~377' bgs, add another joint.

1117 Stacy Griffith onsite, Road crew working berm.

1125 Frantz Lawyer onsite

1137 Bit @ ~397' bgs, add another joint. Stacy heads offsite.

1202 Bit @ ~417' bgs, add another joint.

1211 Take lunch break.

1243 Fire up rig. Road crew back on site.

1259 Bit @ ~437' bgs, add another joint.

1325 Bit @ ~457' bgs, add another joint. Cuttings are damp to wet, sticking inside discharge line and cyclone. Not adding water (air only).

1404 Discharge line clogged at cyclone. Disconnect and clean out cuttings.

1427 Bit @ ~477' bgs, add another joint. Re-attach discharge line to cyclone.

MWL - MW7

Michael Spell 28 april 08

1456 at 495 ft bgs, discharge line is plugged due to very wet cuttings. Disconnect and clean out.

1505 Begin tripping out drill stem and bit.

1537 Tripped out drill pipe had a lot of slough fall off during trip. Tag top of slough at ~7 ft above TD of borehole. Tagger come out dry -- no water at top of slough. Trip drill stem and bit back in to remove slough.

1640 Clean out slough; add ~ 100 gallons of water to clean out drill stem / driven casing; blow all water out of driven casing.

1653 Trip out drill stem and bit; pipe relatively clean.

1721 Finish tripping drill stem and bit. WDC crew Ready's rig for the night.

1735 Unload gear at trailer at ERMO

1802 Leave ERMO for the night.

Michael Skelly 29 April 08

0655 at ERMO gather gear head to MWL

0710 at MWL, WDC crew onsite warming up rig. Conf tailgate safety briefing

0738 Measured WL in MWL - MW7:
492.4 ft below drill rig table
~5.0 ft table to ground surface
487.4 ft below ground surface.
Unable to tag TD of borehole with water level tagger, but had drilled down to 495 ft bgs. Currently only 7.6 ft of water in borehole.

0751 Call Stacy Griffith to discuss water level. She'll call geophysical loggers re: their availability.

0803 Tell Mark Green to standby, awaiting on decision to run geophysics or not. Crew builds monuments

0915 Fax Badge request into Badge office for Al Henderson's access.

0921 Call Mark Green, schedule geophysics for ~ 12 noon.

0940 Call Badge Office, Al's badge is being processed.

1138 Measured WL at 487.6' bgs. Check surface completion at 3 plugged and abandoned wells (MWL-MW1, MW2, MW3) concrete is setting up, brass markers are placed in center of concrete.

1153 Stacy calls, Jet West at IPOC

1215 Pick up Al Henderson (Jet West) at IPOC + escort him onsite

1231 at MWL, give tailgate H+S Briefing to al. WDC crew rigs up to run geophysical tool

1305 Run geophysical log. Schofield + DOE/LV folks onsite to look at berm.

MWL – MW7

Michael Duke 29 April 08

1317 Craig Hauber on site, give tailgate briefing

1322 Stacy Griffith and Nick Sanders on site. Need inspection stickers on eyewash station.

1333 Finish running geophysical log, remove tool from MWL + MW7, Craig Hauber performs drill rig inspection.

1409 Craig Hauber finished inspection received Corp H+S plan from Jet West.

1425 Got printouts of geophysical logs. A few sand layers in the proposed screen interval 4b major sand horizons. Fluid level at 484 ft bgs inside casing. Based on conversation with Sanders and Griffith we'll complete the well as proposed in the P+A/R plans.

1431 Jet West, Sanders + Griffith off site. WDC offsite to get long-term badges at IPOC.

Design well from P+A/R plan (see page 11)

1512 WDC crew onsite, prep to install well materials

1527 Begin installing well materials

- End cap 0.45' (w/ inert well bung inside to protect from baler, bung = 0.32' nylon plug)
- Sump 4.76' blank 5" PVC w/ PVC centralizer
- Screen 9.78' of which 0.23' blank + 0.55' blank on each end (threads), centralizer 2' below
- Screen 9.78'
- Screen 9.78' with PVC centralizer above (2')

1537 Install first 100 ft of blank:
19.78' + 19.82 + 19.84 + 19.80 + 19.80 = 99.01'

1551 Install second 100 ft of blank:
19.78' (w/ 3 centralizers) + 19.82' + 19.78' + 19.79' + 19.81' = 98.9

1603 Install third 100 ft of blank:
19.80' (w/ 3 centralizers) + 19.77' + 19.80' + 19.80' + 19.81 = 98.98'

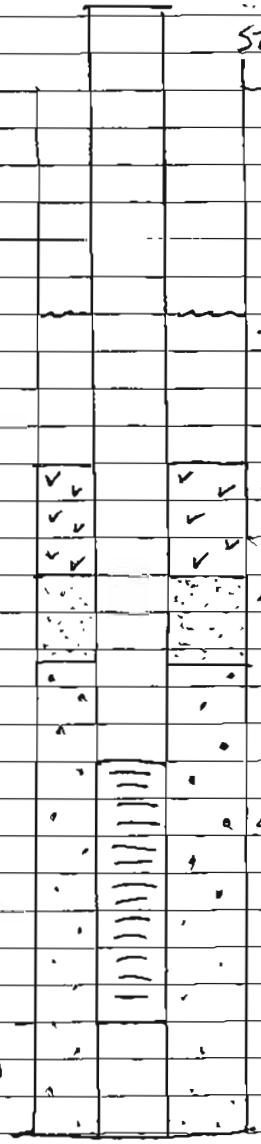
1617 Install fourth 100 ft of blank:
19.81' + 19.82' + 19.76 + 19.78 + 19.81 = 98.98'
(3 centralizers)

Nicholas Kelly

29 April 08

MWL - MW7
Well completion

Planned		Actual
Stickup 30" Ground Surface		Stick up ~ 28" Ground surface
320' - 420' "First Lift" of slurry		307' - 417.4' "First Lift" of slurry
420' - 450' 3/8" bentonite chips		417.4' - 448.6' 3/8" bentonite chips
450' - 455' 40-60 Silica sand		448.6' - 453.8' 60 Silica sand
455' - 496.2' 20-40 silica sand		453.8 - 498.75' 20-40 Silica Sand
461.2' - 491.2' 0.10" slot screen		464.65' - 493.99' screen interval 0.10" slot
491.2' - 496.2' = sump		493.99' - 498.75' = sump
TD = 496.2'		TD = 498.75'



MWL - MW7

Michael Sully 29 April 08

1629 Add remaining blank:
19.78 (w/ss centralizer) + 19.80 + 19.80 + 9.76 = 69.14'
(temporarily add 4.78' for well construction ease, will remove when completed)

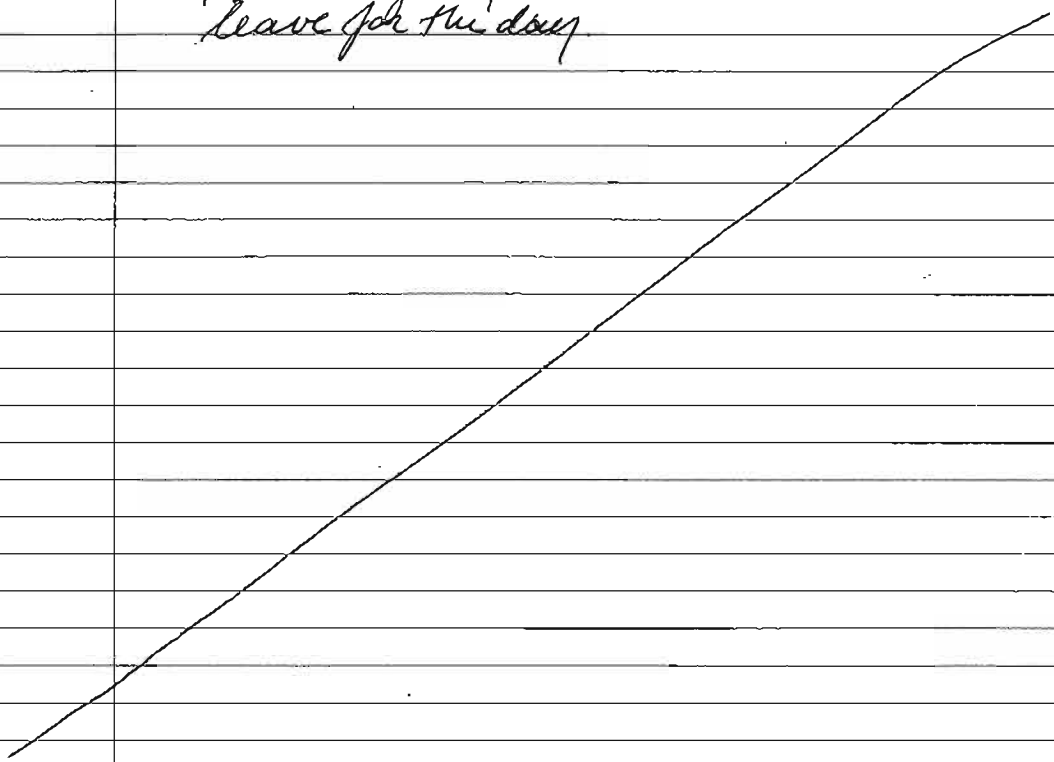
1637 Tag inside of well materials with WDC, tagged at 497.87', should leave 2.56' of stick up at completion.

1641 Finished adding well materials (PVC + centralizers) prep rig for pulling drive casing: mast down, unset hydraulic pullers, move well materials into place.

1721 Pullers in place, mast back up.

1738 Secure site, WDC shut down rig

1804 Secure gear (truck at ERM) leave for the day.



Michael Skelly 30 April 08

0708 at ERMO, pick up gear head to MW2
0729 at MW2, WDC crew warming up rig and preparing to continue well construction. Give tailgate safety briefing. Add 10 bags (50lb) of 20-40 sand pull 10ft of drive casing.
0753 Add 10 bags of 20-40 sand, tag to ensure 5' to 10' of sand remains in drive casing, pull 10' of drive casing (DC).
0809 Add 7 bags of 20-40 sand, tag, pull 10' DC.
0826 Add 5 bags of 20-40 sand, tag, pull 10' DC
0842 Add 5 bags of 20-40 sand, tag, pull 10' DC.
0901 Measure water level: 491.2' TOC, 3.4' stickup = 487.8' bgs
0909 Begin swabbing borehole/well
0928 Finish swabbing well, 20-40 sand settled + foot. Pull DC up several feet
0938 Tag top of 20-40 sand at 453.8' bgs in annulus.
0951 Add 2 x 100 lb sacks of 60 sand, pull casing. Tag top of 60 sand at 448.6' bgs in annulus.
1003 Add 4 x 5 gal buckets of 3/8" bentonite chips, raise casing, hydrate with ~20 gal H_2O
1011 Minor repair of hydraulic line on puller, Mark Green goes for part.
1125 Mark Green returns with part, install
1138 Remove 10' of D.C.
1143 Add 5 buckets, raise D.C. add 2 buckets
1149 Remove 10' of D.C., hydrate with ~20 gal H_2O.
1215 Add 2 buckets of bentonite chips
1221 Remove 10' of D.C.
1226 Final tag top of 3/8" bentonite chips = 417.4' bgs Hydrate with 160 gallons of H_2O. Pull 20 ft of D.C. Allow chips to hydrate.

14

MWL – MW7

Michael Shultz 30 April 2009

1300 Begin mixing Volclay grout: mix 6 bags of Volclay with 280 gallons of water, backfill ~ 110 ft of annulus.

1313 Trip out 120 ft of D.C.

1358 Finish trip. DDC mobs equipment, drill stem/ driving casing to decon pad. Will stand by until 4pm Thursday to allow for grout to set 24 hrs.

1420 at ERMO, stash gear.

1516 Leave site for day.

Michael Skelly 01/14/08

0835 at ERFOs. Still waiting on 100 ft lift of grout. Return badge for Jet West logger, gas up truck, pick up drilling fluid from HWHMF pick up brass caps from ERFO etc.

1203 at MWL, org files in trailer, prep for day.

1228 WDC crew onsite, warm up rig/equip. Conv tailgate safety briefing. Prepare to mix grout/pump/pull DC

1253 Mix 6 bags holeplug grout with ~ 280 gallons of water. Pump into annulus.

1304 Begin pulling DC.

1355 Removed 260' of 9 5/8" D.C. Switch over pullers to remove remaining 11 3/4" D.C.

1423 Pipe truck and fork lift go to decon pad to remove the 9 5/8" D.C. and make room for the 11 3/4" D.C. on pipe truck.

1506 Pipe truck and fork lift back on site.

1525 Mix and pump 2 batches of grout, each ~ 300 gallons and 6 bags volclay.

1533 Begin pulling 11 3/4" D.C. Mark Green had trouble with badge swipe @ TH III. Need to get on access list with new badge numbers:

Mark A. Green	CT 52334
Hector M. Leon	CT 52335
Tarvicio I. Leon	CT 52337
Casey G. Heath	CT 52336

1553 Pulled 140' of 11 3/4" D.C. Mix and pump two more batches of grout, each ~ 300 gallons and 6 bags volclay.

1613 Continue pulling 11 3/4" D.C.

1632 Finish pulling casing, mix and pump ~ 1100 gallons of grout (22 bags)

1640 Measure water level at 485.9 ft bgs.

1708 Run bailer down well, traveled easily

16

MWL – MW7

263-5442

01 MAY 08

Michael Shelby

to the bottom of the well. Removed ~ 5 gals of water. Very dark reddish brown. No sign of volclay grout.

1717 Mast down pull tubing forward to remove the hydraulic packers.

1733 WDC Crew is demobing off of MWL – MW7 taking gear to the decon pad.

1738 Secure trailer head to ERMO.

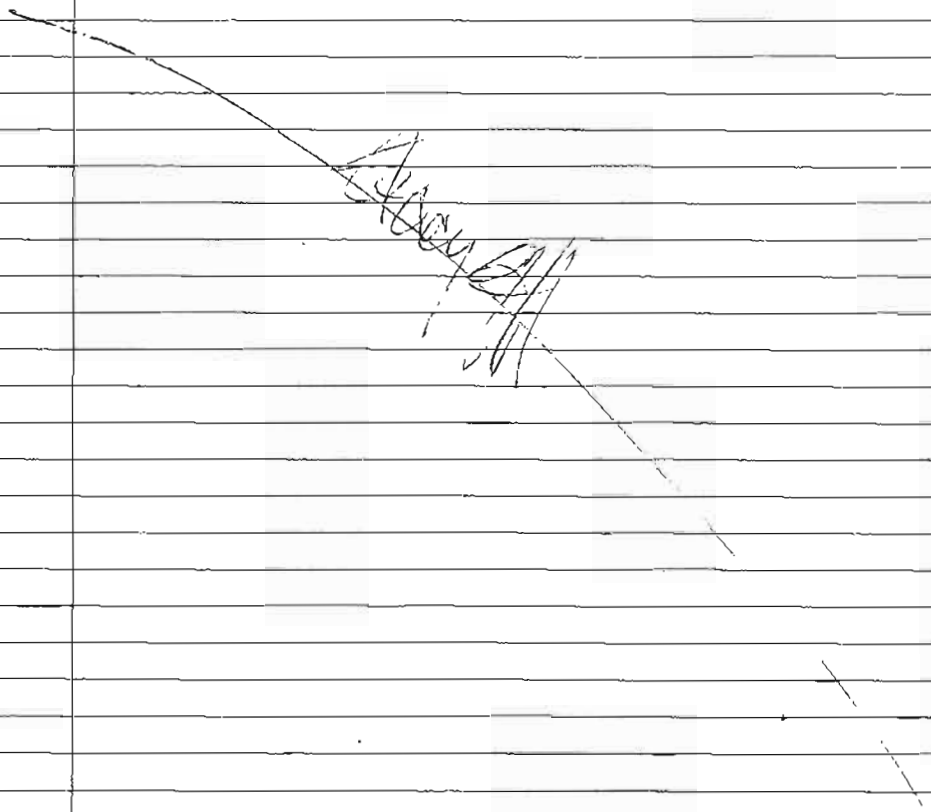
1804 Leave for the day.

02 MAY 08
Task: Install MW6 - MW8
Personnel: S. Griffith - GRAM
Mark Green
Hector Leon
Tarvicio Leon
Casey Heath
} WDC
Weather: 60°s w/ 10-20 mph wind

0730: S. Griffith (SRA) @ ERMOs. WDC crew @ decon pad in TA-III. Mark Green off-site for materials to build well pad @ MW7
1100: SRA on-site @ MW8. Crew setting up rig.
Conduct H&S tailgate mtg.
1235: All personnel on site. Start building well pad. 4858' BGS in MW7
1240: Start drilling MW8 borehole w/ 11 3/4" drill casing 12" shoe, 200' of 20' x 11 5/8 on truck
1300: add 20' -> 40'
Mark Green Dodge CT52693
1430: Drill rig broke down
shut down for day. Arrange for mechanic.
1600: S. Griffith off site

05 May 08
Task: Drilling at MWL
Personnel: S. Griffith, M. Skelly, Mark Green
Weather: clear expected high 80's

0800: Mechanics still working on rig
1022: WL in MWL-MW7 488.67 BTOC
stick up on well:
top of protective casing 32"
top of protctive to inner casing 4"
∴ stick up ~28"
1100: Continue working of rig. Griffith & Skelly offsite



06 May 08
Task: Drilling @ MW-L - MW-8
Personnel: S. Griffith
Mark Green
Hector Leon
Tarvicio Leon
} WDC
Weather: Clear, expected high 80's, breezy

0630: SRG @ ERMO, mob to site.
0700: Conduct tailgate mtg. Rig repairs completed. Resume drilling @ ~15' BGS.
0745: 15' to 40' sand & gravel. Add 20' → 60' on hole.
0820: Add 20' → 80' total
0850: Add 20' → 100' total
0920: Add 20' → 120' total
0940: Add 20' → 140' total
1000: Sample @ 120' BGS slightly moist.
1015: Add 20' → ~~160' total~~ 140' total
1030: Add 20' → 160' total
1055: Add 20' → 180' total
1115: Add 20' → 200' of 11 3/4" drive casing in hole. trip drill stem out & switch to 9 5/8" drive case.
1335: Resume drilling @ 200'
1430: Add 20' → 220'
1515: Add 20' → 240'
Add 20' → 260'
1535 Add 20' → 280'
1610 Add 20' → 300'
Add 20' → 320'
1635 Add 20' → 340'
1645 Add 20' → 360' silts & clays
1705 Add 20' → 380'
1735 Stop for day @ ~375' BGS. All personnel off-site

07 May 08
Task: Drilling @ MWL: MWL-MW8
Personnel: S. Griffith
H. Leon > WDC
T. Leon
Weather: Partly cloudy, expected high 80's & breezy

0630: SRG @ ERMOs. Mob to site. Conduct tailgate mtg w/ Leon brothers
0700: Resume drilling @ 380' bgs. Mark Green off-site for fuel. Plan to drill to ~535' bgs.
0800: Add 20' → 400' total
0845: Add 20' → 420' total
~405' silts & clays begin to plug cyclone line
0920: Add 20' → 440' total
0930: ~428' sand & gravel possible 'ARG B' unit. Skelly on-site
0945: ~435' well-rounded gravel & clay balls.
Add 20' → 460' total
Sample @ ~440' clean sand
Sample of washed well rounded gravels collect. ~435'
1010: Add 20' → 480', expect water table in this next interval (460'-480')
Skelly offsite. Skelly's discussion w/ Will Moats (NMED) this morning concerning setting the screen for this well. Will stated to set well as proposed in work plan. Work Plan stated 'screen interval'
1035: ~465' bgs cyclone line plugs, cuttings moist (silty sand), same to ~475'. Cyclone & line plugged.
1100: Clear cyclone & line. resume drilling. Add 20' → 500'
1130: Scho came by to notify me that fence contractors will be on-site next Monday.

07 May 08 cont

1130: Add 20' → 520'
b/w 500' – 505' transition from fine silty sand to higher % of silt
scale from 505 – 515'
1155: Add 20' → 540' Final length of casing drill
1205 @ ~518' sand/gravel w/ some silt → ARG
drill to ~535'
~518' – 522' ARG type sand/gravel.
522' – 535' silty sand & clay
1220: Total Depth ~535' BGS
Begin injecting water to clear out casing. All added water will be blown out. (~250 gallons)
1235: Trip out drill stem to ~460' bgs (above W) & stand by for geophysical logging in am. Will check for heaving sand in am before tripping out all drill stem for the logging.
1300: WDC crew remain onsite to work on rig maintenance. Either trip out some drill stem @ end of day or raise ~20'.
Mark Green not concerned w/ heaving sands. Will check bottom in am & trip out then.
SRG back to ERMO

08 May 08

Task: Drilling @ MWL ; MWL-MW8

Personnel: S. Griffith
M. Green
H. Leon
T. Leon
} WDC

Weather: Partly cloudy, expected high 80's, breezy

0645: S26 @ ERMO mob to site.
0700: Onsite, conduct tailgate mtg. Tag bottom of borehole w/ drill stem → No sand.
0730: Start tripping out drill stem.
0815: @ 535' BTOC - 4.7' Stick up in 530.3' BGS. through drill casing. Bottom of hole is stiff clay.
0930: Jet West Al Henderson onsite to log well.
1100: Jet West off-site. Start well construction.
Start plug 505' to 535'
Blackhills Bentonite, L.L.C, Pure Wyoming Bentonite 3/8" chip 34 50 lb bags on pallet.
Added 9 bags of chips to 506.5' bags, all below water level. Take lunch + let hydrate.
1309 Start building well. Pulled 30' [illegible] of casing.

Casing lengths

- ✓ 5.2' sump w/ cap
- ✓ 9.75 } centralizer, PVC screen
- ✓ 9.75 }
- ✓ 9.75 centralizer, PVC
- ✓ 20.0
- ✓ 20.1
- ✓ 20.1
- ✓ 20.0
- ✓ 19.79 — centralizer, SS
- ✓ 20.0
- ✓ 20.1
- ✓ 20.1
- ✓ 20.1
- ✓ 20.2

100'

- ✓ 19.91 centralizer, SS
- ✓ 19.91
- ✓ 21.1
- ✓ 20.0
- ✓ 20.1
- ✓ 19.82 cent. SS
- ✓ 19.94
- ✓ 20.1
- ✓ 19.79
- ✓ 20.2 cent. SS
- 19.95
- 19.80
- 19.80

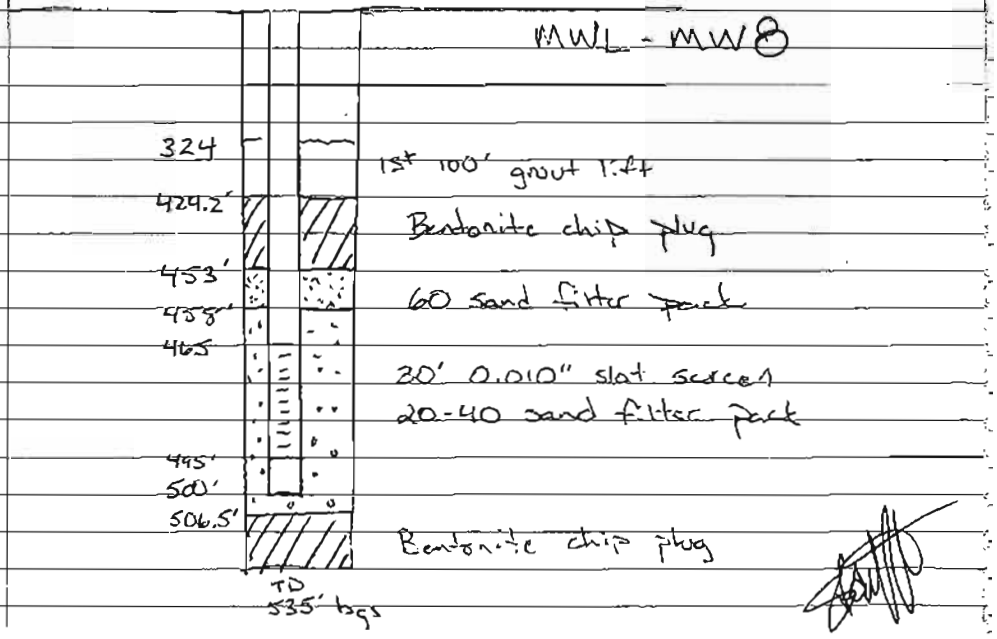
100'

Total = 495.36'

08 May 08 cont

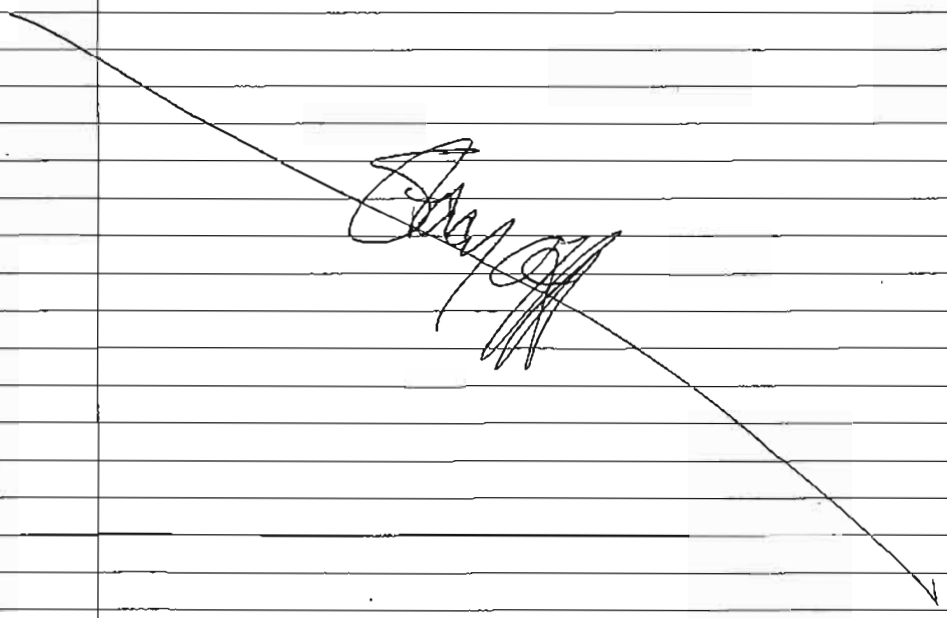
1355 Add 10' to well → Total on string 505.33'
1420 - 9.97
1425 add 4.75' to string
Mark's tagger tape measures 502.5' + 4.75 = 507.25' on string
Set well w/ ~7' of stick up
Add 20/40 Sand ~4' beneath well + 40' of annulus calc. ~36 50lb. bags.
Used 10.5 bags + 12 + 13.5 = 36 bags

1545 Sand to top of screen. Surge well screen w/ 10' bailer.
Sand to 458'. Secondary filter pack 5' 60 sand = 4.5 bags
Add 60 sand to 453' → used 200lb.
Bentonite chip plug 30' → used 17.50lb bags
Plug to 424.2'. Hydrated continuously while adding chips. Let plug sit overnight.
As-built well diagram



09 May 08
Task: Drilling @ MWL : MWL-MW8
Personnel: S. Griffith
M. Green
T Leon
H. Leon
} WDC
Weather: Partly cloudy, expected 80's, windy

0630: SRG @ ERMO. Mob to site.
0700: Conduct tailgate meeting.
Ψ 486.70' bgs
0845: pulled pipe to 280' bgs
1st 100' lift of grout added. 263 gallons → 100'
Grout to ~325' BGS.
WDC crew prep site for next borehole
1100 SRG to ERMO.



12 May 08 Monday
Task: Drilling @ MWL: MWL-MW8
Personnel: S. Griffith
M. Green
T. Leon
H. Leon } WDC
Weather: Partly cloudy, expected high 80's, windy

0645: SRG @ ERMO. Mob to site
0730: Conduct tailgate mtg.
0900: Mix batch of grout, add, pull casing.
M. Skelly on-site.
Continue mixing grout batches & pull casing.
1145: Brine grout to surface.
1330: SRG + M. Skelly off site to ERMO.
WDC crew @ decon pad & prep for next borehole.

MW2 - MW7

Madison/Gulla 13 May 08
0635 @ EKMO, gather gear, head to MW2
0702 On site, WDC crew (Mark Green, Hector Leon, Javier Leon) on site setting up on MW2 - MW9
0715 Give tailgate safety briefing; set up exclusion zone around rig/equipment.
0749 Spud @ MW9 Drill 0-120' with 12" casing
0808 Drive shoe @ ~17', add pipe joint.
0843 Drive shoe @ ~37', add pipe joint.
0902 Drive shoe @ ~57', add pipe joints.
0926 Drive shoe @ ~77', make minor repair on drive hammer.
0942 Add pipe joint.
1001 Drive shoe @ ~97', add pipe joint.
1023 Drive shoe @ ~117', add pipe joint.
1041 Drive shoe @ ~137', add pipe joint.
1059 Drive shoe @ ~157', add pipe joint.
1119 Drive shoe @ ~177', add pipe joint. Mark Miller on site to view geoprobe work.
1131 Mark Miller off site.
1136 Drive shoe @ ~197', add 4' pipe joint to get 12" drive casing to ground surface. Trip out drill stem/bit.
1157 Drill stem/bit tripped out
1211 Drive shoe @ ~200' remove 4' pipe joint. Go to ERFO for supplies. Go to EKMO and call Bryan Nydoske re: Well Development. Look to start week of Memorial Day.
1411 Back at MW2, WDC crew is tripping in 10" Drive casing and drill stem
1429 Resume drilling 200-220' bgs.
1445 Drive shoe @ ~217', add pipe joint.
1504 Drive shoe @ ~237', add pipe joint.
1526 Drive shoe @ ~257' add pipe joint.
1549 Drive shoe @ ~277' add pipe joint.
1609 Drive shoe @ ~297', add pipe joint.

MWL - MW9

Michael Skelly 13 May 08

1643 Drive Shoe @ ~313'. Rubber gasket between 12" and 10" Drivecasing failed.
1649 Gasket repaired, add pipe joint.
1705 Drive Shoe @ ~327' add pipe joint.
1734 Drive Shoe @ ~347'. Shut down for evening. Secure site.
1750 At ERMO unload gear.
1815 Leave Site for the day.

MW2 - MW9

Michael Shelby 14 May 08

0641 at ERM-NO pick up gear
0702 Onsite drill crew warming up rig.
0713 Live tailgate safety briefing begin drilling 360-380
0757 Drive shoe @ ~387', add pipe joint. Fine grained sediments sticking in discharge line and cyclone.
0819 Drive shoe @ ~397', add pipe joint.
0841 Drill stem disconnected at bad threads, repair.
0913 Removed bad piece of drill stem, install different piece of drill stem and drive casing.
0921 Resume drilling 397'-417'
0933 Drive shoe @ ~417', add pipe joint. ARB ~ 415'
1009 Drive shoe @ ~437, add pipe joint.
1041 Drive shoe @ ~457, clean out cyclone and discharge line. Stacy Griffith on site to cover.
1128 Add another joint.
1150 Sample @ 468' silty sand. Cyclone continues to plug
1200 Add 20' → 500' on rig
1220 Poor cuttings return 480-500', Cyclone plugged.
1320: Don Schofield, Barry Birch, Tom Stivinski onsite.
1345: Add 20' → 520' on rig @ 505' cobbles. Injecting water to prevent plugging.
1410: Visitors (Laurie) go to watch soil-vapor sampling. Bottom 20' of borehole (~515 to 535') cobbles, gravels, some clay, sand. Mark cleans out hole & casing. Blows out all water. We will pull drill stem up ~20' inside casing tonight and in morning can check for heaving sands.
1520: SRG offsite.

Michael Sully 15 May 08

0644 at ERMD pack gear head to MWL

0704 Onsite, WDC crew maintaining rig, warming up equipment

0717 Conf tailgate safety briefing. Drill stem used to tag TD @ ~535' bgs. No flowing sands. Begin tripping out pipe.

0748 Drill stem tripped out. Small (<2') clay boot on drill bit.

0758 Tag water level inside casing 504.32' below table, table tol ground surface = 4.75' = 499.57' bgs. Drill crew moves water truck etc out of way for geophysical log run.

0811 Stand by Griffith onsite

0815 Call from Sid Brandstein meet at TH3 gate at 0900

0817 Call from David Miller, need written communication from NNSA on screen interval.

0818 Call from John Gould on screen interval

0821 Al Henderson of Jet West on site, set up on MW9 to run log.

0830 Run geophysical log

0903 Meet Sid Brandstein (NNSA/HWB) on gate (TH-III) escort to MWL. Conf tailgate safety briefing to Sid, he visits logging truck

0941 Finish log of MWL-MW9. Will construct well same as MW8. Move to MW8 and run log in PVC well.

0950 Begin arranging equipment for building well.

1013 Begin pulling 10" drive casing and backfilling with bentonite chips to ~506 ft.

1044 Backfilled borehole to 508.5' bgs using 9 bags of bentonite chips

Mauchan/Shull 15MAY08

1053 Begin running well materials:
- endcap w/ plug
- 5 ft blank w/ PVC centralizer
- 30 ft screen (10 x 3 pieces)
- 470 ft blank (20' x 23 pieces)

1113 Sid Bradweisn offsite.

1153 Tag inside of well materials = 504.3'. Begin adding sand and pulling drive casing.

1225 Geophysical logging complete on MW-7 and MW-8. Al Henderson offsite.

1409 With ~90% of coarse sand in place, swab the well.

1420 Tag top of 20/40 sand at 458.7' bgs after 44 bags (50 lbs) of sand. Begin pulling/adding sand.

1437 Tag top of 20/40 sand at 452.5' bgs after 4 buckets (50 lbs) of sand. Begin pulling and adding 3/8" bentonite chips

1455 Tag top of 3/8" bentonite chips at 419.6' bgs. Hydrate chips. 18 bags placed

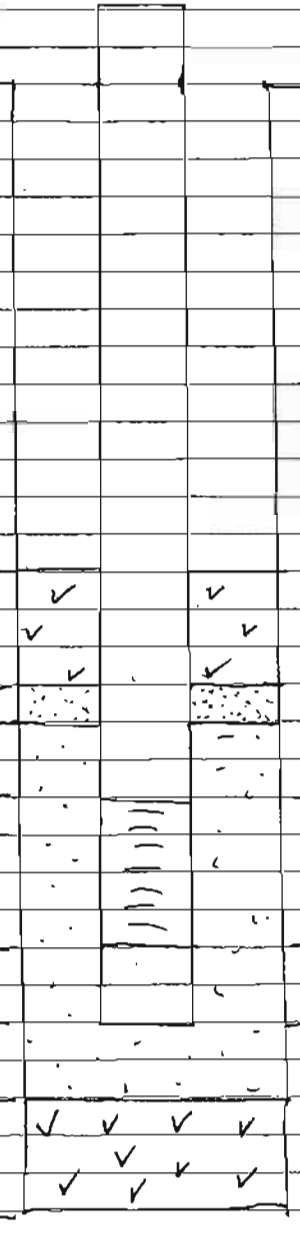
1549 Pump grout (1st lift) and pull drive casing. Grout batch = 300 gallons and 7 bags of Voldan.

1633 Finish stripping out ~100 ft of 10" drive casing. Let 1st lift of grout set for 24 hrs. Drill client/geologist's rig/equipment for the night. Go to ERM's stock gear.

1652 Launch. Daily update, leave site for the day

Michael Bailey MW2 - MW9 15MAY08

Planned Actual



325 Top of "First Lift" of Volclay bentonite grout

425 Top of 3/8" Bentonite Chips — 419.6 ft

455 Top of 60 sand — 452.5 ft

460 Top of 20/40 sand — 458.7 ft

465 Top of screen — 465 ft

495 Bottom of screen — 495 ft

500' Bottom of sump — 500 ft

505 Top of Volclay bentonite chip plug — 500.5 ft

TD = 535 — 535.0 ft

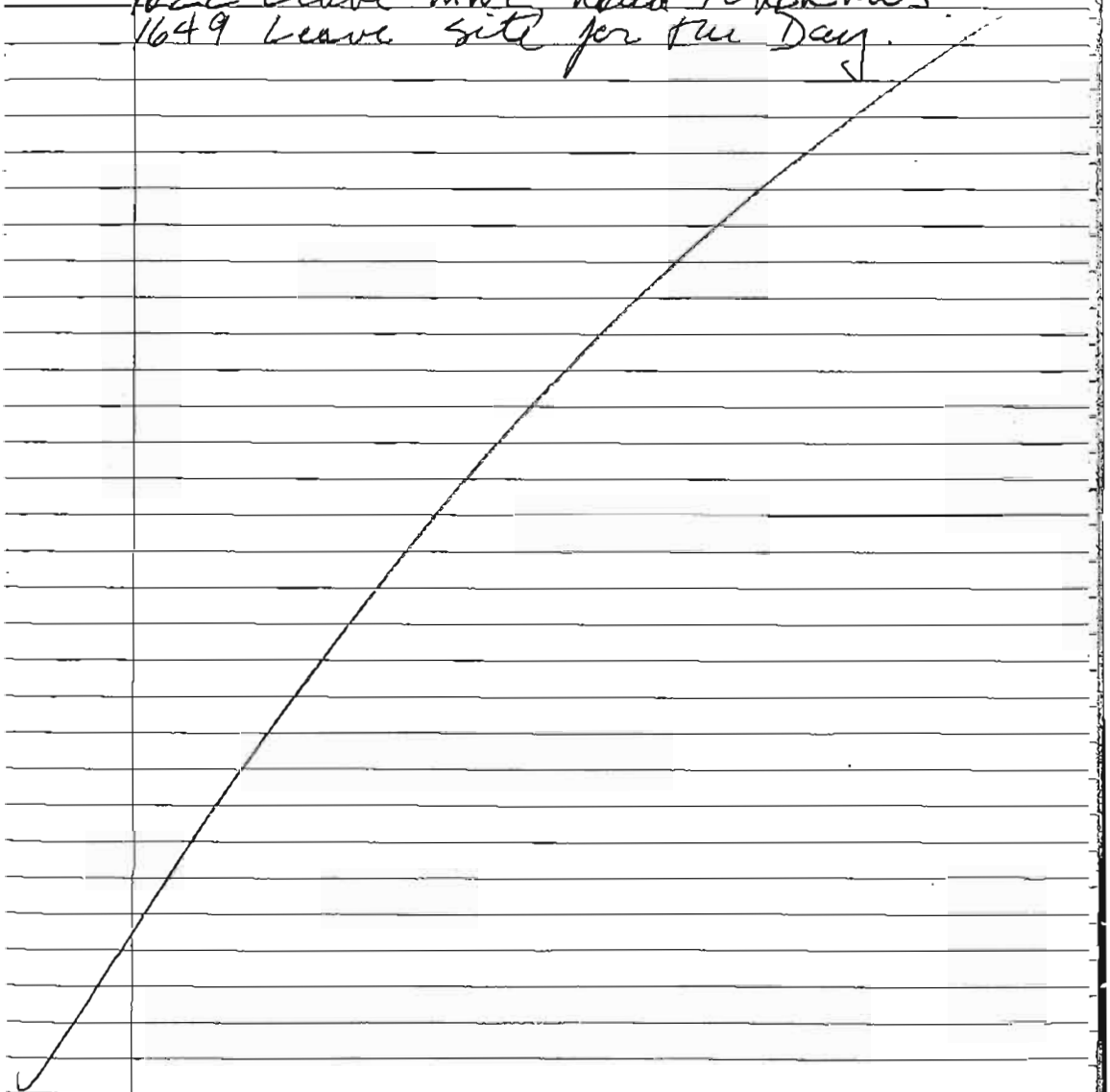
MWL - MW9

Michael Bell 19 MAY 08

0637 at ERWD, gather gear head to MWL.
0703 Onsite, WDC crew is warming up rig, getting load of water + preparing to continue backfilling the annulus. Conf tailgate safety briefing.
0719 Mix batch grout (6 bags, 300gal) pull remainder of 10" Driv casing.
0804 Finish pulling 10" Driv casing, prepare to pull 12" Driv casing.
0821 Water truck takes load of 10" to the decon pad to make room for 12" driv casing.
0848 Water truck back on site. Prepare and pump batch of grout (8 bags + 400 gallons of water). Stacy Griffith onsite.
0921 Pulled 100 ft of 12" driv casing, prep and pump grout.
0939 Pulled remaining 12" driv casing, prep and pump grout.
1009 Finish pumping grout (11 batches 97 bags) Run bailer down the well. Muddy red-brown water was retrieved. No grout in the water.
1017 Prepare to pull rig and hydraulic pulleys off of well.
1046 Rig off of well to decon pad.
1107 Measured water level in MWL-MW9:
492.82' BTOC
Stick up 3.32' ags
489.50' Bgs
Tag total length of pipe (not with pad stick up) = 503.11' less 0.5' with protective end plug.
1350 Steam cleaner broke down waiting on part. Crew prepares well pad forms and protective post.
1504 Cut off PVC (0.75') to make ~30" of stick up. Install steel pipe (10ft, with

Michael Gulley 19 May 08

~ 3.5 ft of stick up and 5.5 ft below ground.
1525 Franz Lauffer onsite.
1603 Franz Lauffer offsite. WDC needs more concrete to finish off pad.
1622 Leave MWL head to EKMOs
1649 Leave site for the Day.



MW1 – MW9

Michael Shell 20 May 08

0815 At ERMOs, tend to office work.
0923 Gather gear, head to MW1. WDC is a decon pad cleaning and loading Run to ERFO for Sanders' supplies.
1015 Drill rig off site to WDC yard.
1028 Pipe truck and trailer loaded and heads to WDC yard.
1315 Check on WDC crew:
- at Decon pad loading/cleaning
- Will finish surface completion at MW9 when water truck is back.
- Should be offsite by 330 or 4.

1549 Check on WDC crew:
- Finished concrete pad
- Loaded gear and fork lift on flat bed trailer and water truck.

1623 WDC off site Leave MW1 for ERMOs.
1702 Leave site for the day.

Michael Shelby 27 May 08

0653 at ERMO's, Gather gear
0746 at IDC meet Jim Ward (WDC) Badge CT 54860. Travel to ERFO
0812 Give safety class Video Training to Jim Ward. Load up drums and pallets.
0955 Finish H+S training review HASP Tailgate safety briefing. Mobilize to MW1
1020 Set up over MW1 - MW7, prepare to develop.
501.77' total depth to Top of Casing
488.89' WL to Top of casing.
1051 Insert surge block. Surge the screened interval.
1111 Switch over to bailing, change out gear + set up Barrel.
1123 Begin Bailing
1203 Stop bailing, well is recovering after bailing
1256 Resume bailing WL had recovered to ~ 490' bgs
1313 Stacy Griffith on site pump 55 gal to Waste drum. Continue bailing.
1417 Allow well to recover some more.
1431 Stacy Griffith finished labeling purge water drum, leaves site.
1556 Pump another 100 gal to Waste drum, continue bailing
1639 Removed 140 gal (>10 bore volumes). Unable to get stable turbidity measurements < 5 NTUs. Will have to continue development with Bennett pump (ERFO).
1647 Secure MW1 Site go to ERMO.
1717 Unload bear leave for the day.

28 May 08 Wednesday
Task: Development @ MWL-MW8
Personnel: S Griffith - GRAM
Jim Ward - WDC
Weather: Clear & windy.

0630: SRG @ ERMO mob to site
Jim Ward onsite. move trailer w/ WDC development equipment to MWL-MW8.
0715: Set up for development. Conduct tailgate safety meeting
0735 Water level 490.40 BTOC and total depth 502.15 BTOC
decon surge tool & begin to surge well.
0815 Switch to bailer. Bail for ~30 min & let recover. Water is very turbid.
0910 Begin bailing again. About 15 gal → slow recovery.
0945 Bail again. Bail ~7 gal. Let recover for 30 min (till 10:30). Still very turbid.
1045 Bailed ~8 gals. Move to MWL-MW9 for surge & bail.
1120 Water level MWL-MW9 490.56 BTOC and total depth 502.50 BTOC
Begin to surge MW9.
1200 Switch to bailer. Bailed low @ 12 gals Turbid. Break for lunch. Mike Skelly on site
1300 Bailed ~3 gals. Move back over to MW8. Skelly to ERMO for supplies.
1405 Skelly back to ERMO. Bailed ~12 gals from MW8, still turbid.
1500 Bailed 6 more gal from MW8 ~50 gals. total Labeled drum for MW8. Bailed ~6 more gals. Still turbid.
1535 Move back to MW9. Bailed ~15 gals ~42 gal. total Still turbid.
1620 WDC & SRG off-site.

Michael Stelly 29 May 08

0642 at ERMO, pick up equipment + trucks and head to MWL.
0702 at MWL. Jim Ward (WDC). Set up on MWL - MW9. Conf Tailgate Safety briefing
0721 WL in MW9 490.88 ft btoc. Resume bailing.
0744 Bailed ~12 gals out of MW9, purged dry.
0751 Set up on MWL - MW8. Water Level in MW8 is 490.44 ft btoc.
0800 Resume bailing MW8.
0813 Bailed ~17 gals out of MW9, purged dry. allow wells to recover.
0915 Chip Roma, Joe Masser, Don Schofield onsite to inspect berm and discuss surface water features.
0937 Removed ~10gal from MW8 - ran dry re-locate to MW9.
0942 Surface Water/Berm inspection Crew offsite.
0945 Resume bailing MW9.
0956 after 7 gal, MW9 bailed dry. allow wells to recover.
1106 Resume bailing MW9.
1117 Purged 9 gal, allow to recover, re-locate to MW8.
1121 Resume bailing MW8.
1142 Purged 12 gal, allow to recover.
1307 Resume bailing MW8.
1331 Purged 12 gal at MW8, allow to recover, re-locate to MW9.
1333 Stacy Griffith had re calculated 10 Bore volumes for (MW7 (83 gal), MW8 (126 gal) and MW9 (124 gal).
1341 Resume bailing MW9
1354 Purged 11 gal @ MW9, allow to recover.

Michael Fields 29 May 08

1456 Resume Bailing MW9
1508 Removed 9 gal from MW9 allow to recover. Re-locate to MW8.
1515 Resume Bailing MW8.
1523 Removed 10 gal from MW8 allow to recover.
1624 Resume bailing MW8.
1629 Removed 8 gal from MW8 (total of 133 gal) purged dry. Done with this phase of development at MW8. Re-locate to MW9
1638 Resume Bailing MW9. (ES)
1653 Removed 9 gal from MW9 (total of 89 gal), purged dry. Done with this phase of development at MW9. Decon equipment. Secure drums, wells (locked) & demob.
1711 Sign WDC paperwork, retrieve Jim Ward's badge. Secure trailer/equipment. Jim Ward off site bound to ERMOs.
1735 Leave ERMOs for the day.

Michael Fuller 24 June 08

0905 Head to MWL
0921 ERFO Crew onsite developing MWL-MW7
Initial water level = 489.90 btoc
Installed Bennett Pump at 493 btoc
Pump at ~ 0.3 gpm
0940 Purged dry after ~ 9/4 gallons
1013 Resume pumping after 80% recovery.
1034 Purged dry after ~ 7 gallons, pumping at ~ 0.5 gpm
1115 Leave MWL. ERFO crew continues to purge/recover at MWL-MW7. Will look to develop well all day long in a similar manner
1430 Call Robert Lynch:
- Removed ~ 53 gal at MWL-MW7
- Parameters stabilized
- Turbidity finished off at < 1 NTU
- Collected waste sample of purge water

Michael Shields 25 JUN 08

0755 Leave for MWL
0813 At MWL - crew is handling purge water, decon equipment, etc. Water level in MWL-MW8 is 490.60 ft bgs
0831 Move water truck to MWL-MW8 and set pump.
0851 Begin Purging MWL-MW8 at ~ 0.3 gpm
0921 Pumped 7 gallons. WL is 497.33 ft bgs.
1010 Well has not yet recovered to 80%. Crew will continue to develop as recovery permits. Leave MWL, go to Motor pool for fuel.

Michael Skelly 2&TMW08

0848 Call Robert Lynch:
- Crew purged MW1 - MW8 dry
- total of ~~2.6~~ 33.5 gal removed 33.5 gal
- Field parameters have stabilized
- Currently deconning equip before mobilizing to MW1 + MW9

The crew will work on MW9 over the next several days. Depth to water in MW9 is 491.41 ft. bgs. 89 gallons of water has been purged at MW9 by WDC (using bailer). To meet the 10 saturated volumes required by the FOP, 35 more gallons need to be removed.

1051 Talked to Robert Lynch.
- removed 4.5 gal from MW9 starting at ~ 930 AM.
- recovered ~ 3 ft in ~ 1 hour
- will purge again when they get back to 80% recovery.

Michael Shelby 03 July 08

0810 Call Randy Hewett (Survey Control Inc.): Will meet at MWL at ~0 AM to survey MWL - MW 7, 8, + 9.

0941 Leave ERMOs, head to MWL

0958 Onsite, unlock wells for survey.

1007 Survey crew onsite, prep to run level loop from MWL - BW2 to the three new wells.

1125 Finish locating and running a level loop for elevations on 3 new MWL Wells! Lock well caps, travel to ERMOs.

APPENDIX D
Lithologic Logs

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW7	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 498.8 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 4/25/08
ELEVATION: 5378.23 FT	GWL: 4892.33 FT (FAMSL) on 5/01/08	DATE COMPLETED: 4/28/08
BOREHOLE DEPTH: 498.8 FT (FBGS)	DTW: 485.9 FT (FBGS) on 5/01/08	WELL INSTALLATION: 6/24/08
CASING DEPTH: 498.8 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 1 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW7 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
0	0-10, sand, pale yellowish brown (10YR 6/2) to grayish orange (10YR 7/4), predominantly fine to medium sand, some gravel (mostly limestone), dry		SW	
10	10-30, sand and gravel, sand as above (color and texture). Gravel mostly limestone, some granite, some metamorphics, dry		GP	
20				
30	30-60, sand, grayish orange (10YR 7/4) to dark yellowish orange, some silt, trace gravel (as above), dry to slightly damp		SW	
40				
50				
60	60-70, sand (as above at 30 FBGS), except moderate yellowish brown (10YR 5/4) and more silt, dry to slightly damp		SW	
70	70-80, sand and gravel (as above at 10 FBGS), dry		GP	
80	80-100, sand (as above at 30 FBGS), dry to slightly damp, trace gravel		SW	
90				
100	100-110, sand and gravel (as above at 70 FBGS), dry		GP	
110				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 498.8 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.83/Northing: 1452230.18

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW7	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 498.8 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 4/25/08
ELEVATION: 5378.23 FT	GWL: 4892.33 FT (FAMSL) on 5/01/08	DATE COMPLETED: 4/28/08
BOREHOLE DEPTH: 498.8 FT (FBGS)	DTW: 485.9 FT (FBGS) on 5/01/08	WELL INSTALLATION: 6/24/08
CASING DEPTH: 498.8 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 2 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW7 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
110	110-120, sand (as above at 80 FBGS), dry to damp		SW	
120	120-130, sand and gravel, pale yellowish brown (10YR 6/2), mostly coarse sand and fine pea-size gravel, dry to damp		GP	
130	130-140, sand (as above at 80 FBGS), dry to damp, more gravel		SW	
140	140-150, sand (as above at 80 FBGS), dry to damp, occasional coarse gravel (> 1-inch)		SW	
150	150-160, sand and gravel (as above at 120 FBGS), dry		GP	
160	160-170, sand (as above at 80 FBGS)		SW	
170	170-180, sand and gravel (as above at 120 FBGS), considerable pea gravel, dry to damp		GP	
180	180-190, sand (as above at 80 FBGS), dry to damp		SW	
190	190-200, sand (as above at 80 FBGS), slightly paler color, dry to damp		SW	
200	200-220, sand and gravel (as above at 120 FBGS), dry to damp		GP	Reduction in borehole diameter at 200 FBGS
210				
220				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 498.8 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.83/Northing: 1452230.18

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW7	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 498.8 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 4/25/08
ELEVATION: 5378.23 FT	GWL: 4892.33 FT (FAMSL) on 5/01/08	DATE COMPLETED: 4/28/08
BOREHOLE DEPTH: 498.8 FT (FBGS)	DTW: 485.9 FT (FBGS) on 5/01/08	WELL INSTALLATION: 6/24/08
CASING DEPTH: 498.8 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 3 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW7 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
220	220-250, sand (as above at 80 FBGS), dry to damp		SW	
250	250-260, sandy gravely silt, pale yellowish brown (10YR 6/2), silt balling up, gravel lithologies as above at 10 FBGS, damp		SM	
260	260-270, sand (as above at 80 FBGS), dry to damp		SW	
270	270-280, sand and gravel (as above at 120 FBGS), very coarse gravel (>2-inches), lithologies as above at 10 FBFS, dry to damp		GP	
280	280-320, sand (as above at 80 FBGS), dry to damp, occasional gravel at 310-320 FBGS		SW	
320	320-350, silty sand and gravel, pale yellowish brown (10YR 6/2), dry to damp, gravel to approximately 1-inch		SM	
330				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 498.8 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.83/Northing: 1452230.18

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW7	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 498.8 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 4/25/08
ELEVATION: 5378.23 FT	GWL: 4892.33 FT (FAMSL) on 5/01/08	DATE COMPLETED: 4/28/08
BOREHOLE DEPTH: 498.8 FT (FBGS)	DTW: 485.9 FT (FBGS) on 5/01/08	WELL INSTALLATION: 6/24/08
CASING DEPTH: 498.8 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 4 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW7 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
330				
340			SM	
350	350-410, sand (as above at 80 FBGS), dry to damp		SW	
360				
370				
380				
390				
400				
410	410-420, silty sand and gravel (as above at 320 FBGS), damp		SM	
420	420-430, sand and gravel, dusky yellow (5YR 6/4) to pale yellowish brown (10YR 6/2), mostly coarse sand and pea gravel. Lithology of gravel much more varied than above, includes volcanics, chert/petrified wood, quartz, dry to damp		SP	
430	430-440, sand and gravel, (as above at 420 FBGS), mostly coarse gravel (approximately 1-inch), well rounded, lithologies as above at 420 FBGS, dry to damp		SP	
440				

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 498.8 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.83/Northing: 1452230.18

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW7	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 498.8 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 4/25/08
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CASING DEPTH: 498.8 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 5 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW7 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
440	440-450, sand and gravel, (as above at 420 FBGS), with some silt balls, dry to damp		SP	
450	450-460, sand and gravel, (as above at 420 FBGS), mostly coarse sand and pea gravel, dry to damp		SP	
460	460-470, silty sand/sandy silt and gravel (as above at 320 FBGS), damp, considerable clay		SM	
470	470-480, silty sand/sandy silt, and gravel (as above at 320 FBGS), very damp		SM	
480 ▽	480-490, silty sand/sandy silt, and gravel (as above at 320 FBGS), very damp		SM	
490	490-498.8, silty sand/sandy silt, and gravel (as above at 320 FBGS), very damp, clay balls		SM	
500				
510				
520				
530				
540				
550				

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 498.8 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.83/Northing: 1452230.18

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW8	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/02/08
ELEVATION: 5379.72 FT	GWL: 4893.02 FT (FAMSL) on 5/12/08	DATE COMPLETED: 5/07/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 486.7 FT (FBGS) on 5/12/08	WELL INSTALLATION: 6/26/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Stacy Griffith	PAGE: 1 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW8 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
0	0-38, sand, grayish orange (10YR 7/4), dry, medium to fine grained sand with trace coarse gravel. Gravel is subangular, mostly limestone (medium to dark grey, some metamorphics)		SW	
40	38-55, sand and gravel, grayish orange (10YR 7/4) to light brown (5YR 6/4), coarse to medium grained gravel. Gravel coarse to medium grained, angular, mostly limestone quartzite, some granite, dry		GP	
60	55-120, sand, grayish orange (10YR 7/4), dry, medium to fine grained sand with trace medium to coarse grained gravel		SW	
110				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.77/Northing: 1452394.58

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW8	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/02/08
ELEVATION: 5379.72 FT	GWL: 4893.02 FT (FAMSL) on 5/12/08	DATE COMPLETED: 5/07/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 486.7 FT (FBGS) on 5/12/08	WELL INSTALLATION: 6/26/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Stacy Griffith	PAGE: 2 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW8 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
110			SW	
120	120-130, sand with fines. Sand fine grained, moderate yellowish brown (10 YR 5/4), some silt, moist		SM	
130	130-235, sand (10YR 6/2), fine grained with trace silt and gravel, moist		SW	
140				
150				
160				
170				
180				
190				
200				Reduction in borehole diameter at 200 FBGS
210				
220				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.77/Northing: 1452394.58

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW8	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/02/08
ELEVATION: 5379.72 FT	GWL: 4893.02 FT (FAMSL) on 5/12/08	DATE COMPLETED: 5/07/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 486.7 FT (FBGS) on 5/12/08	WELL INSTALLATION: 6/26/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Stacy Griffith	PAGE: 3 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW8 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
220				
230			SW	
240	235-265, silt, moderate yellowish brown (10YR 5/4), trace sand. Sand fine grained, moist		SM	
250				
260				
270	265-370, sand (10YR 5/4), fine grained, trace gravel, dry		SW	
280				
290				
300				
310				
320				
330				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.77/Northing: 1452394.58

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW8	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/02/08
ELEVATION: 5379.72 FT	GWL: 4893.02 FT (FAMSL) on 5/12/08	DATE COMPLETED: 5/07/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 486.7 FT (FBGS) on 5/12/08	WELL INSTALLATION: 6/26/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Stacy Griffith	PAGE: 4 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW8 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
330				
340				
350			SW	
360				
370				
380	370-386, sand and silt (10YR 5/4). Sand fine grained, moist		SM	
390	386-390, clayey sand (10YR 5/4). Sand fine grained, moist		SC	
	390-395, sand (10YR 5/4). Sand fine grained, some silt, moist		SM	
400	395-415, sand (10YR 5/4). Sand medium to fine grained, trace fine to medium grained gravel, trace silt, moist, caliche		SW	
410				
420	415-428, silt as above at 235 feet, some sand, moist		ML	
430	428-435, sand and gravel, dark yellowish brown (10YR 4/2), sand medium to coarse grained, trace fines, gravel fine to coarse grained, subangular to subrounded, varied lithologies		SP	
440	435-440, clayey sand (10YR 5/4) as above at 386 feet, moist		ML	

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.77/Northing: 1452394.58

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW8	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/02/08
ELEVATION: 5379.72 FT	GWL: 4893.02 FT (FAMSL) on 5/12/08	DATE COMPLETED: 5/07/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 486.7 FT (FBGS) on 5/12/08	WELL INSTALLATION: 6/26/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Stacy Griffith	PAGE: 5 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW8 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
440	440-518, sand and silt (10YR 4/2), sand fine grained appreciable fines, moist. Trace of clay at times		SM	
520	518-535, sand and gravel (10YR 5/4). Sand fine to coarse grained. Gravel fine to coarse grained, subangular to subrounded, varied lithologies, caliche.		SP	
540	At 535 FBGS, silt and clay		SM	
550				

▽ 490

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.77/Northing: 1452394.58

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW9	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/13/08
ELEVATION: 5376.64 FT	GWL: 4887.14 FT (FAMSL) on 5/19/08	DATE COMPLETED: 5/14/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 489.5 FT (FBGS) on 5/19/08	WELL INSTALLATION: 6/30/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 1 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW9 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
0	0-10, sand, grayish orange (10YR 7/4), moarly fine to medium sand, trace to some gravel (to 2-inches). Gravel, subangular, mostly limestone (medium to dark grey, some metamorphic, some granite		SW	
10	10-20, sand, grayish orange (10YR 7/4), to light brown (5YR 6/4), as above, less gravel, dry		SW	
20	20-30, sand (as above at 10 FBGS), up to 30% gravel (as above at 0 FBGS), dry		GP	
30	30-40, sand, (as above at 20 FBGS), considerably more silt, trace of gravel (as above at 0 FBGS), dry		SW	
40	40-50, sand and gravel, mostly coarse sand/fine (pea) gravel, subangular, gravel lithologies mostly limestone, granite, quartzite, greenstone, dry		GP	
50	50-60, sand and gravel, (as above at 40 FBGS), mostly fine gavel, lithologies as above at 40 FBGS, dry		GP	
60	60-130, sand (as above at 10 FBGS), no gravel to some gravel (as above at 0 FBGS), trace to some silt, dry to damp		SW	
70				
80				
90				
100				
110				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411405.51/Northing: 1452558.78

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW9	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/13/08
ELEVATION: 5376.64 FT	GWL: 4887.14 FT (FAMSL) on 5/19/08	DATE COMPLETED: 5/14/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 489.5 FT (FBGS) on 5/19/08	WELL INSTALLATION: 6/30/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 2 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW9 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
110				
120			SW	
130	130-140, sand and gravel (as above at 40 FBGS), mostly coarse sand, dry to damp		GP	
140	140-150, sand (as above), some coarse gravel, some silt, dry to damp		SW	
150	150-160, sand and gravel (as above at 40 FBGS), up to 40% gravel to 1-inch, damp		GP	
160	160-170, sand and gravel (as above at 40 FBGS), dry to damp		GP	
170	170-220, sand (as above), some coarse sand, no gravel to trace of fine gravel, no silt to trace silt, dry to damp		SW	Reduction in borehole diameter at 200 FBGS
180				
190				
200				
210				
220				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411405.51/Northing: 1452558.78

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW9	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/13/08
ELEVATION: 5376.64 FT	GWL: 4887.14 FT (FAMSL) on 5/19/08	DATE COMPLETED: 5/14/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 489.5 FT (FBGS) on 5/19/08	WELL INSTALLATION: 6/30/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 3 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW9 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
220	220-230, sand and gravel (as above at 40 FBGS), with some silt/fine sand, dry to damp		GP	
230	230-240, sand and gravel (as above at 40 FBGS), some silt, trace of clay, dry to damp		GM	
240	240-250, silt, grayish orange (10YR 7/4) to pale yellowish brown (10YR 6/2), some clay, some sand up to coarse sand/fine gravel, silt/clay balls, damp		SM	
250	250-260, sand and gravel (as above at 40 FBGS), some fine sand and silt, dry to damp		GP	
260	260-310, sand (as above), trace of coarse sand/fine gravel, dry to damp		SW	
270				
280				
290				
300				
310	310-330, silt (as above at 240 FBGS), some clay, some sand, damp		SM	
320				
330				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411405.51/Northing: 1452558.78

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW9	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/13/08
ELEVATION: 5376.64 FT	GWL: 4887.14 FT (FAMSL) on 5/19/08	DATE COMPLETED: 5/14/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 489.5 FT (FBGS) on 5/19/08	WELL INSTALLATION: 6/30/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 4 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW9 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
330	330-340, sand (as above), some gravel to 1-inch, some silt, dry to damp		SW	
340	340-350, sand and gravel (as above at 40 FBGS), some silt, dry to damp		GP	
350	350-370, silt (as above at 240 FBGS), some clay, some sand, trace of fine gravel, dry to damp		SM	
360				
370	370-400, sand (as above), some silt/clay, dry to damp		SW	
380				
390				
400	400-416, silt (as above at 240 FBGS), some sand, damp		SM	
410				
420	416-420, sand and gravel, dark yellowish brown (10YR 4/2), mostly medium to coarse sand, no fines, damp		SP	
	420-430, sand and gravel (as above at 416 FBGS), gravels well rounded with lithologies more varied than above, well rounded, mostly coarse sand, damp		SP	
430	430-440, sand and gravel (as above at 416 FBGS), mostly medium sand, some silt, dry to damp		SP	
440				

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411405.51/Northing: 1452558.78

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW9	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/13/08
ELEVATION: 5376.64 FT	GWL: 4887.14 FT (FAMSL) on 5/19/08	DATE COMPLETED: 5/14/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 489.5 FT (FBGS) on 5/19/08	WELL INSTALLATION: 6/30/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 5 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW9 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
440	440-460, silt (as above at 400 FBGS), considerable clay, damp		ML	
460	460-470, silt (as above at 400 FBGS), damp to wet		SM	
470	470-515, silt and sand and clay (based upon driller comments), wet to saturated, no water produced (loss of drill cuttings)		SM/SC	
490 ▽				
500	515-535, silt and gravel (as above at 420 FBGS), some clay/silt balls, gravel to 2-inches, varied lithologies, saturated but little water produced		SP	
510				
520				
530	Clay, sand, and gravel mixture at 528 FBGS			
540				
550				

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

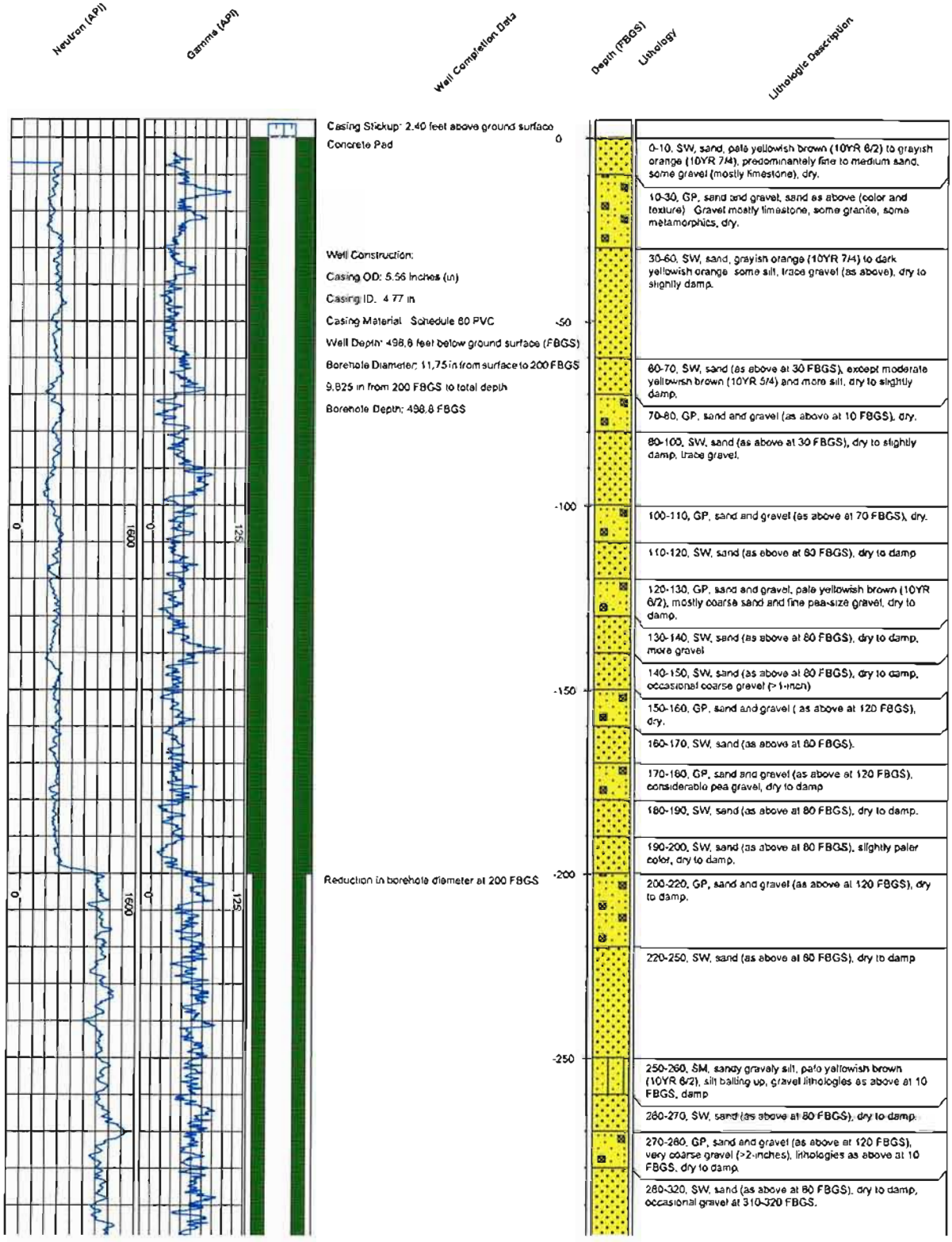
Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411405.51/Northing: 1452558.78

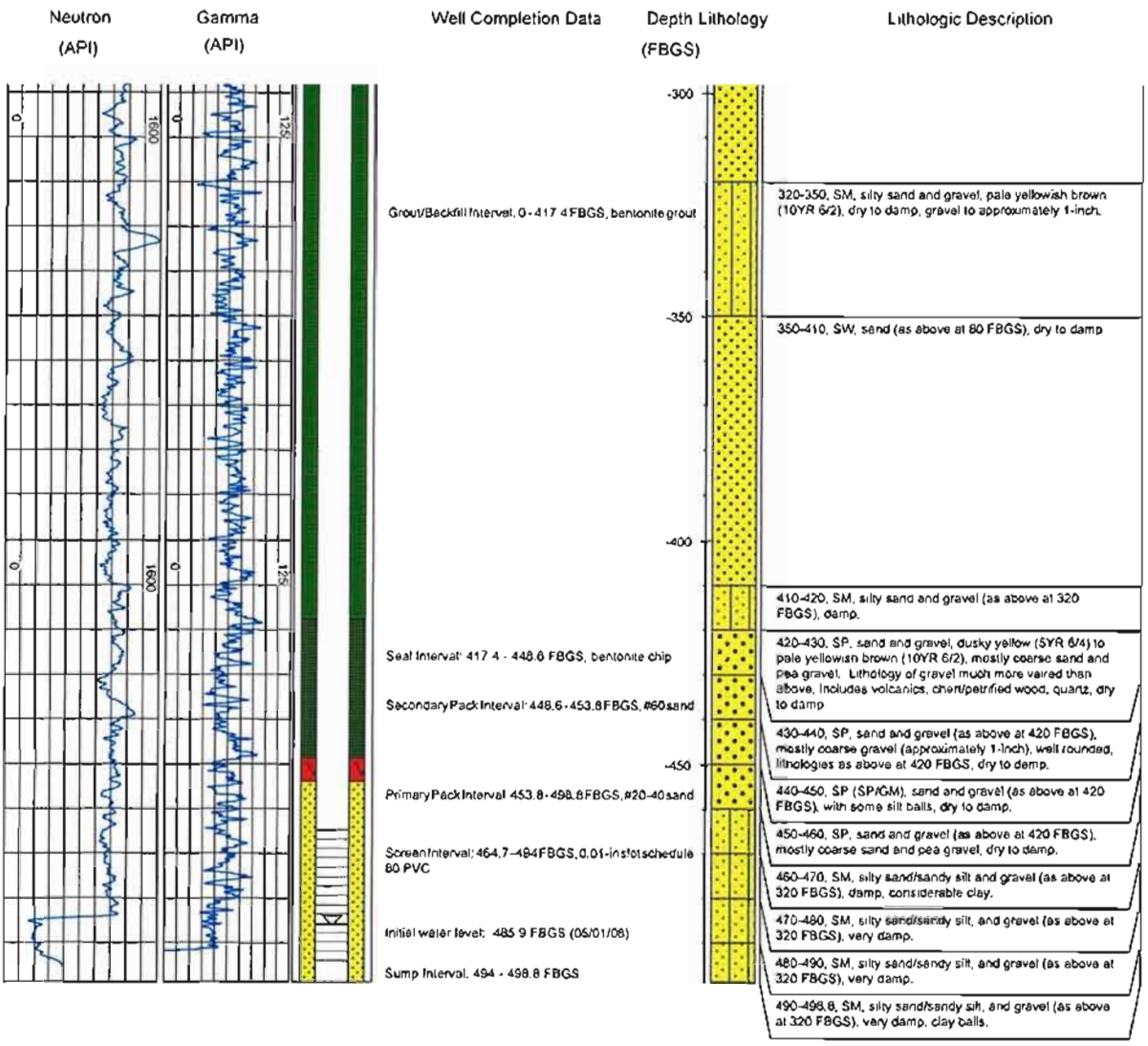
APPENDIX E
Combination Lithologic and Geophysical Logs with
Well Construction Details for MWL-MW7, MWL-MW8, and MWL-MW9

Sandia National Laboratories/New Mexico
Environmental Restoration Department
MWL-MW7

Geologist: *Mike Skelly*
Drilling Date: *April 25-28, 2008*
Well Installation Date: *June 24, 2008*

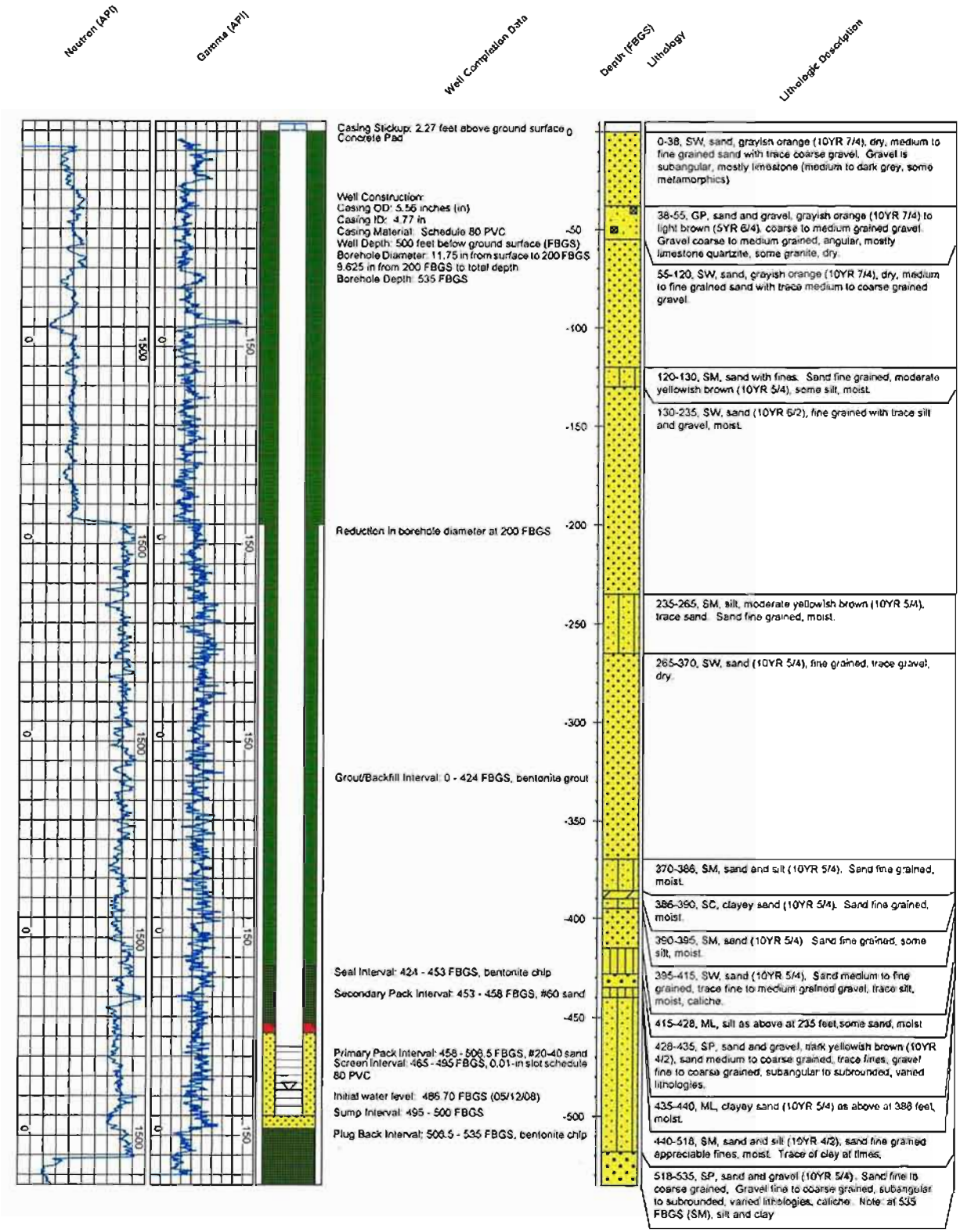


MWL-MW7


Neutron (API)
Gamma (API)
Well Completion Data
Depth Lithology (FBGS)
Lithologic Description
0
1600
0
125
Grout/Backfill Interval: 0 - 417.4 FBGS, bentonite grout
Seal Interval: 417.4 - 448.6 FBGS, bentonite chip
Secondary Pack Interval: 448.6 - 453.8 FBGS, #60 sand
Primary Pack Interval 453.8 - 498.8 FBGS, #20-40 sand
Screen Interval: 464.7 - 484 FBGS, 0.01-in slot schedule 80 PVC
Initial water level: 485.9 FBGS (05/01/06)
Sump Interval: 494 - 498.8 FBGS
-300
-350
-400
-450
320-350, SM, silty sand and gravel, pale yellowish brown (10YR 6/2), dry to damp, gravel to approximately 1-inch.
350-410, SW, sand (as above at 80 FBGS), dry to damp
410-420, SM, silty sand and gravel (as above at 320 FBGS), damp.
420-430, SP, sand and gravel, dusky yellow (5YR 6/4) to pale yellowish brown (10YR 6/2), mostly coarse sand and pea gravel. Lithology of gravel much more varied than above, includes volcanics, chert/petrified wood, quartz, dry to damp
430-440, SP, sand and gravel (as above at 420 FBGS), mostly coarse gravel (approximately 1-inch), well rounded, lithologies as above at 420 FBGS, dry to damp.
440-450, SP (SP/GM), sand and gravel (as above at 420 FBGS), with some silt balls, dry to damp.
450-460, SP, sand and gravel (as above at 420 FBGS), mostly coarse sand and pea gravel, dry to damp.
460-470, SM, silty sand/sandy silt and gravel (as above at 320 FBGS), damp, considerable clay.
470-480, SM, silty sand/sandy silt, and gravel (as above at 320 FBGS), very damp.
480-490, SM, silty sand/sandy silt, and gravel (as above at 320 FBGS), very damp.
490-498.8, SM, silty sand/sandy silt, and gravel (as above at 320 FBGS), very damp, clay balls.

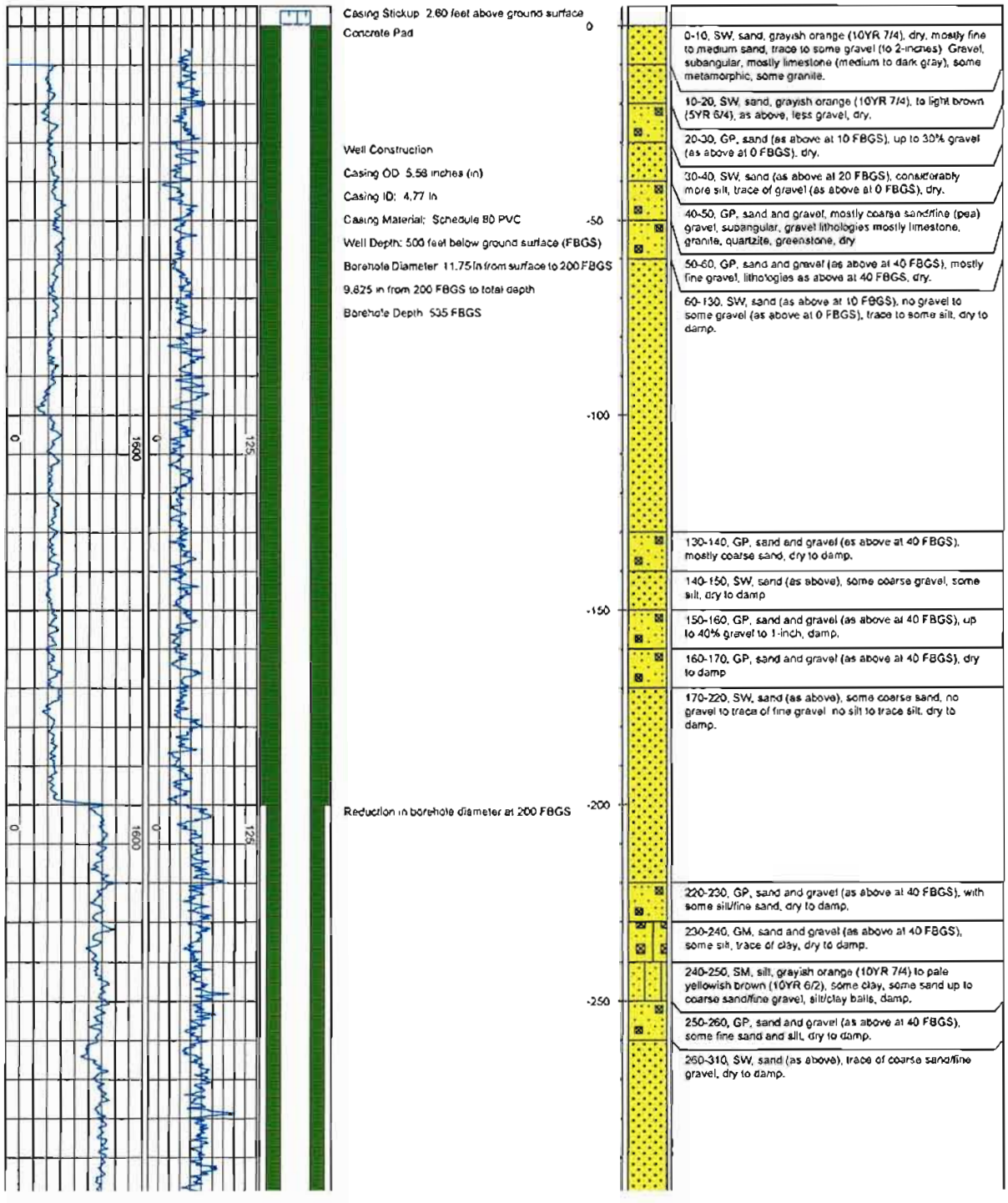
Sandia National Laboratories/New Mexico
Environmental Restoration Department
MWL-MW8

Geologist: *Stacy Griffith*
Drilling Date: *May 02-07, 2008*
Well Installation Date: ***June 26, 2008***

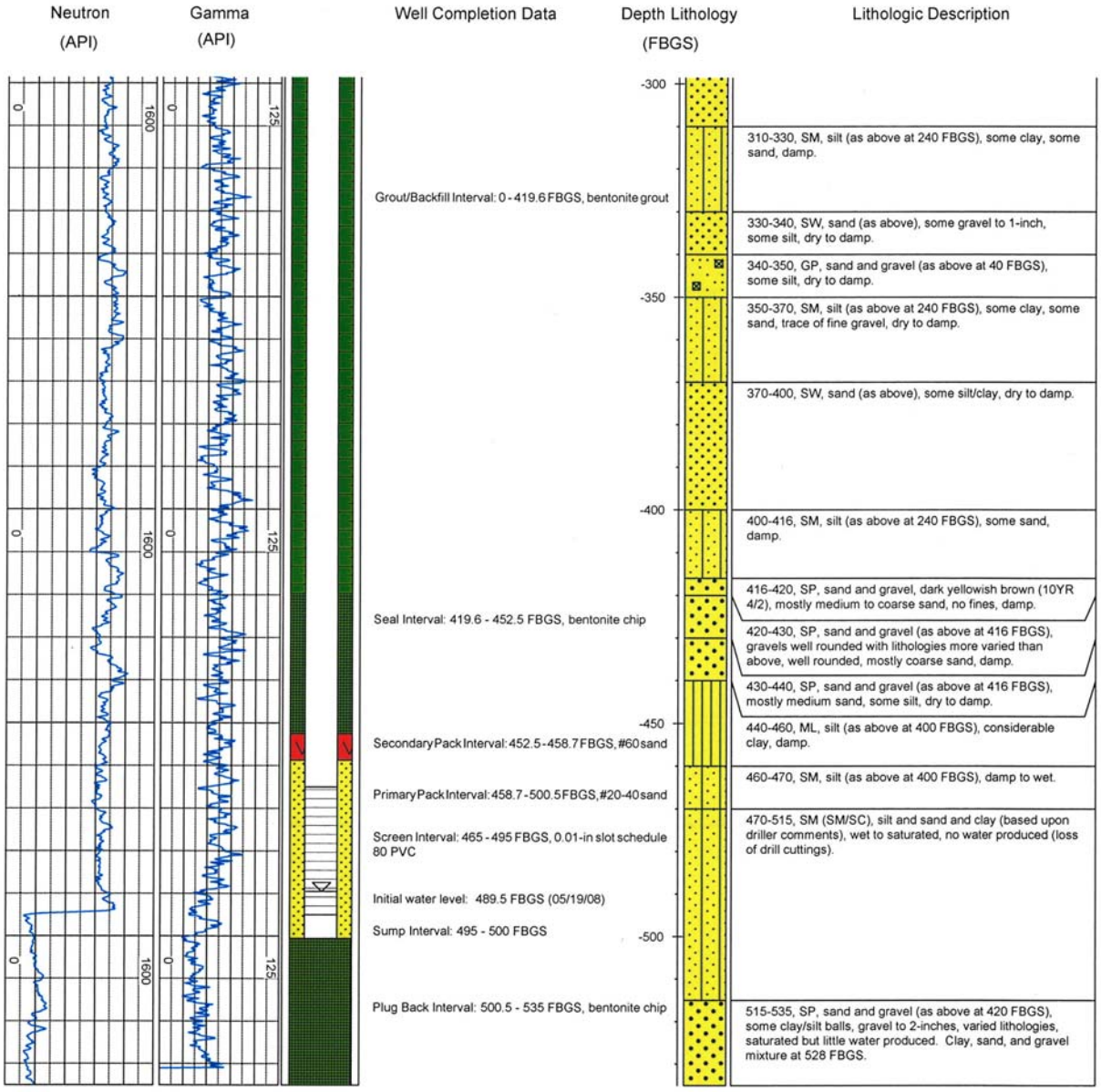


Sandia National Laboratories/New Mexico
Environmental Restoration Department
MWL-MW9

Geologist: *Mike Skelly*
Drilling Date: *May 13-14, 2008*
Well Installation Date: *June 30, 2008*



MWL-MW9


Neutron
(API)
Gamma
(API)
Well Completion Data
Depth Lithology
(FBGS)
Lithologic Description
0
1600
125
-300
-350
-400
-450
-500
Grout/Backfill Interval: 0 - 419.6 FBGS, bentonite grout
Seal Interval: 419.6 - 452.5 FBGS, bentonite chip
Secondary Pack Interval: 452.5 - 458.7 FBGS, #60 sand
Primary Pack Interval: 458.7 - 500.5 FBGS, #20-40 sand
Screen Interval: 465 - 495 FBGS, 0.01-in slot schedule 80 PVC
Initial water level: 489.5 FBGS (05/19/08)
Sump Interval: 495 - 500 FBGS
Plug Back Interval: 500.5 - 535 FBGS, bentonite chip
310-330, SM, silt (as above at 240 FBGS), some clay, some sand, damp.
330-340, SW, sand (as above), some gravel to 1-inch, some silt, dry to damp.
340-350, GP, sand and gravel (as above at 40 FBGS), some silt, dry to damp.
350-370, SM, silt (as above at 240 FBGS), some clay, some sand, trace of fine gravel, dry to damp.
370-400, SW, sand (as above), some silt/clay, dry to damp.
400-416, SM, silt (as above at 240 FBGS), some sand, damp.
416-420, SP, sand and gravel, dark yellowish brown (10YR 4/2), mostly medium to coarse sand, no fines, damp.
420-430, SP, sand and gravel (as above at 416 FBGS), gravels well rounded with lithologies more varied than above, well rounded, mostly coarse sand, damp.
430-440, SP, sand and gravel (as above at 416 FBGS), mostly medium sand, some silt, dry to damp.
440-460, ML, silt (as above at 400 FBGS), considerable clay, damp.
460-470, SM, silt (as above at 400 FBGS), damp to wet.
470-515, SM (SM/SC), silt and sand and clay (based upon driller comments), wet to saturated, no water produced (loss of drill cuttings).
515-535, SP, sand and gravel (as above at 420 FBGS), some clay/silt balls, gravel to 2-inches, varied lithologies, saturated but little water produced. Clay, sand, and gravel mixture at 528 FBGS.

APPENDIX F
Well Construction Diagrams for MWL-MW7, MWL-MW8, and MWL-MW9

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	SNL/NM TA-III
ER ADS #:	1289	**Well Completion Date:**	24-JUN-2008
Well Name:	MWL-MW7	**Completion Zone:**	ALLUVIAL FAN FACIES
Owner Name:	U S. DEPT. OF ENERGY	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	25-APR-2008	**Well Comment:**	BOREHOLE DIAMETER IS 11 3/4 IN. TO 200 FBGS AND 9 5/8 IN. FROM 200 FBGS TO 498 8 FBGS.
Drilling Contractor:	WDC EXPLORATION & WELLS		
Drilling Method:	AIR ROTARY CASING HAMMER		
Borehole Depth:	498 8 FBGS		
Casing Depth:	498.8 FBGS		

Survey Data

Survey Date: 03-JUL-2008

Surveyed By: RANDOLPH C HEWITT SURVEYING

State Plane Coordinates

(X) Easting: 411409.83

(Y) Northing: 1452230.18

Surveyed Elevations (FAMSL)

Protective Casing:	5380.95
Top of Inner Well Casing:	5380.63
Concrete Pad:	5378 29
Ground Surface:	5378 23

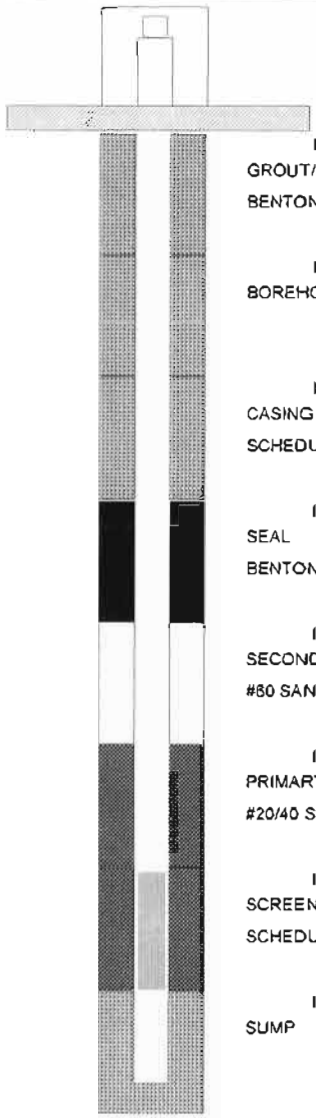
Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4892.33
Initial Depth To Water: (FBGS)	485 9

Last measured water level was 4892 1 **FAMSL**
measured on 04-AUG-2008

Date Updated: 07-AUG-2008

Date Printed: 03-SEP-2008



Completion Data Measured Depths (FBGS)

Interval	Start	Stop
GROUT/BACKFILL	0 '	417 4 '
BENTONITE GROUT		
Interval	**Start**	**Stop**
BOREHOLE	0 '	498.8 '
Interval	**Start**	**Stop**
CASING	0 '	498.8 '
SCHEDULE 80 PVC		
Interval	**Start**	**Stop**
SEAL	417 4 '	448 6 '
BENTONITE CHIPS		
Interval	**Start**	**Stop**
SECONDARY PACK	448 6 '	453.8 '
#60 SAND		
Interval	**Start**	**Stop**
PRIMARY PACK	453 8 '	498.8 '
#20/40 SAND		
Interval	**Start**	**Stop**
SCREEN	464.7 '	494 '
SCHEDULE 80 PVC		
	Slot Size	.01"
Interval	**Start**	**Stop**
SUMP	494 '	498 8 '

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	SNL/NM TA-III
ER ADS #:	1289	**Well Completion Date:**	26-JUN-2008
Well Name:	MWL-MW8	**Completion Zone:**	ALLUVIAL FAN FACIES
Owner Name:	U S. DEPT. OF ENERGY	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	02-MAY-2008	**Well Comment:**	BOREHOLE DIAMETER IS 11 3/4 IN. TO 200 FBGS AND 9 5/8 IN. FROM 200 FBGS TO 535 FBGS
Drilling Contractor:	WDC EXPLORATION & WELLS		
Drilling Method:	AIR ROTARY CASING HAMMER		
Borehole Depth:	535 FBGS		
Casing Depth:	500 FBGS		

Survey Data

Survey Date: 03-JUL-2008

Surveyed By: RANDOLPH C. HEWITT SURVEYING

State Plane Coordinates

(X) Easting: 411409.77

(Y) Northing: 1452394.58

Surveyed Elevations (FAMSL)

Protective Casing:	5382.76
Top of Inner Well Casing:	5382
Concrete Pad:	5379.93
Ground Surface:	5379.72

Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4893.02
Initial Depth To Water: (FBGS)	486.7

Last measured water level was 4891.78 **FAMSL** measured on 04-AUG-2008

Date Updated: 07-AUG-2008

Date Printed: 03-SEP-2008

Completion Data Measured Depths (FBGS)

		Start	Stop
Interval			
GROUT/BACKFILL		0'	424.2'
BENTONITE GROUT			
Interval		**Start**	**Stop**
CASING		0'	500'
SCHEDULE 80 PVC	I.D. 4.767"	O.D. 5.563"	
Interval		**Start**	**Stop**
BOREHOLE		0'	535'
Interval		**Start**	**Stop**
SEAL		424.2'	453'
BENTONITE CHIPS			
Interval		**Start**	**Stop**
SECONDARY PACK		453'	458'
#60 SAND			
Interval		**Start**	**Stop**
PRIMARY PACK		458'	506.5'
#20/40 SAND			
Interval		**Start**	**Stop**
SCREEN		465'	495'
SCHEDULE 80 PVC			
		Slot Size	.01"
Interval		**Start**	**Stop**
SUMP		495'	500'
Interval		**Start**	**Stop**
PLUG BACK		506.5'	535'
BENTONITE CHIPS			

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	SNL/NM TA-III
ER ADS #:	1289	**Well Completion Date:**	30-JUN-2008
Well Name:	MWL-MW9	**Completion Zone:**	ALLUVIAL FAN FACIES
Owner Name:	U.S DEPT. OF ENERGY	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	13-MAY-2008	**Well Comment:**	BOREHOLE DIAMETER IS 11 3/4 IN. TO 200 FBGS AND 9 5/8 IN. FROM 200 FBGS TO 535 FBGS.
Drilling Contractor:	WDC EXPLORATION & WELLS		
Drilling Method:	AIR ROTARY CASING HAMMER		
Borehole Depth:	535 FBGS		
Casing Depth:	500 FBGS		

Survey Data

Survey Date: 03-JUL-2008

Surveyed By: RANDOLPH C HEWITT SURVEYING

State Plane Coordinates

(X) Easting: 411405.51

(Y) Northing: 1452558.78

Surveyed Elevations (FAMSL)

Protective Casing:	5379.83
Top of Inner Well Casing:	5379.24
Concrete Pad:	5377.03
Ground Surface:	5376.64

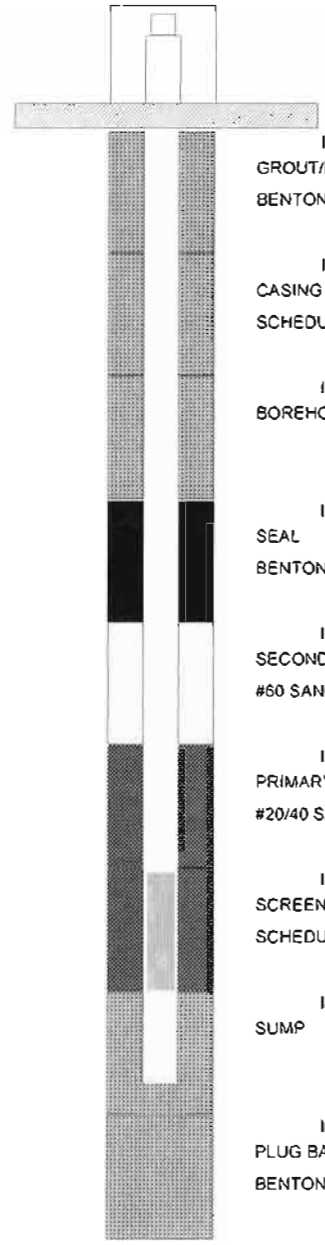
Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4887.14
Initial Depth To Water: (FBGS)	489.5

Last measured water level was 4888.23 **FAMSL**
measured on 04-AUG-2008

Date Updated: 07-AUG-2008

Date Printed: 03-SEP-2008



Completion Data Measured Depths (FBGS)

Interval	Start	Stop
GROUT/BACKFILL	0'	419.6'
BENTONITE GROUT		

Interval	Start	Stop		
CASING	0'	500'		
SCHEDULE 80 PVC	I.D. 4.767"		O.D.	5.563"

Interval	Start	Stop
BOREHOLE	0'	535'

Interval	Start	Stop
SEAL	419.6'	452.5'
BENTONITE CHIPS		

Interval	Start	Stop
SECONDARY PACK	452.5'	458.7'
#60 SAND		

Interval	Start	Stop
PRIMARY PACK	458.7'	500.5'
#20/40 SAND		

Interval	Start	Stop
SCREEN	465'	495'
SCHEDULE 80 PVC		
	Slot Size	.01"

Interval	Start	Stop
SUMP	495'	500'

Interval	Start	Stop
PLUG BACK	500.5'	535'
BENTONITE CHIPS		

APPENDIX G
Well Development Forms for MWL-MW7, MWL-MW8, and MWL-MW9

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: MWL	Project No.:
Well I.D.: MWL - MW7	Date: 27 MAY 08
Weather: Clear + Warm, hi in 80s	
Method: _____ Portable pump _____ Dedicated pump	Pump depth:

PURGE MEASUREMENTS

DO mg/L

~~DTW~~ Depth to Water (FT)	Time 24 hr	Vol. L gls	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
488.89	1020	50 mL								
	1136	5	23.02	0.559	117.6	7.28		>E3	51.0	4.37
	1141	15	21.27	0.552	118.8	7.60		>E3	64.4	5.65
	1148	25	21.20	0.554	103.2	7.77		>E3	81.6	7.59
496.6	1156	35	21.38	0.539	99.8	7.91		>E3	68.3	6.04
	1305	40	22.00	0.533	89.5	7.82		84.5	72.7	6.31
	1310	45	21.24	0.537	92.7	7.64		>E3	76.1	6.11
	1330	65	21.52	0.538	91.8	7.68		116	74.7	6.57
	1351	70	21.17	0.539	84.1	7.44		191	80.0	7.10
	1359	75	21.52	0.540	80.1	7.63		184	83.9	7.33
	1410	80	21.49	0.544	80.1	7.67		124	77.4	6.79
	1455	85	21.23	0.545	89.3	7.54		595	80.8	7.14
	1553	95	21.48	0.552	89.3	7.44		>E3	85.4	7.58
	1609	110	21.58	0.556	85.5	7.73		243	87.6	7.64

COC number(s):

Sample number(s):

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliliters
1/2" OD: 14.6 ml/ft X____ (length of tubing) = _____ milliliters

ATTACHMENT A

page 2/2

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: MWL	Project No.:
Well I.D.: MWL - MW7	Date: 27MAY08
Weather: clear & warm, 80s, slight breeze	
Method: _____ Portable pump _____ Dedicated pump	Pump depth:

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L gls	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
	1618	120	21.49	0.555	82.3	7.78		89.8	82.5	7.22
	1627	140	21.15	0.559	79.7	7.71		80.0	84.7	7.45
COC number(s):										
Sample number(s):										

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliliters
1/2" OD: 21.6 ml/ft X____ (length of tubing)) = _____ milliliters

ATTACHMENT A

Pg. 1

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: MWL-GWM	Project No.:
Well I.D.: MWL-MW7	Date: 6-24-08
Weather	
Method: X Portable pump _____ Dedicated pump	Pump depth: 493'

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L gls	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
489.90	0840	— START +								
491.40	0901	2	23.87	586	188.4	7.16		2.11	60.8	5.09
492.03	0906	4	22.66	592	184.0	7.29		2.22	54.0	4.59
492.66	0911	6	22.48	586	203.1	7.31		1.47	74.0	6.47
492.84	0917	8	22.61	595	197.3	7.36		2.14	58.8	5.05
492.82	0924	10	22.93	594	196.9	7.36		1.41	54.0	4.62
492.82	0931	12	23.19	593	203.0	7.43		1.66	89.7	7.58
493.43	0936	14	22.31	588	208.8	7.40		0.89	90.0	7.80
493.43	0937	well	DRY							
490.50	1017	— start								
492.52	1027	4	22.50	586	209.7	7.30		0.54	83.3	7.04
493.22	1032	6	22.82	586	202.1	7.36		7.36	64.1	5.50
493.45	1034	~~8~~ 7	22.96	587	199.8	7.39		6.40	62.0	5.32
493.45	1034	well	DRY							
COC number(s):										
Sample number(s):										

~4.75 gals purged from tubing 0854

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ millileters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ millileters
1/2" OD: 21.6 ml/ft X____ (length of tubing)) = _____ millileters

Pg. 2

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name:	Project No.:
Well I.D.: MW-MW1 cont.	Date: 6-24-08
Weather	
Method: _____ Portable pump _____ Dedicated pump	Pump depth: 493'

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol L gls	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
490.56	1112		START							
492.30	1121	4	23.53	592	182.5	7.31		1.69	94.7	7.82
492.85	1126	6	23.72	589	181.9	7.38		1.57	62.1	5.25
493.25	1131	8	23.92	589	179.2	7.39		6.34	59.7	5.03
493.43	1134	9.0	23.87	588	179.7	7.38		9.16	60.0	5.06
493.43	1134	well	DRY							
489.52	1258		START							
491.28	1310	4	25.85	592	130.6	7.31		0.84	71.5	5.84
491.66	1319	6	26.44	590	150.7	7.29		3.57	55.7	4.46
492.03	1326	8	26.51	590	149.3	7.36		4.25	59.6	4.78
492.30	1334	10	25.91	589	150.2	7.36		2.35	57.1	4.64
492.55	1341	12	25.84	589	147.5	7.37		1.61	57.5	4.68
492.81	1349	14	25.73	589	153.1	7.36		1.36	56.0	4.55
492.97	1356	16	25.67	589	142.2	7.36		1.02	56.3	4.58
COC number(s):										
Sample number(s):										

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliliters
1/2" OD: 2 1.6 ml/ft X____ (length of tubing)) = _____ milliliters

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

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Project Name:	Project No.:
Well I.D.: MWL-MW7 cont.	Date: 6-24-07
Weather	
Method: _____ Portable pump _____ Dedicated pump	Pump depth:

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L (gls)	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
493.05	1404	18	25.67	589	141.9	7.34		0.39	54.0	4.40
493.31	1411	20	25.47	590	145.0	7.34		0.30	53.0	4.33
493.36	1415	21	25.36	589	144.1	7.34		0.40	52.7	4.32
493.43	1419	22	25.39	590	145.3	7.34		0.33	52.0	4.26
493.43	1420	well	DRY							
COC number(s):										
Sample number(s):										

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliliters
1/2" OD: 2 1.6 ml/ft X____ (length of tubing) = _____ milliliters

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: Mixed Waste landfill	Project No.:
Well I.D.: MWL - MW8	Date: 28-May-08
Weather	
Method: _____ Portable pump _____ Dedicated pump	Pump depth:

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol L gls	Temp °C	Ec ~~µmho~~ mS/cm	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
490.40	0833	~25	20.33	0.313	4.1	7.41	–	E3	72.8	6.56
	0950	~30	21.81	0.629	-20.8	8.12	–	E3	79.2	6.92
	1335	~45	22.24	0.600	-23.9	8.01	–	E3	84.8	7.36
	1445	~50	21.48	0.584	-20.1	7.93	–	E3	75.0	6.57
	1550	~65	21.78	0.578	-12.9	7.77	–	E3	80.9	7.08
29 MAY 490.44	0804	75	20.76	0.552	11.4	7.38	–	284	83.6	7.47
	0927	85	21.67	0.563	3.7	7.56		495	77.9	6.82
	1125	90	22.47	0.563	5.4	7.76	–	32.1	90.7	6.92
	1321	100	21.75	0.561	12.2	7.42		320	88.0	7.55
	1329	110	21.81	0.557	0.9	7.81		414	93.0	8.20
	1518	120	22.20	0.563	9.0	7.50	–	340	83.6	7.21
	1625	130	21.90	0.558	16.4	7.39		545	82.7	7.20
	1629	138	21.15	0.558	0.5	7.83		949	84.5	7.27
COC number(s):										
Sample number(s):										

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliliters
1/2" OD: 21.6 ml/ft X____ (length of tubing)) = _____ milliliters

ATTACHMENT A

P. 1/3

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: MWL-GWM	Project No.:
Well I.D.: MWL-MW8	Date: 6-25-08
Weather	
Method: X Portable pump ____ Dedicated pump	Pump depth: 497'

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol L gls	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
490.60	0851		Start							
494.59	0907	2	23.57	606	267.9	7.13		0.81	33.7	2.85
495.75	0912	4	22.94	604	246.9	7.30		1.65	33.2	2.84
496.25	0915	5	22.78	611	239.7	7.34		1.97	31.5	2.71
496.86	0918	6	22.68	615	231.1	7.36		1.69	28.5	2.45
497.36	0921	7	22.71	621	225.9	7.37		1.59	26.0	2.23
497.33	0921	well	DRY							
491.90	1133		START							
494.82	1142	4	23.90	623	114.9	7.30		4.05	43.5	3.82
495.50	1144	5	23.53	615	131.2	7.32		1.86	60.0	4.51
496.06	1146	6	23.48	614	137.1	7.24		1.45	24.6	2.09
496.73	1148	7	23.41	614	137.6	7.24		6.57	23.2	1.97
497.38	1150	8	23.41	613	138.6	7.26		15.6	26.6	2.29
497.38	1150	well	DRY							
COC number(s):										
Sample number(s):										

~ 4.75 purge prior measurement. 0902

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliliters
1/2" ODI: 2 1.6 ml/ft X____ (length of tubing)) = _____ milliliters

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name:	Project No.:
Well I.D.: MWL-MW8 cont.	Date: 6-25-08 / 6-26-08
Weather	
Method: X Portable pump ____ Dedicated pump	Pump depth: 497

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol L gls	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
492.24	1348		START							
494.78	1401	4	25.69	619	120.4	7.28		14.0	65.9	5.47
495.37	1403	5	25.24	619	141.5	7.22		2.30	75.3	6.19
496.12	1406	6	25.06	618	131.6	7.24		2.24	26.2	2.15
496.60	1409	7	25.11	617	127.1	7.25		9.37	25.4	2.12
497.12	1412	8	25.18	615	123.2	7.28		19.4	30.4	2.50
497.48	1415	8.5	25.14	615	126.2	7.30		22.4	35.1	2.89
497.48	1416		DWELL	DRY	—	—	—	—	—	—
6/26 490.59	0810		START							
493.65	0823	4	21.32	610	140.2	7.42		7.25	60.7	5.41
494.12	0825	5	21.42	612	146.0	7.37		3.26	37.9	3.34
494.81	0828	6	21.74	613	149.3	7.35		2.24	25.4	2.26
495.38	0830	7	21.90	613	141.2	7.36		5.05	23.9	2.05
496.04	0833	8	21.95	613	138.7	7.37		12.1	25.0	2.20
COC number(s):										
Sample number(s):										

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliliters
1/2" OD: 2 1.6 ml/ft X____ (length of tubing)) = _____ milliliters

Pg. 3/3

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name:	Project No.:
Well I.D.: MWL-MW8 cont.	Date: 6-26-08
Weather	
Method: X Portable pump _____ Dedicated pump	Pump depth: 497

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L gls	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
496.72	0835	9	22.02	613	138.0	7.38		19.1	28.8	2.52
497.40	0837	10	22.04	613	137.7	7.38		21.4	31.8	2.78
497.40	0837	well	DRY	—	—	—	—	—	—	—
COC number(s):										
Sample number(s):										

33.5 total

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliileters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliileters
1/2" ODl: 2 1.6 ml/ft X____ (length of tubing)) = _____ milliileters

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: Mixed Waste Landfill	Project No.:
Well I.D.: MW-9	Date: 28-May 08
Weather	
Method: _____ Portable pump _____ Dedicated pump	Pump depth:

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol L gls	Temp °C	Ec ~~umho~~ mS/cm	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
	1215	12	21.62	0.545	-16.4	8.02	—	E3	58.2	7.75
	1305 @ 1527		21.54	0.540	-14.3	7.74	—	E3	76.7	6.75
	1605 @ 1542		21.68	0.534	-17.7	7.87	—	E3	82.9	7.25
49088	0736	51	20.68	0.526	-0.8	7.47	—	~~239~~ E3 @	88.6	7.91
	0947	55	21.45	0.527	1.8	7.65	—	E3	88.0	7.75
	1112	60	21.75	0.528	10.2	7.51	—	380	84.8	7.41
	1349	70	21.87	0.530	11.3	7.55	—	114	85.0	7.31
	@ 1459	80	22.14	0.532	9.3	7.47	—	38.8	87.1	7.52
	1653	89	22.29	0.527	3.2	7.76		51.9	82.9	7.12

COC number(s):

Sample number(s):

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliliters
1/2" OD: 21.6 ml/ft X____ (length of tubing)) = _____ milliliters

P. 1/3

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: MWL- DEV.	Project No.:
Well I.D.: MWL-MW9	Date: 6-26-08
Weather	
Method: X Portable pump _____ Dedicated pump	Pump depth: 497'

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L (gls)	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
491.41	0928		START							
495.54	0946	1	26.82	579	320.0	6.63		.11	29.5	2.36
496.09	0949	2	26.12	571	286.6	6.96		0.93	28.1	2.24
496.81	0952	3	25.33	562	260.4	7.17		1.44	33.7	2.73
497.21	0954	3.5	24.98	558	247.1	7.27		1.26	35.5	2.92
497.51	0955	4	24.74	559	243.0	7.29		1.33	36.6	3.04
497.71	0957	4.5	24.54	557	238.8	7.32		1.81	36.7	3.06
497.71	0957	well	DRY							
491.71	1252		START							
495.61	1301	4	25.22	576	137.4	7.20		6.78	104.0	8.96
496.33	1303	5	24.69	580	156.0	7.17		1.87	65.9	5.14
497.14	1305	6	24.56	579	154.6	7.17		2.09	37.2	3.09
497.74	1307	7	24.39	579	151.5	7.18		2.57	32.3	2.70
497.74	1307	well	DRY							
COC number(s):										
Sample number(s):										

492.67

~4.75 gals purged from tubing 0943

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliliters
1/2" ODl: 2 1.6 ml/ft X____ (length of tubing)) = _____ milliliters

ATTACHMENT A

P. 2/3

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: MWL- DEV.	Project No.:
Well I.D.: MWL-MW9 cont.	Date: 6-27-08
Weather	
Method: X Portable pump ____ Dedicated pump	Pump depth: 497

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L (gls)	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
498.40	0819		START							
495.22	0828	4	19.95	574	163.3	7.35		10.9	78.6	7.49
495.95	0831	5	20.35	577	171.2	7.30		1.28	56.3	5.08
496.60	0834	6	20.80	578	169.8	7.30		0.90	30.0	2.77
497.32	0837	7	20.95	578	167.8	7.31		0.87	29.6	2.92
497.78	0840	8	21.07	578	165.8	7.32		1.09	27.1	2.44
497.78	0840	well	DRY							
491.51	1250		start							
495.08	1300	4	22.52	575	141.3	7.31		8.07	92.6	8.21
495.83	1303	5	22.31	578	156.3	7.28		1.74	75.6	6.20
496.54	1305	6	22.38	578	156.7	7.26		2.58	44.6	3.86
497.37	1308	7	22.42	578	156.9	7.27		2.26	38.2	3.31
497.70	1310	8	22.47	578	154.9	7.28		2.25	38.6	3.34
497.70	1310	well	DRY							
COC number(s):										
Sample number(s):										

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliliters
1/2" OD: 21.6 ml/ft X____ (length of tubing) = _____ milliliters

Pg. 3/3

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: MWL- DEV.	Project No.:
Well I.D.: MWL-MW9 cont.	Date: 6-3008
Weather	
Method: X Portable pump _____ Dedicated pump	Pump depth: 497

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L (gls)	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
491.61	0814		START							
495.56	0823	4	19.88	575	145.4	7.41		5.75	75.9	6.91
496.31	0825	5	20.34	575	149.7	7.34		0.91	42.7	3.85
497.08	0827	6	20.74	569	147.4	7.33		1.02	24.1	2.15
497.79	0829	7	20.94	559	146.6	7.34		1.07	33.8	3.01
497.79	0829		well	DRY						
491.67	1245		START							
495.10	1258	4	23.84	565	120.2	7.35		6.25	78.1	6.84
495.94	1300	5	23.20	578	142.7	7.25		2.30	80.4	6.41
496.46	1303	6	23.13	578	140.0	7.25		1.14	39.2	3.35
497.26	1306	7	22.98	579	137.9	7.26		1.30	31.4	2.69
497.82	1309	8	22.86	577	137.5	7.29		1.93	33.0	2.81
497.82	1309		well	DRY						

COC number(s):

Sample number(s):

Purge Volume Calculations

42.5 gal total purged

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliileters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliileters
1/2" ODl: 2 1.6 ml/ft X____ (length of tubing)) = _____ milliileters

Volume VIII

TAB 17

Responses to NOD: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2

From: SNL/Davis
To: NMED/Bearzi

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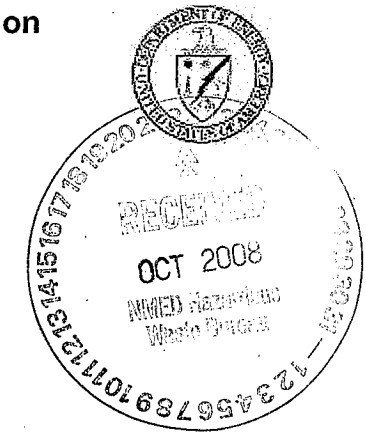
ENTERED

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400



OCT 0 3 2008

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. James Bearzi,
Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Bldg. 1
Santa Fe, New Mexico 87505

Dear Mr. Bearzi:

On behalf of Sandia Corporation (Sandia) and the Department of Energy (DOE), DOE is submitting the DOE/Sandia Responses to The New Mexico Environment Department's (NMED) "Notice of Disapproval: Summary Report for the Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation – Decommissioning of Groundwater Monitoring Well MWL-BW1 Installation of Groundwater Monitoring Well MWL-BW2, April, 2008 Sandia National Laboratories, EPA ID# NM5890110518 HWB-SNL-08-015" August 25, 2008

If you have any questions regarding this submission, please contact me at (505) 845-4392, or John Gould of my staff at (505) 845-6089.

Sincerely,

Kimberly A. Davis
Acting Manager

cc w/enclosure:
W. Moats, NMED (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB
B. Birch, NMED-OB
ES&H Records Center, SNL/NM, Org. 6765, MS 1089
Zimmerman Library, UNM

cc w/o enclosure:

A. Blumberg, SNL/NM, Org. 11100, MS 0141
D. Miller, SNL/NM, Org 6765, MS 0718
J. Cochran, SNL/NM, Org 6765, MS 0719
M. Sanders, SNL/NM, Org. 6765, MS 1089
S. Griffith, SNL/NM, Org. 6765, MS 1089
M. Skelly, SNL/NM, Org. 6765, MS 1089
B. Langkopf, SNL/NM, Org. 6765, MS 1089
Records Center, SNL/NM, Org.6765, MS 1089
J. Estrada, SSO, MS 0184
T. Longo, HQ/GTN, NA-56

AOP 95-45, 06

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: DOE/Sandia Responses to NMED "Notice of Disapproval: Summary Report for the Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation – Decommissioning of Groundwater Monitoring Well MWL-BW1 Installation of Groundwater Monitoring Well MWL-BW2, April, 2008 Sandia National Laboratories, EPA ID# NM5890110518 HWB-SNL-08-015 " August 25, 2008

Document author: Stacy Griffith, Department 06765

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: Francis B. Nimick 9/25/08
Date

Francis B. Nimick
Deputy to the
Nuclear Energy and Global Security Technologies
Center 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: Kimberly Davis 10/3/08
Date

Kimberly Davis
Acting Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Sandia Corporation
Albuquerque, New Mexico
October 20, 2008

DOE/Sandia Responses to NMED "Notice of Disapproval: Summary Report for the Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation – Decommissioning of Groundwater Monitoring Well MWL-BW1 Installation of Groundwater Monitoring Well MWL-BW2, April, 2008 Sandia National Laboratories, EPA ID# NM5890110518 HWB-SNL-08-015 " August 25, 2008

INTRODUCTION

This document responds to comments received in a letter from the New Mexico Environment Department (NMED) to the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia) dated August 25, 2008 regarding the Mixed Waste Landfill (MWL) at Sandia National Laboratories (SNL). The letter is entitled "Notice of Disapproval: Summary Report for the Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation – Decommissioning of Groundwater Monitoring Well MWL-BW1 Installation of Groundwater Monitoring Well MWL-BW2, April, 2008 Sandia National Laboratories" [EPA ID NM5890110518, HWB-SNL-08-015].

This document lists each NMED comment, and the DOE/Sandia response to that comment. The NMED comment is listed in boldface, followed by the DOE/Sandia response, written in normal font under "Response".

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.

Comment 1: Section 2.4, Initial Ground Level and Well Construction, 4th paragraph states "A 30-ft volclay coarse chip plug was placed from 426 to 456 bgs. The first 18 ft of chips were hydrated and allowed to set overnight. The next day, chips were added to 426 ft bgs, hydrated, and allowed to set for approximately 2 hours." Apparently based on this information two separate lifts were placed, followed by hydration of the chips. However, the work plan calls for 5-ft lifts with hydration done between each lift, or placing 6 separate lifts. Clarify how many lifts were emplaced.

Also, associated with the above paragraph, the response of the SNL to item 8 in NMED's Notice of Deficiency dated June, 2007, includes "also, please note that the first sentence of the fourth paragraph in Section 5.2.2 of the plan has been changed from "A 30-ft thick layer of ¼-inch bentonite pellets or 3/8-inch bentonite chips will be placed above the filter pack..." to read "A 10-ft thick layer of ¼-inch bentonite pellets or 3/8-inch bentonite chips...". This change was made based on the consultations with experienced well drillers who pointed out that a 30-ft thick layer of bentonite pellets/chips would be difficult to confidently install inside drive casing." Clarify why SNL chose to stay with the 30-ft layer after requesting and getting approval for a 10-ft layer.

Response 1: As stated in the report, there was 18 feet of bentonite plug material that was placed in the borehole and then hydrated and allowed to set overnight. The next morning, another 12 feet of bentonite plug material was placed in the borehole, hydrated, and allowed to set for 2 hours. This would constitute 2 lifts of bentonite plug material for the 30-ft plug.

Following further discussion with the drilling contractor during the bentonite plug placement, DOE/Sandia made the decision to place a 30-feet plug and hydrate as stated in the report. Apparently, the earlier discussion was with a different drilling contractor. The contractor that installed MWL-BW2 (WDC Wells and Exploration) preferred to place a 30 foot plug to ensure a solid plug to hold the weight of the grout. DOE/Sandia will consider all such modifications to approved well construction details that are made during well installation to be variances and these will be listed as such in future reports.

Comment 2: The work plan calls for use of centralizers and has spacing specifications. Discuss the installation of centralizers and their spacing.

Response 2: A discussion of the placement of centralizers was inadvertently omitted from the summary report. PVC centralizers were placed below and above the screen section and then every 100 feet to the surface.

Comment 3: The work plan, Section 5.2.3, Well Development, states "representative water is assumed to be obtained when pH, temperature, turbidity, and specific conductivity readings stabilize (less than 10% variability over three consecutive well bore volumes) and the water is visually clear of suspended solids with a target turbidity of less than five Nephelometric Turbidity Units (NTUs)". The field data

submitted in the report shows that these conditions were met except for turbidity, which did not stabilized to within 10% variability. However, NMED does accept that the well was adequately developed and that the representative groundwater samples can be obtained. However, rewording of the above criteria should be considered in any future work plans to avoid confusion as to what situations are applicable for the two different criteria for turbidity.

Response 3: The turbidity measurements over the last 150 gallons (3.5 bore volumes) were within the target turbidity of less than five NTUs, but the last three measurements of 2.94, 2.89, and 3.39 where not within 10% variability. The other parameters of pH, temperature, and specific conductivity were within 10% variability. Specifically, the DOE/Sandia Field Operating Procedure (FOP) 94-41 "Well development" states:

> After the minimum well bore volumes have been removed, development should continue until representative water is obtained. Representative water is water that is free of drilling fluids, cuttings, or other materials introduced during well construction. Representative water is assumed to have been obtained when pH, temperature, turbidity, and specific conductivity readings stabilize (less than 10 % variability over 3 consecutive well bore volumes) and the water is visually clear of suspended solids. In addition to this criterion, it is generally agreed that the well should also be developed until the turbidity is less than five (5) NTUs. This limit is derived from water quality standards contained in the Environmental Protection Agency's (EPA) Safe Drinking Water Act (SDWA). Although monitoring wells are rarely used for purposes other than sampling and testing, the optimum sampling results appear to be obtained when the turbidity limit set forth in the SDWA is achieved.

DOE/Sandia will revise FOP 94-41 and set the primary goal for turbidity to be less than 5 NTUs, as recommended by the EPA. The primary goal for turbidity will be defined in future work plans and any deviation from that in the development activities will be considered a variance.

Comment 4: Section 5.0 Variances, states "there were no instances of variance from either Plan or the FOPS/AOPs during these activities". However, NMED notes at least two instances of variance. One state in Section 2.4, Initial Groundwater Level and Well Construction, 4th paragraph, where the use of #60 sand instead of #40-60 sand is acceptable for the reason stated, but such a change is a variance from the plan. Another example is that the plan calls for cutting off the casing at approximately 5 ft bgs. As discussed in Section 3.0, Plug and Abandonment, 2nd paragraph in the report, the casing was cut off at about 14 inches above ground. Again, this is acceptable for the reason stated, but it is still a variance. There may be other variances depending upon the answers to the above items. List and discuss each variance.

Reponses 4: DOE/Sandia did not consider the use of #60 sand to be a variance from the stated use of the sand mixture containing #40 and #60 sand. DOE/Sandia will consider

this a variance in any future work.

During the P&A of MWL-BW1 it was not possible to cut the well casing off 5 feet bgs, as was stated in the work plan. A 20-foot length of conductor casing left in place during the mud-rotary installation was firmly cemented in place with the well casing, preventing access to cut the well casing.

DOE/Sandia will consider these occurrences and all future deviations in P&A and installation activities of groundwater monitoring wells from the stated work plan as a variance.

Comment 5: Much of the Combination Lithologic and Geophysical Logs with Well Construction Details for the MWL-BW2 submitted in Attachment C is difficult to read, submit a readable version. Also, submit an electronic version of the geophysical log data, preferably in depth/value spreadsheet format.

Response 5: The lithologic log has been prepared in a different format and is provided as Attachment A. An electronic version of the geophysical data has been provided to the NMED under separate cover.

ATTACHMENT A
LITHOLOGIC LOG

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-BW2	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 502.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 1/14/08
ELEVATION: 5386.00 FT	GWL: 4915.85 FT (FAMSL) on 1/18/08	DATE COMPLETED: 1/15/08
BOREHOLE DEPTH: 519.0 FT (FBGS)	DTW: 472.5 FT (FBGS) on 1/18/08	WELL INSTALLATION: 1/22/08
CASING DEPTH: 502.0 FT (FBGS)	ENGINEER/GEOLOGIST: Stacy Griffith	PAGE: 1 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-BW2 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
0	0-80, light brown (5YR 6/4), unconsolidated, dry, fine to medium grained sand, some gravel. Gravel is subangular fine to medium grained. Various composition		GM	
80	80-100, silty sand, light brown (5YR 6/4), unconsolidated, dry, fine grained sand, trace medium grained gravel		SM	
100	100-120, no sample collected, cuttings as above		SM	
110				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 300 FBGS and 9.625 in. from 300 FBGS to 519.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411947.89/Northing: 1452389.85

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-BW2	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 502.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 1/14/08
ELEVATION: 5386.00 FT	GWL: 4915.85 FT (FAMSL) on 1/18/08	DATE COMPLETED: 1/15/08
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CASING DEPTH: 502.0 FT (FBGS)	ENGINEER/GEOLOGIST: Stacy Griffith	PAGE: 2 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-BW2 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
110				
			SM	
120	120-155, silty sand, light brown (5YR 6/4), unconsolidated, dry, fine grained sand, trace medium grained gravel			
130				
140			SM	
150				
160	155-180, sand and gravel, light brown (5YR 6/4), unconsolidated, dry, fine to medium grained sand and gravel. Gravel subangular, fine to medium grained. Various composition		GM	
170				
180	180-200, sand and gravel, light brown (5YR 6/4), unconsolidated, dry, fine to medium grained sand and gravel. Gravel fine to coarse grained			
190			GM	
200	200-220, no sample collected, cuttings as above			
210			GM	
220				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 300 FBGS and 9.625 in. from 300 FBGS to 519.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411947.89/Northing: 1452389.85

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-BW2	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
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BOREHOLE DEPTH: 519.0 FT (FBGS)	DTW: 472.5 FT (FBGS) on 1/18/08	WELL INSTALLATION: 1/22/08
CASING DEPTH: 502.0 FT (FBGS)	ENGINEER/GEOLOGIST: Stacy Griffith	PAGE: 3 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-BW2 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
220	220-260, sand and gravel, light brown (5YR 6/4), unconsolidated, dry, fine to medium grained sand and gravel. Gravel medium to coarse grained		GM	
260	260-285, no sample collected, cuttings as above		GM	
290	285-420, silty sand, light brown (5YR 6/4), unconsolidated, moist silt and fine grained sand. Slight plasticity. Trace gravel		SM	Reduction in borehole diameter at 300 FBGS
330				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 300 FBGS and 9.625 in. from 300 FBGS to 519.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411947.89/Northing: 1452389.85

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-BW2	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 502.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 1/14/08
ELEVATION: 5386.00 FT	GWL: 4915.85 FT (FAMSL) on 1/18/08	DATE COMPLETED: 1/15/08
BOREHOLE DEPTH: 519.0 FT (FBGS)	DTW: 472.5 FT (FBGS) on 1/18/08	WELL INSTALLATION: 1/22/08
CASING DEPTH: 502.0 FT (FBGS)	ENGINEER/GEOLOGIST: Stacy Griffith	PAGE: 4 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-BW2 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
330				
340				
350				
360				
370			SM	
380				
390				
400				
410				
420	420-435, clayey silts, light brown (5YR 6/4), clay, silt and fine grained sand. Medium stiff		ML	
430				
440	435-460, sand and gravel, light brown (5YR 6/4), unconsolidated, dry, medium grained sand and gravel. Gravel medium to coarse grained		SP	

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 300 FBGS and 9.625 in. from 300 FBGS to 519.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411947.89/Northing: 1452389.85

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-BW2	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 502.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 1/14/08
ELEVATION: 5386.00 FT	GWL: 4915.85 FT (FAMSL) on 1/18/08	DATE COMPLETED: 1/15/08
BOREHOLE DEPTH: 519.0 FT (FBGS)	DTW: 472.5 FT (FBGS) on 1/18/08	WELL INSTALLATION: 1/22/08
CASING DEPTH: 502.0 FT (FBGS)	ENGINEER/GEOLOGIST: Stacy Griffith	PAGE: 5 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-BW2 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
440				
450			SP	
460	460-470, sand and gravel, light brown (5YR 6/4), unconsolidated, dry, fine to coarse grained sand and gravel		SW	
470 ▽	470-472, sand and gravel, light brown (5YR 6/4), unconsolidated, dry, fine to coarse grained sand and gravel. Trace silt and clay		SW	
480	472-519, Cuttings return poor below water level. According to geophysical log, formation consists of saturated, interbedded sands with silts and clay		SM/ML	
490				
500				
510				
520				
530				
540				
550				

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 300 FBGS and 9.625 in. from 300 FBGS to 519.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411947.89/Northing: 1452389.85

Volume VIII

TAB 18

Notice of Approval: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Well MWL-BW1 and Installation of Well MWL-BW2

From: NMED/Bearzi
To: SNL/Wagner

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NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

October 31, 2008

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Securities Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: NOTICE OF APPROVAL: SUMMARY REPORT FOR THE MIXED WASTE LANDFILL MONITORING WELL PLUG AND ABANDONMENT AND INSTALLATION – DECOMMISSIONING OF GROUNDWATER MONITORING WELL MWL-BW1, INSTALLATION OF GROUNDWATER MONITORING WELL MWL-BW2, APRIL, 2008
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-08-015

Dear Ms. Wagner and Mr. Nimick:

The New Mexico Environment Department (NMED) has reviewed your responses dated October 20, 2008 (with transmittal letter dated October 3, 2008) concerning the Notice of Disapproval issued by the NMED for the subject report on August 25, 2008. The responses are acceptable; the subject report is hereby approved.

If you have any questions regarding this matter, please contact Mr. Sid Brandwein of my staff at (505) 222-9504.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
J. Cochran, SNL, MS 0719
J. Gould, DOE, MS 0184
File: SNL 2008 and Reading
SNL-08-015

Volume VIII

TAB 19

Notice of Approval: Summary Report for Mixed Waste Landfill Monitoring Well Plug and Abandonment and Installation; Decommissioning of Wells MWL-MW1, MWL-MW2, MWL-MW3, Installation of Wells MWL-MW7, MWL-MW8, MWL-MW9

From: NMED/Bearzi
To: SNL/Davis

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NEW MEXICO ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

January 15, 2009

Kimberly Davis
Acting Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Francis B. Nimick
Deputy Director
Nuclear Energy & Global Securities Technologies
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185

RE: NOTICE OF APPROVAL: SUMMARY REPORT FOR MIXED WASTE LANDFILL MONITORING WELL PLUG AND ABANDONMENT AND INSTALLATION -- DECOMMISSIONING OF GROUNDWATER MONITORING WELLS MWL-MW1, MWL-MW2, AND MWL-MW3 INSTALLATION OF GROUNDWATER MONITORING WELLS MWL-MW7, MWL-MW8, AND MWL-MW9, SEPTEMBER, 2008 SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518 HWB-SNL-08-020

Dear Ms. Davis and Mr. Nimick:

The New Mexico Environment Department (NMED) has reviewed the subject report included in your transmittal letter dated September 23, 2008. The subject report is hereby approved.

If you have any questions regarding this matter, please contact Mr. Sid Brandwein of my staff at (505) 222-9504.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
J. Cochran, SNL, MS 0719
J. Gould, DOE, MS 0184
File: SNL 2009 and Reading
SNL-08-020

Volume VIII

Groundwater Studies

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Volume VIII

TAB 20

Toluene Detections in Groundwater Samples from
Mixed Waste Landfill

From: NMED/Bearzi
To: SNL/Wagner

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NEW MEXICO ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
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Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

SARAH COTTRELL
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

April 30, 2010

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Dr. Marianne C. Walck
Director
Nuclear Energy & Global Security Technologies
Sandia Corporation
P.O. Box 5800, MS 0701
Albuquerque, NM 87185-0701

RE: TOLUENE DETECTIONS IN GROUNDWATER
SANDIA NATIONAL LABORATORIES MIXED WASTE LANDFILL
EPA ID# NM5890110518, HWB-SNL-MISC

Dear Ms. Wagner and Dr. Walck:

The New Mexico Environment Department (NMED) has recently obtained laboratory analytical results for groundwater samples collected by the NMED's Department of Energy (DOE) Oversight Bureau from wells located at the Mixed Waste Landfill (MWL) at Sandia National Laboratories (attached). These results indicate that toluene has been detected in groundwater samples from all four of the most recently installed wells at the MWL, including the new background well. Toluene concentrations in the groundwater samples range from 0.37 to 0.97 µg/L, well below the U. S. Environmental Protection Agency Maximum Concentration Level for toluene (1,000 µg/L) and the human health standard set forth by the New Mexico Water Quality Control Commission (750 µg/L). Nevertheless, the NMED expects the U S. Department of Energy and Sandia Corporation (collectively, the Permittees) to determine the source of toluene. Potential sources include equipment or materials used to drill or construct the new wells, analytical laboratory contamination, or the MWL itself.

Pursuant to Section VI.A of the Sandia National Laboratories Compliance Order on Consent (April 29, 2004), the NMED is notifying the Permittees that further investigation is needed to determine the source of the toluene in groundwater at the MWL. The Permittees are directed to conduct a purging/sampling study of the groundwater and any other necessary studies of

groundwater or other media (including evaluation of blanks and potential analytical laboratory contamination) to determine the source of the toluene in the groundwater at the MWL. The Permittees must report the analytical results, the results of quality control samples, and the results of the study to the NMED no later than July 31, 2010.

If you have any questions regarding this matter, please contact Mr. William Moats of my staff at (505) 222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

BRZ:wpm

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE OB
L. King, EPA Region 6 (6PD-N)
J. Gould, DOE/NNSA, MS 0184
J. Cochran, SNL, MS 0719
File: Reading and SNL 2010

Volume VIII

TAB 21

Extension Request for the Toluene Investigation Report
Required for the Mixed Waste Landfill

From: SNL/Wagner
To: NMED/Bearzi

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National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

ENTERED

MAY 21 2010

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

MAY 2010

James Berazi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Bldg. 1
Santa Fe, NM 87505

Subject: Extension Request for the Toluene Investigation Report Required for the Mixed Waste Landfill (MWL)

Dear Mr. Bearzi:

On behalf of the Department of Energy/National Nuclear Security Administration (DOE/NNSA) and Sandia Corporation (Sandia), DOE/NNSA is requesting a 30-day extension for the Toluene Investigation Report that is required for the MWL as specified in your letter dated April 30, 2010. The reason for the 30-day extension request is that additional time is necessary for DOE/NNSA and Sandia to receive, validate and evaluate the new analytical data associated with the MWL purging study and the quarterly groundwater sampling conducted in late April 2010.

This investigation is a top priority for the Sandia Environmental Restoration Project and significant progress has already been accomplished. A 30-day extension will allow for all of the recently completed groundwater sampling results to be included, which are an important component of the overall investigation.

Should you have any question regarding this correspondence, please feel free to contact me at (505) 845-6036 or John Gould of my staff at (505) 845-6089.

Sincerely,

FOR

Patty Wagner
Manager

cc:
W. Moats, NMED (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB
B. Birch, NMED-OB
A. Blumberg, SNL/NM, Org. 11100, MS-0141
M. Walck, SNL/NM, Org. 6700, MS-0701
D. Miller, SNL/NM, Org. 6765, MS-0718
J. Cochran, SNL/NM, Org. 6765, MS-0719
S. Saltzstein, SNL/NM, Org.6702, MS-0701
B. Langkopf, SNL/NM, Org. 6765, MS-0718
C. Daniel, SNL/NM, Org. 6765, MS-0718
Records Center, SNL/NM, Org.6765, MS-0718
Zimmerman Library, UNM
J. Estrada, SSO
J. Gould, SSO

AOP 95-45, 06

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Mixed Waste Landfill Toluene Investigation Report 30-Day Extension Request Letter**

Document author: **Mike Mitchell, Department 06765**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: Marianne C Walck 5/18/2010

Marianne Walck, Director Date
Nuclear Energy & Global Security Technologies
Center 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: Patty Wagner 5/21/10

Ms. Patty Wagner, Manager Date
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Volume VIII

TAB 22

Approval of Extension Request for Toluene Investigation Report
Mixed Waste Landfill, May 21, 2010

From: NMED/Bearzi
To: SNL/Wagner

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NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

SARAH COTTRELL
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

June 4, 2010

Patty Wagner
Manager
Sandia Site Office/NNSA
U.S. Department of Energy
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Dr. Marianne C. Walck
Director
Nuclear Energy & Global Security Technologies
Sandia Corporation
P.O. Box 5800, MS 0701
Albuquerque, NM 87185-0701

RE: EXTENSION REQUEST FOR TOLUENE INVESTIGATION REPORT, MIXED WASTE LANDFILL, MAY 21, 2010
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518

Dear Ms. Wagner and Dr. Walck:

The New Mexico Environment Department (NMED) has received the U. S. Department of Energy's May 21, 2010, request on behalf of itself and Sandia Corporation (collectively the Permittees) for a 30-day extension to submit the subject investigation report pertaining to the detection of toluene in groundwater samples from wells located at the Sandia National Laboratories Mixed Waste Landfill (MWL). The reason for the request is to allow additional time for analytical data to be received from the laboratory. The original due date for the report is July 31, 2010.

The NMED hereby grants the extension; the new due date for the Toluene Investigation Report is August 30, 2010.

If you have any questions regarding this matter, please contact Mr. William Moats of my staff at (505) 222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE OB
L. King, EPA Region 6 (6PD-N)
J. Gould, DOE/NNSA, MS 0184
J. Cochran, SNL, MS 0719
File: Reading and SNL 2010

Volume VIII

TAB 23

Mixed Waste Landfill Toluene Investigation Report, August 2010

From: SNL/Wagner
To: NMED/Bearzi

Back of Tab 23

Notes for Volume VIII, Tab 23:

The document included herein is "Mixed Waste Landfill Toluene Investigation Report, Revised October 2010." The revised report was issued as part of the DOE/SNL response to comments received in the NMED Notice of Disapproval (NOD) dated September 28, 2010 (Justification Binder Volume VIII, Tab 24). The October 14, 2010 response can be found in Justification Binder Volume VIII, Tab 25.

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

ENTERED

AUG 1 8 2010

AUG 2010

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Bldg. 1
Santa Fe, NM 87505

Subject: Submittal of the *"Mixed Waste Landfill (MWL) Toluene Investigation Report"* by the Department of Energy/National Nuclear Security Administration (DOE/NNSA) and Sandia Corporation (Sandia)

Dear Mr. Bearzi:

On behalf of DOE/NNSA and Sandia, the "*Mixed Waste Landfill Toluene Investigation Report"* is being submitted as requested in your letters dated April 30 and June 4, 2010. The report presents an evaluation of MWL and Sandia National Laboratories/New Mexico (SNL/NM) site wide groundwater monitoring toluene results, results of the recent purging/sampling study conducted at all of the MWL groundwater monitoring wells, and other studies designed to determine the source(s) of the toluene detected in groundwater samples.

Toluene is a common laboratory contaminant and is present in many workplace and consumer products. It has been detected at very low concentrations at or near the analytical laboratory method detection limit in groundwater samples collected from the new wells installed in 2008 at the MWL and throughout the SNL/NM site wide groundwater monitoring network. The results of this investigation indicate the MWL is not the source of the toluene. The very low concentrations of toluene detected in samples from the MWL groundwater monitoring wells are similar to detections at other SNL/NM site wide wells, and are consistent with a laboratory and/or ambient environmental source(s), and are expected to continue in the future. The toluene groundwater data reflect the ubiquitous nature of toluene and the very low analytical detection limit (0.25 micrograms per liter). The detections do not represent a release to the environment or widespread low-concentration toluene contamination in the regional aquifer. All detected concentrations of toluene are orders of magnitude lower than the regulatory standards.

Should you have any questions regarding correspondence, please feel free to contact me at (505) 845-6036 or John Gould of my staff at (505) 845-6089.

Sincerely,

Patty Wagner

Patty Wagner
Manager

Enclosure

cc w/enclosure:
W. Moats, NMED (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB
B. Birch, NMED-OB
Records Center, SNL/NM, Org. 6765, MS-0718

cc w/o enclosure:
A. Blumberg, SNL/NM, Org. 11100, MS-0141
M. Walck, SNL/NM, Org. 6700, MS-0701
D. Miller, SNL/NM, Org 6765, MS-0718
J. Cochran, SNL/NM, Org. 6765, MS-0719
S. Saltzstein, SNL/NM, Org. 6702, MS-0701
B. Langkopf, SNL/NM, Org. 6765, MS-0718
C Daniel, SNL/NM, Org. 6765, MS-0718
J. Estrada, SSO, MS-0184
J. Gould, SSO, MS-0184

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Mixed Waste Landfill Toluene Investigation Report**

Document author: **Mike Mitchell, Department 06765**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: Marianne C Walck 8/13/2010

Marianne Walck, Director
Nuclear Energy & Global Security Technologies
Center 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

Date

and

Signature: Patty Wagner 8-18-10

Ms. Patty Wagner, Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Date

Sandia National Laboratories

Sandia National Laboratories/New Mexico Environmental Restoration Project

MIXED WASTE LANDFILL TOLUENE INVESTIGATION REPORT

REVISED OCTOBER 2010

United States Department of Energy
Sandia Site Office

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

EXECUTIVE SUMMARY

This document represents a revision to the August 2010 Mixed Waste Landfill Toluene Investigation Report and incorporates corrections to pages 2-12, 2-21, and 2-22 submitted in response to the New Mexico Environment Department Notice of Disapproval dated September 28, 2010.

The Sandia National Laboratories/New Mexico (SNL/NM) Mixed Waste Landfill (MWL) is a 2.6-acre Solid Waste Management Unit located in the north-central portion of Technical Area III. The MWL was established in 1959 as a disposal area for low-level radioactive and mixed waste generated by SNL/NM research facilities and accepted low-level radioactive and minor amounts of mixed waste from March 1959 through December 1988. The MWL has been extensively characterized, and groundwater monitoring has been conducted since 1990 for major ion chemistry, volatile organic compounds (VOCs), semivolatile organic compounds, nitrate plus nitrite, metals, radionuclides, and perchlorate. Toluene is not a constituent of concern at the MWL based upon the Phase 1 and Phase 2 Resource Conservation and Recovery Act Facility Investigations (SNL/NM September 1990 and Peace et al. September 2002).

Low concentrations of toluene have been historically detected during groundwater monitoring activities at the MWL and at other SNL/NM groundwater monitoring locations. Toluene is a common laboratory contaminant (EPA April 1992 and SNL/NM July 2007), and detections in SNL/NM groundwater samples have been relatively infrequent and at very low concentrations, typically at or near the analytical laboratory detection limits (ranging from 0.25 to 1 micrograms per liter [µg/L]). The U.S. Environmental Protection Agency maximum contaminant level for toluene in drinking water is 1,000 µg/L (EPA 2009), and the New Mexico Environment Department (NMED) maximum allowable concentration is 750 µg/L (Title 20, New Mexico Administrative Code, Chapter 6, Part 2, Section 3103A).

Toluene is a common solvent that is present in many workplace and consumer products, including gasoline, kerosene, heating oil, paints, lacquers, adhesives, nail polish, cosmetics, rubber cement, fabric dyes, and inks. Toluene is essentially ubiquitous in the ambient environment and is present in the ambient air as confirmed by SNL/NM air monitoring program results documented in the Annual Site Environmental Reports, the most recent of which is for Calendar Year (CY) 2008 (SNL/NM September 2009).

During CY 2009, toluene was detected in groundwater samples collected from all four of the new groundwater monitoring wells that were installed in 2008 at the MWL (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9). Toluene concentration ranges were consistent with historical monitoring results (i.e., very low); however, the frequency of detections was higher in 2009 with no unusual indications of laboratory contamination. As a result, in late CY 2009 SNL/NM project personnel initiated an investigation to determine the source of the toluene. The NMED provided further direction in a letter dated April 30, 2010, for conducting a purging/sampling study of the groundwater along with any other studies necessary to determine the toluene source(s) (Bearzi April 2010).

The results of this investigation indicate the MWL is not the source of the toluene. The very low concentrations of toluene detected in groundwater samples from the MWL monitoring wells are consistent with detections reported for samples from other SNL/NM sitewide monitoring wells and a laboratory and/or ambient environmental source(s). In addition, the toluene detections are at concentrations that are orders of magnitude lower than the regulatory standards and are expected to continue in the future. The toluene groundwater results reflect the ubiquitous

nature of toluene and the very low analytical detection limit (0.25 µg/L). The detections do not represent a release to the environment or widespread low-concentration toluene contamination in the regional aquifer.

The key findings of this investigation are as follows:

- A review of the MWL inventory, subsurface soil sampling results, and soil-vapor survey results demonstrate that toluene contamination capable of impacting regional groundwater at a depth of approximately 500 feet below ground surface is not present at the MWL.

- Toluene detections have been reported in groundwater samples collected throughout the SNL/NM sitewide monitoring network, as well as in laboratory and field quality control (QC) samples.

- All detections of toluene in groundwater samples from October 2001 through April 2010 occur within a narrow concentration range (0.217 to 2.2 µg/L) at or near the laboratory method detection limit (typically 0.25 µg/L); of the total results, 88% are less than 1 µg/L, and 63% are less than 0.50 µg/L.

- The number of toluene detections significantly increased across the sitewide groundwater monitoring network in 2009 (2008: 163 samples, 8 detections; 2009: 174 samples, 63 detections). At the MWL, the same trend is evident (2008: 15 samples, 1 detection; 2009: 23 samples, 15 detections). Because a majority of the samples for the new wells installed in 2008 at the MWL (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) and Technical Area V (TAV-MW10) are from 2009 quarterly sampling events when this increase in toluene detections occurred, they have some of the highest toluene detection frequencies as compared to other wells with more pre-2009 results.

- Toluene has also been detected in trip blank (TB) samples (laboratory water in sealed containers never opened in the field) within a concentration range similar to that for groundwater samples (0.184 to 1.21 µg/L).

- The widespread occurrence of toluene detections in groundwater and TB samples from the sitewide monitoring well network, the detection frequency, and the very low concentration range indicate that the toluene detections do not reflect low-level contamination present in the regional aquifer.

- The April 2010 MWL purging/sampling study results showed only laboratory-related toluene contamination in 5 of the 34 groundwater samples. The results for the June 2010 purging/sampling study performed at well TAV-MW10 vary from the MWL results and are consistent with drilling/well materials and/or inadvertent contamination introduced during the drilling/well installation process as possible toluene sources. The purging/sampling study results are not consistent with low-concentration toluene in the regional aquifer.

- Laboratory QC data and the data validation process confirm the presence of toluene sources within the laboratory for some, but not all, cases of low-concentration toluene detections in groundwater samples.

- Other potential sources of toluene are very low levels of toluene present in the ambient environment that impact the groundwater samples as they are being collected and transported to the laboratory and contaminated sample containers.

- Evaluation of the groundwater sampling process for all monitoring wells and the drilling/well installation processes, equipment, and materials for the new wells installed in 2008 (MWL-BW2, MWL-MW7,MWL-MW8, MWL-MW9, and TAV-MW10) supports the conclusion that they are not a source of toluene, but they cannot be ruled out as potential sources. The TAV-MW10 purging/sampling study results and the fact that all five new wells installed in 2008 have detection frequencies ranging from 19 to 58% are consistent with a possible toluene source related to drilling and/or well construction materials.

Based upon the results of this MWL Toluene Investigation, additional investigation into the potential source(s) of toluene at the MWL is not required to confirm the MWL is not the source of toluene. However, the following recommendations are provided that represent best management practices, will build upon this investigation, and will provide additional supporting information:

- Collect additional field blank samples as part of ongoing MWL groundwater monitoring and continue to promote groundwater sampling team awareness of potential cross-contamination issues and sampling process improvement.

- Follow up with the laboratory to tighten the VOC sample container certification process (i.e., process used to certify the sample containers are clean prior to shipment to SNL/NM) and include additional method blank samples when batching and analyzing SNL/NM groundwater samples (i.e., for large sample batches include more than one method blank sample) to reduce the analysis time between method blanks and environmental samples.

- For the MWL Long-Term Monitoring and Maintenance Plan, develop trigger levels for toluene and other identified VOCs at technically reasonable concentrations relative to historic monitoring results to minimize resampling and reporting requirements.

SNL/NM personnel participate in the National Nuclear Security Administration Analytical Management Program, a collaborative effort between the Sample Management Offices (SMOs) at SNL/NM, the Pantex Plant (Pantex), and Los Alamos National Laboratory (LANL) and the third-party data validation and analytical chemistry technical assistance contractor (Analytical Quality Associates [AQA]). Staff from the SMOs and AQA share information and have been working toward the common goal of improving the quality of analytical data since 1994. This effort has intensified over the past year, due in part to the increase in low-concentration toluene detections, and has resulted in a better understanding of the complex issues associated with the extremely low analytical detection limits and corresponding results that are not consistent with known conditions. The combined staff from AQA and the SMOs at SNL/NM, Pantex, and LANL represent well over 100 years of environmental sampling and analysis experience that have been leveraged for this MWL Toluene Investigation. The information and conclusions presented in this report draw upon this experience base. This collaborative effort should continue as it is critical to the cost-effective implementation and management of the Environmental Restoration Project and Long-Term Environmental Stewardship Program missions at these U.S. Department of Energy (DOE) facilities and throughout the DOE complex.

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ACRONYMS AND ABBREVIATIONS

ALS	ALS Laboratory Group
AOP	Administrative Operating Procedure
AQA	Analytical Quality Associates, Inc.
ARCH	air-rotary casing hammer
bgs	below ground surface
CMIP	Corrective Measures Implementation Plan
CMS	Corrective Measures Study
COC	constituent of concern
CWL	Chemical Waste Landfill
CY	Calendar Year
DI	deionized
DOE	U.S. Department of Energy
EB	equipment blank
EPA	U.S. Environmental Protection Agency
ERCL	Environmental Restoration Chemistry Laboratory
ET	evapotranspirative
FB	field blank
GEL	GEL Laboratories, Inc.
KAFB	Kirtland Air Force Base
LANL	Los Alamos National Laboratory
MDL	method detection limit
µg/L	microgram(s) per liter
mg/m^3	milligram(s) per cubic meter
mL	milliliter(s)
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
NNSA	National Nuclear Security Administration
NOD	Notice of Disapproval
NSF	National Sanitation Foundation
OB	Oversight Bureau
Pantex	Pantex Plant
ppb	part(s) per billion
ppmv	part(s) per million by volume
PQL	practical quantitation limit
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
Sandia	Sandia Corporation
SAP	Sampling and Analysis Plan
SMO	Sample Management Office
SNL/NM	Sandia National Laboratories/New Mexico
SOP	Standard Operating Procedure
SOW	Statement of Work
SVOC	semivolatile organic compound
SW	Solid Waste

ACRONYMS AND ABBREVIATIONS (Concluded)

TA	Technical Area
TB	trip blank
TCE	trichloroethene
VOC	volatile organic compound
WDC	WDC Exploration & Wells, Inc.

1.0 INTRODUCTION

The Sandia National Laboratories/New Mexico (SNL/NM) Mixed Waste Landfill (MWL) is located on Kirtland Air Force Base (KAFB), four miles south of the SNL/NM Technical Area (TA)-I facilities and 5 miles southeast of Albuquerque International Sunport. The MWL is a 2.6-acre Solid Waste Management Unit in the north-central portion of TA-III (Figure 1-1). The MWL was established in 1959 as a disposal area for low-level radioactive and mixed waste generated by SNL/NM research facilities and accepted low-level radioactive and minor amounts of mixed waste from March 1959 through December 1988.

Groundwater in the area of the MWL has been extensively characterized and monitored since 1990 for major ion chemistry, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), nitrate plus nitrite, metals, radionuclides, and perchlorate. Nineteen years of quarterly, semiannual, and annual data indicate that groundwater has not been contaminated by releases from the MWL (Goering et al. December 2002; Lyon and Goering January 2006; SNL/NM December 2001a, December 2001b, January 2002, March 2002, July 2002, August 2002, October 2002, June 2003, September 2003, July 2004, November 2006, January 2008, May 2009a, and June 2010). Groundwater monitoring is ongoing and is documented in groundwater monitoring reports submitted annually to the New Mexico Environment Department (NMED). The annual reports and historic quarterly and semiannual reports describe the field activities conducted during the sampling events and present the analytical results (detailed references are provided in Sections 2.0 and 6.0).

The scope of this report describes the investigations performed to determine the potential source(s) of toluene that has been recently detected in MWL groundwater samples at a higher frequency than during previous groundwater monitoring events. The purpose of this report is to present information describing the investigations performed and the results, conclusions, and recommendations.

Figure 1-2 shows the groundwater monitoring well network at the MWL. The current well network consists of seven wells completed within the interfingering, fine-grained, alluvial fan deposits and coarse-grained, Ancestral Rio Grande deposits. Together the alluvial fan and Ancestral Rio Grande deposits form the geologic framework for the regional groundwater aquifer beneath KAFB and the MWL. The monitoring well network consists of one background well (MWL-BW2), one on-site monitoring well (MWL-MW4) with two screen sections completed in different parts of the regional aquifer, and five downgradient wells (MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9).

The MWL groundwater monitoring well network was modified in 2008 due to declining water levels (SNL/NM May 2009a). Four monitoring wells were plugged and abandoned (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) and four new monitoring wells were installed (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9). The background well, MWL-BW2, was installed in January 2008 (SNL/NM April 2008), and monitoring wells MWL-MW7, MWL-MW8, and MWL-MW9 were installed in May 2008 (September 2008a). The NMED approved the well installation reports in October 2008 and January 2009 (Bearzi October 2008a and January 2009). TA-V monitoring well TAV-MW10 was installed in February 2008 as part of the same drilling effort.

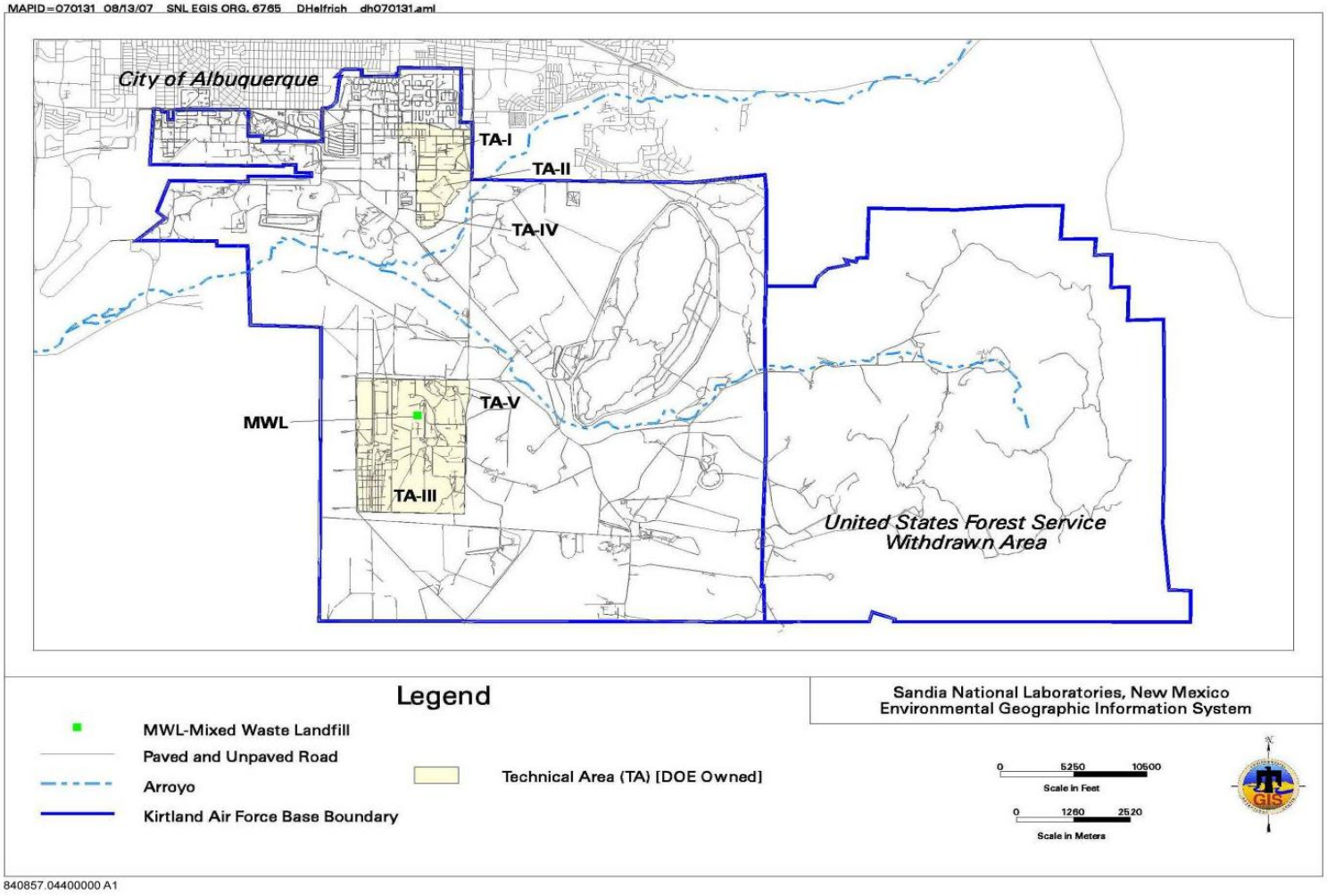

Figure 1-1
Location of Sandia National Laboratories and Kirtland Air Force Base

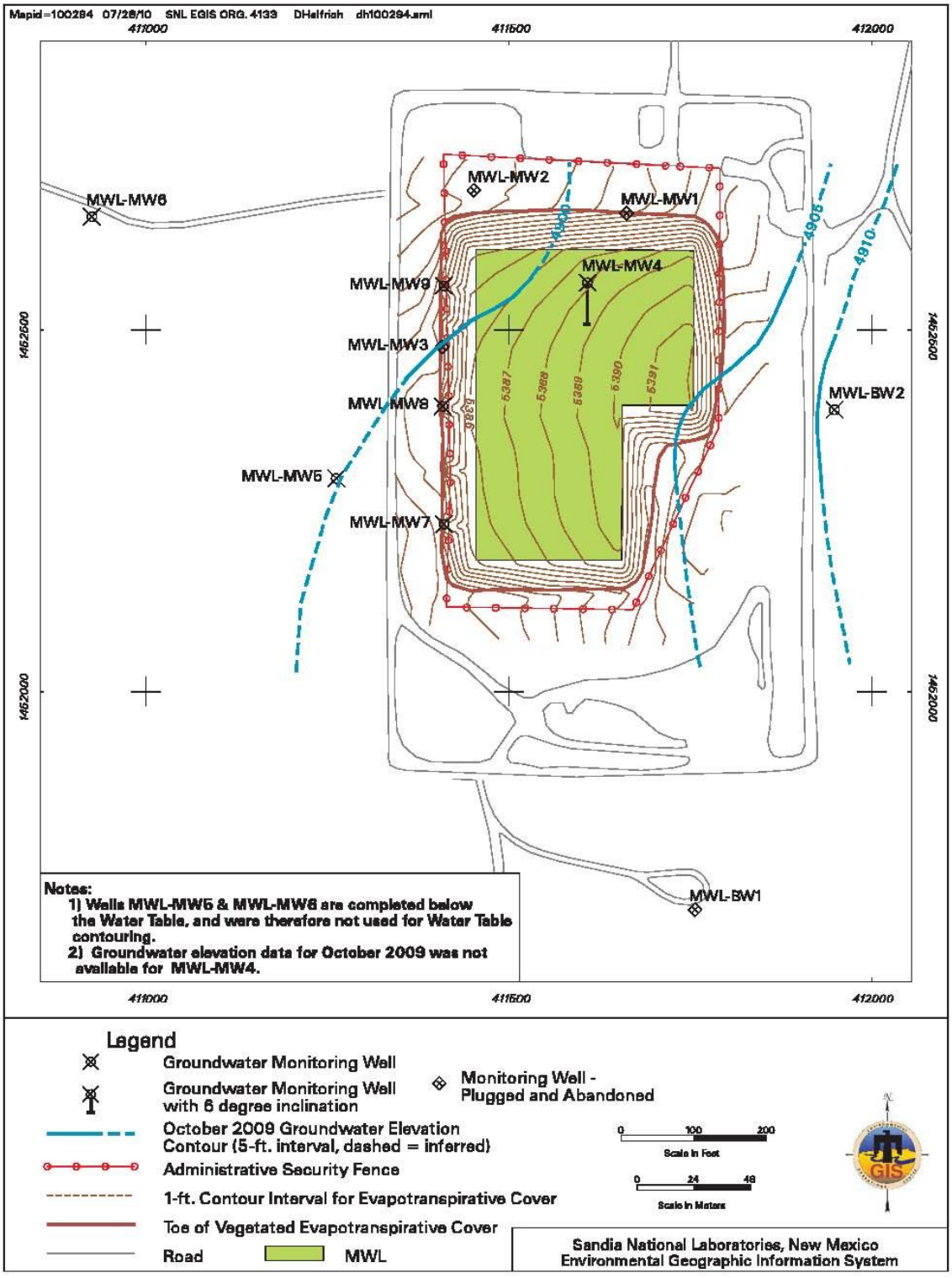

Figure 1-2
Regional Groundwater Elevation and Location of Monitoring Wells at the Mixed Waste Landfill

1.1 Toluene Investigation Background

Toluene and three other organic compounds (methylene chloride, acetone, and bis[2-ethylhexyl]phthalate) have been historically detected during groundwater monitoring activities at the MWL and other SNL/NM groundwater monitoring locations. These compounds are common laboratory organic contaminants (EPA April 1992 and SNL/NM July 2007) and the detections have been relatively infrequent and at very low concentrations, typically at or near the analytical laboratory method detection limit (MDL). All of these organic constituents have been detected in various quality control (QC) and/or quality assurance (QA) samples that in many cases confirm the analytical laboratory as the source.

Toluene is a common solvent, one of the primary components of gasoline, and present in many workplace and consumer products. It is also present in some food products, ambient air, vehicle exhaust, and cigarette smoke. It is a common constituent in kerosene, heating oil, paints, thinners, lacquers, glues, nail polish, cosmetics, rubber cement and products, paints, paintbrush cleaners, stain removers, fabric dyes, inks, and adhesives. Because toluene is a primary component of gasoline, a common solvent, and is found in many consumer and workplace products, it is often present in the ambient air and other environment media at very low concentrations (i.e., it is a ubiquitous environmental contaminant [Eco-USA.Net 2010]). Appendix A summarizes pertinent information on toluene.

The four new MWL wells installed in 2008 (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) have been sampled quarterly since installation. During Calendar Year (CY) 2008, MWL-BW2 was sampled three times and MWL-MW7, MWL-MW8, and MWL-MW9 were sampled two times. In CY 2008, only one detection of toluene was reported (July 2008 sample from MWL-MW9). In CY 2009, all four wells were sampled four times and although the toluene concentration ranges were consistent with historical monitoring results (i.e., very low), the frequency of detections was significantly higher as shown in Table 1-1. Data validation of the CY 2009 results indicates the laboratory may not have been the primary source of the toluene detections in groundwater samples.

Table 1-1
Summary of CY 2009 Toluene Detection Frequency in
Groundwater Samples Collected from MWL Wells Installed in 2008

MWL Well	Number of Samples[a]	Number of Detections	Detection Frequency (%)	Concentration Range (µg/L)[b]
MWL-BW2	5	2	40%	0.366–0.759
MWL-MW7	4	3	75%	0.267–0.645
MWL-MW8	5	5	100%	0.253–0.496
MWL-MW9	5	5	100%	0.306–0.852

[a]Includes duplicate samples.
[b]All results from off-site laboratory analysis in units of µg/L per EPA Method 8260 (EPA November 1986) and associated method updates.
CY = Calendar Year.
EPA = U.S. Environmental Protection Agency.
µg/L = Microgram(s) per liter.
MWL = Mixed Waste Landfill.

As a result, SNL/NM project personnel initiated an investigation in late CY 2009 to determine the source of the toluene in the MWL groundwater samples. The investigation included preliminary testing of sampling equipment and well materials (i.e., sample tubing and polyvinyl chloride [PVC] well casing) and a detailed review of laboratory QC and field QA data. In addition, as of November 2009, several changes were made to the sampling process as best management practices (sample tubing materials, custody tape, etc.). After receiving preliminary VOC results for the January 2010 quarterly sampling event, where again groundwater samples from all four wells (including the background well) had low-concentration detections of toluene, SNL/NM project personnel decided to expand the toluene source investigation. Activities that were identified for this expanded investigation included collecting VOC samples at intermediate steps in the well purging process (i.e., at the beginning, during the middle, and at the end) at each MWL monitoring well during the next quarterly sampling event and investigating in more detail the drilling/well installation process, equipment, and materials.

The NMED provided further direction in a letter dated April 30, 2010, for conducting a purging/sampling study of the groundwater along with any other studies necessary to determine the source of toluene (Bearzi April 2010). The NMED letter referenced the NMED/U.S. Department of Energy (DOE) Oversight Bureau (OB) groundwater split sampling results for the July 2009 sampling event at the MWL, where samples from all four new wells showed detections of toluene at low concentrations (NMED/DOE OB February 2010). The NMED approved a 30-day extension request to allow the April purging/sampling study results to be received, validated, evaluated, and included in this report and established a final submittal date for this report of August 30, 2010.

The NMED-issued Compliance Order on Consent (the Consent Order) transferred the regulatory requirements for groundwater sampling at the MWL to the Consent Order (NMED April 2004). This MWL Toluene Investigation Report was prepared in accordance with Section X.C of the Consent Order. The April 30, 2010 NMED letter (Bearzi April 2010) provided written notification that further investigation was required to determine the source of the toluene in groundwater samples at the MWL pursuant to Section VI.A of the Consent Order. This document represents an investigation report consistent with Section VI.C of the Consent Order that "…presents the results of field activities, summarizes the data collected, and presents the recommendations and conclusions of the investigation."

SNL/NM personnel participate in the National Nuclear Security Administration (NNSA) Analytical Management Program, a collaborative effort between the Sample Management Offices (SMOs) at SNL/NM, the Pantex Plant (Pantex), and Los Alamos National Laboratory (LANL) and the third-party data validation and analytical chemistry technical assistance contractor Analytical Quality Associates (AQA). Personnel from the SMOs, AQA, and GEL Laboratories, Inc. (GEL) communicate on a regular basis to address and resolve analytical issues that arise from the enormous analytical programs associated with these three DOE facilities. It is a team effort with the goal of continuous improvement, targeting the analytical process and methods, field collection methods, and the data review and documentation process. This effort has intensified over the past year, due in part to the increase in low-concentration toluene detections, and has resulted in a better understanding of the complex issues associated with the extremely low analytical detection limits and corresponding results that are not consistent with known conditions. The combined staff from AQA and the SMOs at SNL/NM, Pantex, and LANL represent well over 100 years of environmental sampling and analysis experience that have been leveraged for this MWL Toluene Investigation. The information and conclusions presented in this report draw upon this experience base.

1.2 MWL Site Description and Regulatory Background

The MWL consists of two distinct disposal areas: the classified area (occupying 0.6 acres) and the unclassified area (occupying 2.0 acres). Approximately 100,000 cubic feet of low-level radioactive waste and minor amounts of mixed waste containing approximately 6,300 curies (at the time of disposal) were disposed of in the MWL. Low-level radioactive and mixed waste was disposed of in both areas. Classified wastes were buried in cylindrical pits in the classified area. Unclassified wastes were buried in shallow trenches in the unclassified area.

A Phase 1 Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) was conducted in 1989 and 1990 to determine whether a release of RCRA-regulated contaminants had occurred at the MWL. The Phase 1 RFI indicated that tritium had been released to the environment (SNL/NM September 1990). A Phase 2 RFI was conducted from 1992 to 1995, and the report was submitted to the NMED in September 1996 for technical review and comment. The report went through numerous review and comment response actions. The original report was revised based upon these review and comment response actions, approved by the NMED in December 2002, and published in its final technical format (Peace et al. September 2002). The complete MWL groundwater quality data set was provided to the NMED in the "Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Dated September 1996, Volumes I and II" (SNL/NM June 1998). The Phase 2 RFI Report confirmed that tritium is the contaminant of primary concern at the MWL and includes a detailed summary of the MWL waste inventory as Appendix A (Peace et al. September 2002).

On October 11, 2001, the NMED directed the DOE and Sandia Corporation (Sandia) to conduct a Corrective Measures Study (CMS) for the MWL. The MWL CMS Report was submitted to the NMED on May 21, 2003 (SNL/NM May 2003). Based upon detailed evaluation and risk assessment using guidance provided by the U.S. Environmental Protection Agency (EPA) and NMED, the DOE and Sandia recommended that an alternative vegetative soil cover (i.e., evapotranspirative [ET] Cover) be constructed as the preferred corrective measure for the MWL.

The NMED held a public comment period on the MWL CMS from August 11 to December 9, 2004. A public hearing was held for the MWL CMS from December 2 to December 3 and December 8 to December 9, 2004. Groundwater monitoring results from 1990 through 2004 and well construction issues were addressed as part of the public hearing process. On May 26, 2005, the Secretary of the NMED selected a vegetative soil cover with a biointrusion barrier as the remedy for the MWL. The selection was based upon the administrative record, including the Hearing Officer's report, and was documented in the NMED "Final Order In the Matter of Request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill" (Final Order) (NMED May 2005). The Secretary requested that a Corrective Measures Implementation Plan (CMIP) incorporating the selected remedy be developed within 180 days following the selection of the remedy.

The MWL CMIP (SNL/NM November 2005) was submitted to the NMED in November 2005 and incorporates the remedy selected by the NMED. In September 2006, approval to proceed with MWL security fence removal and ET Cover subgrade construction was received from the NMED (Bearzi September 2006). The NMED issued the first of two Notices of Disapproval (NODs) on the CMIP in November 2006 (Bearzi November 2006). Sandia responded to the first NOD in two parts (Wagner December 2006 and January 2007). The majority of the second NOD comments (Bearzi October 2008b) were holdover issues from the first NOD. The response to

the second NOD (Davis November 2008) resolved these remaining comments, and the CMIP was conditionally approved by the NMED (Bearzi December 2008).

The MWL ET Cover construction began in May 2009 and was completed in September 2009 in accordance with the MWL CMIP (SNL/NM November 2005). The MWL Corrective Measures Implementation Report (SNL/NM January 2010) documenting ET Cover installation was submitted for NMED review and approval on January 26, 2010.

1.3 Toluene Investigation Report Structure

Information on the groundwater data review process, analytical laboratory toluene detection limit, and a comprehensive evaluation of MWL and sitewide groundwater monitoring results are presented in Section 2.0. This information provides the context for the evaluation of potential toluene sources presented in Section 3.0. Potential sources of toluene are evaluated in Section 3.0, including the MWL, the analytical laboratory, the groundwater sampling process, and the well drilling and installation process. The summary and conclusions of this investigation are presented in Section 4.0, and recommendations are presented in Section 5.0. References cited are provided in Section 6.0.

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2.0 GROUNDWATER MONITORING AND DATA EVALUATION

Groundwater monitoring at the MWL was initiated in September 1990. All MWL groundwater monitoring results for the period 1990 through 2001 are comprehensively summarized in "Mixed Waste Landfill Groundwater Report, 1990 through 2001, Sandia National Laboratories, Albuquerque, New Mexico" (Goering et al. December 2002). This summary report contains detailed sampling information for the 28 sampling events that occurred between 1990 and 2001, including the wells sampled by date and the corresponding MWL report that documents the results of the sampling event. Table 2-1 summarizes the MWL Annual Groundwater Monitoring Reports from 2002 through 2009. The well installation dates, well decommissioning dates (if applicable), and frequency of groundwater sampling at each MWL monitoring well are summarized in Table 2-2. The current 2010 MWL groundwater monitoring network is comprised of one background (i.e., hydraulically upgradient) well (MWL-BW2), one on-site well (MWL-MW4), and five hydraulically downgradient wells (MWL-MW5 through MWL-MW9).

This section presents information on the groundwater data review process and analytical laboratory toluene detection limit and provides a comprehensive evaluation of MWL and sitewide groundwater monitoring toluene results. This information provides the context for the evaluation of potential toluene sources presented in Section 3.0. Section 2.1 describes the data validation process that is applied to all final MWL and SNL/NM sitewide groundwater monitoring results as well as the laboratory QA/QC process. Changes in the laboratory toluene detection limit over time are presented in Section 2.2. The variation in detection limits has impacted both the number of reported detections and the frequency of detection for toluene in samples from the SNL/NM monitoring network. Sections 2.3 through 2.5 present data evaluations summarized as follows:

- MWL Toluene Results from 1990 through April 2010 (Section 2.3)
- Sitewide Toluene Results from October 2001 through April 2010 (Section 2.4)
- Sitewide Air Monitoring Results (Section 2.5)

Section 2.6 presents the summary and conclusions.

2.1 Data Validation

All analytical laboratory (contracting, audits, data management, data review and validation, etc.) and sample management activities associated with the SNL/NM groundwater monitoring program are performed by or through the SNL/NM SMO. Since 1995, the majority of groundwater samples have been shipped to GEL in Charleston, South Carolina, for analysis.

Analytical results received from GEL, including laboratory QC data, are first reviewed by the SMO to verify compliance with contract requirements and are then validated by an independent, third-party contractor, AQA, according to the "Data Validation Procedure for Chemical and Radiochemical Data," Revision 2 (SNL/NM July 2007). The analytical data are evaluated using the analytical method performance and QC parameters specified in the analytical methods (i.e., EPA SW [Solid Waste]-846 Method 8260 and subsequent revisions for VOCs [EPA 1986]) and the SMO Analytical Laboratory Statement of Work (SOW) (SNL/NM May 2009b). These parameters are compared with fixed or statistically derived criteria and compared with criteria presented in EPA guidance documents to determine the quality of the

Table 2-1
Summary of Mixed Waste Landfill Annual
Groundwater Monitoring Reports – 2002 through 2009

Year	Title	Report Date	Comments
2002	Mixed Waste Landfill Annual Groundwater Monitoring Report, April 2002	August 2002	Annual sampling conducted April 10–May 14, 2002, at MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, and MWL-MW4. Quarterly sampling conducted at MWL-MW5 and MWL-MW6.
2003	Mixed Waste Landfill Annual Groundwater Monitoring Report, April 2003	June 2003	Annual sampling conducted April 2–April 22, 2003 at MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4, MWL-MW5, and MWL-MW6.
2004	Mixed Waste Landfill Annual Groundwater Monitoring Report, April 2004	July 2004	Annual sampling conducted April 12–April 26, 2004 at MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4, MWL-MW5, and MWL-MW6.
2005	Mixed Waste Landfill Annual Groundwater Monitoring Report, April 2005	January 2006	Annual sampling conducted April 4–April 19, 2005 at MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4, MWL-MW5, and MWL-MW6. Quarterly sampling conducted April, August, November 2004, and February 2005 at MWL-BW1 and MWL-MW1 for perchlorate.
2006	Mixed Waste Landfill Annual Groundwater Monitoring Report, April 2006 Sampling Event	November 2006	Annual sampling conducted April 3–April 18, 2006 at MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4, MWL-MW5, and MWL-MW6.
2007	Mixed Waste Landfill Annual Groundwater Monitoring Report ,Spring 2007 Sampling Event	January 2008	Annual sampling conducted April 2–April 11 and June 4–June 5, 2007 at MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4, MWL-MW5, and MWL-MW6.
2008	Mixed Waste Landfill Annual Groundwater Monitoring Report, Calendar Year 2008	May 2009	Annual sampling conducted April 8–April16, 2008 at MWL-MW4, MWL-MW5, and MWL-MW6. Quarterly sampling conducted April 8-April 16, July 14-July 17, and October 1-October 8, 2008 at MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9.
2009	Mixed Waste Landfill Annual Groundwater Monitoring Report, Calendar Year 2009	June 2010	Sampling conducted January 5–January 8, April 1–April 13, July 7–July 9, and October 5–October 8, 2009 at MWL-BW2, MWL-MW4, MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9.

Table 2-2
Groundwater Monitoring Sampling Frequency Summary for the Mixed Waste Landfill

Monitoring Well	Installation Date	Sampling Frequency Summary
MWL-BW1 MWL-MW1 MWL-MW2 MWL-MW3	July 1989 October 1988 August 1989 August 1989	Quarterly sampling from September 1990 through January 1992. Semiannual sampling from January 1992 through April 1999. Annual sampling from April 1999 through present. Confirmatory sampling of MWL-BW1 for toluene and methylene chloride in October 2000. *Notes:* MWL-BW1 decommissioned in January 2008, MWL-MW1 and MWL-MW3 in April 2008, and MWL-MW2 in May 2008
MWL-MW4	February 1993	Quarterly sampling from April 1993 through April 1999. Semiannual sampling from April 1999 through April 2000. Annual sampling from April 2000 through present. Confirmatory sampling of MWL-MW4 for toluene and methylene chloride in October 2000. *Notes:* Sampled two times in 2001 (February and April) due to Baski® packer issue.
MWL-MW5 MWL-MW6	November 2000 October 2000	Sampled quarterly January through October 2002. Sampled annually April 2003 through present. *Notes:* The 2007 annual sampling event was conducted in April and June 2007.
MWL-BW2	January 2008	Sampled quarterly from April 2008 through present.
MWL-MW7 MWL-MW8 MWL-MW9	May 2008 May 2008 May 2008	Sampled quarterly from July 2008 through present. *Notes:* MWL-MW7, MWL-MW8, and MWL-MW9 were installed in May 2008, but well development was not completed until June 2008.

results through a rigorous review process. The quality parameters are measures of the following: (1) the analytical precision and accuracy, (2) potential contamination from both the field and the laboratory, (3) sample matrix effects, (4) sample inhomogeneity, and (5) correct implementation of method performance requirements (calibration protocols, internal standard and surrogate acceptance, etc.). One hundred percent of the VOC analytical data undergoes this level of validation.

Table 2.1-1 summarizes the 16 validation elements that AQA uses to validate data packages containing VOC data. In the data validation procedure, toluene is identified as a common laboratory contaminant. When laboratory contamination is identified in laboratory QC samples (i.e., method blank samples), the associated environmental and field QC blank samples (i.e., trip blank [TB], equipment blank [EB], and field blank [FB] samples) are qualified using the EPA "Rule of 10" for blank contamination (EPA 1999). This qualification of the data occurs because the laboratory method blank results indicate the toluene contamination for those specific samples is occurring in the laboratory. The Rule of 10 adjusts for this contamination by taking the concentration detected in the laboratory method blank(s), multiplying it by 10, and qualifying all results that fall below that concentration. For low-concentration detections of common laboratory contaminants such as toluene in environmental and field QC blank samples, this typically results in a qualification of "not detected" or "U."

It is important to note that laboratory QC measures, including the analysis of method blank samples, are not perfect and will not catch every instance when the laboratory is the cause of the toluene detection. This is because laboratory blanks represent a "spot check" and not 100% real-time coverage for environmental sample analyses. For instance, for a batch of groundwater samples analyzed late in the afternoon the laboratory method blank may have been analyzed earlier in the morning of that day. Conditions in the laboratory environment may have changed by the time the environmental samples are analyzed. Sensitive gas chromatograph/mass spectrometer equipment used in the EPA Method 8260 VOC analysis can detect low levels of toluene contamination at any time. For example, if someone wearing aftershave, perfume, or slightly contaminated clothing/personal protective equipment walks by the equipment during sample runs, the instrument can report a toluene detection above the MDL. Also, if contaminated environmental samples are run after the method blank and contaminate the instrument, toluene detections can result in the environmental samples analyzed after the contaminated samples. Because the method blank may have been run many hours before the environmental samples, it may not be a reliable indicator of contamination that may be present throughout the entire analytical process. Nevertheless, the required method blanks do provide a reasonably good indicator of laboratory performance and contamination issues.

2.2 Laboratory Method Detection Limit

The laboratory reports VOC analytical results according to two detection limits. The statistically derived MDL is the lower of two detection limits and represents a detection concentration limit with a 99% confidence level that the compound is actually present. However, the concentration is qualified as estimated (i.e., with "J" by the laboratory) when it falls above the MDL but below the practical quantitation limit (PQL) because the PQL, set equal to the lowest calibration standard concentration, is the lowest level at which measurements become quantitatively meaningful. In other words, the PQL represents the concentration limit at which results are reproducible within a fairly narrow uncertainty window on a routine day-to-day basis. The PQL is often roughly 5 to 10 times the MDL. In very general terms, a concentration below

Table 2.1-1
Data Validation Elements for Review of EPA Method 8260 VOC Data

Validation Element
Data Package completeness
Holding times
Sample preservation (including assessment for 2-chloroethyl vinyl ether)
GC/MS instrument tune
Initial calibration • Number and TAL of standards • Response factors, % Relative Standard Deviation (average Response Factor curve) • Linear regression curve (slope, r^2, intercept)
Calibration verification • Initial Calibration Verification frequency, TAL, %Difference • Continuing Calibration Verification frequency, TAL, %Difference
Blanks • Method blanks • Field blanks, equipment blanks, trip blanks
Surrogate recovery
Internal standard • Recovery • Retention time
MS/MSD • Parent sample source • TAL • Frequency • Recovery • MS/MSD RPD
LCS • Frequency • TAL • %Recovery
Sample carry-over
Dilutions
Mass spectra evaluation (upon request for focused validation)
Manual integration evaluation (upon request for focused validation)
TIC (when TIC reports are requested)

EPA = U.S. Environmental Protection Agency.
GC/MS = Gas Chromatograph/Mass Spectrometer.
LCS = Laboratory control sample.
MS/MSD = Matrix spike/matrix spike duplicate.
RPD = Relative percent difference.
TAL = Target analyte list.
TIC = Tentatively identified compound.
VOC = Volatile organic compound.

the MDL cannot be “seen” or detected by the laboratory instrumentation; a concentration between the MDL and PQL indicates the compound is present, but the actual concentration value is uncertain and is considered to be an estimate, whereas a concentration at or above the PQL is an accurate value with small uncertainty.

As part of its QC protocol the laboratory prepares and analyzes method blank samples comprised of ultra-clean, laboratory-provided water with each batch of samples from clients such as SNL/NM. The purpose of a method blank is to help identify any contamination from the laboratory reagents, standards, and ambient environment that might affect sampling results. In preparing a method blank, surrogate and internal standard compounds are added to clean water following the sample process the environmental samples go through prior to analysis.

Figure 2.2-1 shows the GEL MDL for toluene over time according to the EPA SW-846 Method 8260 and subsequent revisions (EPA 1986). Prior to 1995, the SNL/NM SMO required off-site laboratories to provide reporting limits that were approximately equivalent to PQLs. The toluene reporting limit and corresponding MDL equivalent during this time period were generally 5 and 1 micrograms per liter (µg/L), respectively. However, in some cases lower values were reported during this time period, including results from the on-site SNL/NM Environmental Restoration Chemistry Laboratory (ERCL). Although the MDL and PQL can change for an individual analysis depending upon many factors, the toluene MDL has generally been consistent with Figure 2.2-1 for MWL groundwater sample analyses. Between May 1998 and May 2005, the toluene MDL changed several times, ranging from 0.5 to 0.17 µg/L. Since May 2005, the MDL has remained relatively stable at a concentration of 0.25 µg/L.

GEL must verify the MDL for every organic constituent at least annually. This verification includes both the analysis of standards for each analyte prepared at concentrations at or near the MDL and the examination of the population of method blank results acquired over the previous year. Method blank results are a good indicator of potential laboratory contamination issues but are not perfect, particularly where VOCs are concerned, as discussed in Section 2.1.

2.3 MWL Toluene Groundwater Monitoring Results

Groundwater monitoring results have been and will continue to be documented and submitted to the NMED through MWL Annual Groundwater Monitoring Reports. All MWL groundwater monitoring results for the period 1990 through 2001 are comprehensively summarized in the “Mixed Waste Landfill Groundwater Report, 1990 through 2001, Sandia National Laboratories, Albuquerque, New Mexico” (Goering et al. December 2002) that also presents the hydrogeologic setting and conceptual site model. Table 2.3-1 summarizes all toluene detections in MWL annual, semiannual, and quarterly groundwater samples by monitoring well for the period from 1990 through April 2010. In most cases, these results are from an off-site analytical laboratory under contract through the SMO, although a few of the pre-2001 sampling event results are from ERCL. Since 1995, most quarterly and annual sampling results have been from GEL.

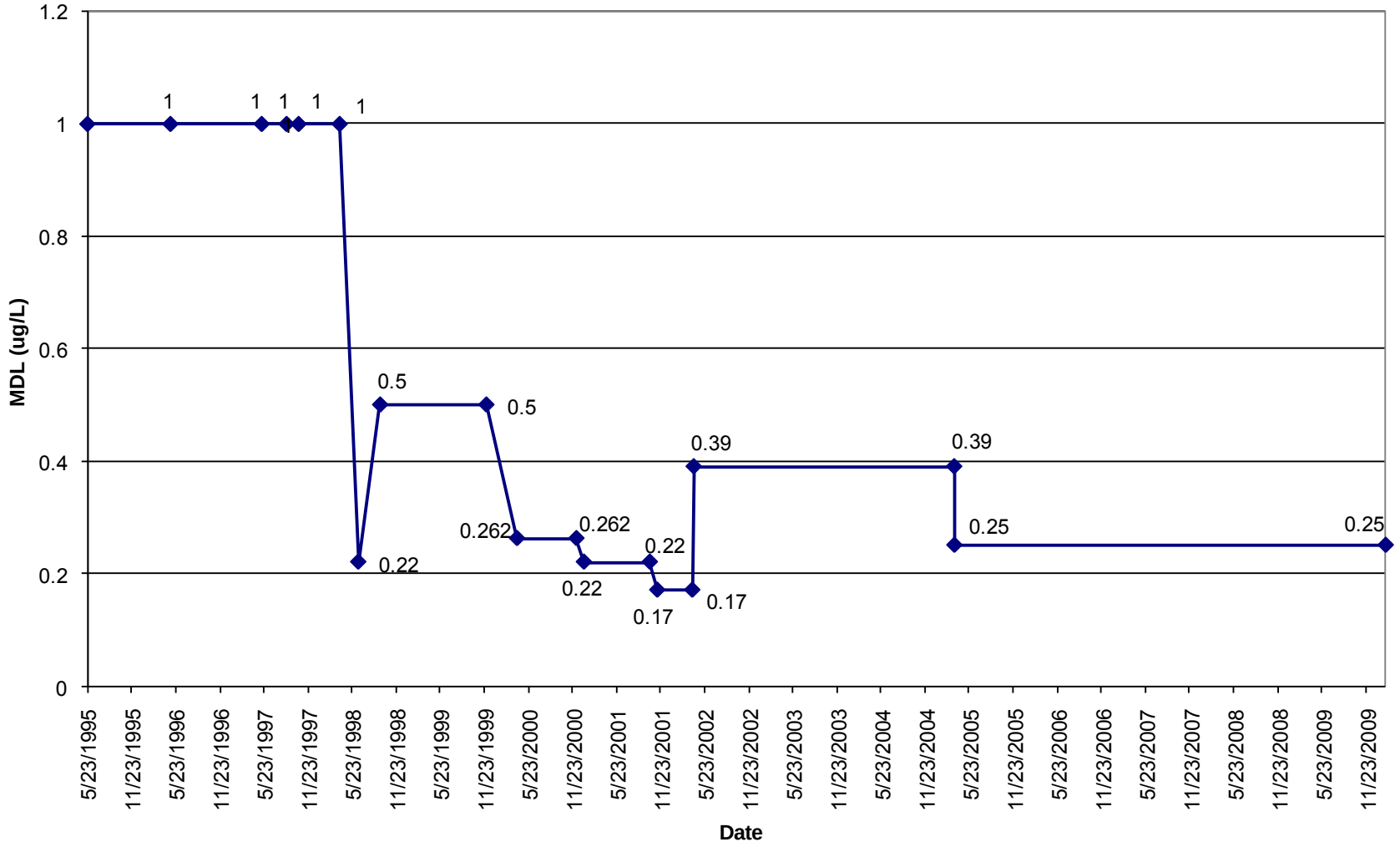

Figure 2.2-1
Toluene Method Detection Limit for GEL Laboratories, Inc., 1995 to present

Table 2.3-1
Summary of Toluene Detected in MWL Groundwater Samples – 1990 through 2010

Well	Sample Date	Result (µg/L)[a]	Comments
Original Monitoring Wells			
MWL-BW1 Well installed June 1989 Well decommissioned January 2008	04-28-97	0.83 J	ERCL result (on-site laboratory)
	04-06-00	2.54	
	04-06-01	0.31 J	
MWL-MW1 Well installed September 1988 Well decommissioned April 2008	11-06-98	0.59 J	
	04-13-01	0.246 J	
MWL-MW2 Well installed July 1989 Well decommissioned May 2008	04-15-96	1.84 J	
	04-24-97	0.53 J	ERCL result (on-site laboratory)
	04-19-99	0.57 J	
	04-23-01	0.537 J	
MWL-MW3 Well installed August 1989 Well decommissioned April 2008	04-12-99	0.98 J	
	04-11-07	0.275 J	
MWL-MW4 Well installed February 1993	05-31-94	0.54 J	
	10-15-97	4.4	
	11-06-98	13	
	11-06-98	11	Duplicate sample
	04-14-99	4.2	
	04-07-00	2.7	ERCL result (on-site laboratory)
	02-07-01	1.27	
	02-07-01	1.36	Duplicate sample
	02-09-01	0.679 J	
	02-09-01	0.709 J	Duplicate sample
	04-04-01	0.359 J	
	04-05-01	0.225 J	Duplicate sample
	06-05-07	0.321 J	
MWL-MW5 Well installed November 2000	01-17-01	0.765 J	
New Monitoring Wells Installed in 2008			
MWL-BW2 Well installed January 2008	01-05-09	0.759 J	
	07-06-09	0.366 J	
	01-04-10	0.438 J	
MWL-MW7 Well installed May 2008	01-06-09	0.510 J	
	04-08-09	0.267 J	
	07-07-09	0.645 J	
	01-05-10	0.320 J	
	01-05-10	0.285 J	Duplicate sample
MWL-MW8 Well installed May 2008	01-07-09	0.496 J	
	01-07-09	0.495 J	Duplicate sample
	04-07-09	0.457 J	
	07-08-09	0.475 J	
	10-07-09	0.253 J	
	01-06-10	1.45	

Refer to footnotes at end of table.

Table 2.3-1 (Concluded)
Summary of Toluene Detected in MWL Groundwater Samples – 1990 through 2010

Well	Sample Date	Result (µg/L)[a]	Comments
New Monitoring Wells Installed in 2008 (Continued)			
MWL-MW9 Well installed May 2008	07-15-08	0.510 J	
	01-08-09	0.852 J	
	04-09-09	0.306 J	
	07-09-09	0.711 J	
	07-09-09	0.692 J	Duplicate sample
	10-05-09	0.513 J	
	01-07-10	1.10	

[a]All results from off-site laboratory analysis in units of µg/L per EPA Method 8260 (EPA November 1986) and associated method updates except as noted in the comment field.

EPA = U.S. Environmental Protection Agency.
ERCL = Environmental Restoration Chemistry Laboratory (on-site laboratory).
J = Estimated value by the laboratory, above the method detection limit but below the practical quantitation limit.
µg/L = Microgram(s) per liter.
MWL = Mixed Waste Landfill.

Toluene has been detected in groundwater samples from the MWL at very low concentrations since 1994. Except for MWL-MW6, samples from all wells, including the two background monitoring wells (MWL-BW1 and MWL-BW2), have had at least one detection of toluene. From the start of groundwater monitoring at the MWL in 1990 through April 2010, there have been 47 detections of toluene in MWL groundwater monitoring samples collected for quarterly, semiannual, or annual sampling events, of which 14 are from MWL-MW4 samples. The MWL-MW4 results are related to a unique situation (the Baski® packer) that is described in Section 2.3.1; the results are not included in the following discussion.

Toluene concentrations range from 0.246 µg/L (MWL-MW1) to 2.54 µg/L (MWL-BW1). The maximum detection of 2.54 µg/L occurred in the April 2000 sample from the original background monitoring well, but there were no other toluene detections during sampling conducted through 2008 when MWL-BW1 was decommissioned. Only four results exceed 1 µg/L. Of the 33 toluene detections (excluding the 14 MWL-MW4 results) all but 4 results are qualified as estimated concentrations (i.e., "J" values). These results are qualified as estimated by the laboratory because the result falls between the MDL and PQL. Only five detections were reported from the time period prior to 1998 when the MDL was 1 µg/L. Of the 21 detections in samples from the new monitoring wells installed since 2008 (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9), 16 occurred in 2009 and only 2 would have been reported with the pre-1997 MDL of 1 µg/L (Section 2.2). In addition, the existing wells (MWL-BW1 and MWL-MW1 through MWL-MW6) were sampled on an annual basis for many years (Table 2-2), whereas the new wells installed in 2008 have been sampled quarterly since installation. The relationship between sampling frequency, toluene detection frequency, and the timing of well installation is discussed in Section 2.4.

A concentration of 1 µg/L equals 1 part per billion (ppb). In summary, the toluene results for the MWL groundwater monitoring samples represent extremely low concentrations that are close to the MDL and orders of magnitude less than the EPA maximum contaminant level of 1,000 µg/L (EPA 2009) and the NMED maximum allowable concentration of 750 µg/L (Title 20, New Mexico Administrative Code, Chapter 6, Part 2, Section 3103A).

As discussed in Section 2.1, the toluene results for MWL groundwater samples are reviewed according to the contract requirements and data validation process (SNL/NM July 2007). From October 2001 through April 2010, the toluene results for 10 environmental samples were qualified as not detected during data validation because of laboratory contamination documented in method blank samples. Of these 10 results, 5 were from the April 2010 quarterly sampling event. These data confirm that in some instances the source of toluene detected in MWL groundwater samples is the analytical laboratory.

2.3.1 MWL-MW4 Toluene Summary

As presented in the "MWL Annual Groundwater Monitoring Report, FY 2001" (SNL/NM December 2001a) and "MWL Groundwater Report, 1990 through 2001" (Goering et al. December 2002), the toluene detections in samples from MWL-MW4 through 2001 are most likely related to the Baski® inflatable packer that separates the two discrete screen intervals that are 20 feet apart (Peace et al. September 2002). Nitrogen gas pressure is maintained in the packer to inflate a rubber element that seals against the well casing between the two screen intervals.

In February 2001, a purging/sampling test was performed to evaluate the packer as a potential source of the detected toluene. The results for samples collected after purging were lower in concentrations than the samples collected before MWL-MW4 was purged, suggesting that toluene was originating from the packer.

In May 2001, the packer was removed for servicing, and the rubber element of the packer showed significant damage and deterioration from a pinhole leak. After inspecting and repairing the packer, personnel from Baski Inc., the manufacturer of the packer, informed Sandia that the damaged rubber element was the likely source of low-level detections of toluene, as it is used in the manufacturing process for the exposed rubber element and can leach from the element if it is damaged. The packer was repaired and a Teflon® sleeve was used to cover the rubber element when it was reinstalled. Since the annual sampling event in April 2002, there has been only one detection of toluene in MWL-MW4 samples, reported for the June 2007 sample at a concentration of 0.321 J µg/L.

2.3.2 NMED/DOE OB Split Sampling

The NMED/DOE OB performs periodic split sampling during SNL/NM groundwater monitoring sampling events and sends its split samples to the ALS Laboratory Group (ALS) in Fort Collins, Colorado. The NMED/DOE OB samples are split samples collected from the monitoring wells at the same time the SNL/NM samples are collected, following the same procedures and using the same equipment. Not all wells are split-sampled during each event, and the analytical results requested by the NMED/DOE OB are often a subset of the full MWL monitoring analytical suite. Samples for VOCs are collected in ALS-provided containers with hydrochloric acid preservative and shipped to ALS with TB samples. The SNL/NM and NMED/DOE OB toluene results for four sampling events conducted from 2008 through January 2010 are presented in Table 2.3-2 for comparison.

The NMED/DOE/OB results correlate closely with the SNL/NM results indicating the source of the low-concentration toluene results for these samples is not the analytical laboratory. For this time period, no SNL/NM or NMED/DOE OB TB results showed detections of toluene, and none of the results were qualified during data validation.

2.3.3 April and June 2010 Purging/Sampling Study Results

During the April 2010 annual sampling event at the MWL, samples for VOC analysis were collected from all groundwater monitoring wells during the purging process. The purpose of the purging/sampling study was to evaluate potential toluene sources related to drilling/well materials and/or inadvertent contamination that may have occurred during the drilling/well installation process. Although samples from wells MWL-MW4 through MWL-MW6 have not shown as many toluene detections as the new wells installed in 2008 (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9), these wells were included in the purging/sampling study.

During June 2010, a similar purging/sampling study was conducted at monitoring well TAV-MW10 because it was drilled and installed in February 2008 during the same drilling effort and by the same drilling contractor as the new wells at the MWL (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9). Toluene was also detected three times in TAV-MW10 samples during the eight sampling events prior to June 2010 (one result was qualified as a nondetection during data validation).

Table 2.3-2
Comparison of Split-Sampling Toluene Results for Groundwater Samples Collected by SNL/NM and the NMED/DOE OB at the MWL – 2008 through 2010

Well	Sample Date	SNL/NM Result[a] (µg/L)	NMED/DOE OB Results[b] (µg/L)
MWL-BW2	04-09-08	ND (0.25)	ND (0.17)
	07-17-08	ND (0.25)	ND (0.17)
	07-06-09	0.366 J	0.37 J
MWL-MW7	07-16-08	ND (0.25)	ND (0.17)
	01-06-09	0.510 J	0.5 J
	07-07-09	0.645 J	0.7 J
	01-05-10	0.32 J	ND (0.17)
MWL-MW8	07-14-08	ND (0.25)	ND (0.17)
	07-08-09	0.475 J	0.52 J
	01-06-10	1.45	1.1
MWL-MW9	07-15-08	0.510 J	0.35 J
	07-09-09	0.711 J	0.97 J
	01-07-10	1.1	0.77 J

[a]SNL/NM results from GEL Laboratories, Inc., validated by AQA.
[b]NMED/DOE OB results from ALS Laboratory Group, validated by AQA.
AQA = Analytical Quality Associates Inc.
DOE = U.S. Department of Energy.
J = Estimated value, above the method detection limit but below the practical quantitation limit.
µg/L = Microgram(s) per liter.
MWL = Mixed Waste Landfill.
ND = Not detected above the method detection limit, shown in parentheses.
NMED = New Mexico Environment Department.
OB = Oversight Bureau.
SNL/NM = Sandia National Laboratories/New Mexico.

2.3.3.1 MWL Purging/Sampling Study

Samples were collected at the beginning of and during the purging process, as well as at the end. The last sample collected represents the quarterly groundwater monitoring result. The samples collected at the start of and during the purging process were collected to determine whether toluene concentrations are higher in the groundwater prior to and during the purging process, as might be the case if a toluene source exists in the well itself (i.e., if toluene was leaching from the PVC screen material or contaminated filter pack material). Purging/sampling study results helped to identify the Baski® packer as the source of past toluene detections in samples from MWL-MW4 (SNL/NM December 2001a).

Table 2.3-3 presents the number of samples collected from each MWL well for the purging/sampling study as well as the toluene results. No detections of toluene were reported for any of the environmental or field QC blank samples, in contrast to the numerous detections reported in the 2009 and January 2010 sampling results where toluene detections at low concentrations were frequent. Two toluene detections for samples from MWL-BW2 (0.310 and 0.570 µg/L), three for samples from MWL-MW8 (0.260 to 0.660 µg/L), two for TB samples (0.630 and 0.660 µg/L), and one for an EB sample (0.330 µg/L) were qualified with "U" as not detected during data validation because of laboratory contamination identified in the laboratory method blank samples.

Table 2.3-3
Summary of April 2010 Toluene Purging/Sampling Study Results for MWL Wells

MWL Well	Number of Samples	Toluene Results/Comments
MWL-BW2	6	3 results not detected at 0.25 µg/L. 3 results qualified as not detected at 1.0 µg/L during data validation.
MWL-MW4	4	All results not detected at 0.25 µg/L.
MWL-MW5	6	All results not detected at 0.25 µg/L.
MWL-MW6	5	All results not detected at 0.25 µg/L.
MWL-MW7	5	All results not detected at 0.25 µg/L.
MWL-MW8	4	1 result not detected at 0.25 µg/L. 3 results qualified as not detected at 1.0 µg/L during data validation.
MWL-MW9	4	All results not detected at 0.25 µg/L.
Trip Blanks	10	8 results not detected at 0.25 µg/L. 2 results qualified as not detected at 1.0 µg/L during data validation.
Equipment Blanks	2	1 result not detected at 0.25 µg/L. 1 result qualified as not detected at 1.0 µg/L during data validation.
Field Blanks	2	All results not detected at 0.25 µg/L.
Total	**48**	34 environmental sample results, 14 field QC sample results

µg/L = Microgram(s) per liter.
MWL = Mixed Waste Landfill.
QC = Quality control.

The results of the April 2010 purging/sampling study, which was specifically requested by the NMED (Bearzi April 2010), support the conclusion that toluene is not present in the groundwater or derived from drilling/well materials. If drilling/well materials or inadvertent contamination introduced during the drilling/well installation process were the source of toluene, the initial sample should have had a detectable toluene concentration. All toluene results reported for the April 2010 sampling event (0.260 to 0.660 µg/L), including detections in the EB and TB samples, are associated with the laboratory process and were qualified as not detected during the data validation process.

2.3.3.2 TAV-MW10 Purging/Sampling Study

Since installation in February 2008, monitoring well TAV-MW10 has been sampled eight times (April, September, and December 2008; February, June, September, and December 2009; and February 2010). Three toluene detections have been associated with the eight sampling events (April 2008, February 2009, and June 2009), with toluene concentrations ranging from 0.252 to 0.39 µg/L. The April 2008 result (0.39 µg/L) was qualified as not detected during data validation due to toluene contamination detected in the associated laboratory method blank sample. The other two detections from 2009 samples were not qualified. The nondetected results from September 2008 and September 2009 were rejected during the data validation process due to laboratory QC issues. These two rejected nondetected results are not considered in the toluene detection frequency for this well, which is 25% (two detections out of eight samples, including two duplicate samples; Appendix B).

During the recent sampling event completed in June 2010, a purging/sampling study was performed following the same procedure that was used for the MWL monitoring wells. Four samples were collected during the purging process prior to collection of the final environmental and duplicate sample. Toluene was detected in two of the purging samples (first and third samples collected), but was not detected in any of the other samples. The toluene results are presented in Table 2.3-4.

Table 2.3-4
Summary of June 2010 Toluene Purging/Sampling
Study Results for Monitoring Well TAV-MW10

Sample Time	Volume of Water Purged (gallons)	Toluene Result (µg/L)	Comments
June 7, 2010 – 8:30 a.m.	Initial groundwater	0.350 J	Purging test sample
June 7, 2010 – 8:53 a.m.	8	ND (0.25)	Purging test sample
June 7, 2010 – 9:12 a.m.	16	0.330 J	Purging test sample
June 7, 2010 – 9:30 a.m.	24	ND (0.25)	Purging test sample
June 7, 2010 – 9:48 a.m.	>31 gallons	ND (0.25)	Environmental sample
June 7, 2010 – 9:48 a.m.	>31 gallons	ND (0.25)	Duplicate sample

J = Estimated value, above the method detection limit but below the practical quantitation limit.
µg/L = Microgram(s) per liter.
MW = Monitoring well.
ND = Not detected at the method detection limit, shown in parentheses.
TAV = Technical Area V.

The results for the June 2010 purging/sampling study performed at well TAV-MW10 vary from the MWL results. The fact that very low concentrations of toluene were detected only in samples collected early in the purging process and not in the final samples is consistent with drilling/well materials and/or inadvertent contamination introduced during the drilling/well installation process as possible toluene sources.

2.4 Sitewide Toluene Data Evaluation

Toluene results for all six SNL/NM groundwater monitoring programs (i.e., sitewide groundwater) were evaluated to determine whether the toluene detections at the MWL represent a unique situation or are occurring at other locations. Section 2.4.1 presents an evaluation of the sitewide environmental groundwater sampling results, and Section 2.4.2 presents an evaluation of the results for sitewide environmental field QC samples. Supporting summary information is provided in Appendix B for each monitoring well, including the number of toluene detections and nondetections, concentration range, number of results qualified as not detected during data validation, and the year the well was installed.

2.4.1 Sitewide Groundwater Sampling Results

Groundwater sampling results from October 2001 through April 2010 were evaluated for 93 monitoring wells and Coyote Springs, including a total of 1,606 results (environmental, split, and duplicate samples). The monitoring wells are located within six SNL/NM groundwater project areas and are collectively referred to as “sitewide monitoring wells and results” in this

report. These project areas are summarized in Table 2.4-1, which also presents the regulatory designation for each and the identification prefixes used for labeling associated monitoring wells. An important factor in this data analysis effort is that toluene is not a primary constituent of concern (COC) at any of the groundwater project areas. Toluene detections may have been expected based on the use of fuels at the Burn Site Groundwater Area of Concern. However, only one detection of toluene was reported for the samples collected from seven Burn Site Groundwater monitoring wells included in this study, and 101 nondetected results for toluene were reported. Figure 2.4-1 shows the locations of all sitewide monitoring wells across KAFB; Figure 1-1 shows the location of the MWL; and Figure 1-2 shows the location of the MWL groundwater monitoring wells. Supporting information is provided in Appendix B for this sitewide data evaluation.

Table 2.4-1
Summary of SNL/NM Groundwater Project Areas

Program or Project Area	Designation	Well Identification Prefix
Groundwater Protection Program	Groundwater Surveillance Monitoring	NWTA3-, SWTA3-, PL-, CTF-, TRE-, SFR-, MRN-, GREYSTONE-, EOD HILL, COYOTE SPRING
Chemical Waste Landfill	Regulated Unit	CWL-
Mixed Waste Landfill	SWMU	MWL-
Technical Area V	Groundwater AOC	LWDS-, TAV-, AVN-
Tijeras Arroyo Groundwater	Groundwater AOC	EUBANK-, PGS- , TA1-, TA2-, TJA-, WYO-
Burn Site Groundwater	Groundwater AOC	CYN-

AOC = Area of Concern.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.

Of the 1,638 results evaluated (environmental, split, and duplicate samples). 118 detections of toluene were reported. Twenty-three of these detections (19%) are for samples from the MWL wells (21 from the new wells installed in 2008). These totals do not include 71 detections that were qualified as not detected during the data validation process due to contamination identified in laboratory QC blank samples. An additional 20 nondetected results were also qualified during data validation for the same reasons. Four results were rejected due to other laboratory QC issues and are not included in the evaluation.

Figure 2.4-2 shows all toluene detections for groundwater samples from this time period from all SNL/NM monitoring wells, with MWL groundwater sampling results shown in red and results for all other wells in blue. The red vertical lines indicate 2008 through 2010 MWL quarterly sampling events. Several important points are illustrated in this graph, which are summarized as follows:

- All 118 detections occur at very low concentrations within a narrow concentration range (0.17 to 2.2 µg/L), with only 3 detections exceeding 1.5 µg/L (no MWL samples), and only 14 detections exceeding 1 µg/L (2 only in MWL samples). Of the total results, 88% are less than 1 µg/L (104 out of 118 results), and 63% are less than 0.50 µg/L (74 out of 118).

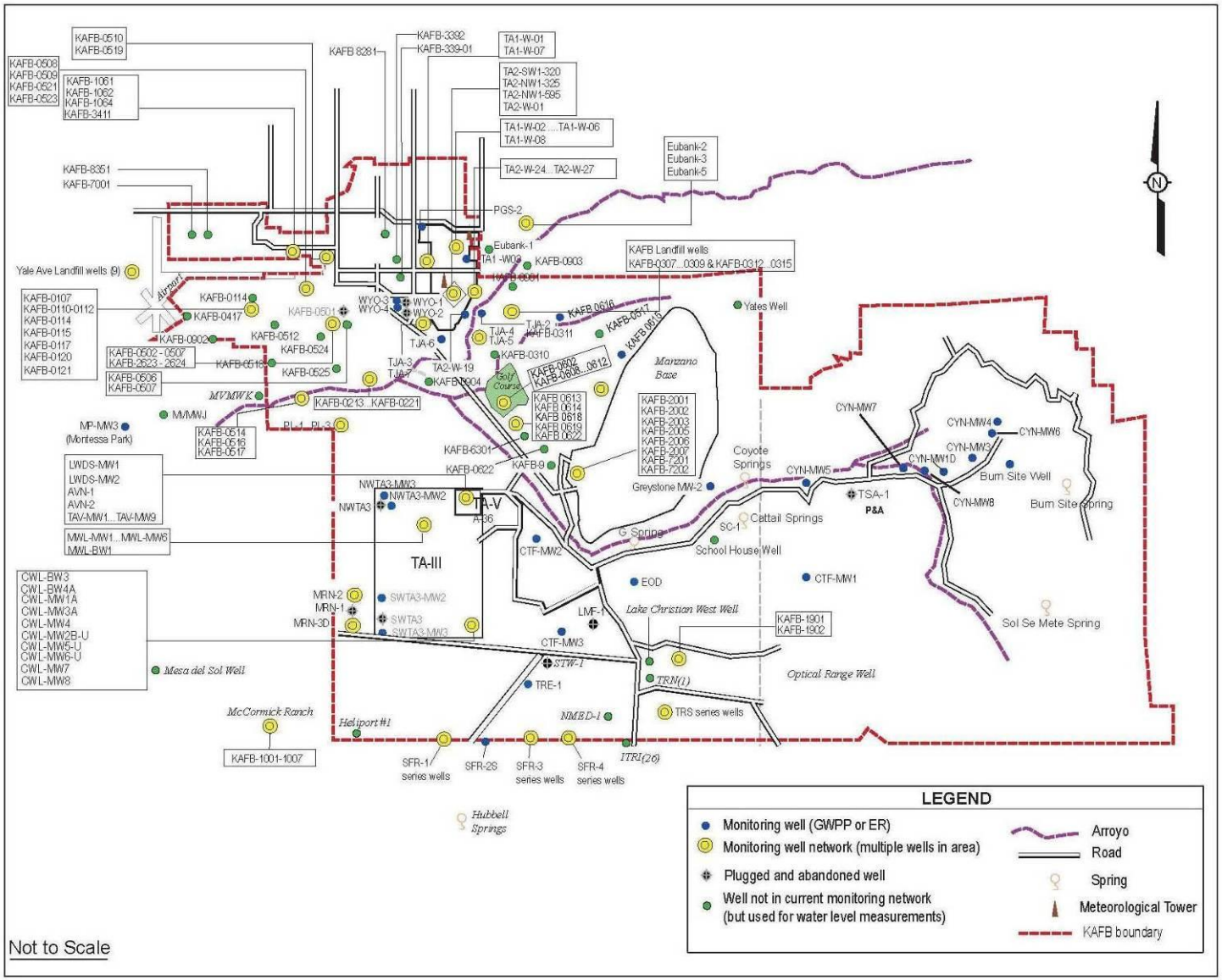

Figure 2.4-1
Location of SNL/NM Sitewide Monitoring Wells and Coyote Springs

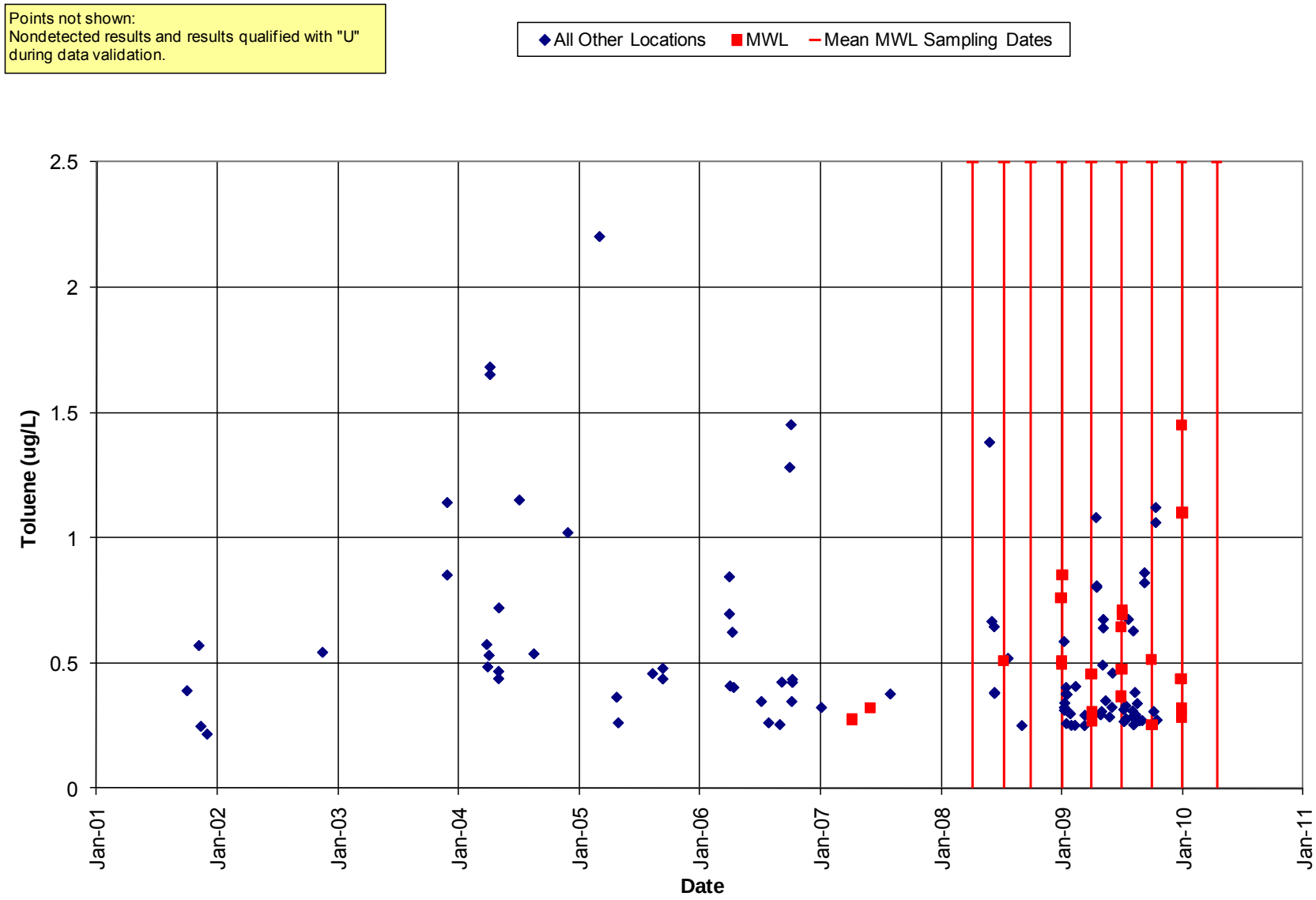

Figure 2.4-2
Sitewide Groundwater Monitoring Toluene Results for October 2001 through April 2010

- In a general sense toluene detections appear to cluster with respect to time, with more detections occurring in the years 2004, 2006, and 2009 in comparison to 2002, 2003, and 2008.

- Between 2008 and 2009, the number of samples remained relatively constant, but the number of toluene detections significantly increased across the sitewide groundwater monitoring network (2008: 163 samples, 8 detections; 2009: 174 samples, 63 detections).

- For the same time period at the MWL, the same trend is evident (2008: 15 samples, 1 detection; 2009: 23 samples, 15 detections).

Toluene contamination occurring at the laboratory, as confirmed during data validation, accounted for 71 detections, which represents 58% of the total unqualified detections (118 unqualified detections versus 68 qualified detections) and 4% of the total sample population. An evaluation of the laboratory as a source of toluene in MWL groundwater samples is presented in Section 3.2.

The number of detections versus the number of samples, or the frequency of detection at a given monitoring well, allows comparison of wells that have been sampled at different frequencies or a different number of times. Figure 2.4-3 shows the detection frequency at all of the monitoring wells with at least one toluene detection. MWL monitoring wells are shown in red and all other wells are shown in blue. The new MWL monitoring wells installed in 2008 (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) show a higher relative detection frequency, ranging from 19% in background well MWL-BW2 to 58% in MWL-MW9. Four Chemical Waste Landfill (CWL) wells (background wells CWL-BW3 [25%] and CWL-BW4A [25%] and monitoring wells CWL-MW5U [28%] and CWL-MW6U [32%]) also show a relatively high detection frequency, as does Groundwater Protection Program well EUBANK-2 (25%). Also of note is well TAV-MW10 (25%) that was installed during the same drilling effort as the new MWL wells in 2008. In addition to the new MWL and TA-V wells installed in 2008, 20 monitoring wells have a detection frequency greater than or equal to 10%.

A different perspective is presented in Figure 2.4-4, which shows the percentage of toluene detections that occurred in 2009 for all the monitoring wells with a detection frequency greater than or equal to 10%. The percentage of toluene detections in 2009 for the new MWL wells (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) and TAV-MW10 ranges from 60 to 100%. For other wells that have been sampled more extensively prior to 2009, the impact of the 2009 detections is less. Figures 2.4-2 and 2.4-3 taken together reflect the impact of the higher number of overall toluene detections in 2009 on the wells that were installed and began quarterly sampling in 2008. The fact that these wells were installed just prior to 2009 and were sampled four times throughout 2009 has resulted in a detection frequency that is biased high versus monitoring wells that were installed prior to 2008 and sampled only twice (semiannually) or once (annually) during 2009.

Even considering the 2009 bias for the newly installed MWL wells, the detection frequencies shown in Figure 2.4-3 are all below 60%, with the majority below 30%, and do not suggest the presence of a toluene plume beneath the MWL (i.e., if environmental contamination were present in the groundwater, the detection frequencies would be higher). Of the 13 wells with the highest detection frequency (19 to 58%), 3 are background wells (CWL-BW3, CWL-BW4A, and MWL-BW2), with detection frequencies of 25, 25, and 19% respectively. The fact that toluene is

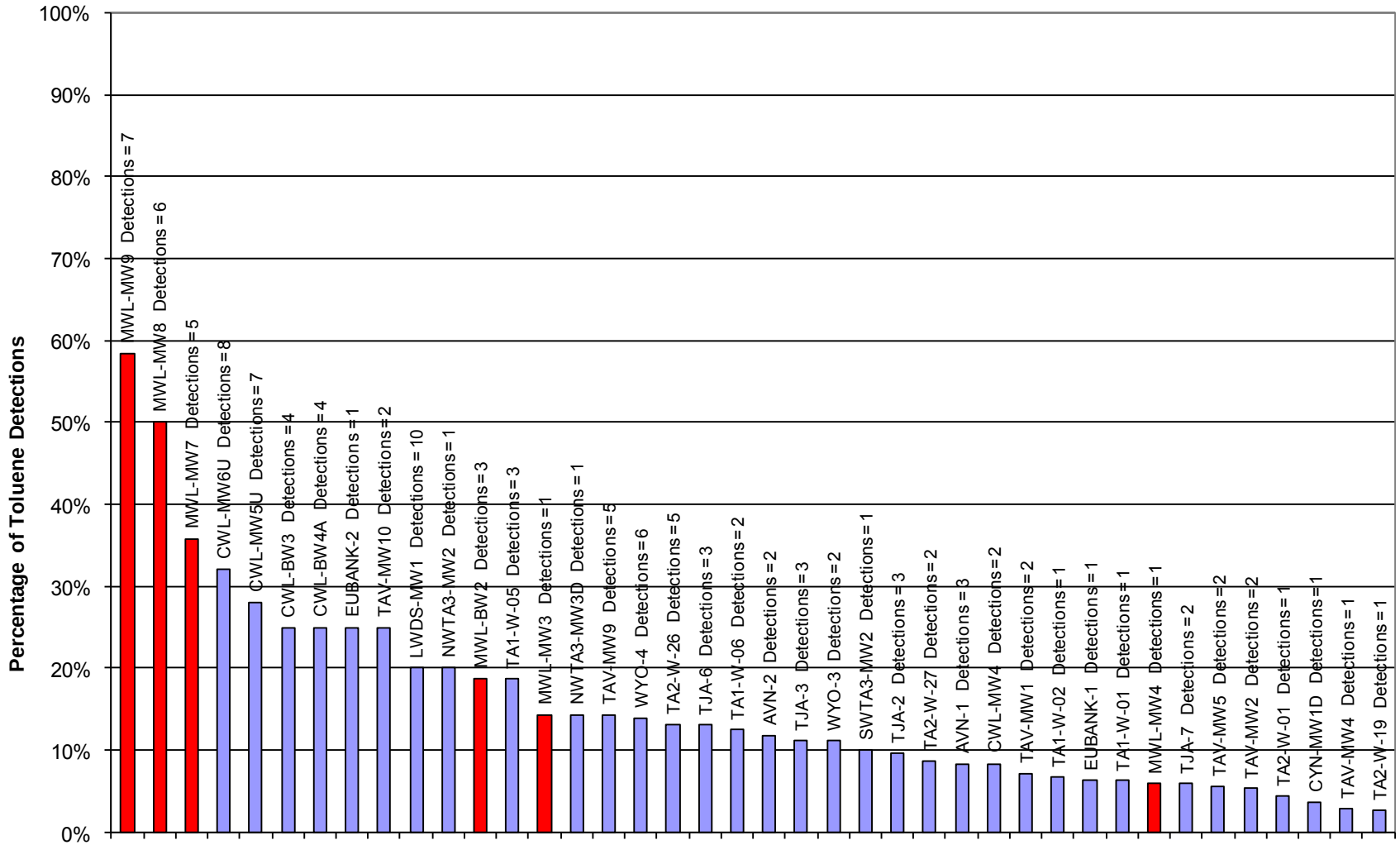

Figure 2.4-3
Frequency of Toluene Detections in Sitewide Monitoring Well Samples – October 2001 through April 2010

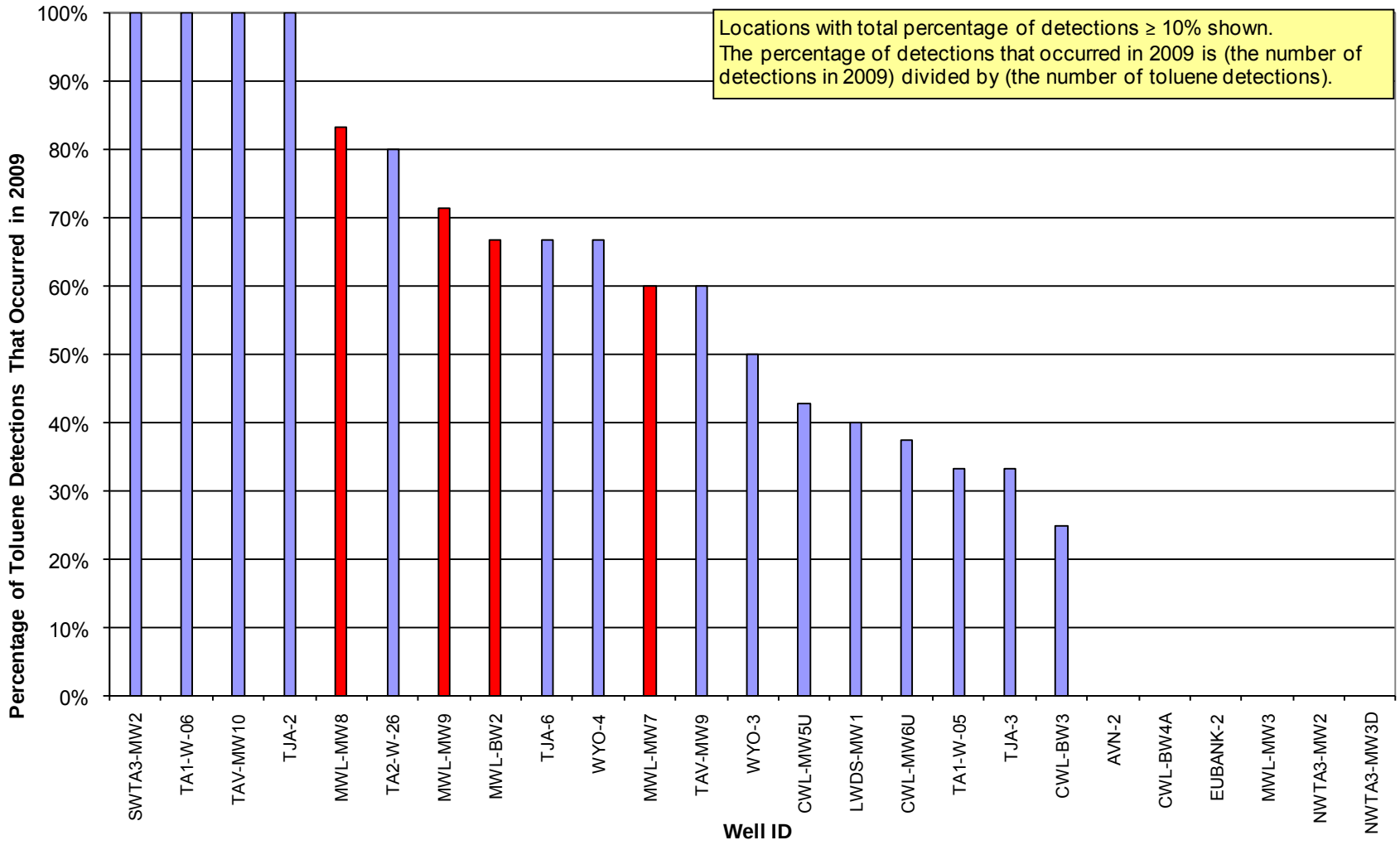

Figure 2.4-4
Frequency of 2009 Toluene Detections in Sitewide Monitoring Well Samples – October 2001 through April 2010

being detected in samples from background wells that are installed hydraulically upgradient at sites where toluene is not a COC further supports the conclusion that the very low-concentration toluene detections are not related to contamination in the regional aquifer. In addition, Figure 2.4-4 shows that the five new wells installed in 2008 (MWL-BW2, MWL-MW7, MWL-MW8, MWL-MW9, and TAV-MW10) have detection frequencies ranging from 19 to 58%, suggesting a possible toluene source related to drilling and/or well construction materials.

2.4.2 Sitewide Quality Control Blank Data Evaluation

Field QC samples are collected or maintained with environmental groundwater samples as part of the groundwater sampling process. These field QC samples include TB, EB, and FB samples. A TB sample is prepared by the laboratory and kept with environmental VOC samples after collection through transport to the laboratory to assess whether contamination occurred during storage and shipment. An EB sample is collected after decontamination of sampling equipment to verify the effectiveness of the decontamination process. An FB sample is collected in the field where the environmental sample is collected to check for potential contamination sources that may be present during actual sample collection in the field.

Figure 2.4-5 shows the toluene detection frequency for EB, FB, and TB data associated with the October 2001 through April 2010 environmental sampling data. As part of the data validation process, blank data are qualified following the same procedure that is followed for validating environmental sample data. If contamination is detected in the associated laboratory method blank, the related environmental and TB-EB-FB data are qualified accordingly. For the very low concentrations reported for the sitewide October 2001 through April 2010 data set, this results in a qualification of not detected (i.e., "U"-qualified).

Table 2.4-2 summarizes the total number of TB, EB, and FB samples, the number of detections, and the detection frequency. Both Figure 2.4-5 and Table 2.4-2 also show the number of blanks qualified as nondetected results during the data validation process due to laboratory contamination. The percentage of data qualified as nondetected ranges from 2% for TB samples to 4% for FB samples.

Table 2.4-2
Summary of Toluene Results for Field QC Blank Samples

Field QC Blank Samples	Number of Detections	Number of Samples	% Detections	Number of DV-Qualified Detections	% Detections Including DV-Qualified Data	Concentration Range in µg/L
Equipment Blanks	19	271	7%	9	10%	0.194–10.6[a]
Field Blanks	6	124	5%	5	9%	0.272–0.7
Trip Blanks	126	1463	9%	31	11%	0.184–1.21
TOTAL	**151**	**1,858**	**—**	**45**	**—**	

[a]Two EB sample results exceeded 1 µg/L from CWL (5.16 µg/L, June 2008) and TA-V (10.6 µg/L, March 2005). All other EB results ≤ 0.882 µg/L.

CWL = Chemical Waste Landfill.
DV = Data Validation.
EB = Equipment blank.
µg/L = Microgram(s) per liter.
QC = Quality Control.
TA = Technical Area.

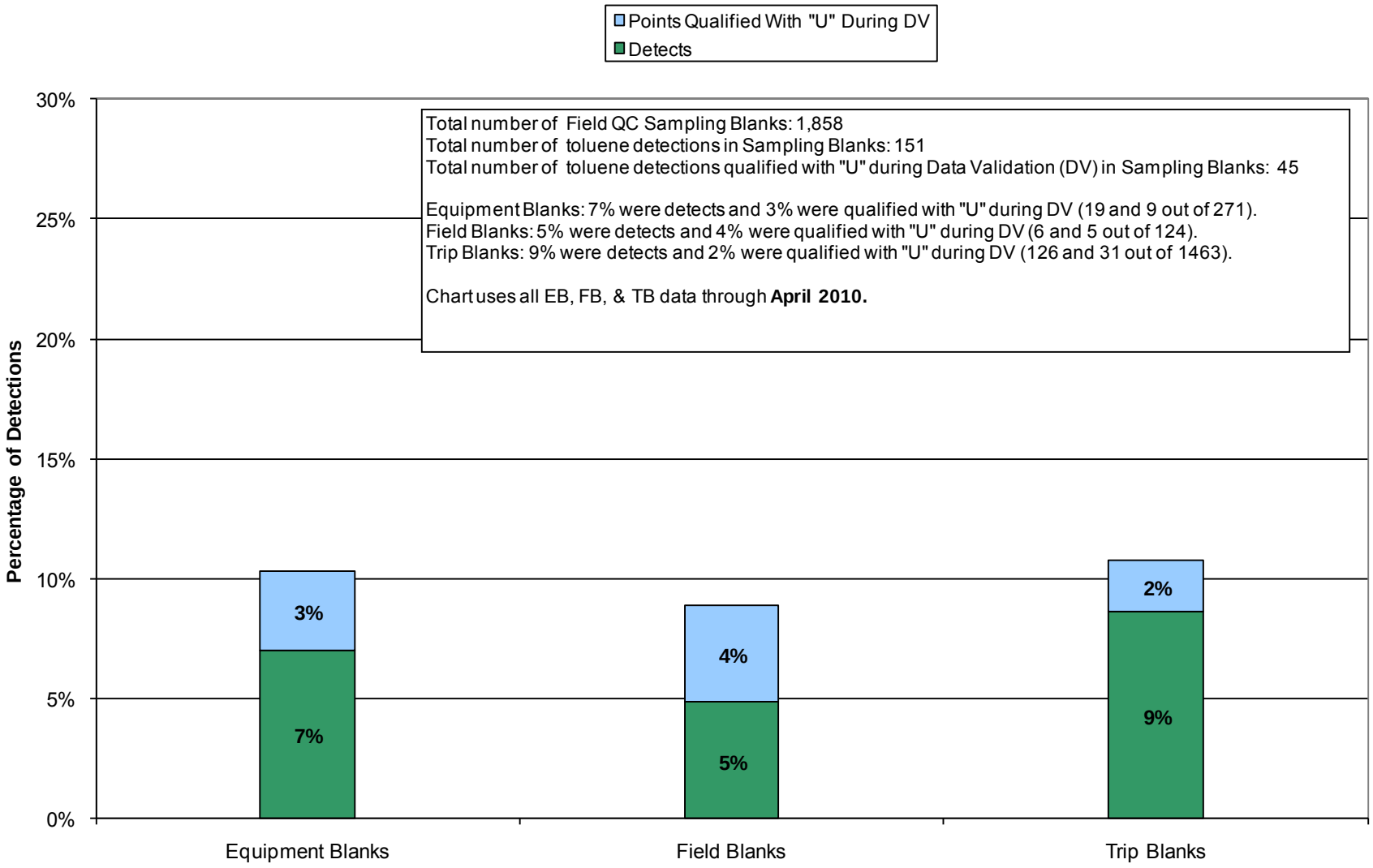

Figure 2.4-5
Frequency of Toluene Detections in Sitewide Field QC Blank Samples – October 2001 through April 2010

The number of TB samples far exceeds the number of FB and EB samples because TBs accompany every shipment of VOC samples. Due to the relatively short holding time for the EPA Method 8260 VOC analysis (14 days for aqueous samples), VOC samples from multiple wells cannot be batched together, resulting in multiple shipments that all contain TB samples. The detection frequency of the field QC blank samples does not indicate systematic problems with the shipping, decontamination, or sampling process. Instead, the results for all three types of field QC blank samples suggest that they are subject to the same contamination source(s) as the environmental samples.

The TB samples should not be indicating contamination at all as they are prepared by the laboratory with ultra-clean water and never opened during the sampling and shipping process. They simply travel with the samples from the field to the laboratory in the sample shipping container (typically a cooler) to monitor for cross-contamination during shipment, which can occur if there are contaminated samples in the shipping container or if a contaminated sample breaks during shipment. Because the environmental samples show only very low toluene concentrations, cross-contamination during sampling and shipment should not be occurring, even if an environmental sample broke open during shipment. Based upon more than a thousand sampling results, there is simply not enough toluene in the environmental groundwater samples to diffuse from the environmental sample through the sealed TB container.

If the sampling process (i.e., equipment and method) was flawed, the percentage of detections in FB samples should be higher. Instead, FBs show the lowest detection frequency of all the field QC blanks. Similarly, the EB results should only show measureable contamination if there were significant concentrations of toluene in the groundwater being sampled. The fact that both the environmental samples and all the field QC blanks show very low concentrations at or near the laboratory MDL further supports the conclusion that the field QC blank samples are being affected by the same non-groundwater source(s) as the environmental samples. Only three field QC blank samples had toluene detections exceeding 1 µg/L (two EB samples and one TB sample). The two EB sample results of 10.6 and 5.16 µg/L appear to be outliers as they were significantly higher than any of the environmental sample results.

While the sampling equipment and method do not appear to be the source of toluene, some cases of toluene contamination do appear to be occurring during the sampling process. In other words, ambient environmental sources of toluene outside the sampling process appear to be impacting the field QC blank and environmental samples during the sampling process. In addition, some cases where the laboratory is the source of the toluene detections are probably not being identified. As discussed in Section 2.1, the laboratory QA/QC processes provide a valid check for laboratory contamination, but they are not perfect.

2.5 Sitewide Air Monitoring Data Evaluation

The VOC Air Monitoring Program at SNL/NM was developed using DOE orders and EPA standards to ensure accurate data and good comparability with ambient air surveillance data obtained by the City of Albuquerque Environmental Health Department. Ambient air sampling is performed at four strategic monitoring locations across SNL/NM, one of which is located at the northern end of the MWL along the site access road. A sample is collected once a month at each site during a 24-hour period on a weekday (Monday through Friday). Air is sampled at the breathing zone, generally around 2 meters above the ground, to assess ambient conditions to which people could be exposed.

Results for 2008 through 2009 show no anomalously high detections of toluene at the MWL air monitoring station; however, the results are collected only one day each month. Toluene is routinely detected at low concentrations at all four monitoring locations (SNL/NM September 2008b and September 2009). For 2009, the toluene results ranged from 0.16 to 0.825 milligrams per cubic meter (mg/m^3) at the MWL monitoring station. In April 2009, an elevated detection at the TA-II air monitoring station (37.8 mg/m^3) was attributed to a vehicle idling adjacent to the monitoring station.

2.6 Groundwater Data Evaluation Summary and Conclusions

Groundwater monitoring has been conducted at the MWL for VOCs, including toluene, since 1990. Except for MWL-MW6, toluene has been detected in groundwater samples from all MWL monitoring wells at very low concentrations since 1994. There have been 47 detections of toluene in MWL groundwater monitoring samples, of which 14 are from MWL-MW4 samples. The probable source for most of the 14 detections in samples from MWL-MW4 is the Baski® packer (Section 2.3.1). Of the 33 toluene detections (excluding the 14 MWL-MW4 detections), 21 are from the new monitoring wells installed in 2008, and all but 4 results are qualified as estimated concentrations (i.e., "J" values) because they are below the laboratory PQL (1 µg/L). Samples from both background monitoring wells (MWL-BW1 and MWL-BW2) have had three detections of toluene.

The April 2010 purging/sampling study results for the MWL wells showed only laboratory-related toluene contamination in 5 of the 34 groundwater samples. The results for the June 2010 purging/sampling study performed at well TAV-MW10 vary from the MWL results and are consistent with drilling/well materials and/or inadvertent contamination introduced during the drilling/well installation process as possible toluene sources. The purging/sampling study results are not consistent with the presence of low-concentration toluene in the regional aquifer.

An evaluation of more than 1,600 sitewide groundwater sampling results from October 2001 through April 2010 reveals that low-concentration detections of toluene are occurring in samples from across the SNL/NM sitewide monitoring well network. The number of toluene detections at low concentrations in samples from across the sitewide monitoring well network increased dramatically in 2009, coinciding with quarterly sampling of the newly installed MWL monitoring wells (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) and TAV-MW10. As a result, the toluene detection frequency is significantly higher in samples from these wells than in those from other sitewide wells with more sampling results from the pre-2009 period.

An evaluation of more than 1,800 sitewide field sampling QC blank results from October 2001 through April 2010 shows a pattern of low-concentration toluene detection very similar to the environmental groundwater sampling results. The relatively consistent toluene detection frequency of approximately 10% for the three types of field QC blanks (accounting for qualified results) suggests the sampling process (equipment decontamination, sample collection, and sample shipment) is not the source of toluene. These sampling results indicate an ambient environmental and/or laboratory source that is affecting both the environmental and field QC blank samples during the sampling process.

Laboratory QC method blank samples analyzed with sitewide and MWL groundwater samples confirm the laboratory is also a source of toluene. This is documented through the data validation process and evident in the number of results for environmental and field QC samples that are qualified as not detected. However, GEL is not the only contamination source, as

demonstrated by the abundant unqualified 2009 toluene results and the NMED/DOE OB split sampling results that show very similar concentrations from analyses performed at a different laboratory from 2008 through January 2010.

A review of the 2008 and 2009 air monitoring data collected for the SNL/NM Air Monitoring Program indicates low concentrations of toluene are present in the ambient air across the facility and at the MWL. Because these data are collected only one day per month, the data set is not large enough to support conclusions beyond confirming that toluene is present in the ambient air at measurable concentrations.

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3.0 EVALUATION OF POTENTIAL SOURCES

This section presents an evaluation of potential toluene sources considered, which include the following:

- **MWL.** Toluene from the waste disposal areas migrating to the regional aquifer and then being detected in groundwater samples from the monitoring wells (Section 3.1)
- **Analytical Laboratory.** Sample contamination occurring during laboratory processing and/or analysis (Section 3.2)
- **Sampling Process.** Sample contamination through contact with sampling materials or equipment that contain toluene or by the introduction of toluene contamination during the sampling method or overall sampling process (Section 3.3)
- **Drilling and Well Installation Process.** Toluene transferring to the groundwater within the monitoring well from equipment and/or materials used to drill and install the monitoring well (Section 3.4)

The conclusions of this evaluation are presented at the end of each section and in Section 4.0.

3.1 Mixed Waste Landfill

A detailed review of records and interviews of employees who worked at the MWL were conducted as part of the initial MWL investigation process. The first major field investigation was conducted as part of the Phase 1 RFI in 1989 and 1990 to determine whether a release of RCRA-regulated contaminants had occurred at the MWL. The Phase 1 RFI indicated that tritium had been released to the environment (SNL/NM September 1990). The Phase 2 RFI was conducted from 1992 through 1995 and consisted of reconnaissance radiological surveys, air monitoring, passive and active soil-vapor surveys, nonintrusive geophysical surveys, soil sampling for background metals and radionuclides, surface soil sampling, borehole drilling and subsurface soil sampling, vadose zone tests, aquifer tests, and risk assessment. The Phase 2 RFI confirmed the findings of the Phase 1 RFI; tritium is the contaminant of primary concern at the MWL. After numerous reviews and comment response actions, the Phase 2 RFI Report was revised and approved by the NMED in December 2002, and published in its final technical format (Peace et al. September 2002). A detailed summary of the waste inventory was included as Appendix A.

The Phase 2 RFI did not identify toluene as a COC based upon the inventory information and the results of the field investigation, including soil-vapor surveys and subsurface borehole soil sampling results. No free liquids were disposed of in the MWL with the exception of the May and June 1967 discharge to Trench D of approximately 204,000 gallons of coolant wastewater from the SNL/NM Engineering Reactor Facility. Based upon a review of the inventory, the only waste items that contained liquids prior to solidification and disposal are summarized as follows:

- 1 waste container with 5 gallons of oil adsorbed onto vermiculite
- 1 waste container with 1.5 gallons of solvents adsorbed onto vermiculite
- 2 waste containers, each with 1 gallon of toluene adsorbed onto vermiculite
- 1 gallon of tritium-contaminated acetone solidified with Safe-T-Set

This represents a total of approximately 9.5 gallons of liquid waste that were solidified or adsorbed onto vermiculite and then disposed of in the MWL.

In 1995, fifteen boreholes were drilled and subsurface soil samples were collected. Two of the boreholes were drilled vertically on the east side of the MWL; the remaining boreholes were inclined 30 degrees from vertical at locations on all four sides of the MWL. These 13 boreholes thus projected beneath the disposal areas. A total of 88 soil samples were collected from the 15 boreholes at depths ranging from 10 to 122 feet below ground surface (bgs). These samples were analyzed for VOCs, including toluene, using EPA Method 8260.

No VOCs were detected in soil samples from four of the boreholes. Low concentrations of nine VOCs were reported for soil samples collected from the other 11 boreholes. Of the 27 detections reported for the nine VOCs, 23 detections were qualified by the laboratory (less than the PQL) or during data validation as estimated (i.e., "J"-qualified). Four of the reported VOCs (toluene, 2-butanone, acetone, and methylene chloride) are considered common laboratory contaminants (EPA April 1992). These 4 VOCs are responsible for 14 of the 27 detections in the soil samples. Toluene was detected once below the PQL at a concentration of 20.4 J micrograms per kilogram (equivalent to ppb) reported for the sample collected at a depth of 119 feet bgs from BH-13.

Subsurface soil-vapor sampling was performed across the entire MWL area in 1994 as part of the Phase 2 RFI, and then again in 2008 as requested by the NMED (Bearzi November 2006). The purpose of the 2008 soil-vapor survey was to confirm that conditions had not changed significantly since completion of the Phase 2 RFI work in the mid-1990s (SNL/NM August 2008). The results for both surveys are summarized in Table 3.1-1.

Table 3.1-1
Summary of 1994 and 2008 Soil-Vapor Survey Toluene Results

Total Number of Samples	96 (72 from 1994; 24 from 2008)
Depth of Samples	10 to 50 feet below ground surface
Number of Toluene Detections	15
Frequency of Toluene Detections	16% (15 detections in 96 samples)
Concentration Range for Toluene Detections	1.2 to 26 parts per billion by volume

To determine whether these soil-vapor concentrations of toluene pose a significant risk to groundwater quality, a conservative phase partitioning model was prepared (Appendix C). This calculation is designed to determine the concentration of toluene that would result in groundwater using Henry's Law assuming that the maximum concentration of toluene soil vapor from the upper 50 feet of the vadose zone beneath the MWL was in direct contact and in equilibrium with the capillary fringe above the water table approximately 450 feet beneath the deepest soil-vapor sampling depth. Previous soil-vapor surveys have determined that the maximum toluene soil-vapor concentration was 26 parts per billion by volume. For the fine-grained alluvial deposits that overlie the water table beneath the MWL, the capillary fringe is several feet thick. This calculation is hypothetical, unrealistic, and does not take into account

many processes and factors that would result in a much lower toluene concentration in groundwater, such as dilution of the toluene in the groundwater once it has diffused through the capillary fringe. It is provided only to demonstrate that the known concentrations of toluene in soil vapor at the MWL are not capable of producing the very low concentrations of toluene measured in the groundwater samples collected from beneath the site.

The calculated toluene concentration in groundwater at the top of the water table would be 0.015 µg/L. This concentration is an order of magnitude below the laboratory MDL (0.25 µg/L) that would not be detectable. This calculation demonstrates that the concentrations of toluene in soil vapor cannot produce the very low levels of toluene measured in the MWL groundwater samples even assuming a hypothetical, unrealistic scenario (i.e., where the maximum concentration of toluene soil vapor from the upper 50 feet beneath the disposal areas is projected 450 feet downward to the water table with no attenuation and no dilution once it has diffused into the groundwater).

At the CWL, located south of the MWL in TA-III, a release of trichloroethene (TCE) to the groundwater via a VOC soil-vapor plume has been documented, investigated, and soil-vapor extraction/landfill excavation voluntary corrective measures completed (SNL/NM December 2004). Subsurface TCE soil-vapor concentrations in the upper 50 feet of the vadose zone beneath the disposal areas were initially characterized in the thousands to tens of thousands of parts per million volume (ppmv) basis (i.e., 10,000 ppmv), which resulted from liquid solvent disposal (thousands of gallons) into unlined pits and trenches (SNL/NM December 2004). Based upon the experience gained investigating, remediating, and monitoring both VOC soil vapor in the vadose zone and VOCs in groundwater, these extremely high concentrations of VOC soil vapor are required to drive advective-dispersive soil-vapor transport necessary for contamination to reach groundwater (SNL/NM December 2004, Annex E). Even with the amount of liquid disposal at the CWL, liquid solvent penetrated no deeper than approximately 30 feet into the subsurface (SNL/NM April 2003 and December 2004). In contrast, the highest detection of toluene in soil-vapor sampling performed at the MWL in 1994 and 2008 was 0.026 ppmv. There is no evidence of these types of conditions that would be required to create a VOC/toluene soil-vapor plume of sufficient mass and concentration to impact groundwater at the MWL.

Summary and Conclusion

The inventory information, subsurface soil sampling results, and soil-vapor survey results (Peace et al. September 2002 and SNL/NM August 2008) confirm that toluene is not a COC at the MWL. Based upon this information, there is no evidence of toluene contamination capable of impacting groundwater beneath the MWL.

3.2 Analytical Laboratory

This section evaluates the analytical laboratory as a source of toluene contamination that can occur during groundwater sample processing and analysis. Section 3.2.1 discusses laboratory method blank samples, and Section 3.2.2 addresses the data validation review of laboratory sampling results.

3.2.1 Method Blank Samples

As discussed in Section 2.2, the analytical laboratory (GEL) analyzes QC method blank samples with every batch or group of environmental samples from clients such as SNL/NM. The results for these method blank samples are used to determine whether the laboratory is the source of contaminants detected in the client samples and to verify that the MDL for specific compounds, such as toluene, are technically sound. According to the SMO analytical laboratory SOW (SNL/NM May 2009b), if a contaminant such as toluene is detected in the method blank sample population above the MDL at a frequency of greater than 10% over an annual period, corrective action is required and would likely result in the laboratory raising the associated MDL.

Figure 3.2-1 shows the detections of toluene in the GEL method blanks for the period from January 2008 through May 2010. There were 43 detections out of 3,783 method blank samples analyzed for a detection frequency of approximately 1%. These data demonstrate that GEL was in full compliance with the SOW requirements relative to the toluene MDL and does not appear to be the primary source of toluene contamination for the 2008 through early 2010 sitewide groundwater monitoring results. The concentration range for the method blank detections is very similar to the range for the sitewide environmental samples (0.25 to 0.8137 µg/L).

Figure 3.2-1 shows that detections appear to cluster during relatively narrow time periods. Figure 3.2-2 focuses on the March though May 2010 time period and shows how the early 2010 method blank cluster resolves into two clusters: one in March and one in April 2010 (there are method blank samples analyzed between these dates but the results were nondetected). Some of the April 2010 detections were associated with the MWL April sampling event and resulted in eight toluene detections in samples associated with MWL-BW2 and MWL-MW8 being qualified as not detected during the data validation process.

Summary and Conclusion

While the laboratory method blank protocol and results demonstrate that GEL's performance is excellent, it is unrealistic to assume that even the best analytical laboratory will not occasionally (randomly) have false positive results and cross-contamination issues. This is particularly true for volatile compounds that are found in many common materials throughout industrialized society. As discussed in Sections 2.1 (Data Validation) and 2.2 (Laboratory Method Detection Limit), method blank analysis and data validation protocols provide a rigorous approach to identifying data quality issues and have identified many specific cases where the laboratory was the source of toluene contamination. Even so, they are not perfect. While it is accurate to say that the GEL method blank results indicate exemplary performance, it is not realistic to say that all cases of toluene laboratory contamination have been identified and addressed for this time period. Based on the extremely low detection limit and ubiquitous nature of toluene, identifying every case of contamination in the laboratory is neither feasible nor possible.

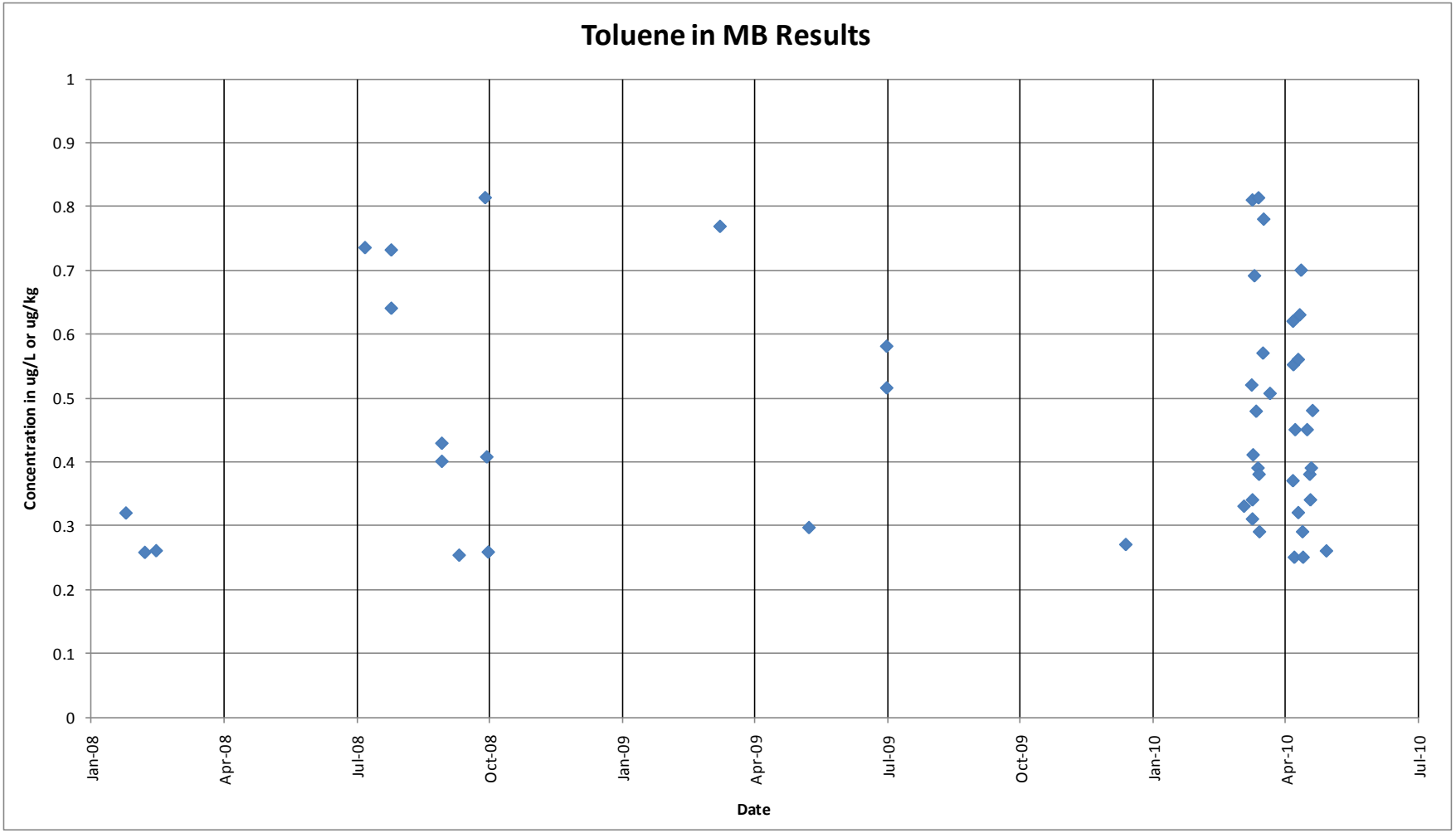

Figure 3.2-1
Toluene Concentrations in GEL Laboratories, Inc. Method Blank Samples – January 2008 through May 2010

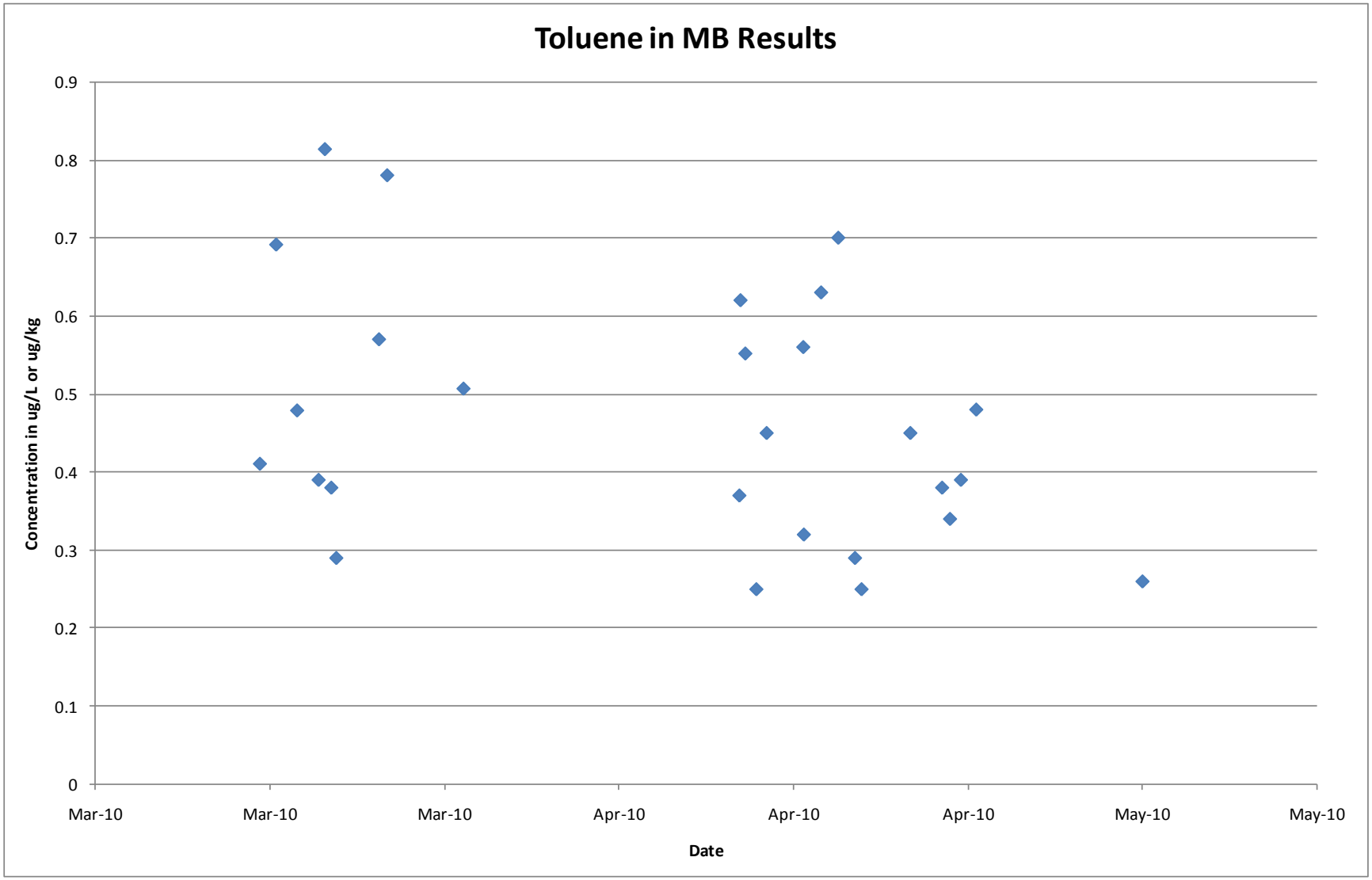

Figure 3.2-2
Toluene Concentrations in GEL Laboratories, Inc. Method Blank Samples – March through May 2010

3.2.2 Data Validation Review

As described in Section 2.1, all SNL/NM sitewide and MWL groundwater monitoring data are validated according to the SNL/NM "Data Validation Procedure for Chemical and Radiochemical Data," AOP [Administrative Operating Procedure] 00-003, Revision 2 (SNL/NM July 2007). Because of the significant increase in toluene detections in 2009 at both the MWL and across the entire sitewide monitoring network, a review was conducted of all the data validation reports for this period. Based upon this review, there were no findings that indicated the laboratory was the primary source of the increase in toluene detections.

Conclusions

The laboratory method blank data demonstrate that GEL is in compliance with EPA Method 8260 and SMO SOW requirements for VOC analysis. While its performance is exemplary with a method blank toluene contamination frequency of approximately 1% for 2008 through early 2010, toluene contamination is occurring at the laboratory as documented by the GEL QA/QC Program and the SNL/NM data validation process. However, GEL does not appear to be the primary source of the increased toluene detection frequency for 2009 that is discussed in Section 2.3.

3.3 Sampling Method and Equipment

This section evaluates the groundwater sampling equipment, methods, and process as a potential source of toluene contamination in groundwater samples. Groundwater sampling methods and procedures are described in the MWL Annual Groundwater Monitoring Reports and Sampling and Analysis Plans (SAPs) that are prepared for each sampling event. A Bennett™ sampling system permanently mounted in the SNL/NM water sampling truck is used to purge the monitoring wells and collect the groundwater samples after depth-to-water measurements are collected. The pump intake is set near or at the bottom of each screen interval, and the minimum achievable flow rate, given limitations of equipment and well characteristics, is used for all purging and sampling activities. All groundwater samples are collected directly from the pump discharge tubing located in the water sampling truck into pre-preserved, laboratory-provided sample containers. A description of the sampling equipment used is presented in Table 3.3-1. A photograph of the water sampling truck is shown in Figure 3.3-1. A view of the in-flow and discharge tubing inside the water truck is shown in Figure 3.3-2.

Prior to sampling each monitoring well, the portable Bennett™ sampling system; including the pump, tubing bundle (portion that is exposed to groundwater), and the water lines inside the truck are decontaminated at the Building 9925 field office. As appropriate, based upon SAP requirements, an EB sample may also be collected prior to mobilizing to the site for sampling. In accordance with SNL/NM FOP [Field Operating Procedure] 05-03, "Long-Term Environmental Stewardship Groundwater Sampling Equipment Decontamination" (SNL/NM November 2009), the following solutions are pumped through the sampling system: 5 gallons of deionized (DI) water mixed with 20 milliliters (mL) of nonphosphate laboratory detergent; 5 gallons of DI water; 5 gallons of DI water mixed with 20 mL of reagent-grade nitric acid; and 15 gallons of DI water. In addition, the outside of the pump tubing is rinsed with DI water. The EB (or rinsate) samples are collected from the pump discharge tubing in the water truck to verify the effectiveness of the equipment decontamination process.

Table 3.3-1
MWL Groundwater Sampling Equipment

Bennett™ Portable Sampling System: • Model 1800 submersible piston pump • 700-foot polypropylene tubing bundle. Three lines consisting of the pneumatic tubing, air exhaust tubing, and water discharge tubing • Bennett™ tubing bundle reel, equipped with an electric power drive motor
Water Sample Field Equipment: • YSI 6920 V2 water quality meter with pH probe, EC probe, ORP probe, DO probe, and temperature probe • HACH 2100P turbidity meter • Model 101 Solinst water level meter (750-foot tape)
Water Truck Equipment: • Stainless steel (laboratory grade) and Teflon® tubing lines for water discharge. Water discharges from the Bennett™ system through a flow meter, to a flow cell (YSI water quality meter), to a sampling port (with valves for sampling), then empties to buckets or waste containers • Nitrogen gas cylinders (for powering the downhole pump) and pressure regulator • Laptop computer

Note that MWL-MW4 has a dedicated Bennett™ pump sampling system.
DO = Dissolved oxygen.
EC = Electroconductivity.
MWL = Mixed Waste Landfill.
ORP = Oxidation-reduction potential.

Figure 3.3-1
Groundwater Sampling Truck with Bennett™ Pump and Solinst Water Level Meter (red reel in left foreground) Deployed in the Monitoring Well

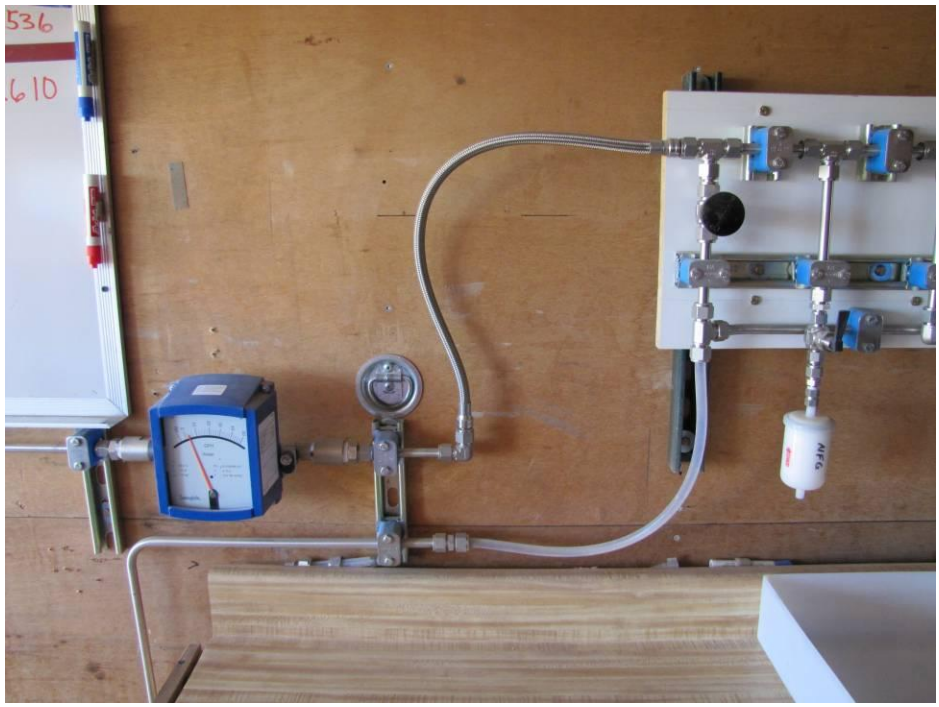

Figure 3.3-2
View of the Tubing Inside the Groundwater Sampling Water Truck

Groundwater is pumped from the well into the water truck in a closed system. Electrical power for the sampling system is provided by the water truck battery through AC/DC inverters (engine is off during all sampling activities). Nitrogen gas is used to pressurize the Bennett™ pump system through pneumatic tubing. Figure 3.3-2 shows the laboratory-grade, stainless steel tubing inside the water truck. Groundwater flows through the tubing shown on the far left side under the white board through the flow meter (blue box on left side of photograph) to discharge lines (vertical stainless steel tubing) on the panel on the right side of photograph where the groundwater sample containers are filled.

The one vertical discharge line shown in Figure 3.3-2 has a filter attached for the collection of the filtered sample for total metals. The flow cell where groundwater field readings are measured with the YSI 6920 V2 water quality meter is located just out of view on the right-hand side of the tubing panel shown in Figure 3.3-2. The clear tubing in the lower left side of the tubing panel carries water not collected in the sampling process to waste containers. The tubing system is equipped with valves so that once stabilized field parameters are documented and recorded, the groundwater can flow directly though the discharge tubing into containers, bypassing the flow cell. The only part of the sampling process that is not closed to the atmosphere is when the groundwater is discharged into the sample containers and waste containers (excess groundwater not needed for samples) inside the back of the truck. Sample management and custody procedures are performed in accordance with AOP 95-16, Revision 02, “Sample Management and Custody” (SNL/NM March 2007).

3.3.1 Field Quality Control Blank Sample Results

Field QC sample results are discussed and evaluated in Section 2.4.2. The same equipment is used to sample all the monitoring wells at SNL/NM, and the sampling is performed by the same field personnel. As summarized in Section 2.4.2, there is no clear evidence in the various field QC blank samples to indicate that the source of the toluene contamination is related to the sampling equipment or method/process. Both the environmental samples and all the field QC blanks that have detections of toluene, including those associated with the MWL, show very low concentrations at or near the laboratory MDL. This is the case for TB samples that are prepared by the laboratory with ultra-clean water and only travel with the environmental samples; they are not opened until they reach the laboratory. These data support the conclusion that the sampling equipment and method/process is not the source of toluene contamination in the groundwater samples. Instead, these field QC blank samples appear to be affected by the same ambient environment and/or laboratory toluene source as the environmental samples.

3.3.2 Sample Tubing Bath Test Results

In November 2009, SNL/NM submitted various tubing materials used in the groundwater sampling process to GEL for bath testing to determine whether toluene may be leaching out of the tubing and contaminating groundwater samples. Tubing material included nylon tubing, Tygon® tubing, Teflon® tubing, and polypropylene tubing; all tubing samples were new material. SNL/NM requested GEL to place the material in a DI water bath inside a sealed laboratory glass container, collect samples of the water after 24-hour, 7-day, and 14-day time intervals, and analyze each water sample for VOCs and SVOCs to identify any compounds from the material. A control test was also set up by the laboratory that was identical except that it contained no tubing materials. No VOCs or SVOCs were detected in any water bath samples, except for

acetone, chloroform, and methylene chloride; toluene was not detected. These compounds were detected in nylon and Tygon® samples. Detected VOCs are summarized in Table 3.3-2. No VOCs or SVOCs were detected in the control samples, Teflon® tubing samples, or polypropylene tubing samples.

Table 3.3-2
Summary of Detected VOCs in the Sample Tubing Bath Test

Compound	Nylon Tubing			Tygon® Tubing		
	24-hour	7-day	14-day	24-hour	7-day	14-day
Acetone (µg/L)	ND (3.50)	7.61	ND (3.50)	ND (3.50)	ND (3.50)	ND (3.50)
Chloroform (µg/L)	ND (0.250)	ND (0.250)	ND (0.250)	ND (0.250)	0.562	ND (0.250)
Methylene Chloride (µg/L)	11.1	11.5	9.42	8.85	7.70	5.35

µg/L = Microgram(s) per liter.
ND = Not detected above the method detection limit, shown in parentheses.
VOC = Volatile organic compound.

A summary report of the bath tests is provided in Appendix D. The results are not definitive proof but do support the conclusion that the tubing is probably not the source of toluene. In addition, the tubing is probably not the source of the detected acetone, chloroform, and methylene chloride, all of which are common laboratory contaminants, except for chloroform (EPA April 1992).

3.3.3 Sample Containers

All VOC sample containers (40-mL glass vials with plastic screw-on caps with septum) are supplied by GEL and certified clean by the supplier who provides the containers to GEL. The containers are compliant with the requirements specified in EPA 540/R-93/051, "Specifications and Guidance for Contaminant-Free Containers" (EPA December 1992). Each batch/lot of VOC sample collection vials are tested by GEL in accordance with its "Standard Operating Procedure (SOP) for Container Suitability Testing" (GL-LB-E-02, Revision 3). In accordance with this SOP, 1% of a container lot is analyzed and verified clean by GEL prior to sending the vials to SNL/NM for sample collection. According to the certification and GEL SOP, all VOC target analyte concentrations are required to be less than 0.5 µg/L. Container batches/lots are certified clean as long as 80% of the results for any given target analyte are nondetections. Although this procedure meets EPA requirements, the MDL used for container verification is higher than the MDL used for environmental samples (0.50 versus 0.25 µg/L), and the acceptable failure criterion is relatively high (i.e., less than 20%). This is significant because of the 118 detections of toluene in the sitewide environmental sample set evaluated for this report, 74 detections, or 63%, were less than 0.50 µg/L. The SNL/NM SMO is working with GEL to address this issue. Contaminated VOC sample containers are a possible source of the toluene detected in both the environmental and field QC samples. The vials could have been inadvertently contaminated while at the supplier, during shipment and handling at the laboratory, or during shipment and handling at SNL/NM.

The use of hydrochloric acid as a VOC preservative is also under review. The preservative (dilute hydrochloric acid) is added to the bottles by the supplier before they are sent to the laboratory, which in turn ships them to SNL/NM. The acid may react with the VOC vial septum in the screw-on cap. Although this is not likely a source for toluene, it may be a source of other contaminants. This is currently under investigation by the SNL/NM SMO and is addressed in new guidance from the EPA (EPA SW-846 Method 8260 and subsequent revisions for VOCs [EPA 1986], Chapter 2, Table 2-40[A] and Chapter 4, Table 4-1).

In addition, based upon SMO collaborative efforts, adhesive materials on the custody tape were identified as presenting a potential contamination source.

3.3.4 Modifications to the Sampling Process and Conclusions

As a result of the evaluation of the entire sampling process, the following modifications were made as of November 2009. These changes were implemented as best management practices and do not reflect measures that are expected to eliminate toluene detections based upon the results of this toluene source investigation:

- All nylon and Tygon® tubing water lines in the water sampling truck were replaced with stainless steel tubing.
- Coordination with the vendor has resulted in better quality (higher purity) DI water used during both the equipment decontamination process and for the collection of EB and FB samples.
- No custody tape is placed around the lids of VOC sample vials. Instead, sample vials are placed into plastic bags and the custody tape is secured to the outside of the bag.
- Prior to the January 2010 sampling event, the field team replaced the Bennett™ pump and polypropylene tubing bundle with new equipment.

During the January 2010 quarterly sampling event that was performed with new polypropylene tubing, all of the groundwater samples from the newly installed MWL wells had low concentrations of toluene. During the April 2010 sampling event, no detections of toluene were reported for any of the groundwater samples collected from the same wells. The impacts of the modifications listed are uncertain; however, they do represent sampling process improvements based upon the information evaluated to date.

3.3.5 Conclusions

The evaluation of the sampling equipment, methods, and overall process suggests that this is not the source of low concentrations of toluene detected in groundwater samples. However, it is clear that in some cases the very low concentrations of toluene are present in the groundwater samples received and analyzed by GEL (i.e., the contamination is not occurring at the laboratory). This is most strongly indicated by the results for the NMED/DOE OB split samples, which showed similar detections of toluene in split samples analyzed by a different laboratory, and the detection frequency and concentration range in the results for the field QC blank samples (in particular TB results). The data collectively indicate an ambient environmental

source(s) of very low-level toluene that is/are impacting the samples during the collection and/or shipment process, in addition to documented cases of toluene contamination by the laboratory as determined by laboratory QC data and the data validation process. Drilling/well materials, inadvertent contamination that may have occurred during the drilling/well installation process, and/or contaminated sample containers may also be a source of toluene detected in the groundwater samples.

3.4 Drilling and Well Installation

This section evaluates the drilling and well installation equipment, methods, materials, and process as a potential source of toluene contamination in groundwater samples. During January through May 2008, five monitoring wells (MWL-BW2, MWL-MW7, MWL-MW8, MWL-MW9, and TAV-MW10) were installed at the MWL and TA-V (SNL/NM April 2008, June 2008, and September 2008a). The five wells were installed during two field programs (Table 3.4-1). The SNL/NM contractor, WDC Exploration & Wells, Inc. (WDC), is a licensed driller with the New Mexico Office of the State Engineer (NMOSE June 2010). WDC installed each well in accordance with standard environmental procedures as set forth in the SNL/NM drilling contract SOW. Since July 1988, WDC has installed 68 monitoring wells at SNL/NM. An SNL/NM geologist oversaw the drilling operations, logged the drill cuttings, and subsequently prepared the well installation reports. NMED staff visited the drilling site during both field programs on February 1, 2008, and May 15, 2008.

Prior to the drilling at each of the five well sites, the drill rig and equipment were decontaminated using a pressurized steam cleaner at the TA-III decontamination pad using KAFB potable water. The air-rotary casing hammer (ARCH) technique was used to advance each borehole to an approximate depth of 500 feet bgs. The ARCH technique typically consists of a conventional air-rotary drill string that is drilled through a driven, large-diameter, nonrotating steel casing. Air circulation is used to lift the drill cuttings from the drill bit to the ground surface. The drive casing reduces borehole sloughing and eliminates the need for drilling mud. Upon completion of drilling and reaching total depth, the drill string is pulled from the drive casing. The PVC well casing is then installed down through the drive casing. The sand pack, bentonite pellets, and grout are installed in the annulus as the drive casing is extracted. After construction of the well is complete, the well is developed by swabbing, bailing, and pumping.

Materials used for constructing the five monitoring wells are summarized in Table 3.4-1. The materials were supplied by the drilling contractor and consisted of materials that do not contain chemicals that would be of concern relative to environmental monitoring situations. Most manufacturers of the well materials voluntarily participate in industry-led certification programs. For example, Halliburton-Baroid is enrolled in the National Sanitation Foundation (NSF)/American National Standards Institute-certified program in which random audits are conducted at the manufacturing facility, and samples are collected for subsequent analyses at the NSF laboratory. Materials that meet the requirements of the appropriate standard are then certified and appear in the NSF Listings (NSF, 2010).

Certifications of the well materials used for construction of the five monitoring wells at SNL/NM in 2008 are summarized in Table 3.4-2.

Table 3.4-1
Materials and Contractors Used for Constructing the MWL and TA-V Monitoring Wells in 2008

	Field Program One		Field Program Two		
	MWL-BW2	**TAV-MW10**	**MWL-MW7**	**MWL-MW8**	**MWL-MW9**
Details	**Company or Manufacturer**	**Company or Manufacturer**	**Company or Manufacturer**	**Company or Manufacturer**	**Company or Manufacturer**
Drilling Contractor and rig number	WDC Exploration & Wells, Inc., Rig #105	WDC Exploration & Wells, Inc., Rig #105	WDC Exploration & Wells, Inc., Rig #111	WDC Exploration & Wells, Inc., Rig #111	WDC Exploration & Wells, Inc., Rig #111
Drill rig model	Speedstar 30K	Speedstar 30K	Speedstar 50K	Speedstar 50K	Speedstar 50K
Well Installation Date	14 Jan–22 Jan 2008	31 Jan–6 Feb 2008	25 Apr–1 May 2008	2 May–12 May 2008	13 May–20 May 2008
Drilling fluids, mud, additives	None used	None used	None used	None used	None used
Injected water for removing cuttings at total depth	KAFB potable water, 100–150 gallons used	KAFB potable water, yes, no estimate	KAFB potable water, used – 100 gallons	KAFB potable water, used 250 gallons	KAFB potable water, yes, no estimate
Thread compound for drill string and drive casing	Matex Thread Compound ES	Matex Thread Compound ES	Matex Thread Compound ES	Matex Thread Compound ES	Matex Thread Compound ES
Lubricant for casing hammer	Matex RDO	Matex RDO	Matex RDO	Matex RDO	Matex RDO
Well casing, screen, sump, bottom cap, centralizers	Monoflex PVC, Schedule 80, 5-inch diameter	Monoflex PVC, Schedule 80, 5-inch diameter	Monoflex PVC, Schedule 80, 5-inch diameter	Monoflex PVC, Schedule 80, 5-inch diameter	Monoflex PVC, Schedule 80, 5-inch diameter
Thread compound for PVC casing materials	None used	None used	None used	None used	None used
Glue for PVC materials	None used	None used	None used	None used	None used
Sand pack, primary	CSSI #20-40	CSSI #10-20	CSSI #40-60	CSSI #40-60	CSSI #40-60
Grout, from annular seal to ground surface	M-I SWACO Smooth Grout 20	Baroid Quik-Grout	M-I SWACO Smooth Grout 20	M-I SWACO Smooth Grout 20	M-I SWACO Smooth Grout 20
Annular seal, above secondary sand pack	Volclay Coarse Chips	Volclay Coarse Chips	Volclay Coarse Chips	Volclay Coarse Chips	Volclay Coarse Chips
Sand pack, secondary	CSSI #60	CSSI #40-60	CSSI #60	CSSI #60	CSSI #60
Grout, bottom plug	Volclay Coarse Chips	Not installed	Not installed	Volclay Coarse Chips	Volclay Coarse Chips
Screened interval, ft bgs	467–497	508–528	464–494	465–495	465–495
Total depth of casing, ft bgs	502	533	499	500	500
Total depth of borehole, ft bgs	519	539	499	535	535
Well Development, WDC	10–11 Mar 2008	12–13 Mar 2008	25 Apr–1 May 2008	2–12 May 2008	13–20 May 2008
Steel pipe for bailing, swabbing, and pumping	No thread compound or additives used	No thread compound or additives used	No thread compound or additives used	No thread compound or additives used	No thread compound or additives used

Refer to footnotes at end of table.

Table 3.4-1 (Concluded)
Materials and Contractors Used for Constructing the MWL and TA-V Monitoring Wells in 2008

	Field Program One		Field Program Two		
	MWL-BW2	**TAV-MW10**	**MWL-MW7**	**MWL-MW8**	**MWL-MW9**
Details	**Company or Manufacturer**	**Company or Manufacturer**	**Company or Manufacturer**	**Company or Manufacturer**	**Company or Manufacturer**
Geophysical Logging, Jet West Company	Natural gamma and thermal neutron, 1 Jan 2008	Not conducted	Natural gamma and thermal neutron, 15 May 2008	Natural gamma and thermal neutron, 15 May 2008	Natural gamma and thermal neutron, 15 May 2008

Monoflex is registered trademark of Campbell Manufacturing, Inc., which is owned by Baker Manufacturing Company, LLC.
Volclay® is manufactured by CETCO.
M-I SWACO Smooth Grout 20™ is manufacture by M-I LLC.
Baroid Quik-Grout® is manufactured by Halliburton.
Matex Thread Compound ES and RDO are vegetable oil based and manufactured in Canada by Chemical Control (1989) Corporation.
bgs = Below ground surface.
CSSI = Colorado Silica Sand® Inc. (previously owned by Oglebay Norton Industrial Sands, now owned by Carmeuse Industrial Sands). Sand for monitoring wells is quarried at locations in Colorado, Texas, and California.
ft = Foot (feet).
KAFB = Kirtland Air Force Base.
MWL = Mixed Waste Landfill.
PVC = Polyvinyl chloride.
RDO = Rock drill oil.
TA-V = Technical Area V.
WDC = WDC Exploration & Wells, Inc.

Table 3.4-2
Certifications for Well Materials Used at SNL/NM in 2008

Trade Name	Certification	Manufacturer	Use
Quik-Grout[a]	NSF Standard 60	Halliburton-Baroid	Grout
CSSI Sand[b]	NSF Standard 61	Carmeuse Industrial Sands	Sand pack
Matex Thread Compound ES[c]	None	Chemical Control (1989) Corporation	Pipe dope(vegetable oil-based)
Matex RDO (rock drill oil)[c]	None	Chemical Control (1989) Corporation	Lubricant for casing hammer (vegetable oil-based)
M-I Smooth Grout 20[d]	NSF Standard 61	M-I LLC	Grout
Monoflex PVC[e]	ASTM F-480, D-1784, D-1785	Campbell Manufacturing Inc.	Well Casing and Screen
Volclay Coarse Chips[f]	NSF Standard 61	CETCO	Bentonite Chips

Notes:
[a]Quik-Grout® is manufactured by Halliburton-Baroid.
[b]CSSI = Colorado Silica Sand® Inc. (Carmeuse Industrial Sands). Sand for monitoring wells is quarried at locations in Colorado, Texas, and California.
[c]Matex Thread Compound ES and RDO are manufactured in Canada by Chemical Control (1989) Corporation.
[d]M-I SWACO Smooth Grout 20™ is manufactured by M-I LLC.
[e]Monoflex is registered trademark of Campbell Manufacturing, Inc., which is owned by Baker Manufacturing Company, LLC.
[f]Volclay® is manufactured by CETCO (Colloid Environmental Technologies Company).
ASTM = ASTM International (American Society for Testing and Materials).
NSF = National Sanitation Foundation.
PVC = Polyvinyl chloride.
SNL/NM = Sandia National Laboratories/New Mexico.

The well casings and screens were constructed of PVC, which is the most commonly used monitoring well casing material in the environmental field (Nielsen 2006). PVC is widely accepted for monitoring purposes because of its inertness, durability, and resistance to corrosion. Monoflex brand materials are manufactured by the Campbell Manufacturing Inc. using PVC Type 1 stock in accordance with engineering specifications set forth in various ASTM International [American Society for Testing and Materials] procedures. Pipe extruders ship blank PVC pipe to Campbell Manufacturing where the threads and slots are machined. The pipe extruders adhere to NSF standards, but their company names are confidential and therefore cannot be searched in the NSF listings. After machining, the Monoflex well casing is shipped inside sealed polyethylene bags. The PVC therefore does not need to be cleaned at the drill site.

Rigid PVC, sometimes identified as uPVC, is by design an inert material and typically ideal for potable water-supply piping and monitoring wells. As a result, few technical articles discuss the potential leaching of chemicals from PVC. Rather, the opposite issue has been of more concern in the environmental field. For example, the National Ground Water Association has published several articles that discuss the potential sorption of chemicals onto the PVC pipe surface or into the pipe matrix. However, the actual impact of sorption in typical environmental site conditions is considered to be negligible because groundwater continuously migrates through the well screen (Nielsen 2006).

PVC is a thermoplastic polymer composed of repeating vinyl groups. PVC formulations also contain various stabilizers, fillers, pigments, and lubricants (Nielsen, 2006). The NSF has set specifications for certain chemical constituents in PVC to ensure that PVC Type 1 is suitable for potable water supplies. By design, PVC formulations do not incorporate toluene. Due to the concern that chemicals could be inadvertently present in, and subsequently leached from, PVC piping used in potable water distribution systems, the NSF and American Water Works Association has conducted extensive testing of piping materials (Tomboulian et al. 2004). This testing did not identify toluene as being one of the chemicals that leached from PVC.

Another DOE facility, Pantex, has studied the role that well materials can have on the spurious detection of toluene in groundwater samples (BWXT April 2002). In 2001, Pantex installed a series of six FLUTe monitoring wells equipped with multi-level sampling ports. Instead of rigid well casing, the FLUTe wells used a flexible borehole liner that was constructed of nylon fabric with a urethane coating. Multiple sampling ports along the length of the liner were constructed of nylon, polypropylene, and polyester. Leaching tests of the well materials determined that toluene leached from both the liner and the sampling ports (BWXT April 2002 and Charbeneau et al. 2002). Because the chemical composition of the FLUTe materials is different from the PVC well materials used at SNL/NM, the Pantex study is not directly analogous to this report. However, the Pantex study demonstrates that in some instances well materials may be sources for contaminants detected in associated groundwater samples and should be considered carefully.

In summary, a comprehensive review of the drilling and well installation process, including the equipment and materials used, supports the conclusion that they are not the source of toluene detected in groundwater samples collected from the new wells installed in 2008. The most likely way in which the drilling or well installation process and/or materials could be a source of toluene is through inadvertent contamination of the equipment or materials prior to or during the fieldwork. At the drilling site both the air compressor and drill rig contain diesel fuel and emit exhaust. Although a clean and well organized drilling site is maintained as a rule, drilling by nature is a challenging operation with the potential for cross-contamination.

3.4.1 PVC Bath Test Results

In November 2009, SNL/NM submitted samples of PVC casing used on past well installations to GEL for bath testing to determine whether toluene may be leaching out of the PVC and contaminating groundwater samples. The PVC well casing was collected from the Environmental Restoration Field Office storage area and the manufacturer and lot number of the PVC are not known. SNL/NM requested that GEL place the material in a DI water bath inside a sealed laboratory glass container, collect samples of the water after 24-hour, 7-day, and 14-day time intervals, and analyze each water sample for VOCs and SVOCs to identify compounds leached from the material. A control test was also set up by the laboratory that was identical except that it contained no PVC materials. No VOCs or SVOCs were detected in either the water bath or control test samples.

A summary report of the bath tests is provided in Appendix D. The results are not definitive proof, but do support the conclusion that PVC well casing and screen are probably not the source of toluene.

3.4.2 April and June 2010 Purging/Sampling Study Results

The April and June 2010 purging/sampling study results are presented in Section 2.3.3. This testing was originally planned, as required by the NMED letter (Bearzi April 2010), to test the hypothesis for the new wells installed in 2008 that the well materials, or contamination introduced during drilling/well installation, were the source of toluene in groundwater samples. If this were the case, the concentration of toluene would be higher in the initial samples and decrease through the purging process. For the MWL, including the new wells installed in 2008, all 48 results (34 environmental samples and 14 field QC samples) for toluene were nondetected except for laboratory contamination detected in 5 environmental and 3 field QC blank samples. The results for the June 2010 purging/sampling study performed at well TAV-MW10 vary from the MWL results. Low concentrations of toluene were detected early in the purging process (first and third samples) and not in the final samples, which is consistent with drilling/well materials and/or inadvertent contamination during the drilling/well installation process as possible toluene sources.

3.4.3 Drilling and Well Installation Summary and Conclusions

The evaluation of the drilling and well installation equipment, materials, and process for the five new wells installed in 2008, along with the PVC bath tests and purging/sampling study results, supports the conclusion that they are not the source of toluene detected in the corresponding groundwater samples. Although the purging/sampling study results at well TAV-MW10 are consistent with a drilling/well material source, the overall toluene detection frequency in samples collected from this well previous to the June 2010 study was 25%. This means that three out of four groundwater samples contained no detectable concentrations of toluene. If the drilling/well construction materials were the source of toluene, a higher detection frequency would be expected. In contrast, samples from wells MWL-MW9 and MWL-MW8 have the two highest reported toluene detection frequencies (58 and 50%, respectively), and toluene was not detected in the purging/sampling study samples at these two wells. Although they cannot be entirely ruled out, drilling/well materials and/or inadvertent contamination introduced during the drilling/well construction process do not appear to be the sources of the low concentrations of toluene detected in associated groundwater samples.

4.0 SUMMARY AND CONCLUSIONS

As directed by the NMED (Bearzi April 2010), this report presents the results of the MWL Toluene Investigation. This section presents the summary and conclusions of this investigation.

4.1 Summary

Toluene detections in all samples, including SNL/NM sitewide and MWL groundwater samples, occur within a very narrow concentration range at or near the laboratory MDL. This is also the case for laboratory QC method blank samples and field QC blank samples. Most groundwater sample toluene results (88%) are less than 1 µg/L and qualified as estimated by the laboratory. Low concentrations of toluene were detected in groundwater samples from wells across the SNL/NM site, including the MWL, where toluene is not a COC. Furthermore, detections were reported in samples from hydraulically upgradient background wells and sitewide perimeter wells. TB samples are comprised of ultra-clean laboratory water, travel with the groundwater samples during collection and shipment, and are only opened during preparation and analysis at the laboratory. These samples have a toluene detection frequency of 11% and a concentration range very similar to the environmental samples and other field QC blank samples.

Approximately 2% of all TB sampling results and 4% of all environmental sampling results have been qualified through the data validation process as not detected due to confirmed laboratory contamination. Low-level toluene results in samples from MWL wells have also been qualified as not detected due to confirmed laboratory contamination as recently as April 2010.

In 2009, the number of sitewide samples remained constant relative to previous years, but the number of toluene detections significantly increased in samples from across the sitewide groundwater monitoring network (2008: 163 samples, 8 detections; 2009: 174 samples, 63 detections). At the MWL and TA-V during this time period, the new wells installed in 2008 (MWL-BW2, MWL-MW7, MWL-MW8, MWL-MW9, and TAV-MW10) were being sampled quarterly, and the detection frequency of low levels of toluene was also higher than historic results for samples from the existing MWL and TA-V wells. Data validation reviews and a more detailed review of laboratory QC method blank results for this time period indicate the laboratory is not the primary source of this toluene detection frequency increase.

4.2 Conclusions

The results of this investigation provide the context and technical basis for interpreting the widespread, very low concentrations of toluene reported in groundwater sampling results at the MWL and across SNL/NM. The very low concentrations of toluene detected in samples from the MWL groundwater monitoring wells are consistent with detections in samples from other SNL/NM sitewide monitoring wells and a laboratory and/or ambient environmental source(s) and are expected to continue in the future. The toluene groundwater data reflect the ubiquitous nature of toluene and the very low analytical detection limit; the detections do not represent a release to the environment or widespread low-concentration toluene contamination in the regional aquifer. While it is important to investigate and identify potential sources of toluene contamination, trying to determine every potential source is not warranted considering the

ubiquitous nature of toluene and the fact that the regulatory standards are orders of magnitude higher than the detected concentrations.

The key findings and conclusions of this investigation are presented as follows:

- The MWL is not the source of the toluene in groundwater samples. A review of the MWL inventory, subsurface soil sampling results, and soil-vapor survey results confirm that toluene is not a COC and demonstrate that toluene contamination capable of impacting regional groundwater at a depth of approximately 500 feet bgs is not present at the MWL.

- The widespread occurrence of toluene detections in groundwater and TB samples from the sitewide monitoring well network, the detection frequency, and the very low concentration range indicate that the toluene source is not low-level contamination present in the regional aquifer. All toluene detections in groundwater samples from October 2001 through April 2010 occur within a very narrow concentration range (0.217 to 2.2 µg/L) at or near the laboratory MDL (typically 0.25 µg/L); of the total detections, 88% are less than the PQL of 1 µg/L, and 63% are less than 0.50 µg/L.

- The number of toluene detections significantly increased across the sitewide groundwater monitoring network in 2009 (2008: 163 samples, 8 detections; 2009: 174 samples, 63 detections). At the MWL, the same trend is evident (2008: 15 samples, 1 detection; 2009: 23 samples, 15 detections). Because a majority of the samples for the new wells installed in 2008 at the MWL (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) and TA- V (TAV-MW10) are from 2009 quarterly sampling events when this increase in toluene detections occurred, they have some of the highest toluene detection frequencies as compared to other wells with more pre-2009 results.

- Detections of toluene in field QC samples support the conclusion that the sampling equipment, method, and overall process are not the source of toluene contamination in the groundwater samples. Instead, these field QC blank samples appear to be affected by the same ambient environmental and/or laboratory toluene source(s) as the environmental samples. In particular, toluene detections in TB samples (ultra-clean laboratory water in sealed containers never opened in the field) occur within a concentration range similar to that for groundwater samples (0.184 to 1.21 µg/L) and have a toluene detection frequency of 11%.

- The April 2010 MWL purging/sampling study results showed only laboratory-related toluene contamination in 5 of the 34 groundwater samples. The results for the June 2010 purging/sampling study performed at well TAV-MW10 vary from the MWL results and are consistent with drilling/well materials and/or inadvertent contamination introduced during the drilling/well installation process as possible toluene sources. The purging/sampling study results are not consistent with low-concentration toluene in the regional aquifer.

- Laboratory QC data and the data validation process confirm the presence of toluene sources within the laboratory for some, but not all, cases of low-concentration toluene detections in groundwater samples. The increase in toluene detections observed in 2009 does not appear to be related to laboratory sources.

- Other potential sources of toluene are very low levels of toluene present in the ambient air/environment that impact the groundwater samples during the sampling process and transportation to the laboratory and contaminated sample containers.

- Evaluation of the groundwater sampling process for all monitoring wells and the drilling/well installation processes, equipment, and materials for the new wells installed in 2008 (MWL-BW2, MWL-MW7, MWL-MW8, MWL-MW9, and TAV-MW10) supports the conclusion that they are not a source of toluene, but they cannot be ruled out as potential sources. The TAV-MW10 purging/sampling study results and the fact that all five new wells installed in 2008 have detection frequencies ranging from 19 to 58% are consistent with a possible toluene source related to drilling and/or well construction materials.

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5.0 RECOMMENDATIONS

Based upon the results of this MWL Toluene Investigation, additional investigation into the potential sources of toluene at the MWL is not required to confirm the MWL is not the source of toluene. However, several recommendations are provided that represent best management practices, will build upon this investigation, and will provide additional supporting documentation.

- Collect additional FB samples as part of ongoing MWL groundwater monitoring and continue to promote groundwater sampling team awareness of potential cross-contamination issues and sampling process improvement.

- Follow up with the laboratory to tighten the VOC sample container certification process (i.e., process used to certify the sample containers are clean prior to shipment to SNL/NM) and include additional method blank samples when batching and analyzing SNL/NM groundwater samples (i.e., for large sample batches include more than one method blank sample) to reduce the analysis time between method blanks and environmental samples.

- For the MWL Long-Term Monitoring and Maintenance Plan, develop trigger levels for toluene and other identified laboratory contaminants that are set at technically reasonable concentrations relative to historic monitoring results and process knowledge to minimize resampling and additional reporting. Setting a trigger level at the MDL or PQL would be counterproductive.

In addition, the NNSA Analytical Management Program collaborative effort should continue between the SNL/NM, Pantex, and LANL SMOs; AQA; and GEL to share information and work toward a well-defined process to address issues such as these types of low-level VOC results, as it is critical to the cost-effective implementation and management of the Environmental Restoration Project and Long-Term Environmental Stewardship Program missions at these DOE facilities and throughout the DOE complex.

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APPENDIX A
Mixed Waste Landfill Toluene Investigation Report – General Information on Toluene

Introduction, Sources, and Use

Toluene (or methylbenzene, toluel, phenylmethane; C_7H_8) is a clear, colorless, noncorrosive, flammable liquid with a distinctive, sweet, benzene-like odor. Toluene is an aromatic hydrocarbon and is volatile at standard temperatures and pressures (i.e., changes from liquid to vapor). It is the lowest-molecular-weight alkylbenzene, which possesses properties similar to benzene. It is a primary additive to gasoline along with benzene and xylene. Toluene occurs naturally in crude oil and in the tolu tree. It is produced in the process of making gasoline and other fuels from crude oil, in making coke from coal, and as a by-product in the manufacture of styrene. Toluene is used in making paints, paint thinners, nail polish, lacquers, adhesives, and rubber, and in some printing and leather tanning processes. It is common solvent (a substance that can dissolve other substances) and used in the manufacture of benzoic acid, benzaldehyde, TNT [trinitrotoluene], and other organic compounds.

Toluene concentrations in urban air range from 0.01 to 0.05 parts per million (ppm) (Bentley-Phillips and Baylor 1974). It is released from manufacturing plants, automobile and coke-oven emissions, and gasoline evaporation. It is also released to the air by cigarette smoke (NIOSH 1984). Toluene is a component of high-flash aromatic naphthas, which are produced from crude oil by primary distillation and as by-products in the coal tar industry.

Physical Properties

Physical properties for toluene are summarized in the following table below:

Flammability Limits % (lower and upper limits)	1.4–6.7
Flash Point	4.4°C and 40°F
Freezing Point	-94.99°C
Melting Point	-95°C
Molecular Weight	92.14
Specific Gravity at 25°C	0.87
Vapor Pressure millimeters mercury (Hg) (°C)	36.7

°C = Degree(s) Celsius.
°F = Degree(s) Fahrenheit.

At a concentration of approximately 8 ppm, toluene produces a detectable odor in the air; at a concentration of 0.04 to 1 ppm, it has a detectable taste in water.

Fate and Transport

Toluene enters the environment when materials that contain it, such as gasoline, paints, paint thinners, adhesives, nail polish, etc. are used. The toluene evaporates (i.e., volatilizes) and becomes mixed with the air. Toluene can potentially impact surface water, soil, and groundwater from spills of solvents and petroleum products, leaking underground storage tanks containing gasoline, and disposal of materials containing toluene in landfills or waste disposal sites.

Based upon experience with trichloroethene (a chlorinated solvent) at the Sandia National Laboratories/New Mexico (SNL/NM) Chemical Waste Landfill (CWL), transport in the subsurface of volatile organic contamination to the regional aquifer will occur only through soil-

vapor migration. The very thick, dry vadose zone (unsaturated zone between the ground surface and the top of the regional groundwater aquifer or water table, approximately 500 feet beneath the CWL and Mixed Waste Landfill) severely limits the downward migration of volatile organic liquids. The liquids volatilize (i.e., change from liquid to vapor) in the shallow subsurface (0 to 30 feet below ground surface) to form soil vapor, which in turn migrates through the vadose zone controlled by molecular diffusion through the soil-vapor medium, advection-dispersive transport via soil-vapor flow, and reversible and irreversible attenuation processes (SNL/NM December 2004).

Toluene does not usually remain in the environment for long periods of time as it is readily broken down to other chemicals by microorganisms in soil and will evaporate from surface water and surface soil. Toluene dissolved in groundwater does not break down quickly as there are fewer microorganisms in groundwater.

Toluene can be taken up into fish and shellfish, plants, and animals living in water containing toluene, but it does not concentrate or build up to high levels because most animal species can convert the toluene into other compounds that are excreted.

Exposure Pathways

Humans may be exposed to toluene from many sources, including drinking water, eating food, breathing air, and inhaling toluene volatilizing from various products. Exposure to toluene may also occur through breathing the chemical in the workplace, during fueling of vehicles, and/or in the ambient air. People who work with gasoline, kerosene, heating oil, paints, lacquers, and toluene-containing solvents and/or products are at the greatest risk of exposure. Because toluene is a common solvent and is found in many consumer products, exposure to toluene can occur at home and outdoors while using gasoline, nail polish, cosmetics, rubber cement, paints, paintbrush cleaners, stain removers, fabric dyes, inks, and adhesives. Smokers are exposed to small amounts of toluene from cigarette smoke.

Toluene can enter the body by breathing vapors (i.e., inhalation) or eating or drinking contaminated food or water. Toluene can also be absorbed through the skin into the bloodstream. When breathing air containing toluene, the chemical is introduced directly into the blood from the lungs. Daily exposure to toluene can occur in the home, at work, or during travel. Factors such as age, sex, body composition, and health status affect what happens to toluene once it enters the body. After being taken into the body, more than 75% of the toluene is eliminated within 12 hours. It may leave the body unchanged in the air exhaled or in urine excreted after some of the toluene has been chemically altered to become more water soluble. Generally, the body converts toluene into less harmful chemicals, such as hippuric acid.

The toluene level in the air outside residential areas is usually less than 1 ppm in cities and suburbs that are not in close proximity to an industrial area. The toluene inside homes is also likely to be less than 1 ppm. The amount of toluene in food has not been reported but is likely to be low. Traces of toluene have been found in eggs that were stored in polystyrene containers containing toluene.

The average person may be exposed to only about 300 micrograms (µg) of toluene a day unless they smoke cigarettes or work with toluene-containing products. If a person smokes a pack of cigarettes a day, exposure increases by approximately 1,000 µg.

Health Effects

Toluene is a central nervous system depressant and a skin and mucous membrane irritant. Toluene can cause headaches, confusion, and memory loss. Symptoms depend upon many factors, including the amount of toluene taken in and length of exposure. Low to moderate, day-after-day exposure in the workplace can cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, and loss of appetite. These symptoms usually disappear when exposure ceases. The effects of long-term exposure to low levels of toluene are not well known.

If exposed to a large amount of toluene within a short period of time (such as deliberately sniffing paint or glue), the first symptom is light-headedness. If exposure continues, dizziness, sleepiness, unconsciousness, or even death can occur. Toluene causes death by interfering with breathing and heart function. When exposure ceases, the symptoms typically abate.

Studies in workers and animals exposed to toluene indicate that toluene does not cause cancer. The International Agency for Research on Cancer and the Department of Health and Human Services have not classified toluene for carcinogenic effects. The U.S. Environmental Protection Agency (EPA) has not classified toluene as a human carcinogen.

Regulatory Standards for Toluene in Drinking Water

In 1974, the U.S. Congress passed the Safe Drinking Water Act. This law requires the EPA to determine the level of contaminants in drinking water at which no adverse health effects are likely to occur. These nonenforceable health goals, based solely on possible health risks and exposure over a lifetime with an adequate margin of safety, are called maximum contaminant level goals (MCLGs). The MCLG for toluene is 1 milligram per liter (mg/L) or 1 ppm. The EPA has set an enforceable regulation for toluene, the maximum contaminant level (MCL), at 1 mg/L or 1 ppm (EPA 2009). MCLs are set as close to the health goals as possible, considering cost, benefits, and the ability of public water systems to detect and remove contaminants using suitable treatment technologies. In the case of toluene, the MCL equals the MCLG because analytical methods and treatment technology pose no limitations.

States may set more stringent drinking water MCLGs or MCLs. The New Mexico Environment Department has set a slightly lower regulatory standard for toluene (maximum allowable concentration or MAC) of 0.750 mg/L or 0.750 ppm (Title 20, New Mexico Administrative Code, Chapter 6, Part 2, Section 3103).

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APPENDIX B
Mixed Waste Landfill Toluene Investigation Report – Sitewide Data Evaluation Supporting Information

Table B-1
Mixed Waste Landfill Toluene Investigation
Toluene Detections – All Sitewide Locations – October 2001 through April 2010

Well ID	Number of Toluene Detections	Number of Nondetections	Toluene Detection Frequency	Toluene Concentration Range	Number of Qualified Detections[1]	Well Installation Date
AVN-1	3	33	8%	0.255-0.285	1	May 1995
AVN-2	2	15	12%	1.02-2.2	2	June 1995
COYOTE SPRINGS	0	7	0%	N/A	0	N/A
CTF-MW1	0	10	0%	N/A	0	August 2001
CTF-MW2	0	14	0%	N/A	0	August 2001
CTF-MW3	0	11	0%	N/A	1	August 2001
CWL-BW2	0	1	0%	N/A	1	September 1985
CWL-BW3	4	12	25%	0.273-1.45	2	September 1988
CWL-BW4A	4	12	25%	0.696-1.38	1	May 1994
CWL-MW2A	0	5	0%	N/A	2	August 1988
CWL-MW2BL	0	20	0%	N/A	1	June 1994
CWL-MW2BU	0	16	0%	N/A	1	June 1994
CWL-MW4	2	22	8%	0.379-0.383	1	May 1990
CWL-MW5L	0	19	0%	N/A	1	April 1994
CWL-MW5U	7	18	28%	0.423-1.12	1	April 1994
CWL-MW6L	0	18	0%	N/A	1	May 1994
CWL-MW6U	8	17	32%	0.307-0.808	5	May 1994
CWL-MW7	0	12	0%	N/A	0	March 2003
CWL-MW8	0	13	0%	N/A	0	April 2003
CYN-MW1D	1	26	4%	0.248	0	December 1997
CYN-MW3	0	21	0%	N/A	1	June 1999
CYN-MW4	0	22	0%	N/A	2	June 1999
CYN-MW5	0	13	0%	N/A	1	August 2001
CYN-MW6	0	11	0%	N/A	0	December 2005
CYN-MW7	0	4	0%	N/A	0	December 2005
CYN-MW8	0	4	0%	N/A	0	January 2006
EOD HILL	0	3	0%	N/A	0	Unknown
EUBANK-1	1	15	6%	0.292	0	July 1988
EUBANK-2	1	3	25%	0.72	0	November 1996
EUBANK-3	0	4	0%	N/A	0	November 1996
EUBANK-5	0	4	0%	N/A	0	November 1996[2]
GREYSTONE-MW2	0	9	0%	N/A	1	April 2002
LWDS-MW1	10	40	20%	0.251-1.68	5	May 1993
LWDS-MW2	0	34	0%	N/A	1	October 1992
MRN-2	0	9	0%	N/A	1	January 1995
MRN-3D	0	5	0%	N/A	2	July 2003
MWL-BW1	0	6	0%	N/A	1	July 1989
MWL-BW2	3	13	19%	0.366-0.759	2	January 2008
MWL-MW1	0	8	0%	N/A	1	October 1988
MWL-MW2	0	9	0%	N/A	1	August 1989
MWL-MW3	1	6	14%	0.275	1	August 1989
MWL-MW4	1	16	6%	0.321	0	February 1993
MWL-MW5	0	22	0%	N/A	1	November 2000
MWL-MW6	0	23	0%	N/A	0	October 2000

Table B-1 (Continued)
Mixed Waste Landfill Toluene Investigation
Toluene Detections – All Sitewide Locations

Well ID	Number of Toluene Detections	Number of Nondetections	Toluene Detection Frequency	Toluene Concentration Range	Number of Qualified Detections[1]	Well Installation Date
MWL-MW7	5	9	36%	0.267-0.645	0	June 2008
MWL-MW8	6	6	50%	0.253-1.45	3	June 2008
MWL-MW9	7	5	58%	0.306-1.1	0	June 2008
NWTA3-MW2	1	4	20%	0.458	0	August 2000
NWTA3-MW3D	1	6	14%	1.15	1	July 2003
PGS-2	0	16	0%	N/A	0	September 1995
PL-2	0	8	0%	N/A	0	November 1994
PL-3	0	5	0%	N/A	0	December 1994
SFR-2S	0	8	0%	N/A	0	August 1992
SFR-4T	0	9	0%	N/A	0	September 1993
SWTA3-MW2	1	9	10%	0.251	0	May 2002
SWTA3-MW3	0	7	0%	N/A	1	February 2004
SWTA3-MW4	0	5	0%	N/A	0	August 2005
TA1-W-01	1	15	6%	0.315	0	March 1997
TA1-W-02	1	14	7%	0.267	0	February 1998
TA1-W-03	0	17	0%	N/A	1	January 1998
TA1-W-04	0	17	0%	N/A	2	October 1998
TA1-W-05	3	13	19%	0.33-0.364	0	November 1998
TA1-W-06	2	14	13%	0.275-0.278	1	February 1998
TA1-W-07	0	3	0%	N/A	0	August 1998
TA1-W-08	0	20	0%	N/A	0	August 2001
TA2-NW1-325	0	3	0%	N/A	0	April 1993
TA2-NW1-595	0	24	0%	N/A	2	July 1993
TA2-SW1-320	0	31	0%	N/A	0	November 1992
TA2-W-01	1	22	4%	0.586	0	June 1994
TA2-W-19	1	37	3%	0.383	0	November 1995
TA2-W-24	0	2	0%	N/A	0	February 1998
TA2-W-25	0	2	0%	N/A	0	April 1997
TA2-W-26	5	33	13%	0.259-0.309	0	January 1998
TA2-W-27	2	21	9%	0.312-0.323	3	February 1998
TAG-W-27	0	1	0%	N/A	0	February 1995
TAV-MW1	2	26	7%	0.479-0.57	2	February 1995
TAV-MW10	2	6	25%	0.252-0.324	1	February 2008
TAV-MW2	2	36	5%	0.271-0.531	1	March 1995
TAV-MW3	0	35	0%	N/A	1	April 1997
TAV-MW4	1	34	3%	0.574	0	April 1997
TAV-MW5	2	34	6%	0.252-0.485	0	April 1997
TAV-MW6	0	43	0%	N/A	2	April 2001
TAV-MW7	0	38	0%	N/A	0	April 2001
TAV-MW8	0	40	0%	N/A	1	April 2001
TAV-MW9	5	30	14%	0.298-0.543	0	March 2001
TJA-2	3	28	10%	0.254-0.492	0	July 1994
TJA-3	3	24	11%	0.217-0.39	1	August 1998

Table B-1 (Concluded)
Mixed Waste Landfill Toluene Investigation
Toluene Detections – All Sitewide Locations

Well ID	Number of Toluene Detections	Number of Nondetections	Toluene Detection Frequency	Toluene Concentration Range	Number of Qualified Detections[1]	Well Installation Date
TJA-4	0	34	0%	N/A	1	August 1998
TJA-5	0	2	0%	N/A	0	August 1998
TJA-6	3	20	13%	0.323-0.403	0	February 2001
TJA-7	2	32	6%	0.294-0.307	1	March 2001
TRE-1	0	10	0%	N/A	0	July 1995
WYO-3	2	16	11%	0.519-0.674	3	July 2001
WYO-4	6	37	14%	0.262-0.674	1	July 2001
Grand Total	**118**	**1,516[3]**	**7%[4]**	**0.217-2.2**	**71**	**--**

[1]Detections qualified as "not detected results" during data validation due to toluene laboratory contamination detected in laboratory method blank and/or control samples.
[2] City of Albuquerque monitoring well – installation date estimated.
[3]Total does not include 4 nondetect results that were qualified as "rejected" during data validation for wells CWL-BW4A (2 results) and TAV-MW10 (2 results).
[4]Overall detection frequency calculated as follows: total number of detections (118) divided by the total number of samples (118 + 1,516).
Wells highlighted in yellow are wells with a toluene detection frequency greater than or equal to 10%.
ID = Identification.
N/A = Not Applicable.

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APPENDIX C
Mixed Waste Landfill Toluene Investigation Report – Phase Partitioning Calculations to Determine the Potential Toluene Concentration in Groundwater Using Maximum Soil-Vapor Concentrations

Technical Memorandum

Mixed Waste Landfill Toluene Investigation Report
Phase Partitioning of Toluene in Soil Vapor and Groundwater

Background

For evaluating the Mixed Waste Landfill (MWL) as a potential source of the toluene detections in groundwater monitoring samples, the relationship between concentrations of toluene in soil vapor and groundwater were evaluated. The phase partitioning approach is highly conservative and does not represent actual conditions; it is being used only to illustrate the fact that a sufficient source term of toluene in soil vapor does not exist at the MWL to contaminate the groundwater, which is located at a depth of approximately 500 feet below ground surface (bgs).

The approach used for this phase partitioning calculation assumes that a hypothetical toluene soil-vapor plume exists in equilibrium in the subsurface immediately above the capillary fringe, which in turn immediately overlies the regional water table. This hypothetical toluene soil-vapor plume is also assumed to be laterally extensive across the entire capillary fringe beneath the MWL and at the maximum toluene concentration detected in soil-vapor samples collected from within 50 feet of the ground surface at the MWL. This scenario is not realistic because (1) toluene soil-vapor data (Peace et al. December 2002 and SNL/NM August 2008) indicate its distribution in the subsurface immediately beneath the former disposal areas is sporadic with most (85%) of the results for soil-vapor samples being nondetected; (2) no dilution is assumed for the concentrations of toluene in the aquifer; and (3) other real-world factors such as stratigraphic discontinuities in the vadose zone that would further attenuate the toluene concentrations are not considered.

This hypothetical phase partitioning calculation is provided to evaluate whether or not the MWL could be the source of toluene contamination detected in the MWL groundwater samples assuming extremely conservative, unrealistic conditions. This calculation builds upon previous SNL/NM work performed at the Chemical Waste Landfill (CWL) over the past 16 years, as described in CWL reports (SNL/NM October 1995 and December 2004, and Peterson June 1999).

Phase Partitioning Calculations

Phase partitioning of toluene is dependent on the Henry's Law constant. This constant is a ratio that relates the concentrations of toluene in vapor and aqueous phases at equilibrium conditions, such that

$$C_V = H\, C_W \qquad \textit{(equation 1)}$$

Where,
- C_V = Equilibrium concentration of toluene in the vapor-phase (mass/volume)
- C_W = Equilibrium concentration of toluene in the aqueous phase (mass/volume)
- H = Henry's Law constant for toluene (unitless).

The Henry's Law constant for toluene was developed using U.S. Environmental Protection Agency (EPA) guidance (EPA 1996) and determined to be 0.272 (NMED 2009). This phase partitioning represents what would occur in a laboratory setting under ideal conditions. However, the actual interface between saturated and unsaturated materials, where partitioning is occurring in the vadose zone, is far more complex such that calculations are far more difficult to quantify and defend. For example, vapor phase toluene mass is lost in the capillary fringe before reaching the water table. Although the maximum soil-vapor concentration at depth provides the maximum toluene concentration in groundwater at the upper extent of the capillary fringe, the groundwater at this horizon is rarely sampled because it is essentially "trapped" in the sediments and not mobile. The downwardly increasing water saturation between the upper horizon of the capillary fringe and the water table further dilutes the toluene.

For calculating the predicted toluene concentration at the water table, it is necessary to consider dilution as follows:

$$C_{Wt} = C_{Wc}/DAF \qquad \textit{(equation 2)}$$

Where,
- C_{Wt} = Toluene concentration in groundwater at the water table (mass/volume)
- C_{Wc} = Toluene concentration in groundwater at the upper extent of the capillary fringe in equilibrium with soil vapor (mass/volume)
- DAF = Dilution Attenuation Factor (unitless)

Using calculations provided in the EPA Soil Screening Guidance (EPA 1996), the DAF cited is 20.

Site-Specific Calculations

Using the phase partitioning relationships described in Equations 1 and 2, it is possible to evaluate the phase partitioning of toluene using site-specific data. Because the soil-vapor and groundwater samples collected at the MWL were analyzed using different analytical methods and the results presented in different units ("ppb v/v" for soil-vapor results and "µg/L" [micrograms per liter] for groundwater results), a conversion was necessary. In order to be comparable, the soil-vapor results were converted to units of µg/L using the following formula (NMED 2000):

$$C_v = (ppmv)(MW)(P)/(R)(T) \qquad \textit{(equation 3)}$$

Where,
- C_v = Equilibrium concentration of toluene in the vapor-phase (µg/L)
- ppmv = Parts per million by volume
- MW = Molecular weight (calculated to be 92.14 grams per mole for toluene)
- P = Pressure in atm (assumed to be 0.83)
- R = Ideal gas constant at 293K (0.082 atm/L/mole/K)
- T = Temperature in K (= ^{o}C + 273) (assumed to be 20°C)

For example, 9.5 ppmv of soil vapor would convert to:

$$C_v = (ppmv)(MW)(P)/(R)(T)$$
$$= (0.026)(92.14)(0.83)/(0.082)(293)$$
$$= 0.083\ \mu g/L$$

Using Equation 1, this results in an aqueous phase concentration of 0.3 µg/L in the capillary fringe. Using Equation 2, the toluene concentration in the water table would be 0.015 µg/L.

Conclusion

The calculated toluene concentration in groundwater at the water table is 0.015 µg/L. This concentration is equivalent to 15 parts per trillion and approximately an order of magnitude below the laboratory method detection limit (0.25 µg/L), and thus would not be detectable in groundwater samples. This calculation demonstrates that the known concentrations of toluene in soil vapor at the MWL are not capable of producing the very low concentrations of toluene measured in the groundwater even assuming a hypothetical, unrealistic scenario (i.e., a scenario where the maximum concentration of toluene soil vapor from the upper 50 feet beneath the disposal areas is assumed to have migrated through the entire vadose zone via advective transport to the water table with no appreciable attenuation and thereafter no dilution occurring within the aquifer).

References

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APPENDIX D
Mixed Waste Landfill Toluene Investigation Report – Bath Test Study of Groundwater Sampling Tubing and Monitoring Well Polyvinyl Chloride Materials

Potential Leaching of VOCs and SVOCs from Sample Tubing and Well Materials Used at Sandia National Laboratories/New Mexico

Objective

Toluene has historically been detected at very low concentrations (less than 3 micrograms per liter [µg/L]) in Mixed Waste Landfill (MWL) groundwater samples. Bath tests were conducted to determine whether toluene could potentially leach from tubing and well casing materials used by Sandia National Laboratories/New Mexico (SNL/NM) during groundwater monitoring well installation and collection of groundwater samples.

Process

Testing Materials

Sample tubing and well-casing materials were obtained from storage sheds at the Environmental Restoration Field Office on November 10, 2009. The materials were shipped to GEL Laboratories, Inc. (GEL) in Charleston, South Carolina, using standard SNL/NM Sample Management Office shipping procedures. The materials arrived at GEL on November 13, 2009. The materials were delivered with proper analysis request/chain-of-custody documentation (AR/COC 612482) and signatures. All sample containers arrived without any visible signs of tampering or breakage.

The sample tubing consisted of four types: nylon tubing, Tygon® tubing, Teflon® tubing, and polypropylene tubing. All tubing was 0.5-inch inner diameter (ID) in size. The well casing was 5-inch ID, Schedule 80 polyvinyl chloride (PVC) blank well casing.

Experimental Method

An informal leaching procedure was designed by SNL/NM and GEL. Five baths and one control blank were used. Laboratory-grade glass beakers were used for each of the five baths and the control blank. Thus, six glass beakers were used. Each bath was dedicated to a particular type of material. A single piece of material was placed into each of the five beakers; the beakers were then filled with deionized (DI) water and sealed. The sixth beaker, the control blank, was filled with DI water and sealed in a manner consistent with the other five beakers. All six beakers were stored at room temperature. The materials remained submerged during the exposure time. Water samples were drawn from each beaker at time intervals of 24 hours, 7 days, and 14 days.

Sample Analyses

Each water sample was analyzed for volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs). Samples were analyzed for VOCs by Gas Chromatograph/Mass Spectrometer (GC/MS) using U.S. Environmental Protection Agency (EPA) Method SW846 8260B. Samples were analyzed for SVOCs by GC/MS using EPA Method SW846 8270C. Sample preparation, analysis, and reporting were conducted in accordance with GEL Standard

Operating Procedure GL-OA-E-038 REV#12. Tables D-1 and D-2 summarize the laboratory instruments used to analyze the water samples.

Table D-1
Instrument Systems Used to Perform the VOC Analyses

Instrument ID	Instrument	System Configuration	Column ID	Column Description	P&T Trap
VOA1.I	Gas Chromatograph/ Mass Spectrometer	HP6890/HP5973	RTX-624	Restek, 60m x 0.25mm x 1.4um	Trap 10
VOA9.I	Gas Chromatograph/ Mass Spectrometer	HP6890/HP5973	DB-624	J&W, 60m x 0.25mm x 1.4um	Trap 10

Table D-2
Instrument Systems Used to Perform the SVOC Analyses

Instrument ID	Instrument	System Configuration	Column ID	Column Description
MSD2.I	Agilent 5975 Mass Spectrometer	HP7890A/HP5975C	DB-5MS	25m x 0.2mm, 0.33um (5% Phenylmethylpolysiloxane)
MSD4.I	HP Mass Spectrometer	HP6890/HP5973	DB-5MS	25m x 0.2mm, 0.33um (5% Phenylmethylpolysiloxane)
MSD1.I	HP 5973 Mass Spectrometer	HP6890/HP5973	ZB-5ms	25m x 0.2mm, 0.33um (5% Polysilarylene-95% Polydimethylsiloxane)

Analytical Results

The VOC and SVOC analytical results for water samples drawn from the glass beakers are summarized as follows. The laboratory Certificates of Analysis are attached.

Toluene

As shown in Table D-3, toluene was not detected in any of the 18 water samples drawn from the glass beakers. None of the 24-hour, 7-day, or 14-day water samples for the five test material contained detectable concentrations of toluene. Similarly, the control blanks contained no detectable toluene concentrations for the three time periods.

Other Compounds

SVOCs were not detected in any of the 18 water samples. Three VOCs (acetone, chloromethane, and methylene chloride) were the only VOCs detected in any of the water samples. These three VOCs were mainly detected in water samples associated with the nylon and Tygon® tubing materials, but chloromethane was present in the water sample associated with the PVC well casing material and in one of the control blank samples. The detected VOCs are summarized in Table D-4.

Table D-3
Toluene Analytical Results for Water Samples Drawn from the Glass Beakers

Beaker Contents	Exposure Time	Toluene (µg/L)	Qualifier	MDL	PQL
Nylon tubing and DI water	24 hour	ND	U	0.250	1.00
Tygon tubing and DI water	24 hour	ND	U	0.250	1.00
Teflon tubing and DI water	24 hour	ND	U	0.250	1.00
Polypropylene tubing and DI water	24 hour	ND	U	0.250	1.00
PVC Well casing and DI water	24 hour	ND	U	0.250	1.00
Control blank (DI water only)	24 hour	ND	U	0.250	1.00
Nylon tubing and DI water	7 day	ND	U	0.250	1.00
Tygon tubing and DI water	7 day	ND	U	0.250	1.00
Teflon tubing and DI water	7 day	ND	U	0.250	1.00
Polypropylene tubing and DI water	7 day	ND	U	0.250	1.00
PVC Well casing and DI water	7 day	ND	U	0.250	1.00
Control blank (DI water only)	14 day	ND	U	0.250	1.00
Nylon tubing and DI water	14 day	ND	U	0.250	1.00
Tygon tubing and DI water	14 day	ND	U	0.250	1.00
Teflon tubing and DI water	14 day	ND	U	0.250	1.00
Polypropylene tubing and DI water	14 day	ND	U	0.250	1.00
PVC Well casing and DI water	14 day	ND	U	0.250	1.00
Control blank (DI water only)	14 day	ND	U	0.250	1.00

DI = Deionized.
MDL = Effective method detection limit.
µg/L = Microgram(s) per liter.
ND = Result is less than MDL (not detected).
PQL = Effective practical quantitation limit.
PVC = Polyvinyl chloride.
U = The analyte was analyzed for but not detected. The associated numerical value is the sample quantitation limit.

Table D-4
Summary of Detected Volatile Organic Compounds in Tubing and PVC Water Samples

	Nylon Tubing			Tygon Tubing			PVC Well Casing	Control Blank
Compound	24-hr	7-day	14-day	24-hr	7-day	14-day	24-hr	14-day
Acetone, µg/L MDL = 3.50	ND	7.61 (J)	ND	ND	ND	ND	ND	ND
Chloromethane, µg/L MDL = 0.300	ND	ND	ND	ND	0.562 (J)	ND	0.473 (J)	0.371 (J)
Methylene chloride, µg/L MDL = 0.300	11.1*	11.5*	9.42 (J)	8.85 (J)	7.70 (J)	5.35 (J)	ND	ND

DL = Detection limit.
MDL = Method detection limit
µg/L = Microgram(s) per liter.
ND = Not detected.
PQL = Practical quantitation limit.
PVC = Polyvinyl chloride.
RL = Reporting limit.

Qualifiers:
J = Estimated value; the analyte concentration fell above the effective DL and below the RL.
* = The analyte concentration fell above the PQL.

Quality Control

An aliquot of the 14-day water for the Teflon® tubing (Sample 087938-C01) was designated for spike analysis. The spiking chemical was reagent-grade toluene. The matrix spike designations are indicated as "PS" or "PSD." The "PS" designation (post spike) indicates that the matrix was fortified prior to analysis but after applying any preparation factors, such as a dilution. A summary of the quality control analysis for toluene is shown in Table D-5.

Table D-5
Summary of Matrix Spike Quality Control Water Samples for the Teflon® Tubing Test

Sample	NOM (µg/L)	Toluene (µg/L)	Qual	QC (µg/L)	RPD%	REC%	Acceptance Limit
Method Blank (MB)	—	—	U	ND	—	—	—
Laboratory Control Sample (LCS)	50	—	—	52.7	—	105	(74–120%)
Method Blank (MB)	—	—	U	ND	—	—	—
Laboratory Control Sample (LCS)	50	—	—	43.96	—	87.9	(74–120%)
Post Spike (PS)	50 U	ND	—	39.1	—	78.1	(65–124%)
Post Spike Duplicate (PSD)	50 U	ND	—	45.2	14.6	90.5	(RPD 0–20%) (REC 65–124%)

ND = Result is less than detection limit (not detected).
NOM = Nominal concentration of the spiking compound.
Qual = Qualifier.
QC = Quality control. Amount of compound found in the QC sample.
REC = Recovery for the control samples.
RPD = Relative percent difference between PS/PSD.
U = The analyte was analyzed for but not detected. The associated numerical value is the sample quantitation limit.

GEL conducted a standard internal data validation for the VOC and SVOC analytical results. All holding times were met. The method blank and laboratory control samples met the acceptance limit criteria. The spike recoveries and spike duplicate recoveries were within the required acceptance limits. Relative percent difference between the matrix spike pair met the acceptance limits.

Conclusions

Toluene was not detected in any of the water samples drawn from the beakers containing the SNL/NM test materials. This suggests that neither the tubing used in groundwater sampling nor the well casing materials are the source of toluene recently detected in the groundwater samples at the MWL.

VOC Analyses

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087940-A01
Sample ID: 241350011
Matrix: AQUEOUS
Collect Date: 24-NOV-09 14:00
Receive Date: 24-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: PVC Well Casing
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Volatile Organics Federal											
8260B TCL Liquid Federal "As Received"											
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4	12/02/09	1244	928279	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1					
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1					
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1					
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1					
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1					
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1					
2-Butanone	U	ND	1.25	5.00	ug/L	1					
2-Hexanone	U	ND	1.25	5.00	ug/L	1					
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1					
Acetone	U	ND	3.50	10.0	ug/L	1					
Benzene	U	ND	0.300	1.00	ug/L	1					
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1					
Bromoform	U	ND	0.250	1.00	ug/L	1					
Bromomethane	U	ND	0.300	1.00	ug/L	1					
Carbon disulfide	U	ND	1.25	5.00	ug/L	1					
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1					
Chlorobenzene	U	ND	0.250	1.00	ug/L	1					
Chloroethane	U	ND	0.300	1.00	ug/L	1					
Chloroform	U	ND	0.250	1.00	ug/L	1					
Chloromethane	J	0.473	0.300	1.00	ug/L	1					
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1					
Ethylbenzene	U	ND	0.250	1.00	ug/L	1					
Methylene chloride	U	ND	3.00	10.0	ug/L	1					
Styrene	U	ND	0.250	1.00	ug/L	1					
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1					
Toluene	U	ND	0.250	1.00	ug/L	1					
Trichloroethylene	U	ND	0.250	1.00	ug/L	1					
Vinyl acetate	U	ND	1.50	5.00	ug/L	1					
Vinyl chloride	U	ND	0.500	1.00	ug/L	1					
Xylenes (total)	U	ND	0.300	1.00	ug/L	1					
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1					
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1					
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1					
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1					

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087940-A01
Sample ID: 241350011

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	61.6 ug/L	50.0	123	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	50.3 ug/L	50.0	101	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	55.7 ug/L	50.0	111	(76%-129%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087936-D01
Sample ID: 241350006
Matrix: AQUEOUS
Collect Date: 24-NOV-09 14:00
Receive Date: 24-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Control Blank
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics Federal										
8260B TCL Liquid Federal "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 12/02/09	1011	928279	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087936-D01
Sample ID: 241350006

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	52.4 ug/L	50.0	105	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	47.4 ug/L	50.0	94.8	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	53.8 ug/L	50.0	108	(76%-129%)

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Certificate of Analysis

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087936-A01
Sample ID: 241350007
Matrix: AQUEOUS
Collect Date: 24-NOV-09 14:00
Receive Date: 24-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Nylon Tubing
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics Federal										
8260B TCL Liquid Federal "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 12/02/09	1041	928279	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride		11.1	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087936-A01
Sample ID: 241350007

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	54.3 ug/L	50.0	109	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	47.8 ug/L	50.0	95.5	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	56.2 ug/L	50.0	112	(76%-129%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087937-A01
Sample ID: 241350008
Matrix: AQUEOUS
Collect Date: 24-NOV-09 14:00
Receive Date: 24-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Tygon Tubing
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics Federal										
8260B TCL Liquid Federal "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 12/02/09	1112	928279	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	J	8.85	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087937-A01
Sample ID: 241350008

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	55.3 ug/L	50.0	111	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	47.7 ug/L	50.0	95.4	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	56.1 ug/L	50.0	112	(76%-129%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087938-A01
Sample ID: 241350009
Matrix: AQUEOUS
Collect Date: 24-NOV-09 14:00
Receive Date: 24-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Teflon Tubing
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics Federal										
8260B TCL Liquid Federal "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 12/02/09	1143	928279	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087938-A01
Sample ID: 241350009

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	55.4 ug/L	50.0	111	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	48.4 ug/L	50.0	96.8	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	55.8 ug/L	50.0	112	(76%-129%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087939-A01
Sample ID: 241350010
Matrix: AQUEOUS
Collect Date: 24-NOV-09 14:00
Receive Date: 24-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Polypropylene Tubing
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics Federal										
8260B TCL Liquid Federal "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 12/02/09	1213	928279	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087939-A01
Sample ID: 241350010

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	55.6 ug/L	50.0	111	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	48.1 ug/L	50.0	96.2	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	54.3 ug/L	50.0	109	(76%-129%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087936-D02
Sample ID: 241350012
Matrix: AQUEOUS
Collect Date: 30-NOV-09 14:30
Receive Date: 30-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Control Blank
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics Federal										
8260B TCL Liquid Federal "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 12/02/09	1315	928279	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087936-D02
Sample ID: 241350012

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	57.7 ug/L	50.0	115	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	47.9 ug/L	50.0	95.8	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	55.8 ug/L	50.0	112	(76%-129%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087936-B01
Sample ID: 241350013
Matrix: AQUEOUS
Collect Date: 30-NOV-09 14:30
Receive Date: 30-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Nylon Tubing
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics Federal										
8260B TCL Liquid Federal "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 12/02/09	1346	928279	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	J	7.61	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride		11.5	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087936-B01
Sample ID: 241350013

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	59.1 ug/L	50.0	118	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	49.0 ug/L	50.0	97.9	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	56.7 ug/L	50.0	113	(76%-129%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087937-B01
Sample ID: 241350014
Matrix: AQUEOUS
Collect Date: 30-NOV-09 14:30
Receive Date: 30-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Tygon Tubing
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics Federal										
8260B TCL Liquid Federal "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 12/02/09	1417	928279	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	J	0.562	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	J	7.70	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087937-B01
Sample ID: 241350014

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	60.2 ug/L	50.0	120	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	46.4 ug/L	50.0	92.9	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	56.4 ug/L	50.0	113	(76%-129%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087938-B01
Sample ID: 241350015
Matrix: AQUEOUS
Collect Date: 30-NOV-09 14:30
Receive Date: 30-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Teflon Tubing
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics Federal										
8260B TCL Liquid Federal "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 12/02/09	1448	928279	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087938-B01
Sample ID: 241350015

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	58.4 ug/L	50.0	117	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	47.5 ug/L	50.0	95.0	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	55.6 ug/L	50.0	111	(76%-129%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087939-B01
Sample ID: 241350016
Matrix: AQUEOUS
Collect Date: 30-NOV-09 14:30
Receive Date: 30-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Polypropylene Tubing
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics Federal										
8260B TCL Liquid Federal "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 12/02/09	1519	928279	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087939-B01
Sample ID: 241350016

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	52.7 ug/L	50.0	105	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	47.2 ug/L	50.0	94.4	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	51.0 ug/L	50.0	102	(76%-129%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087940-B01
Sample ID: 241350017
Matrix: AQUEOUS
Collect Date: 30-NOV-09 14:30
Receive Date: 30-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: PVC Well Casing
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics Federal										
8260B TCL Liquid Federal "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 12/02/09	1550	928279	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087940-B01
Sample ID: 241350017

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	55.1 ug/L	50.0	110	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	47.4 ug/L	50.0	94.8	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	53.4 ug/L	50.0	107	(76%-129%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087936-D03
Sample ID: 241350018
Matrix: AQUEOUS
Collect Date: 07-DEC-09 14:30
Receive Date: 07-DEC-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Control Blank
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics Federal										
8260B TCL Liquid Federal "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 12/09/09	1154	930872	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	J	0.371	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087936-D03
Sample ID: 241350018

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	45.7 ug/L	50.0	91.3	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	41.2 ug/L	50.0	82.3	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	44.2 ug/L	50.0	88.5	(76%-129%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087936-C01
Sample ID: 241350019
Matrix: AQUEOUS
Collect Date: 07-DEC-09 14:30
Receive Date: 07-DEC-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Nylon Tubing
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics Federal										
8260B TCL Liquid Federal "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 12/09/09	1221	930872	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	J	9.42	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087936-C01
Sample ID: 241350019

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	49.1 ug/L	50.0	98.3	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	43.5 ug/L	50.0	87.0	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	48.4 ug/L	50.0	96.8	(76%-129%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087937-C01
Sample ID: 241350020
Matrix: AQUEOUS
Collect Date: 07-DEC-09 14:30
Receive Date: 07-DEC-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Tygon Tubing
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics Federal										
8260B TCL Liquid Federal "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 12/09/09	1249	930872	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	J	5.35	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087937-C01
Sample ID: 241350020

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	47.9 ug/L	50.0	95.8	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	42.2 ug/L	50.0	84.5	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	45.8 ug/L	50.0	91.7	(76%-129%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087938-C01
Sample ID: 241350021
Matrix: AQUEOUS
Collect Date: 07-DEC-09 14:30
Receive Date: 07-DEC-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Teflon Tubing
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics Federal										
8260B TCL Liquid Federal "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 12/09/09	1317	930872	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087938-C01
Sample ID: 241350021

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	47.0 ug/L	50.0	93.9	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	41.4 ug/L	50.0	82.9	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	46.3 ug/L	50.0	92.7	(76%-129%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087939-C01
Sample ID: 241350022
Matrix: AQUEOUS
Collect Date: 07-DEC-09 14:30
Receive Date: 07-DEC-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Polypropylene Tubing
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics Federal										
8260B TCL Liquid Federal "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 12/09/09	1345	930872	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087939-C01
Sample ID: 241350022

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	45.6 ug/L	50.0	91.3	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	41.6 ug/L	50.0	83.2	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	45.2 ug/L	50.0	90.4	(76%-129%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087940-C01
Sample ID: 241350023
Matrix: AQUEOUS
Collect Date: 07-DEC-09 14:30
Receive Date: 07-DEC-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: PVC Well Casing
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics Federal										
8260B TCL Liquid Federal "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 12/09/09	1413	930872	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Company : Sandia National Laboratories
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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 11, 2009

Client Sample ID: 087940-C01
Sample ID: 241350023

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid Federal "As Received"	44.5 ug/L	50.0	89.0	(59%-130%)
Bromofluorobenzene	8260B TCL Liquid Federal "As Received"	38.7 ug/L	50.0	77.5	(71%-126%)
Toluene-d8	8260B TCL Liquid Federal "As Received"	42.8 ug/L	50.0	85.7	(76%-129%)

SVOC Analyses

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Certificate of Analysis Report
for

SNLS003 Sandia National Labs (691436)

Client SDG: 241350 GEL Work Order: 241350

The Qualifiers in this report are defined as follows:

* Recovery or %RPD not within acceptance limits and/or spike amount not compatible with the sample or the duplicate RPD's are not applicable where the concentration falls below the effective PQL.

** Indicates analyte is a surrogate compound.

U The analyte was analyzed for but not detected below this concentration. For Organic and Inorganic analytes the result is less than the effective MDL. For radiochemical analytes the result is less than the Decision Level

Review/Validation

GEL requires all analytical data to be verified by a qualified data reviewer. In addition, all CLP-like deliverables receive a third level review of the fractional data package.

The following data validator verified the information presented in this case narrative:

Signature: Dan Beacham **Name: Daniel Beacham**

Date: 30 DEC 2009 **Title: Data Validator**

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087940-A01
Sample ID: 241350011
Matrix: AQUEOUS
Collect Date: 24-NOV-09 14:00
Receive Date: 24-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: PVC Well Casing 24 Hour
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
1,2,4-Trichlorobenzene	U	ND	1.89	9.43	ug/L	1	AGS1 12/01/09	2250	926148	1
1,2-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1				
1,3-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1				
1,4-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1				
2,4,5-Trichlorophenol	U	ND	1.89	9.43	ug/L	1				
2,4,6-Trichlorophenol	U	ND	1.89	9.43	ug/L	1				
2,4-Dichlorophenol	U	ND	1.89	9.43	ug/L	1				
2,4-Dimethylphenol	U	ND	1.89	9.43	ug/L	1				
2,4-Dinitrophenol	U	ND	4.72	18.9	ug/L	1				
2,4-Dinitrotoluene	U	ND	1.89	9.43	ug/L	1				
2,6-Dinitrotoluene	U	ND	1.89	9.43	ug/L	1				
2-Chloronaphthalene	U	ND	0.283	0.943	ug/L	1				
2-Chlorophenol	U	ND	1.89	9.43	ug/L	1				
2-Methyl-4,6-dinitrophenol	U	ND	2.83	9.43	ug/L	1				
2-Methylnaphthalene	U	ND	0.283	0.943	ug/L	1				
2-Nitrophenol	U	ND	1.89	9.43	ug/L	1				
3,3'-Dichlorobenzidine	U	ND	1.89	9.43	ug/L	1				
4-Bromophenylphenylether	U	ND	1.89	9.43	ug/L	1				
4-Chloro-3-methylphenol	U	ND	1.89	9.43	ug/L	1				
4-Chloroaniline	U	ND	1.89	9.43	ug/L	1				
4-Chlorophenylphenylether	U	ND	1.89	9.43	ug/L	1				
4-Nitrophenol	U	ND	1.89	9.43	ug/L	1				
Acenaphthene	U	ND	0.292	0.943	ug/L	1				
Acenaphthylene	U	ND	0.189	0.943	ug/L	1				
Anthracene	U	ND	0.189	0.943	ug/L	1				
Benzo(a)anthracene	U	ND	0.189	0.943	ug/L	1				
Benzo(a)pyrene	U	ND	0.189	0.943	ug/L	1				
Benzo(b)fluoranthene	U	ND	0.189	0.943	ug/L	1				
Benzo(ghi)perylene	U	ND	0.189	0.943	ug/L	1				
Benzo(k)fluoranthene	U	ND	0.189	0.943	ug/L	1				
Butylbenzylphthalate	U	ND	1.89	9.43	ug/L	1				
Carbazole	U	ND	0.189	0.943	ug/L	1				
Chrysene	U	ND	0.189	0.943	ug/L	1				
Di-n-butylphthalate	U	ND	1.89	9.43	ug/L	1				
Di-n-octylphthalate	U	ND	2.83	9.43	ug/L	1				
Dibenzo(a,h)anthracene	U	ND	0.189	0.943	ug/L	1				
Dibenzofuran	U	ND	1.89	9.43	ug/L	1				
Diethylphthalate	U	ND	1.89	9.43	ug/L	1				

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087940-A01
Sample ID: 241350011

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.89	9.43	ug/L	1				
Diphenylamine	U	ND	2.83	9.43	ug/L	1				
Fluoranthene	U	ND	0.189	0.943	ug/L	1				
Fluorene	U	ND	0.189	0.943	ug/L	1				
Hexachlorobenzene	U	ND	1.89	9.43	ug/L	1				
Hexachlorobutadiene	U	ND	1.89	9.43	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.83	9.43	ug/L	1				
Hexachloroethane	U	ND	1.89	9.43	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.189	0.943	ug/L	1				
Isophorone	U	ND	2.83	9.43	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.89	9.43	ug/L	1				
Naphthalene	U	ND	0.283	0.943	ug/L	1				
Nitrobenzene	U	ND	2.83	9.43	ug/L	1				
Pentachlorophenol	U	ND	1.89	9.43	ug/L	1				
Phenanthrene	U	ND	0.189	0.943	ug/L	1				
Phenol	U	ND	0.943	9.43	ug/L	1				
Pyrene	U	ND	0.283	0.943	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.83	9.43	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.89	9.43	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.89	9.43	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.89	9.43	ug/L	1				
m,p-Cresols	U	ND	2.83	9.43	ug/L	1				
m-Nitroaniline	U	ND	1.89	9.43	ug/L	1				
o-Cresol	U	ND	1.89	9.43	ug/L	1				
o-Nitroaniline	U	ND	1.89	9.43	ug/L	1				
p-Nitroaniline	U	ND	2.83	9.43	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	RXC1	11/27/09	1536	926147

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	38.8 ug/L	47.2	82.2	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	39.2 ug/L	47.2	83.0	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	37.2 ug/L	47.2	78.9	(46%-130%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087940-A01
Sample ID: 241350011

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
2,4,6-Tribromophenol		3510/8270C TCL BNA Liquid "As Received"		76.1	ug/L	94.3	80.7		(39%-115%)		
2-Fluorophenol		3510/8270C TCL BNA Liquid "As Received"		43.2	ug/L	94.3	45.8		(25%-92%)		
Phenol-d5		3510/8270C TCL BNA Liquid "As Received"		26.1	ug/L	94.3	27.7		(15%-73%)		

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-D01
Sample ID: 241350006
Matrix: AQUEOUS
Collect Date: 24-NOV-09 14:00
Receive Date: 24-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Control Blank 24 Hour
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
1,2,4-Trichlorobenzene	U	ND	1.92	9.62	ug/L	1	AGS1 12/01/09	2108	926148	1
1,2-Dichlorobenzene	U	ND	1.92	9.62	ug/L	1				
1,3-Dichlorobenzene	U	ND	1.92	9.62	ug/L	1				
1,4-Dichlorobenzene	U	ND	1.92	9.62	ug/L	1				
2,4,5-Trichlorophenol	U	ND	1.92	9.62	ug/L	1				
2,4,6-Trichlorophenol	U	ND	1.92	9.62	ug/L	1				
2,4-Dichlorophenol	U	ND	1.92	9.62	ug/L	1				
2,4-Dimethylphenol	U	ND	1.92	9.62	ug/L	1				
2,4-Dinitrophenol	U	ND	4.81	19.2	ug/L	1				
2,4-Dinitrotoluene	U	ND	1.92	9.62	ug/L	1				
2,6-Dinitrotoluene	U	ND	1.92	9.62	ug/L	1				
2-Chloronaphthalene	U	ND	0.288	0.962	ug/L	1				
2-Chlorophenol	U	ND	1.92	9.62	ug/L	1				
2-Methyl-4,6-dinitrophenol	U	ND	2.88	9.62	ug/L	1				
2-Methylnaphthalene	U	ND	0.288	0.962	ug/L	1				
2-Nitrophenol	U	ND	1.92	9.62	ug/L	1				
3,3'-Dichlorobenzidine	U	ND	1.92	9.62	ug/L	1				
4-Bromophenylphenylether	U	ND	1.92	9.62	ug/L	1				
4-Chloro-3-methylphenol	U	ND	1.92	9.62	ug/L	1				
4-Chloroaniline	U	ND	1.92	9.62	ug/L	1				
4-Chlorophenylphenylether	U	ND	1.92	9.62	ug/L	1				
4-Nitrophenol	U	ND	1.92	9.62	ug/L	1				
Acenaphthene	U	ND	0.298	0.962	ug/L	1				
Acenaphthylene	U	ND	0.192	0.962	ug/L	1				
Anthracene	U	ND	0.192	0.962	ug/L	1				
Benzo(a)anthracene	U	ND	0.192	0.962	ug/L	1				
Benzo(a)pyrene	U	ND	0.192	0.962	ug/L	1				
Benzo(b)fluoranthene	U	ND	0.192	0.962	ug/L	1				
Benzo(ghi)perylene	U	ND	0.192	0.962	ug/L	1				
Benzo(k)fluoranthene	U	ND	0.192	0.962	ug/L	1				
Butylbenzylphthalate	U	ND	1.92	9.62	ug/L	1				
Carbazole	U	ND	0.192	0.962	ug/L	1				
Chrysene	U	ND	0.192	0.962	ug/L	1				
Di-n-butylphthalate	U	ND	1.92	9.62	ug/L	1				
Di-n-octylphthalate	U	ND	2.88	9.62	ug/L	1				
Dibenzo(a,h)anthracene	U	ND	0.192	0.962	ug/L	1				
Dibenzofuran	U	ND	1.92	9.62	ug/L	1				
Diethylphthalate	U	ND	1.92	9.62	ug/L	1				

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-D01
Sample ID: 241350006

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.92	9.62	ug/L	1				
Diphenylamine	U	ND	2.88	9.62	ug/L	1				
Fluoranthene	U	ND	0.192	0.962	ug/L	1				
Fluorene	U	ND	0.192	0.962	ug/L	1				
Hexachlorobenzene	U	ND	1.92	9.62	ug/L	1				
Hexachlorobutadiene	U	ND	1.92	9.62	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.88	9.62	ug/L	1				
Hexachloroethane	U	ND	1.92	9.62	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.192	0.962	ug/L	1				
Isophorone	U	ND	2.88	9.62	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.92	9.62	ug/L	1				
Naphthalene	U	ND	0.288	0.962	ug/L	1				
Nitrobenzene	U	ND	2.88	9.62	ug/L	1				
Pentachlorophenol	U	ND	1.92	9.62	ug/L	1				
Phenanthrene	U	ND	0.192	0.962	ug/L	1				
Phenol	U	ND	0.962	9.62	ug/L	1				
Pyrene	U	ND	0.288	0.962	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.88	9.62	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.92	9.62	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.92	9.62	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.92	9.62	ug/L	1				
m,p-Cresols	U	ND	2.88	9.62	ug/L	1				
m-Nitroaniline	U	ND	1.92	9.62	ug/L	1				
o-Cresol	U	ND	1.92	9.62	ug/L	1				
o-Nitroaniline	U	ND	1.92	9.62	ug/L	1				
p-Nitroaniline	U	ND	2.88	9.62	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	RXC1	11/27/09	1536	926147

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	43.4 ug/L	48.1	90.2	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	43.2 ug/L	48.1	89.9	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	44.3 ug/L	48.1	92.2	(46%-130%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-D01
Sample ID: 241350006

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
2,4,6-Tribromophenol		3510/8270C TCL BNA Liquid "As Received"		33.8	ug/L	96.2	35.1*		(39%-115%)		
2-Fluorophenol		3510/8270C TCL BNA Liquid "As Received"		16.5	ug/L	96.2	17.2*		(25%-92%)		
Phenol-d5		3510/8270C TCL BNA Liquid "As Received"		12.4	ug/L	96.2	12.9*		(15%-73%)		

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-A01
Sample ID: 241350007
Matrix: AQUEOUS
Collect Date: 24-NOV-09 14:00
Receive Date: 24-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Nylon Tubing 24 Hour
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
1,2,4-Trichlorobenzene	U	ND	1.92	9.62	ug/L	1	AGS1 12/01/09	2128	926148	1
1,2-Dichlorobenzene	U	ND	1.92	9.62	ug/L	1				
1,3-Dichlorobenzene	U	ND	1.92	9.62	ug/L	1				
1,4-Dichlorobenzene	U	ND	1.92	9.62	ug/L	1				
2,4,5-Trichlorophenol	U	ND	1.92	9.62	ug/L	1				
2,4,6-Trichlorophenol	U	ND	1.92	9.62	ug/L	1				
2,4-Dichlorophenol	U	ND	1.92	9.62	ug/L	1				
2,4-Dimethylphenol	U	ND	1.92	9.62	ug/L	1				
2,4-Dinitrophenol	U	ND	4.81	19.2	ug/L	1				
2,4-Dinitrotoluene	U	ND	1.92	9.62	ug/L	1				
2,6-Dinitrotoluene	U	ND	1.92	9.62	ug/L	1				
2-Chloronaphthalene	U	ND	0.288	0.962	ug/L	1				
2-Chlorophenol	U	ND	1.92	9.62	ug/L	1				
2-Methyl-4,6-dinitrophenol	U	ND	2.88	9.62	ug/L	1				
2-Methylnaphthalene	U	ND	0.288	0.962	ug/L	1				
2-Nitrophenol	U	ND	1.92	9.62	ug/L	1				
3,3'-Dichlorobenzidine	U	ND	1.92	9.62	ug/L	1				
4-Bromophenylphenylether	U	ND	1.92	9.62	ug/L	1				
4-Chloro-3-methylphenol	U	ND	1.92	9.62	ug/L	1				
4-Chloroaniline	U	ND	1.92	9.62	ug/L	1				
4-Chlorophenylphenylether	U	ND	1.92	9.62	ug/L	1				
4-Nitrophenol	U	ND	1.92	9.62	ug/L	1				
Acenaphthene	U	ND	0.298	0.962	ug/L	1				
Acenaphthylene	U	ND	0.192	0.962	ug/L	1				
Anthracene	U	ND	0.192	0.962	ug/L	1				
Benzo(a)anthracene	U	ND	0.192	0.962	ug/L	1				
Benzo(a)pyrene	U	ND	0.192	0.962	ug/L	1				
Benzo(b)fluoranthene	U	ND	0.192	0.962	ug/L	1				
Benzo(ghi)perylene	U	ND	0.192	0.962	ug/L	1				
Benzo(k)fluoranthene	U	ND	0.192	0.962	ug/L	1				
Butylbenzylphthalate	U	ND	1.92	9.62	ug/L	1				
Carbazole	U	ND	0.192	0.962	ug/L	1				
Chrysene	U	ND	0.192	0.962	ug/L	1				
Di-n-butylphthalate	U	ND	1.92	9.62	ug/L	1				
Di-n-octylphthalate	U	ND	2.88	9.62	ug/L	1				
Dibenzo(a,h)anthracene	U	ND	0.192	0.962	ug/L	1				
Dibenzofuran	U	ND	1.92	9.62	ug/L	1				
Diethylphthalate	U	ND	1.92	9.62	ug/L	1				

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-A01
Sample ID: 241350007

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.92	9.62	ug/L	1				
Diphenylamine	U	ND	2.88	9.62	ug/L	1				
Fluoranthene	U	ND	0.192	0.962	ug/L	1				
Fluorene	U	ND	0.192	0.962	ug/L	1				
Hexachlorobenzene	U	ND	1.92	9.62	ug/L	1				
Hexachlorobutadiene	U	ND	1.92	9.62	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.88	9.62	ug/L	1				
Hexachloroethane	U	ND	1.92	9.62	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.192	0.962	ug/L	1				
Isophorone	U	ND	2.88	9.62	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.92	9.62	ug/L	1				
Naphthalene	U	ND	0.288	0.962	ug/L	1				
Nitrobenzene	U	ND	2.88	9.62	ug/L	1				
Pentachlorophenol	U	ND	1.92	9.62	ug/L	1				
Phenanthrene	U	ND	0.192	0.962	ug/L	1				
Phenol	U	ND	0.962	9.62	ug/L	1				
Pyrene	U	ND	0.288	0.962	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.88	9.62	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.92	9.62	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.92	9.62	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.92	9.62	ug/L	1				
m,p-Cresols	U	ND	2.88	9.62	ug/L	1				
m-Nitroaniline	U	ND	1.92	9.62	ug/L	1				
o-Cresol	U	ND	1.92	9.62	ug/L	1				
o-Nitroaniline	U	ND	1.92	9.62	ug/L	1				
p-Nitroaniline	U	ND	2.88	9.62	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	RXC1	11/27/09	1536	926147

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	40.4 ug/L	48.1	84.1	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	39.8 ug/L	48.1	82.8	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	42.8 ug/L	48.1	89.0	(46%-130%)

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Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-A01
Sample ID: 241350007

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
2,4,6-Tribromophenol		3510/8270C TCL BNA Liquid "As Received"		72.2	ug/L	96.2	75.1		(39%-115%)		
2-Fluorophenol		3510/8270C TCL BNA Liquid "As Received"		37.6	ug/L	96.2	39.1		(25%-92%)		
Phenol-d5		3510/8270C TCL BNA Liquid "As Received"		24.8	ug/L	96.2	25.7		(15%-73%)		

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087937-A01
Sample ID: 241350008
Matrix: AQUEOUS
Collect Date: 24-NOV-09 14:00
Receive Date: 24-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Tygon Tubing 24 Hour
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
1,2,4-Trichlorobenzene	U	ND	1.90	9.52	ug/L	1	AGS1 12/01/09	2149	926148	1
1,2-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
1,3-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
1,4-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
2,4,5-Trichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4,6-Trichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dimethylphenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dinitrophenol	U	ND	4.76	19.0	ug/L	1				
2,4-Dinitrotoluene	U	ND	1.90	9.52	ug/L	1				
2,6-Dinitrotoluene	U	ND	1.90	9.52	ug/L	1				
2-Chloronaphthalene	U	ND	0.286	0.952	ug/L	1				
2-Chlorophenol	U	ND	1.90	9.52	ug/L	1				
2-Methyl-4,6-dinitrophenol	U	ND	2.86	9.52	ug/L	1				
2-Methylnaphthalene	U	ND	0.286	0.952	ug/L	1				
2-Nitrophenol	U	ND	1.90	9.52	ug/L	1				
3,3'-Dichlorobenzidine	U	ND	1.90	9.52	ug/L	1				
4-Bromophenylphenylether	U	ND	1.90	9.52	ug/L	1				
4-Chloro-3-methylphenol	U	ND	1.90	9.52	ug/L	1				
4-Chloroaniline	U	ND	1.90	9.52	ug/L	1				
4-Chlorophenylphenylether	U	ND	1.90	9.52	ug/L	1				
4-Nitrophenol	U	ND	1.90	9.52	ug/L	1				
Acenaphthene	U	ND	0.295	0.952	ug/L	1				
Acenaphthylene	U	ND	0.190	0.952	ug/L	1				
Anthracene	U	ND	0.190	0.952	ug/L	1				
Benzo(a)anthracene	U	ND	0.190	0.952	ug/L	1				
Benzo(a)pyrene	U	ND	0.190	0.952	ug/L	1				
Benzo(b)fluoranthene	U	ND	0.190	0.952	ug/L	1				
Benzo(ghi)perylene	U	ND	0.190	0.952	ug/L	1				
Benzo(k)fluoranthene	U	ND	0.190	0.952	ug/L	1				
Butylbenzylphthalate	U	ND	1.90	9.52	ug/L	1				
Carbazole	U	ND	0.190	0.952	ug/L	1				
Chrysene	U	ND	0.190	0.952	ug/L	1				
Di-n-butylphthalate	U	ND	1.90	9.52	ug/L	1				
Di-n-octylphthalate	U	ND	2.86	9.52	ug/L	1				
Dibenzo(a,h)anthracene	U	ND	0.190	0.952	ug/L	1				
Dibenzofuran	U	ND	1.90	9.52	ug/L	1				
Diethylphthalate	U	ND	1.90	9.52	ug/L	1				

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087937-A01
Sample ID: 241350008

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.90	9.52	ug/L	1				
Diphenylamine	U	ND	2.86	9.52	ug/L	1				
Fluoranthene	U	ND	0.190	0.952	ug/L	1				
Fluorene	U	ND	0.190	0.952	ug/L	1				
Hexachlorobenzene	U	ND	1.90	9.52	ug/L	1				
Hexachlorobutadiene	U	ND	1.90	9.52	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.86	9.52	ug/L	1				
Hexachloroethane	U	ND	1.90	9.52	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.190	0.952	ug/L	1				
Isophorone	U	ND	2.86	9.52	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.90	9.52	ug/L	1				
Naphthalene	U	ND	0.286	0.952	ug/L	1				
Nitrobenzene	U	ND	2.86	9.52	ug/L	1				
Pentachlorophenol	U	ND	1.90	9.52	ug/L	1				
Phenanthrene	U	ND	0.190	0.952	ug/L	1				
Phenol	U	ND	0.952	9.52	ug/L	1				
Pyrene	U	ND	0.286	0.952	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.86	9.52	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.90	9.52	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.90	9.52	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.90	9.52	ug/L	1				
m,p-Cresols	U	ND	2.86	9.52	ug/L	1				
m-Nitroaniline	U	ND	1.90	9.52	ug/L	1				
o-Cresol	U	ND	1.90	9.52	ug/L	1				
o-Nitroaniline	U	ND	1.90	9.52	ug/L	1				
p-Nitroaniline	U	ND	2.86	9.52	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	RXC1	11/27/09	1536	926147

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	37.3 ug/L	47.6	78.3	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	36.7 ug/L	47.6	77.0	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	42.9 ug/L	47.6	90.2	(46%-130%)

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087937-A01
Sample ID: 241350008

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
2,4,6-Tribromophenol		3510/8270C TCL BNA Liquid "As Received"		69.0	ug/L	95.2	72.4		(39%-115%)		
2-Fluorophenol		3510/8270C TCL BNA Liquid "As Received"		34.9	ug/L	95.2	36.7		(25%-92%)		
Phenol-d5		3510/8270C TCL BNA Liquid "As Received"		21.5	ug/L	95.2	22.5		(15%-73%)		

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087938-A01
Sample ID: 241350009
Matrix: AQUEOUS
Collect Date: 24-NOV-09 14:00
Receive Date: 24-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Teflon Tubing 24 Hour
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
1,2,4-Trichlorobenzene	U	ND	1.90	9.52	ug/L	1	AGS1 12/01/09	2209	926148	1
1,2-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
1,3-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
1,4-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
2,4,5-Trichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4,6-Trichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dimethylphenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dinitrophenol	U	ND	4.76	19.0	ug/L	1				
2,4-Dinitrotoluene	U	ND	1.90	9.52	ug/L	1				
2,6-Dinitrotoluene	U	ND	1.90	9.52	ug/L	1				
2-Chloronaphthalene	U	ND	0.286	0.952	ug/L	1				
2-Chlorophenol	U	ND	1.90	9.52	ug/L	1				
2-Methyl-4,6-dinitrophenol	U	ND	2.86	9.52	ug/L	1				
2-Methylnaphthalene	U	ND	0.286	0.952	ug/L	1				
2-Nitrophenol	U	ND	1.90	9.52	ug/L	1				
3,3'-Dichlorobenzidine	U	ND	1.90	9.52	ug/L	1				
4-Bromophenylphenylether	U	ND	1.90	9.52	ug/L	1				
4-Chloro-3-methylphenol	U	ND	1.90	9.52	ug/L	1				
4-Chloroaniline	U	ND	1.90	9.52	ug/L	1				
4-Chlorophenylphenylether	U	ND	1.90	9.52	ug/L	1				
4-Nitrophenol	U	ND	1.90	9.52	ug/L	1				
Acenaphthene	U	ND	0.295	0.952	ug/L	1				
Acenaphthylene	U	ND	0.190	0.952	ug/L	1				
Anthracene	U	ND	0.190	0.952	ug/L	1				
Benzo(a)anthracene	U	ND	0.190	0.952	ug/L	1				
Benzo(a)pyrene	U	ND	0.190	0.952	ug/L	1				
Benzo(b)fluoranthene	U	ND	0.190	0.952	ug/L	1				
Benzo(ghi)perylene	U	ND	0.190	0.952	ug/L	1				
Benzo(k)fluoranthene	U	ND	0.190	0.952	ug/L	1				
Butylbenzylphthalate	U	ND	1.90	9.52	ug/L	1				
Carbazole	U	ND	0.190	0.952	ug/L	1				
Chrysene	U	ND	0.190	0.952	ug/L	1				
Di-n-butylphthalate	U	ND	1.90	9.52	ug/L	1				
Di-n-octylphthalate	U	ND	2.86	9.52	ug/L	1				
Dibenzo(a,h)anthracene	U	ND	0.190	0.952	ug/L	1				
Dibenzofuran	U	ND	1.90	9.52	ug/L	1				
Diethylphthalate	U	ND	1.90	9.52	ug/L	1				

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087938-A01
Sample ID: 241350009

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.90	9.52	ug/L	1				
Diphenylamine	U	ND	2.86	9.52	ug/L	1				
Fluoranthene	U	ND	0.190	0.952	ug/L	1				
Fluorene	U	ND	0.190	0.952	ug/L	1				
Hexachlorobenzene	U	ND	1.90	9.52	ug/L	1				
Hexachlorobutadiene	U	ND	1.90	9.52	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.86	9.52	ug/L	1				
Hexachloroethane	U	ND	1.90	9.52	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.190	0.952	ug/L	1				
Isophorone	U	ND	2.86	9.52	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.90	9.52	ug/L	1				
Naphthalene	U	ND	0.286	0.952	ug/L	1				
Nitrobenzene	U	ND	2.86	9.52	ug/L	1				
Pentachlorophenol	U	ND	1.90	9.52	ug/L	1				
Phenanthrene	U	ND	0.190	0.952	ug/L	1				
Phenol	U	ND	0.952	9.52	ug/L	1				
Pyrene	U	ND	0.286	0.952	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.86	9.52	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.90	9.52	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.90	9.52	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.90	9.52	ug/L	1				
m,p-Cresols	U	ND	2.86	9.52	ug/L	1				
m-Nitroaniline	U	ND	1.90	9.52	ug/L	1				
o-Cresol	U	ND	1.90	9.52	ug/L	1				
o-Nitroaniline	U	ND	1.90	9.52	ug/L	1				
p-Nitroaniline	U	ND	2.86	9.52	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	RXC1	11/27/09	1536	926147

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	39.5 ug/L	47.6	82.9	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	38.9 ug/L	47.6	81.6	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	45.5 ug/L	47.6	95.6	(46%-130%)

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Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087938-A01
Sample ID: 241350009

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
2,4,6-Tribromophenol		3510/8270C TCL BNA Liquid "As Received"		64.5	ug/L	95.2	67.7		(39%-115%)		
2-Fluorophenol		3510/8270C TCL BNA Liquid "As Received"		35.7	ug/L	95.2	37.5		(25%-92%)		
Phenol-d5		3510/8270C TCL BNA Liquid "As Received"		22.5	ug/L	95.2	23.6		(15%-73%)		

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087939-A01
Sample ID: 241350010
Matrix: AQUEOUS
Collect Date: 24-NOV-09 14:00
Receive Date: 24-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Polypropylene Tubing 24 Hour
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
1,2,4-Trichlorobenzene	U	ND	1.89	9.43	ug/L	1	AGS1 12/01/09	2229	926148	1
1,2-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1				
1,3-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1				
1,4-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1				
2,4,5-Trichlorophenol	U	ND	1.89	9.43	ug/L	1				
2,4,6-Trichlorophenol	U	ND	1.89	9.43	ug/L	1				
2,4-Dichlorophenol	U	ND	1.89	9.43	ug/L	1				
2,4-Dimethylphenol	U	ND	1.89	9.43	ug/L	1				
2,4-Dinitrophenol	U	ND	4.72	18.9	ug/L	1				
2,4-Dinitrotoluene	U	ND	1.89	9.43	ug/L	1				
2,6-Dinitrotoluene	U	ND	1.89	9.43	ug/L	1				
2-Chloronaphthalene	U	ND	0.283	0.943	ug/L	1				
2-Chlorophenol	U	ND	1.89	9.43	ug/L	1				
2-Methyl-4,6-dinitrophenol	U	ND	2.83	9.43	ug/L	1				
2-Methylnaphthalene	U	ND	0.283	0.943	ug/L	1				
2-Nitrophenol	U	ND	1.89	9.43	ug/L	1				
3,3'-Dichlorobenzidine	U	ND	1.89	9.43	ug/L	1				
4-Bromophenylphenylether	U	ND	1.89	9.43	ug/L	1				
4-Chloro-3-methylphenol	U	ND	1.89	9.43	ug/L	1				
4-Chloroaniline	U	ND	1.89	9.43	ug/L	1				
4-Chlorophenylphenylether	U	ND	1.89	9.43	ug/L	1				
4-Nitrophenol	U	ND	1.89	9.43	ug/L	1				
Acenaphthene	U	ND	0.292	0.943	ug/L	1				
Acenaphthylene	U	ND	0.189	0.943	ug/L	1				
Anthracene	U	ND	0.189	0.943	ug/L	1				
Benzo(a)anthracene	U	ND	0.189	0.943	ug/L	1				
Benzo(a)pyrene	U	ND	0.189	0.943	ug/L	1				
Benzo(b)fluoranthene	U	ND	0.189	0.943	ug/L	1				
Benzo(ghi)perylene	U	ND	0.189	0.943	ug/L	1				
Benzo(k)fluoranthene	U	ND	0.189	0.943	ug/L	1				
Butylbenzylphthalate	U	ND	1.89	9.43	ug/L	1				
Carbazole	U	ND	0.189	0.943	ug/L	1				
Chrysene	U	ND	0.189	0.943	ug/L	1				
Di-n-butylphthalate	U	ND	1.89	9.43	ug/L	1				
Di-n-octylphthalate	U	ND	2.83	9.43	ug/L	1				
Dibenzo(a,h)anthracene	U	ND	0.189	0.943	ug/L	1				
Dibenzofuran	U	ND	1.89	9.43	ug/L	1				
Diethylphthalate	U	ND	1.89	9.43	ug/L	1				

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087939-A01
Sample ID: 241350010

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.89	9.43	ug/L	1				
Diphenylamine	U	ND	2.83	9.43	ug/L	1				
Fluoranthene	U	ND	0.189	0.943	ug/L	1				
Fluorene	U	ND	0.189	0.943	ug/L	1				
Hexachlorobenzene	U	ND	1.89	9.43	ug/L	1				
Hexachlorobutadiene	U	ND	1.89	9.43	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.83	9.43	ug/L	1				
Hexachloroethane	U	ND	1.89	9.43	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.189	0.943	ug/L	1				
Isophorone	U	ND	2.83	9.43	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.89	9.43	ug/L	1				
Naphthalene	U	ND	0.283	0.943	ug/L	1				
Nitrobenzene	U	ND	2.83	9.43	ug/L	1				
Pentachlorophenol	U	ND	1.89	9.43	ug/L	1				
Phenanthrene	U	ND	0.189	0.943	ug/L	1				
Phenol	U	ND	0.943	9.43	ug/L	1				
Pyrene	U	ND	0.283	0.943	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.83	9.43	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.89	9.43	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.89	9.43	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.89	9.43	ug/L	1				
m,p-Cresols	U	ND	2.83	9.43	ug/L	1				
m-Nitroaniline	U	ND	1.89	9.43	ug/L	1				
o-Cresol	U	ND	1.89	9.43	ug/L	1				
o-Nitroaniline	U	ND	1.89	9.43	ug/L	1				
p-Nitroaniline	U	ND	2.83	9.43	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	RXC1	11/27/09	1536	926147

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	40.5 ug/L	47.2	86.0	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	40.3 ug/L	47.2	85.4	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	39.4 ug/L	47.2	83.5	(46%-130%)

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Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087939-A01
Sample ID: 241350010

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
2,4,6-Tribromophenol		3510/8270C TCL BNA Liquid "As Received"		72.4	ug/L	94.3	76.7		(39%-115%)		
2-Fluorophenol		3510/8270C TCL BNA Liquid "As Received"		41.0	ug/L	94.3	43.5		(25%-92%)		
Phenol-d5		3510/8270C TCL BNA Liquid "As Received"		25.2	ug/L	94.3	26.7		(15%-73%)		

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-D02
Sample ID: 241350012
Matrix: AQUEOUS
Collect Date: 30-NOV-09 14:30
Receive Date: 30-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Control Blank 7 Day
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
1,2,4-Trichlorobenzene	U	ND	1.90	9.52	ug/L	1	JMB3 12/05/09	1319	929021	1
1,2-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
1,3-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
1,4-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
2,4,5-Trichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4,6-Trichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dimethylphenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dinitrophenol	U	ND	4.76	19.0	ug/L	1				
2,4-Dinitrotoluene	U	ND	1.90	9.52	ug/L	1				
2,6-Dinitrotoluene	U	ND	1.90	9.52	ug/L	1				
2-Chloronaphthalene	U	ND	0.286	0.952	ug/L	1				
2-Chlorophenol	U	ND	1.90	9.52	ug/L	1				
2-Methyl-4,6-dinitrophenol	U	ND	2.86	9.52	ug/L	1				
2-Methylnaphthalene	U	ND	0.286	0.952	ug/L	1				
2-Nitrophenol	U	ND	1.90	9.52	ug/L	1				
3,3'-Dichlorobenzidine	U	ND	1.90	9.52	ug/L	1				
4-Bromophenylphenylether	U	ND	1.90	9.52	ug/L	1				
4-Chloro-3-methylphenol	U	ND	1.90	9.52	ug/L	1				
4-Chloroaniline	U	ND	1.90	9.52	ug/L	1				
4-Chlorophenylphenylether	U	ND	1.90	9.52	ug/L	1				
4-Nitrophenol	U	ND	1.90	9.52	ug/L	1				
Acenaphthene	U	ND	0.295	0.952	ug/L	1				
Acenaphthylene	U	ND	0.190	0.952	ug/L	1				
Anthracene	U	ND	0.190	0.952	ug/L	1				
Benzo(a)anthracene	U	ND	0.190	0.952	ug/L	1				
Benzo(a)pyrene	U	ND	0.190	0.952	ug/L	1				
Benzo(b)fluoranthene	U	ND	0.190	0.952	ug/L	1				
Benzo(ghi)perylene	U	ND	0.190	0.952	ug/L	1				
Benzo(k)fluoranthene	U	ND	0.190	0.952	ug/L	1				
Butylbenzylphthalate	U	ND	1.90	9.52	ug/L	1				
Carbazole	U	ND	0.190	0.952	ug/L	1				
Chrysene	U	ND	0.190	0.952	ug/L	1				
Di-n-butylphthalate	U	ND	1.90	9.52	ug/L	1				
Di-n-octylphthalate	U	ND	2.86	9.52	ug/L	1				
Dibenzo(a,h)anthracene	U	ND	0.190	0.952	ug/L	1				
Dibenzofuran	U	ND	1.90	9.52	ug/L	1				
Diethylphthalate	U	ND	1.90	9.52	ug/L	1				

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-D02
Sample ID: 241350012

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.90	9.52	ug/L	1				
Diphenylamine	U	ND	2.86	9.52	ug/L	1				
Fluoranthene	U	ND	0.190	0.952	ug/L	1				
Fluorene	U	ND	0.190	0.952	ug/L	1				
Hexachlorobenzene	U	ND	1.90	9.52	ug/L	1				
Hexachlorobutadiene	U	ND	1.90	9.52	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.86	9.52	ug/L	1				
Hexachloroethane	U	ND	1.90	9.52	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.190	0.952	ug/L	1				
Isophorone	U	ND	2.86	9.52	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.90	9.52	ug/L	1				
Naphthalene	U	ND	0.286	0.952	ug/L	1				
Nitrobenzene	U	ND	2.86	9.52	ug/L	1				
Pentachlorophenol	U	ND	1.90	9.52	ug/L	1				
Phenanthrene	U	ND	0.190	0.952	ug/L	1				
Phenol	U	ND	0.952	9.52	ug/L	1				
Pyrene	U	ND	0.286	0.952	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.86	9.52	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.90	9.52	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.90	9.52	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.90	9.52	ug/L	1				
m,p-Cresols	U	ND	2.86	9.52	ug/L	1				
m-Nitroaniline	U	ND	1.90	9.52	ug/L	1				
o-Cresol	U	ND	1.90	9.52	ug/L	1				
o-Nitroaniline	U	ND	1.90	9.52	ug/L	1				
p-Nitroaniline	U	ND	2.86	9.52	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	JXC7	12/04/09	1357	929019

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	38.4 ug/L	47.6	80.7	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	34.4 ug/L	47.6	72.2	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	37.8 ug/L	47.6	79.3	(46%-130%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-D02
Sample ID: 241350012

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
2,4,6-Tribromophenol		3510/8270C TCL BNA Liquid "As Received"		68.1	ug/L	95.2	71.5		(39%-115%)		
2-Fluorophenol		3510/8270C TCL BNA Liquid "As Received"		38.8	ug/L	95.2	40.8		(25%-92%)		
Phenol-d5		3510/8270C TCL BNA Liquid "As Received"		23.4	ug/L	95.2	24.5		(15%-73%)		

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-B01
Sample ID: 241350013
Matrix: AQUEOUS
Collect Date: 30-NOV-09 14:30
Receive Date: 30-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Nylon Tubing 7 Day
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
1,2,4-Trichlorobenzene	U	ND	1.90	9.52	ug/L	1	JMB3 12/05/09	1340	929021	1
1,2-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
1,3-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
1,4-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
2,4,5-Trichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4,6-Trichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dimethylphenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dinitrophenol	U	ND	4.76	19.0	ug/L	1				
2,4-Dinitrotoluene	U	ND	1.90	9.52	ug/L	1				
2,6-Dinitrotoluene	U	ND	1.90	9.52	ug/L	1				
2-Chloronaphthalene	U	ND	0.286	0.952	ug/L	1				
2-Chlorophenol	U	ND	1.90	9.52	ug/L	1				
2-Methyl-4,6-dinitrophenol	U	ND	2.86	9.52	ug/L	1				
2-Methylnaphthalene	U	ND	0.286	0.952	ug/L	1				
2-Nitrophenol	U	ND	1.90	9.52	ug/L	1				
3,3'-Dichlorobenzidine	U	ND	1.90	9.52	ug/L	1				
4-Bromophenylphenylether	U	ND	1.90	9.52	ug/L	1				
4-Chloro-3-methylphenol	U	ND	1.90	9.52	ug/L	1				
4-Chloroaniline	U	ND	1.90	9.52	ug/L	1				
4-Chlorophenylphenylether	U	ND	1.90	9.52	ug/L	1				
4-Nitrophenol	U	ND	1.90	9.52	ug/L	1				
Acenaphthene	U	ND	0.295	0.952	ug/L	1				
Acenaphthylene	U	ND	0.190	0.952	ug/L	1				
Anthracene	U	ND	0.190	0.952	ug/L	1				
Benzo(a)anthracene	U	ND	0.190	0.952	ug/L	1				
Benzo(a)pyrene	U	ND	0.190	0.952	ug/L	1				
Benzo(b)fluoranthene	U	ND	0.190	0.952	ug/L	1				
Benzo(ghi)perylene	U	ND	0.190	0.952	ug/L	1				
Benzo(k)fluoranthene	U	ND	0.190	0.952	ug/L	1				
Butylbenzylphthalate	U	ND	1.90	9.52	ug/L	1				
Carbazole	U	ND	0.190	0.952	ug/L	1				
Chrysene	U	ND	0.190	0.952	ug/L	1				
Di-n-butylphthalate	U	ND	1.90	9.52	ug/L	1				
Di-n-octylphthalate	U	ND	2.86	9.52	ug/L	1				
Dibenzo(a,h)anthracene	U	ND	0.190	0.952	ug/L	1				
Dibenzofuran	U	ND	1.90	9.52	ug/L	1				
Diethylphthalate	U	ND	1.90	9.52	ug/L	1				

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Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-B01
Sample ID: 241350013

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.90	9.52	ug/L	1				
Diphenylamine	U	ND	2.86	9.52	ug/L	1				
Fluoranthene	U	ND	0.190	0.952	ug/L	1				
Fluorene	U	ND	0.190	0.952	ug/L	1				
Hexachlorobenzene	U	ND	1.90	9.52	ug/L	1				
Hexachlorobutadiene	U	ND	1.90	9.52	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.86	9.52	ug/L	1				
Hexachloroethane	U	ND	1.90	9.52	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.190	0.952	ug/L	1				
Isophorone	U	ND	2.86	9.52	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.90	9.52	ug/L	1				
Naphthalene	U	ND	0.286	0.952	ug/L	1				
Nitrobenzene	U	ND	2.86	9.52	ug/L	1				
Pentachlorophenol	U	ND	1.90	9.52	ug/L	1				
Phenanthrene	U	ND	0.190	0.952	ug/L	1				
Phenol	U	ND	0.952	9.52	ug/L	1				
Pyrene	U	ND	0.286	0.952	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.86	9.52	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.90	9.52	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.90	9.52	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.90	9.52	ug/L	1				
m,p-Cresols	U	ND	2.86	9.52	ug/L	1				
m-Nitroaniline	U	ND	1.90	9.52	ug/L	1				
o-Cresol	U	ND	1.90	9.52	ug/L	1				
o-Nitroaniline	U	ND	1.90	9.52	ug/L	1				
p-Nitroaniline	U	ND	2.86	9.52	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	JXC7	12/04/09	1357	929019

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	35.4 ug/L	47.6	74.3	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	32.3 ug/L	47.6	67.8	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	34.9 ug/L	47.6	73.2	(46%-130%)

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Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-B01
Sample ID: 241350013

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
2,4,6-Tribromophenol		3510/8270C TCL BNA Liquid "As Received"		68.6	ug/L	95.2	72.1		(39%-115%)		
2-Fluorophenol		3510/8270C TCL BNA Liquid "As Received"		36.1	ug/L	95.2	37.9		(25%-92%)		
Phenol-d5		3510/8270C TCL BNA Liquid "As Received"		21.3	ug/L	95.2	22.4		(15%-73%)		

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087937-B01
Sample ID: 241350014
Matrix: AQUEOUS
Collect Date: 30-NOV-09 14:30
Receive Date: 30-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Tygon Tubing 7 Day
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
1,2,4-Trichlorobenzene	U	ND	1.92	9.62	ug/L	1	JMB3 12/05/09	1401	929021	1
1,2-Dichlorobenzene	U	ND	1.92	9.62	ug/L	1				
1,3-Dichlorobenzene	U	ND	1.92	9.62	ug/L	1				
1,4-Dichlorobenzene	U	ND	1.92	9.62	ug/L	1				
2,4,5-Trichlorophenol	U	ND	1.92	9.62	ug/L	1				
2,4,6-Trichlorophenol	U	ND	1.92	9.62	ug/L	1				
2,4-Dichlorophenol	U	ND	1.92	9.62	ug/L	1				
2,4-Dimethylphenol	U	ND	1.92	9.62	ug/L	1				
2,4-Dinitrophenol	U	ND	4.81	19.2	ug/L	1				
2,4-Dinitrotoluene	U	ND	1.92	9.62	ug/L	1				
2,6-Dinitrotoluene	U	ND	1.92	9.62	ug/L	1				
2-Chloronaphthalene	U	ND	0.288	0.962	ug/L	1				
2-Chlorophenol	U	ND	1.92	9.62	ug/L	1				
2-Methyl-4,6-dinitrophenol	U	ND	2.88	9.62	ug/L	1				
2-Methylnaphthalene	U	ND	0.288	0.962	ug/L	1				
2-Nitrophenol	U	ND	1.92	9.62	ug/L	1				
3,3'-Dichlorobenzidine	U	ND	1.92	9.62	ug/L	1				
4-Bromophenylphenylether	U	ND	1.92	9.62	ug/L	1				
4-Chloro-3-methylphenol	U	ND	1.92	9.62	ug/L	1				
4-Chloroaniline	U	ND	1.92	9.62	ug/L	1				
4-Chlorophenylphenylether	U	ND	1.92	9.62	ug/L	1				
4-Nitrophenol	U	ND	1.92	9.62	ug/L	1				
Acenaphthene	U	ND	0.298	0.962	ug/L	1				
Acenaphthylene	U	ND	0.192	0.962	ug/L	1				
Anthracene	U	ND	0.192	0.962	ug/L	1				
Benzo(a)anthracene	U	ND	0.192	0.962	ug/L	1				
Benzo(a)pyrene	U	ND	0.192	0.962	ug/L	1				
Benzo(b)fluoranthene	U	ND	0.192	0.962	ug/L	1				
Benzo(ghi)perylene	U	ND	0.192	0.962	ug/L	1				
Benzo(k)fluoranthene	U	ND	0.192	0.962	ug/L	1				
Butylbenzylphthalate	U	ND	1.92	9.62	ug/L	1				
Carbazole	U	ND	0.192	0.962	ug/L	1				
Chrysene	U	ND	0.192	0.962	ug/L	1				
Di-n-butylphthalate	U	ND	1.92	9.62	ug/L	1				
Di-n-octylphthalate	U	ND	2.88	9.62	ug/L	1				
Dibenzo(a,h)anthracene	U	ND	0.192	0.962	ug/L	1				
Dibenzofuran	U	ND	1.92	9.62	ug/L	1				
Diethylphthalate	U	ND	1.92	9.62	ug/L	1				

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087937-B01
Sample ID: 241350014

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.92	9.62	ug/L	1				
Diphenylamine	U	ND	2.88	9.62	ug/L	1				
Fluoranthene	U	ND	0.192	0.962	ug/L	1				
Fluorene	U	ND	0.192	0.962	ug/L	1				
Hexachlorobenzene	U	ND	1.92	9.62	ug/L	1				
Hexachlorobutadiene	U	ND	1.92	9.62	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.88	9.62	ug/L	1				
Hexachloroethane	U	ND	1.92	9.62	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.192	0.962	ug/L	1				
Isophorone	U	ND	2.88	9.62	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.92	9.62	ug/L	1				
Naphthalene	U	ND	0.288	0.962	ug/L	1				
Nitrobenzene	U	ND	2.88	9.62	ug/L	1				
Pentachlorophenol	U	ND	1.92	9.62	ug/L	1				
Phenanthrene	U	ND	0.192	0.962	ug/L	1				
Phenol	U	ND	0.962	9.62	ug/L	1				
Pyrene	U	ND	0.288	0.962	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.88	9.62	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.92	9.62	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.92	9.62	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.92	9.62	ug/L	1				
m,p-Cresols	U	ND	2.88	9.62	ug/L	1				
m-Nitroaniline	U	ND	1.92	9.62	ug/L	1				
o-Cresol	U	ND	1.92	9.62	ug/L	1				
o-Nitroaniline	U	ND	1.92	9.62	ug/L	1				
p-Nitroaniline	U	ND	2.88	9.62	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	JXC7	12/04/09	1357	929019

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	36.6 ug/L	48.1	76.0	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	33.6 ug/L	48.1	69.8	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	34.1 ug/L	48.1	71.0	(46%-130%)

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087937-B01
Sample ID: 241350014

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
2,4,6-Tribromophenol		3510/8270C TCL BNA Liquid "As Received"		68.5	ug/L	96.2	71.3		(39%-115%)		
2-Fluorophenol		3510/8270C TCL BNA Liquid "As Received"		37.7	ug/L	96.2	39.2		(25%-92%)		
Phenol-d5		3510/8270C TCL BNA Liquid "As Received"		22.6	ug/L	96.2	23.5		(15%-73%)		

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087938-B01
Sample ID: 241350015
Matrix: AQUEOUS
Collect Date: 30-NOV-09 14:30
Receive Date: 30-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Teflon Tubing 7 Day
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
1,2,4-Trichlorobenzene	U	ND	1.92	9.62	ug/L	1	JMB3 12/05/09	1422	929021	1
1,2-Dichlorobenzene	U	ND	1.92	9.62	ug/L	1				
1,3-Dichlorobenzene	U	ND	1.92	9.62	ug/L	1				
1,4-Dichlorobenzene	U	ND	1.92	9.62	ug/L	1				
2,4,5-Trichlorophenol	U	ND	1.92	9.62	ug/L	1				
2,4,6-Trichlorophenol	U	ND	1.92	9.62	ug/L	1				
2,4-Dichlorophenol	U	ND	1.92	9.62	ug/L	1				
2,4-Dimethylphenol	U	ND	1.92	9.62	ug/L	1				
2,4-Dinitrophenol	U	ND	4.81	19.2	ug/L	1				
2,4-Dinitrotoluene	U	ND	1.92	9.62	ug/L	1				
2,6-Dinitrotoluene	U	ND	1.92	9.62	ug/L	1				
2-Chloronaphthalene	U	ND	0.288	0.962	ug/L	1				
2-Chlorophenol	U	ND	1.92	9.62	ug/L	1				
2-Methyl-4,6-dinitrophenol	U	ND	2.88	9.62	ug/L	1				
2-Methylnaphthalene	U	ND	0.288	0.962	ug/L	1				
2-Nitrophenol	U	ND	1.92	9.62	ug/L	1				
3,3'-Dichlorobenzidine	U	ND	1.92	9.62	ug/L	1				
4-Bromophenylphenylether	U	ND	1.92	9.62	ug/L	1				
4-Chloro-3-methylphenol	U	ND	1.92	9.62	ug/L	1				
4-Chloroaniline	U	ND	1.92	9.62	ug/L	1				
4-Chlorophenylphenylether	U	ND	1.92	9.62	ug/L	1				
4-Nitrophenol	U	ND	1.92	9.62	ug/L	1				
Acenaphthene	U	ND	0.298	0.962	ug/L	1				
Acenaphthylene	U	ND	0.192	0.962	ug/L	1				
Anthracene	U	ND	0.192	0.962	ug/L	1				
Benzo(a)anthracene	U	ND	0.192	0.962	ug/L	1				
Benzo(a)pyrene	U	ND	0.192	0.962	ug/L	1				
Benzo(b)fluoranthene	U	ND	0.192	0.962	ug/L	1				
Benzo(ghi)perylene	U	ND	0.192	0.962	ug/L	1				
Benzo(k)fluoranthene	U	ND	0.192	0.962	ug/L	1				
Butylbenzylphthalate	U	ND	1.92	9.62	ug/L	1				
Carbazole	U	ND	0.192	0.962	ug/L	1				
Chrysene	U	ND	0.192	0.962	ug/L	1				
Di-n-butylphthalate	U	ND	1.92	9.62	ug/L	1				
Di-n-octylphthalate	U	ND	2.88	9.62	ug/L	1				
Dibenzo(a,h)anthracene	U	ND	0.192	0.962	ug/L	1				
Dibenzofuran	U	ND	1.92	9.62	ug/L	1				
Diethylphthalate	U	ND	1.92	9.62	ug/L	1				

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087938-B01
Sample ID: 241350015

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.92	9.62	ug/L	1				
Diphenylamine	U	ND	2.88	9.62	ug/L	1				
Fluoranthene	U	ND	0.192	0.962	ug/L	1				
Fluorene	U	ND	0.192	0.962	ug/L	1				
Hexachlorobenzene	U	ND	1.92	9.62	ug/L	1				
Hexachlorobutadiene	U	ND	1.92	9.62	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.88	9.62	ug/L	1				
Hexachloroethane	U	ND	1.92	9.62	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.192	0.962	ug/L	1				
Isophorone	U	ND	2.88	9.62	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.92	9.62	ug/L	1				
Naphthalene	U	ND	0.288	0.962	ug/L	1				
Nitrobenzene	U	ND	2.88	9.62	ug/L	1				
Pentachlorophenol	U	ND	1.92	9.62	ug/L	1				
Phenanthrene	U	ND	0.192	0.962	ug/L	1				
Phenol	U	ND	0.962	9.62	ug/L	1				
Pyrene	U	ND	0.288	0.962	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.88	9.62	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.92	9.62	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.92	9.62	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.92	9.62	ug/L	1				
m,p-Cresols	U	ND	2.88	9.62	ug/L	1				
m-Nitroaniline	U	ND	1.92	9.62	ug/L	1				
o-Cresol	U	ND	1.92	9.62	ug/L	1				
o-Nitroaniline	U	ND	1.92	9.62	ug/L	1				
p-Nitroaniline	U	ND	2.88	9.62	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	JXC7	12/04/09	1357	929019

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	35.6 ug/L	48.1	74.0	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	32.3 ug/L	48.1	67.2	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	34.3 ug/L	48.1	71.3	(46%-130%)

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087938-B01
Sample ID: 241350015

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
2,4,6-Tribromophenol		3510/8270C TCL BNA Liquid "As Received"		67.0	ug/L	96.2	69.6		(39%-115%)		
2-Fluorophenol		3510/8270C TCL BNA Liquid "As Received"		42.0	ug/L	96.2	43.7		(25%-92%)		
Phenol-d5		3510/8270C TCL BNA Liquid "As Received"		27.3	ug/L	96.2	28.3		(15%-73%)		

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087939-B01
Sample ID: 241350016
Matrix: AQUEOUS
Collect Date: 30-NOV-09 14:30
Receive Date: 30-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Polypropylene Tubing 7 Day
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
1,2,4-Trichlorobenzene	U	ND	1.90	9.52	ug/L	1	JMB3 12/05/09	1443	929021	1
1,2-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
1,3-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
1,4-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
2,4,5-Trichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4,6-Trichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dimethylphenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dinitrophenol	U	ND	4.76	19.0	ug/L	1				
2,4-Dinitrotoluene	U	ND	1.90	9.52	ug/L	1				
2,6-Dinitrotoluene	U	ND	1.90	9.52	ug/L	1				
2-Chloronaphthalene	U	ND	0.286	0.952	ug/L	1				
2-Chlorophenol	U	ND	1.90	9.52	ug/L	1				
2-Methyl-4,6-dinitrophenol	U	ND	2.86	9.52	ug/L	1				
2-Methylnaphthalene	U	ND	0.286	0.952	ug/L	1				
2-Nitrophenol	U	ND	1.90	9.52	ug/L	1				
3,3'-Dichlorobenzidine	U	ND	1.90	9.52	ug/L	1				
4-Bromophenylphenylether	U	ND	1.90	9.52	ug/L	1				
4-Chloro-3-methylphenol	U	ND	1.90	9.52	ug/L	1				
4-Chloroaniline	U	ND	1.90	9.52	ug/L	1				
4-Chlorophenylphenylether	U	ND	1.90	9.52	ug/L	1				
4-Nitrophenol	U	ND	1.90	9.52	ug/L	1				
Acenaphthene	U	ND	0.295	0.952	ug/L	1				
Acenaphthylene	U	ND	0.190	0.952	ug/L	1				
Anthracene	U	ND	0.190	0.952	ug/L	1				
Benzo(a)anthracene	U	ND	0.190	0.952	ug/L	1				
Benzo(a)pyrene	U	ND	0.190	0.952	ug/L	1				
Benzo(b)fluoranthene	U	ND	0.190	0.952	ug/L	1				
Benzo(ghi)perylene	U	ND	0.190	0.952	ug/L	1				
Benzo(k)fluoranthene	U	ND	0.190	0.952	ug/L	1				
Butylbenzylphthalate	U	ND	1.90	9.52	ug/L	1				
Carbazole	U	ND	0.190	0.952	ug/L	1				
Chrysene	U	ND	0.190	0.952	ug/L	1				
Di-n-butylphthalate	U	ND	1.90	9.52	ug/L	1				
Di-n-octylphthalate	U	ND	2.86	9.52	ug/L	1				
Dibenzo(a,h)anthracene	U	ND	0.190	0.952	ug/L	1				
Dibenzofuran	U	ND	1.90	9.52	ug/L	1				
Diethylphthalate	U	ND	1.90	9.52	ug/L	1				

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087939-B01
Sample ID: 241350016

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.90	9.52	ug/L	1				
Diphenylamine	U	ND	2.86	9.52	ug/L	1				
Fluoranthene	U	ND	0.190	0.952	ug/L	1				
Fluorene	U	ND	0.190	0.952	ug/L	1				
Hexachlorobenzene	U	ND	1.90	9.52	ug/L	1				
Hexachlorobutadiene	U	ND	1.90	9.52	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.86	9.52	ug/L	1				
Hexachloroethane	U	ND	1.90	9.52	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.190	0.952	ug/L	1				
Isophorone	U	ND	2.86	9.52	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.90	9.52	ug/L	1				
Naphthalene	U	ND	0.286	0.952	ug/L	1				
Nitrobenzene	U	ND	2.86	9.52	ug/L	1				
Pentachlorophenol	U	ND	1.90	9.52	ug/L	1				
Phenanthrene	U	ND	0.190	0.952	ug/L	1				
Phenol	U	ND	0.952	9.52	ug/L	1				
Pyrene	U	ND	0.286	0.952	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.86	9.52	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.90	9.52	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.90	9.52	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.90	9.52	ug/L	1				
m,p-Cresols	U	ND	2.86	9.52	ug/L	1				
m-Nitroaniline	U	ND	1.90	9.52	ug/L	1				
o-Cresol	U	ND	1.90	9.52	ug/L	1				
o-Nitroaniline	U	ND	1.90	9.52	ug/L	1				
p-Nitroaniline	U	ND	2.86	9.52	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	JXC7	12/04/09	1357	929019

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	35.7 ug/L	47.6	75.0	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	32.8 ug/L	47.6	68.9	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	34.5 ug/L	47.6	72.4	(46%-130%)

Note: Page 106 of 377 was not included in the original report.

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Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087940-B01
Sample ID: 241350017
Matrix: AQUEOUS
Collect Date: 30-NOV-09 14:30
Receive Date: 30-NOV-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: PVC Well Casing 7 Day
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Semi-Volatile-GC/MS											
3510/8270C TCL BNA Liquid "As Received"											
1,2,4-Trichlorobenzene	U	ND	1.91	9.57	ug/L	1	JMB3	12/05/09	1505	929021	1
1,2-Dichlorobenzene	U	ND	1.91	9.57	ug/L	1					
1,3-Dichlorobenzene	U	ND	1.91	9.57	ug/L	1					
1,4-Dichlorobenzene	U	ND	1.91	9.57	ug/L	1					
2,4,5-Trichlorophenol	U	ND	1.91	9.57	ug/L	1					
2,4,6-Trichlorophenol	U	ND	1.91	9.57	ug/L	1					
2,4-Dichlorophenol	U	ND	1.91	9.57	ug/L	1					
2,4-Dimethylphenol	U	ND	1.91	9.57	ug/L	1					
2,4-Dinitrophenol	U	ND	4.78	19.1	ug/L	1					
2,4-Dinitrotoluene	U	ND	1.91	9.57	ug/L	1					
2,6-Dinitrotoluene	U	ND	1.91	9.57	ug/L	1					
2-Chloronaphthalene	U	ND	0.287	0.957	ug/L	1					
2-Chlorophenol	U	ND	1.91	9.57	ug/L	1					
2-Methyl-4,6-dinitrophenol	U	ND	2.87	9.57	ug/L	1					
2-Methylnaphthalene	U	ND	0.287	0.957	ug/L	1					
2-Nitrophenol	U	ND	1.91	9.57	ug/L	1					
3,3'-Dichlorobenzidine	U	ND	1.91	9.57	ug/L	1					
4-Bromophenylphenylether	U	ND	1.91	9.57	ug/L	1					
4-Chloro-3-methylphenol	U	ND	1.91	9.57	ug/L	1					
4-Chloroaniline	U	ND	1.91	9.57	ug/L	1					
4-Chlorophenylphenylether	U	ND	1.91	9.57	ug/L	1					
4-Nitrophenol	U	ND	1.91	9.57	ug/L	1					
Acenaphthene	U	ND	0.297	0.957	ug/L	1					
Acenaphthylene	U	ND	0.191	0.957	ug/L	1					
Anthracene	U	ND	0.191	0.957	ug/L	1					
Benzo(a)anthracene	U	ND	0.191	0.957	ug/L	1					
Benzo(a)pyrene	U	ND	0.191	0.957	ug/L	1					
Benzo(b)fluoranthene	U	ND	0.191	0.957	ug/L	1					
Benzo(ghi)perylene	U	ND	0.191	0.957	ug/L	1					
Benzo(k)fluoranthene	U	ND	0.191	0.957	ug/L	1					
Butylbenzylphthalate	U	ND	1.91	9.57	ug/L	1					
Carbazole	U	ND	0.191	0.957	ug/L	1					
Chrysene	U	ND	0.191	0.957	ug/L	1					
Di-n-butylphthalate	U	ND	1.91	9.57	ug/L	1					
Di-n-octylphthalate	U	ND	2.87	9.57	ug/L	1					
Dibenzo(a,h)anthracene	U	ND	0.191	0.957	ug/L	1					
Dibenzofuran	U	ND	1.91	9.57	ug/L	1					
Diethylphthalate	U	ND	1.91	9.57	ug/L	1					

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087940-B01
Sample ID: 241350017

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.91	9.57	ug/L	1				
Diphenylamine	U	ND	2.87	9.57	ug/L	1				
Fluoranthene	U	ND	0.191	0.957	ug/L	1				
Fluorene	U	ND	0.191	0.957	ug/L	1				
Hexachlorobenzene	U	ND	1.91	9.57	ug/L	1				
Hexachlorobutadiene	U	ND	1.91	9.57	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.87	9.57	ug/L	1				
Hexachloroethane	U	ND	1.91	9.57	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.191	0.957	ug/L	1				
Isophorone	U	ND	2.87	9.57	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.91	9.57	ug/L	1				
Naphthalene	U	ND	0.287	0.957	ug/L	1				
Nitrobenzene	U	ND	2.87	9.57	ug/L	1				
Pentachlorophenol	U	ND	1.91	9.57	ug/L	1				
Phenanthrene	U	ND	0.191	0.957	ug/L	1				
Phenol	U	ND	0.957	9.57	ug/L	1				
Pyrene	U	ND	0.287	0.957	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.87	9.57	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.91	9.57	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.91	9.57	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.91	9.57	ug/L	1				
m,p-Cresols	U	ND	2.87	9.57	ug/L	1				
m-Nitroaniline	U	ND	1.91	9.57	ug/L	1				
o-Cresol	U	ND	1.91	9.57	ug/L	1				
o-Nitroaniline	U	ND	1.91	9.57	ug/L	1				
p-Nitroaniline	U	ND	2.87	9.57	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	JXC7	12/04/09	1357	929019

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	34.2 ug/L	47.8	71.5	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	30.4 ug/L	47.8	63.5	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	35.8 ug/L	47.8	74.8	(46%-130%)

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087940-B01
Sample ID: 241350017

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
2,4,6-Tribromophenol		3510/8270C TCL BNA Liquid "As Received"		69.5	ug/L	95.7	72.7		(39%-115%)		
2-Fluorophenol		3510/8270C TCL BNA Liquid "As Received"		34.2	ug/L	95.7	35.8		(25%-92%)		
Phenol-d5		3510/8270C TCL BNA Liquid "As Received"		20.9	ug/L	95.7	21.8		(15%-73%)		

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-D03
Sample ID: 241350018
Matrix: AQUEOUS
Collect Date: 07-DEC-09 14:30
Receive Date: 07-DEC-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Control Blank 14 Day
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
1,2,4-Trichlorobenzene	U	ND	1.89	9.43	ug/L	1	AMY 12/15/09	1443	932173	1
1,2-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1				
1,3-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1				
1,4-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1				
2,4,5-Trichlorophenol	U	ND	1.89	9.43	ug/L	1				
2,4,6-Trichlorophenol	U	ND	1.89	9.43	ug/L	1				
2,4-Dichlorophenol	U	ND	1.89	9.43	ug/L	1				
2,4-Dimethylphenol	U	ND	1.89	9.43	ug/L	1				
2,4-Dinitrophenol	U	ND	4.72	18.9	ug/L	1				
2,4-Dinitrotoluene	U	ND	1.89	9.43	ug/L	1				
2,6-Dinitrotoluene	U	ND	1.89	9.43	ug/L	1				
2-Chloronaphthalene	U	ND	0.283	0.943	ug/L	1				
2-Chlorophenol	U	ND	1.89	9.43	ug/L	1				
2-Methyl-4,6-dinitrophenol	U	ND	2.83	9.43	ug/L	1				
2-Methylnaphthalene	U	ND	0.283	0.943	ug/L	1				
2-Nitrophenol	U	ND	1.89	9.43	ug/L	1				
3,3'-Dichlorobenzidine	U	ND	1.89	9.43	ug/L	1				
4-Bromophenylphenylether	U	ND	1.89	9.43	ug/L	1				
4-Chloro-3-methylphenol	U	ND	1.89	9.43	ug/L	1				
4-Chloroaniline	U	ND	1.89	9.43	ug/L	1				
4-Chlorophenylphenylether	U	ND	1.89	9.43	ug/L	1				
4-Nitrophenol	U	ND	1.89	9.43	ug/L	1				
Acenaphthene	U	ND	0.292	0.943	ug/L	1				
Acenaphthylene	U	ND	0.189	0.943	ug/L	1				
Anthracene	U	ND	0.189	0.943	ug/L	1				
Benzo(a)anthracene	U	ND	0.189	0.943	ug/L	1				
Benzo(a)pyrene	U	ND	0.189	0.943	ug/L	1				
Benzo(b)fluoranthene	U	ND	0.189	0.943	ug/L	1				
Benzo(ghi)perylene	U	ND	0.189	0.943	ug/L	1				
Benzo(k)fluoranthene	U	ND	0.189	0.943	ug/L	1				
Butylbenzylphthalate	U	ND	1.89	9.43	ug/L	1				
Carbazole	U	ND	0.189	0.943	ug/L	1				
Chrysene	U	ND	0.189	0.943	ug/L	1				
Di-n-butylphthalate	U	ND	1.89	9.43	ug/L	1				
Di-n-octylphthalate	U	ND	2.83	9.43	ug/L	1				
Dibenzo(a,h)anthracene	U	ND	0.189	0.943	ug/L	1				
Dibenzofuran	U	ND	1.89	9.43	ug/L	1				
Diethylphthalate	U	ND	1.89	9.43	ug/L	1				

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-D03
Sample ID: 241350018

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.89	9.43	ug/L	1				
Diphenylamine	U	ND	2.83	9.43	ug/L	1				
Fluoranthene	U	ND	0.189	0.943	ug/L	1				
Fluorene	U	ND	0.189	0.943	ug/L	1				
Hexachlorobenzene	U	ND	1.89	9.43	ug/L	1				
Hexachlorobutadiene	U	ND	1.89	9.43	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.83	9.43	ug/L	1				
Hexachloroethane	U	ND	1.89	9.43	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.189	0.943	ug/L	1				
Isophorone	U	ND	2.83	9.43	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.89	9.43	ug/L	1				
Naphthalene	U	ND	0.283	0.943	ug/L	1				
Nitrobenzene	U	ND	2.83	9.43	ug/L	1				
Pentachlorophenol	U	ND	1.89	9.43	ug/L	1				
Phenanthrene	U	ND	0.189	0.943	ug/L	1				
Phenol	U	ND	0.943	9.43	ug/L	1				
Pyrene	U	ND	0.283	0.943	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.83	9.43	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.89	9.43	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.89	9.43	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.89	9.43	ug/L	1				
m,p-Cresols	U	ND	2.83	9.43	ug/L	1				
m-Nitroaniline	U	ND	1.89	9.43	ug/L	1				
o-Cresol	U	ND	1.89	9.43	ug/L	1				
o-Nitroaniline	U	ND	1.89	9.43	ug/L	1				
p-Nitroaniline	U	ND	2.83	9.43	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	TXA1	12/14/09	1832	932171

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	40.7 ug/L	47.2	86.2	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	40.7 ug/L	47.2	86.4	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	50.0 ug/L	47.2	106	(46%-130%)

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1515 Eubank SE
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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-D03
Sample ID: 241350018

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
2,4,6-Tribromophenol		3510/8270C TCL BNA Liquid "As Received"		84.2	ug/L	94.3	89.2		(39%-115%)		
2-Fluorophenol		3510/8270C TCL BNA Liquid "As Received"		42.1	ug/L	94.3	44.6		(25%-92%)		
Phenol-d5		3510/8270C TCL BNA Liquid "As Received"		25.6	ug/L	94.3	27.1		(15%-73%)		

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-C01
Sample ID: 241350019
Matrix: AQUEOUS
Collect Date: 07-DEC-09 14:30
Receive Date: 07-DEC-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Nylon Tubing 14 Day
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Semi-Volatile-GC/MS											
3510/8270C TCL BNA Liquid "As Received"											
1,2,4-Trichlorobenzene	U	ND	1.89	9.43	ug/L	1	AMY	12/15/09	1506	932173	1
1,2-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1					
1,3-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1					
1,4-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1					
2,4,5-Trichlorophenol	U	ND	1.89	9.43	ug/L	1					
2,4,6-Trichlorophenol	U	ND	1.89	9.43	ug/L	1					
2,4-Dichlorophenol	U	ND	1.89	9.43	ug/L	1					
2,4-Dimethylphenol	U	ND	1.89	9.43	ug/L	1					
2,4-Dinitrophenol	U	ND	4.72	18.9	ug/L	1					
2,4-Dinitrotoluene	U	ND	1.89	9.43	ug/L	1					
2,6-Dinitrotoluene	U	ND	1.89	9.43	ug/L	1					
2-Chloronaphthalene	U	ND	0.283	0.943	ug/L	1					
2-Chlorophenol	U	ND	1.89	9.43	ug/L	1					
2-Methyl-4,6-dinitrophenol	U	ND	2.83	9.43	ug/L	1					
2-Methylnaphthalene	U	ND	0.283	0.943	ug/L	1					
2-Nitrophenol	U	ND	1.89	9.43	ug/L	1					
3,3'-Dichlorobenzidine	U	ND	1.89	9.43	ug/L	1					
4-Bromophenylphenylether	U	ND	1.89	9.43	ug/L	1					
4-Chloro-3-methylphenol	U	ND	1.89	9.43	ug/L	1					
4-Chloroaniline	U	ND	1.89	9.43	ug/L	1					
4-Chlorophenylphenylether	U	ND	1.89	9.43	ug/L	1					
4-Nitrophenol	U	ND	1.89	9.43	ug/L	1					
Acenaphthene	U	ND	0.292	0.943	ug/L	1					
Acenaphthylene	U	ND	0.189	0.943	ug/L	1					
Anthracene	U	ND	0.189	0.943	ug/L	1					
Benzo(a)anthracene	U	ND	0.189	0.943	ug/L	1					
Benzo(a)pyrene	U	ND	0.189	0.943	ug/L	1					
Benzo(b)fluoranthene	U	ND	0.189	0.943	ug/L	1					
Benzo(ghi)perylene	U	ND	0.189	0.943	ug/L	1					
Benzo(k)fluoranthene	U	ND	0.189	0.943	ug/L	1					
Butylbenzylphthalate	U	ND	1.89	9.43	ug/L	1					
Carbazole	U	ND	0.189	0.943	ug/L	1					
Chrysene	U	ND	0.189	0.943	ug/L	1					
Di-n-butylphthalate	U	ND	1.89	9.43	ug/L	1					
Di-n-octylphthalate	U	ND	2.83	9.43	ug/L	1					
Dibenzo(a,h)anthracene	U	ND	0.189	0.943	ug/L	1					
Dibenzofuran	U	ND	1.89	9.43	ug/L	1					
Diethylphthalate	U	ND	1.89	9.43	ug/L	1					

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-C01
Sample ID: 241350019

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.89	9.43	ug/L	1				
Diphenylamine	U	ND	2.83	9.43	ug/L	1				
Fluoranthene	U	ND	0.189	0.943	ug/L	1				
Fluorene	U	ND	0.189	0.943	ug/L	1				
Hexachlorobenzene	U	ND	1.89	9.43	ug/L	1				
Hexachlorobutadiene	U	ND	1.89	9.43	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.83	9.43	ug/L	1				
Hexachloroethane	U	ND	1.89	9.43	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.189	0.943	ug/L	1				
Isophorone	U	ND	2.83	9.43	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.89	9.43	ug/L	1				
Naphthalene	U	ND	0.283	0.943	ug/L	1				
Nitrobenzene	U	ND	2.83	9.43	ug/L	1				
Pentachlorophenol	U	ND	1.89	9.43	ug/L	1				
Phenanthrene	U	ND	0.189	0.943	ug/L	1				
Phenol	U	ND	0.943	9.43	ug/L	1				
Pyrene	U	ND	0.283	0.943	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.83	9.43	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.89	9.43	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.89	9.43	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.89	9.43	ug/L	1				
m,p-Cresols	U	ND	2.83	9.43	ug/L	1				
m-Nitroaniline	U	ND	1.89	9.43	ug/L	1				
o-Cresol	U	ND	1.89	9.43	ug/L	1				
o-Nitroaniline	U	ND	1.89	9.43	ug/L	1				
p-Nitroaniline	U	ND	2.83	9.43	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	TXA1	12/14/09	1832	932171

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	37.3 ug/L	47.2	79.0	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	37.7 ug/L	47.2	80.0	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	43.5 ug/L	47.2	92.1	(46%-130%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087936-C01
Sample ID: 241350019

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
2,4,6-Tribromophenol		3510/8270C TCL BNA Liquid "As Received"		83.3	ug/L	94.3	88.2		(39%-115%)		
2-Fluorophenol		3510/8270C TCL BNA Liquid "As Received"		37.9	ug/L	94.3	40.2		(25%-92%)		
Phenol-d5		3510/8270C TCL BNA Liquid "As Received"		23.3	ug/L	94.3	24.7		(15%-73%)		

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087937-C01
Sample ID: 241350020
Matrix: AQUEOUS
Collect Date: 07-DEC-09 14:30
Receive Date: 07-DEC-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Tygon Tubing 14 Day
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
1,2,4-Trichlorobenzene	U	ND	1.90	9.52	ug/L	1	AMY 12/15/09	1529	932173	1
1,2-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
1,3-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
1,4-Dichlorobenzene	U	ND	1.90	9.52	ug/L	1				
2,4,5-Trichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4,6-Trichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dichlorophenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dimethylphenol	U	ND	1.90	9.52	ug/L	1				
2,4-Dinitrophenol	U	ND	4.76	19.0	ug/L	1				
2,4-Dinitrotoluene	U	ND	1.90	9.52	ug/L	1				
2,6-Dinitrotoluene	U	ND	1.90	9.52	ug/L	1				
2-Chloronaphthalene	U	ND	0.286	0.952	ug/L	1				
2-Chlorophenol	U	ND	1.90	9.52	ug/L	1				
2-Methyl-4,6-dinitrophenol	U	ND	2.86	9.52	ug/L	1				
2-Methylnaphthalene	U	ND	0.286	0.952	ug/L	1				
2-Nitrophenol	U	ND	1.90	9.52	ug/L	1				
3,3'-Dichlorobenzidine	U	ND	1.90	9.52	ug/L	1				
4-Bromophenylphenylether	U	ND	1.90	9.52	ug/L	1				
4-Chloro-3-methylphenol	U	ND	1.90	9.52	ug/L	1				
4-Chloroaniline	U	ND	1.90	9.52	ug/L	1				
4-Chlorophenylphenylether	U	ND	1.90	9.52	ug/L	1				
4-Nitrophenol	U	ND	1.90	9.52	ug/L	1				
Acenaphthene	U	ND	0.295	0.952	ug/L	1				
Acenaphthylene	U	ND	0.190	0.952	ug/L	1				
Anthracene	U	ND	0.190	0.952	ug/L	1				
Benzo(a)anthracene	U	ND	0.190	0.952	ug/L	1				
Benzo(a)pyrene	U	ND	0.190	0.952	ug/L	1				
Benzo(b)fluoranthene	U	ND	0.190	0.952	ug/L	1				
Benzo(ghi)perylene	U	ND	0.190	0.952	ug/L	1				
Benzo(k)fluoranthene	U	ND	0.190	0.952	ug/L	1				
Butylbenzylphthalate	U	ND	1.90	9.52	ug/L	1				
Carbazole	U	ND	0.190	0.952	ug/L	1				
Chrysene	U	ND	0.190	0.952	ug/L	1				
Di-n-butylphthalate	U	ND	1.90	9.52	ug/L	1				
Di-n-octylphthalate	U	ND	2.86	9.52	ug/L	1				
Dibenzo(a,h)anthracene	U	ND	0.190	0.952	ug/L	1				
Dibenzofuran	U	ND	1.90	9.52	ug/L	1				
Diethylphthalate	U	ND	1.90	9.52	ug/L	1				

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087937-C01
Sample ID: 241350020

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.90	9.52	ug/L	1				
Diphenylamine	U	ND	2.86	9.52	ug/L	1				
Fluoranthene	U	ND	0.190	0.952	ug/L	1				
Fluorene	U	ND	0.190	0.952	ug/L	1				
Hexachlorobenzene	U	ND	1.90	9.52	ug/L	1				
Hexachlorobutadiene	U	ND	1.90	9.52	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.86	9.52	ug/L	1				
Hexachloroethane	U	ND	1.90	9.52	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.190	0.952	ug/L	1				
Isophorone	U	ND	2.86	9.52	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.90	9.52	ug/L	1				
Naphthalene	U	ND	0.286	0.952	ug/L	1				
Nitrobenzene	U	ND	2.86	9.52	ug/L	1				
Pentachlorophenol	U	ND	1.90	9.52	ug/L	1				
Phenanthrene	U	ND	0.190	0.952	ug/L	1				
Phenol	U	ND	0.952	9.52	ug/L	1				
Pyrene	U	ND	0.286	0.952	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.86	9.52	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.90	9.52	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.90	9.52	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.90	9.52	ug/L	1				
m,p-Cresols	U	ND	2.86	9.52	ug/L	1				
m-Nitroaniline	U	ND	1.90	9.52	ug/L	1				
o-Cresol	U	ND	1.90	9.52	ug/L	1				
o-Nitroaniline	U	ND	1.90	9.52	ug/L	1				
p-Nitroaniline	U	ND	2.86	9.52	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	TXA1	12/14/09	1832	932171

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	36.9 ug/L	47.6	77.6	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	36.2 ug/L	47.6	76.0	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	44.5 ug/L	47.6	93.4	(46%-130%)

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087937-C01
Sample ID: 241350020

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
2,4,6-Tribromophenol		3510/8270C TCL BNA Liquid "As Received"		86.3	ug/L	95.2	90.6		(39%-115%)		
2-Fluorophenol		3510/8270C TCL BNA Liquid "As Received"		37.8	ug/L	95.2	39.7		(25%-92%)		
Phenol-d5		3510/8270C TCL BNA Liquid "As Received"		23.7	ug/L	95.2	24.9		(15%-73%)		

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087938-C01
Sample ID: 241350021
Matrix: AQUEOUS
Collect Date: 07-DEC-09 14:30
Receive Date: 07-DEC-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Teflon Tubing 14 Day
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
1,2,4-Trichlorobenzene	U	ND	1.89	9.43	ug/L	1	AMY 12/15/09	1552	932173	1
1,2-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1				
1,3-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1				
1,4-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1				
2,4,5-Trichlorophenol	U	ND	1.89	9.43	ug/L	1				
2,4,6-Trichlorophenol	U	ND	1.89	9.43	ug/L	1				
2,4-Dichlorophenol	U	ND	1.89	9.43	ug/L	1				
2,4-Dimethylphenol	U	ND	1.89	9.43	ug/L	1				
2,4-Dinitrophenol	U	ND	4.72	18.9	ug/L	1				
2,4-Dinitrotoluene	U	ND	1.89	9.43	ug/L	1				
2,6-Dinitrotoluene	U	ND	1.89	9.43	ug/L	1				
2-Chloronaphthalene	U	ND	0.283	0.943	ug/L	1				
2-Chlorophenol	U	ND	1.89	9.43	ug/L	1				
2-Methyl-4,6-dinitrophenol	U	ND	2.83	9.43	ug/L	1				
2-Methylnaphthalene	U	ND	0.283	0.943	ug/L	1				
2-Nitrophenol	U	ND	1.89	9.43	ug/L	1				
3,3'-Dichlorobenzidine	U	ND	1.89	9.43	ug/L	1				
4-Bromophenylphenylether	U	ND	1.89	9.43	ug/L	1				
4-Chloro-3-methylphenol	U	ND	1.89	9.43	ug/L	1				
4-Chloroaniline	U	ND	1.89	9.43	ug/L	1				
4-Chlorophenylphenylether	U	ND	1.89	9.43	ug/L	1				
4-Nitrophenol	U	ND	1.89	9.43	ug/L	1				
Acenaphthene	U	ND	0.292	0.943	ug/L	1				
Acenaphthylene	U	ND	0.189	0.943	ug/L	1				
Anthracene	U	ND	0.189	0.943	ug/L	1				
Benzo(a)anthracene	U	ND	0.189	0.943	ug/L	1				
Benzo(a)pyrene	U	ND	0.189	0.943	ug/L	1				
Benzo(b)fluoranthene	U	ND	0.189	0.943	ug/L	1				
Benzo(ghi)perylene	U	ND	0.189	0.943	ug/L	1				
Benzo(k)fluoranthene	U	ND	0.189	0.943	ug/L	1				
Butylbenzylphthalate	U	ND	1.89	9.43	ug/L	1				
Carbazole	U	ND	0.189	0.943	ug/L	1				
Chrysene	U	ND	0.189	0.943	ug/L	1				
Di-n-butylphthalate	U	ND	1.89	9.43	ug/L	1				
Di-n-octylphthalate	U	ND	2.83	9.43	ug/L	1				
Dibenzo(a,h)anthracene	U	ND	0.189	0.943	ug/L	1				
Dibenzofuran	U	ND	1.89	9.43	ug/L	1				
Diethylphthalate	U	ND	1.89	9.43	ug/L	1				

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087938-C01
Sample ID: 241350021

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.89	9.43	ug/L	1				
Diphenylamine	U	ND	2.83	9.43	ug/L	1				
Fluoranthene	U	ND	0.189	0.943	ug/L	1				
Fluorene	U	ND	0.189	0.943	ug/L	1				
Hexachlorobenzene	U	ND	1.89	9.43	ug/L	1				
Hexachlorobutadiene	U	ND	1.89	9.43	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.83	9.43	ug/L	1				
Hexachloroethane	U	ND	1.89	9.43	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.189	0.943	ug/L	1				
Isophorone	U	ND	2.83	9.43	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.89	9.43	ug/L	1				
Naphthalene	U	ND	0.283	0.943	ug/L	1				
Nitrobenzene	U	ND	2.83	9.43	ug/L	1				
Pentachlorophenol	U	ND	1.89	9.43	ug/L	1				
Phenanthrene	U	ND	0.189	0.943	ug/L	1				
Phenol	U	ND	0.943	9.43	ug/L	1				
Pyrene	U	ND	0.283	0.943	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.83	9.43	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.89	9.43	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.89	9.43	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.89	9.43	ug/L	1				
m,p-Cresols	U	ND	2.83	9.43	ug/L	1				
m-Nitroaniline	U	ND	1.89	9.43	ug/L	1				
o-Cresol	U	ND	1.89	9.43	ug/L	1				
o-Nitroaniline	U	ND	1.89	9.43	ug/L	1				
p-Nitroaniline	U	ND	2.83	9.43	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	TXA1	12/14/09	1832	932171

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	35.3 ug/L	47.2	74.9	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	36.4 ug/L	47.2	77.1	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	41.0 ug/L	47.2	87.0	(46%-130%)

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087938-C01
Sample ID: 241350021

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
2,4,6-Tribromophenol		3510/8270C TCL BNA Liquid "As Received"		77.0	ug/L	94.3	81.6		(39%-115%)		
2-Fluorophenol		3510/8270C TCL BNA Liquid "As Received"		36.9	ug/L	94.3	39.1		(25%-92%)		
Phenol-d5		3510/8270C TCL BNA Liquid "As Received"		22.9	ug/L	94.3	24.3		(15%-73%)		

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087939-C01
Sample ID: 241350022
Matrix: AQUEOUS
Collect Date: 07-DEC-09 14:30
Receive Date: 07-DEC-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: Polypropylene Tubing 14 Day
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
1,2,4-Trichlorobenzene	U	ND	1.89	9.43	ug/L	1	AMY 12/15/09	1615	932173	1
1,2-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1				
1,3-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1				
1,4-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1				
2,4,5-Trichlorophenol	U	ND	1.89	9.43	ug/L	1				
2,4,6-Trichlorophenol	U	ND	1.89	9.43	ug/L	1				
2,4-Dichlorophenol	U	ND	1.89	9.43	ug/L	1				
2,4-Dimethylphenol	U	ND	1.89	9.43	ug/L	1				
2,4-Dinitrophenol	U	ND	4.72	18.9	ug/L	1				
2,4-Dinitrotoluene	U	ND	1.89	9.43	ug/L	1				
2,6-Dinitrotoluene	U	ND	1.89	9.43	ug/L	1				
2-Chloronaphthalene	U	ND	0.283	0.943	ug/L	1				
2-Chlorophenol	U	ND	1.89	9.43	ug/L	1				
2-Methyl-4,6-dinitrophenol	U	ND	2.83	9.43	ug/L	1				
2-Methylnaphthalene	U	ND	0.283	0.943	ug/L	1				
2-Nitrophenol	U	ND	1.89	9.43	ug/L	1				
3,3'-Dichlorobenzidine	U	ND	1.89	9.43	ug/L	1				
4-Bromophenylphenylether	U	ND	1.89	9.43	ug/L	1				
4-Chloro-3-methylphenol	U	ND	1.89	9.43	ug/L	1				
4-Chloroaniline	U	ND	1.89	9.43	ug/L	1				
4-Chlorophenylphenylether	U	ND	1.89	9.43	ug/L	1				
4-Nitrophenol	U	ND	1.89	9.43	ug/L	1				
Acenaphthene	U	ND	0.292	0.943	ug/L	1				
Acenaphthylene	U	ND	0.189	0.943	ug/L	1				
Anthracene	U	ND	0.189	0.943	ug/L	1				
Benzo(a)anthracene	U	ND	0.189	0.943	ug/L	1				
Benzo(a)pyrene	U	ND	0.189	0.943	ug/L	1				
Benzo(b)fluoranthene	U	ND	0.189	0.943	ug/L	1				
Benzo(ghi)perylene	U	ND	0.189	0.943	ug/L	1				
Benzo(k)fluoranthene	U	ND	0.189	0.943	ug/L	1				
Butylbenzylphthalate	U	ND	1.89	9.43	ug/L	1				
Carbazole	U	ND	0.189	0.943	ug/L	1				
Chrysene	U	ND	0.189	0.943	ug/L	1				
Di-n-butylphthalate	U	ND	1.89	9.43	ug/L	1				
Di-n-octylphthalate	U	ND	2.83	9.43	ug/L	1				
Dibenzo(a,h)anthracene	U	ND	0.189	0.943	ug/L	1				
Dibenzofuran	U	ND	1.89	9.43	ug/L	1				
Diethylphthalate	U	ND	1.89	9.43	ug/L	1				

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Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087939-C01
Sample ID: 241350022

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.89	9.43	ug/L	1				
Diphenylamine	U	ND	2.83	9.43	ug/L	1				
Fluoranthene	U	ND	0.189	0.943	ug/L	1				
Fluorene	U	ND	0.189	0.943	ug/L	1				
Hexachlorobenzene	U	ND	1.89	9.43	ug/L	1				
Hexachlorobutadiene	U	ND	1.89	9.43	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.83	9.43	ug/L	1				
Hexachloroethane	U	ND	1.89	9.43	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.189	0.943	ug/L	1				
Isophorone	U	ND	2.83	9.43	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.89	9.43	ug/L	1				
Naphthalene	U	ND	0.283	0.943	ug/L	1				
Nitrobenzene	U	ND	2.83	9.43	ug/L	1				
Pentachlorophenol	U	ND	1.89	9.43	ug/L	1				
Phenanthrene	U	ND	0.189	0.943	ug/L	1				
Phenol	U	ND	0.943	9.43	ug/L	1				
Pyrene	U	ND	0.283	0.943	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.83	9.43	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.89	9.43	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.89	9.43	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.89	9.43	ug/L	1				
m,p-Cresols	U	ND	2.83	9.43	ug/L	1				
m-Nitroaniline	U	ND	1.89	9.43	ug/L	1				
o-Cresol	U	ND	1.89	9.43	ug/L	1				
o-Nitroaniline	U	ND	1.89	9.43	ug/L	1				
p-Nitroaniline	U	ND	2.83	9.43	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	TXA1	12/14/09	1832	932171

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	35.2 ug/L	47.2	74.7	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	35.8 ug/L	47.2	76.0	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	43.0 ug/L	47.2	91.3	(46%-130%)

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087939-C01
Sample ID: 241350022

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
2,4,6-Tribromophenol		3510/8270C TCL BNA Liquid "As Received"		79.8	ug/L	94.3	84.5		(39%-115%)		
2-Fluorophenol		3510/8270C TCL BNA Liquid "As Received"		34.5	ug/L	94.3	36.6		(25%-92%)		
Phenol-d5		3510/8270C TCL BNA Liquid "As Received"		21.6	ug/L	94.3	22.9		(15%-73%)		

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087940-C01
Sample ID: 241350023
Matrix: AQUEOUS
Collect Date: 07-DEC-09 14:30
Receive Date: 07-DEC-09
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: PVC Well Casing 14 Day
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Semi-Volatile-GC/MS											
3510/8270C TCL BNA Liquid "As Received"											
1,2,4-Trichlorobenzene	U	ND	1.89	9.43	ug/L	1	AMY	12/15/09	1637	932173	1
1,2-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1					
1,3-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1					
1,4-Dichlorobenzene	U	ND	1.89	9.43	ug/L	1					
2,4,5-Trichlorophenol	U	ND	1.89	9.43	ug/L	1					
2,4,6-Trichlorophenol	U	ND	1.89	9.43	ug/L	1					
2,4-Dichlorophenol	U	ND	1.89	9.43	ug/L	1					
2,4-Dimethylphenol	U	ND	1.89	9.43	ug/L	1					
2,4-Dinitrophenol	U	ND	4.72	18.9	ug/L	1					
2,4-Dinitrotoluene	U	ND	1.89	9.43	ug/L	1					
2,6-Dinitrotoluene	U	ND	1.89	9.43	ug/L	1					
2-Chloronaphthalene	U	ND	0.283	0.943	ug/L	1					
2-Chlorophenol	U	ND	1.89	9.43	ug/L	1					
2-Methyl-4,6-dinitrophenol	U	ND	2.83	9.43	ug/L	1					
2-Methylnaphthalene	U	ND	0.283	0.943	ug/L	1					
2-Nitrophenol	U	ND	1.89	9.43	ug/L	1					
3,3'-Dichlorobenzidine	U	ND	1.89	9.43	ug/L	1					
4-Bromophenylphenylether	U	ND	1.89	9.43	ug/L	1					
4-Chloro-3-methylphenol	U	ND	1.89	9.43	ug/L	1					
4-Chloroaniline	U	ND	1.89	9.43	ug/L	1					
4-Chlorophenylphenylether	U	ND	1.89	9.43	ug/L	1					
4-Nitrophenol	U	ND	1.89	9.43	ug/L	1					
Acenaphthene	U	ND	0.292	0.943	ug/L	1					
Acenaphthylene	U	ND	0.189	0.943	ug/L	1					
Anthracene	U	ND	0.189	0.943	ug/L	1					
Benzo(a)anthracene	U	ND	0.189	0.943	ug/L	1					
Benzo(a)pyrene	U	ND	0.189	0.943	ug/L	1					
Benzo(b)fluoranthene	U	ND	0.189	0.943	ug/L	1					
Benzo(ghi)perylene	U	ND	0.189	0.943	ug/L	1					
Benzo(k)fluoranthene	U	ND	0.189	0.943	ug/L	1					
Butylbenzylphthalate	U	ND	1.89	9.43	ug/L	1					
Carbazole	U	ND	0.189	0.943	ug/L	1					
Chrysene	U	ND	0.189	0.943	ug/L	1					
Di-n-butylphthalate	U	ND	1.89	9.43	ug/L	1					
Di-n-octylphthalate	U	ND	2.83	9.43	ug/L	1					
Dibenzo(a,h)anthracene	U	ND	0.189	0.943	ug/L	1					
Dibenzofuran	U	ND	1.89	9.43	ug/L	1					
Diethylphthalate	U	ND	1.89	9.43	ug/L	1					

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087940-C01
Sample ID: 241350023

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Semi-Volatile-GC/MS										
3510/8270C TCL BNA Liquid "As Received"										
Dimethylphthalate	U	ND	1.89	9.43	ug/L	1				
Diphenylamine	U	ND	2.83	9.43	ug/L	1				
Fluoranthene	U	ND	0.189	0.943	ug/L	1				
Fluorene	U	ND	0.189	0.943	ug/L	1				
Hexachlorobenzene	U	ND	1.89	9.43	ug/L	1				
Hexachlorobutadiene	U	ND	1.89	9.43	ug/L	1				
Hexachlorocyclopentadiene	U	ND	2.83	9.43	ug/L	1				
Hexachloroethane	U	ND	1.89	9.43	ug/L	1				
Indeno(1,2,3-cd)pyrene	U	ND	0.189	0.943	ug/L	1				
Isophorone	U	ND	2.83	9.43	ug/L	1				
N-Nitrosodipropylamine	U	ND	1.89	9.43	ug/L	1				
Naphthalene	U	ND	0.283	0.943	ug/L	1				
Nitrobenzene	U	ND	2.83	9.43	ug/L	1				
Pentachlorophenol	U	ND	1.89	9.43	ug/L	1				
Phenanthrene	U	ND	0.189	0.943	ug/L	1				
Phenol	U	ND	0.943	9.43	ug/L	1				
Pyrene	U	ND	0.283	0.943	ug/L	1				
bis(2-Chloroethoxy)methane	U	ND	2.83	9.43	ug/L	1				
bis(2-Chloroethyl) ether	U	ND	1.89	9.43	ug/L	1				
bis(2-Chloroisopropyl)ether	U	ND	1.89	9.43	ug/L	1				
bis(2-Ethylhexyl)phthalate	U	ND	1.89	9.43	ug/L	1				
m,p-Cresols	U	ND	2.83	9.43	ug/L	1				
m-Nitroaniline	U	ND	1.89	9.43	ug/L	1				
o-Cresol	U	ND	1.89	9.43	ug/L	1				
o-Nitroaniline	U	ND	1.89	9.43	ug/L	1				
p-Nitroaniline	U	ND	2.83	9.43	ug/L	1				

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3510C	3510C BNA Liq. Prep-8270 Analysis	TXA1	12/14/09	1832	932171

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8270C	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
2-Fluorobiphenyl	3510/8270C TCL BNA Liquid "As Received"	40.5 ug/L	47.2	85.8	(35%-100%)
Nitrobenzene-d5	3510/8270C TCL BNA Liquid "As Received"	40.7 ug/L	47.2	86.3	(40%-112%)
p-Terphenyl-d14	3510/8270C TCL BNA Liquid "As Received"	47.3 ug/L	47.2	100	(46%-130%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: December 30, 2009

Client Sample ID: 087940-C01
Sample ID: 241350023

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
2,4,6-Tribromophenol		3510/8270C TCL BNA Liquid "As Received"		83.4	ug/L	94.3	88.4		(39%-115%)		
2-Fluorophenol		3510/8270C TCL BNA Liquid "As Received"		41.5	ug/L	94.3	44.0		(25%-92%)		
Phenol-d5		3510/8270C TCL BNA Liquid "As Received"		25.6	ug/L	94.3	27.2		(15%-73%)		

Quality Control Summary for VOC Analysis

QC Summary

Report Date: December 11, 2009
Page 1 of 9

Sandia National Laboratories
MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico

Contact: **Ms. Pamela M. Puissant**

Workorder: **241350**

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS										
Batch 928279										
QC1201984940 LCS										
1,1,1-Trichloroethane	50.0			52.5	ug/L		105	(73%-132%)	RXM4	12/02/09 08:38
1,1,2,2-Tetrachloroethane	50.0			52.6	ug/L		105	(71%-121%)		
1,1,2-Trichloroethane	50.0			51.1	ug/L		102	(76%-120%)		
1,1-Dichloroethane	50.0			50.2	ug/L		100	(75%-121%)		
1,1-Dichloroethylene	50.0			50.2	ug/L		100	(70%-128%)		
1,2-Dichloroethane	50.0			45.2	ug/L		90.3	(70%-123%)		
1,2-Dichloropropane	50.0			52.8	ug/L		106	(75%-121%)		
2-Butanone	250			190	ug/L		75.8	(31%-160%)		
2-Hexanone	250			184	ug/L		73.8	(34%-162%)		
4-Methyl-2-pentanone	250			229	ug/L		91.8	(68%-132%)		
Acetone	250			186	ug/L		74.5	(28%-157%)		
Benzene	50.0			53.9	ug/L		108	(72%-120%)		
Bromodichloromethane	50.0			51.5	ug/L		103	(77%-130%)		
Bromoform	50.0			56.3	ug/L		113	(77%-139%)		
Bromomethane	50.0			58.9	ug/L		118	(63%-131%)		
Carbon disulfide	250			314	ug/L		126	(63%-129%)		
Carbon tetrachloride	50.0			54.0	ug/L		108	(75%-139%)		
Chlorobenzene	50.0			53.9	ug/L		108	(76%-120%)		
Chloroethane	50.0			58.7	ug/L		117	(67%-126%)		
Chloroform	50.0			49.9	ug/L		99.7	(76%-121%)		
Chloromethane	50.0			50.0	ug/L		99.9	(52%-139%)		
Dibromochloromethane	50.0			53.5	ug/L		107	(82%-131%)		
Ethylbenzene	50.0			51.6	ug/L		103	(75%-120%)		
Methylene chloride	50.0			54.3	ug/L		109	(72%-131%)		
Styrene	50.0			54.8	ug/L		110	(76%-126%)		
Tetrachloroethylene	50.0			56.4	ug/L		113	(72%-126%)		
Toluene	50.0			52.7	ug/L		105	(74%-120%)		
Trichloroethylene	50.0			54.4	ug/L		109	(76%-123%)		
Vinyl acetate	250			307	ug/L		123	(61%-134%)		
Vinyl chloride	50.0			52.4	ug/L		105	(61%-131%)		
Xylenes (total)	150			164	ug/L		109	(75%-121%)		
cis-1,2-Dichloroethylene	50.0			55.5	ug/L		111	(77%-124%)		
cis-1,3-Dichloropropylene	50.0			54.3	ug/L		109	(79%-127%)		
trans-1,2-Dichloroethylene	50.0			56.9	ug/L		114	(71%-124%)		
trans-1,3-Dichloropropylene	50.0			50.4	ug/L		101	(81%-127%)		
**1,2-Dichloroethane-d4	50.0			53.8	ug/L		108	(59%-130%)		

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS										
Batch 928279										
**Bromofluorobenzene	50.0			45.7	ug/L		91.5	(71%-126%)		
**Toluene-d8	50.0			52.8	ug/L		106	(76%-129%)	RXM4	12/02/09 08:38
QC1201984937 MB										
1,1,1-Trichloroethane			U	ND	ug/L					12/02/09 09:40
1,1,2,2-Tetrachloroethane			U	ND	ug/L					
1,1,2-Trichloroethane			U	ND	ug/L					
1,1-Dichloroethane			U	ND	ug/L					
1,1-Dichloroethylene			U	ND	ug/L					
1,2-Dichloroethane			U	ND	ug/L					
1,2-Dichloropropane			U	ND	ug/L					
2-Butanone			U	ND	ug/L					
2-Hexanone			U	ND	ug/L					
4-Methyl-2-pentanone			U	ND	ug/L					
Acetone			U	ND	ug/L					
Benzene			U	ND	ug/L					
Bromodichloromethane			U	ND	ug/L					
Bromoform			U	ND	ug/L					
Bromomethane			U	ND	ug/L					
Carbon disulfide			U	ND	ug/L					
Carbon tetrachloride			U	ND	ug/L					
Chlorobenzene			U	ND	ug/L					
Chloroethane			U	ND	ug/L					
Chloroform			U	ND	ug/L					
Chloromethane			U	ND	ug/L					
Dibromochloromethane			U	ND	ug/L					
Ethylbenzene			U	ND	ug/L					
Methylene chloride			U	ND	ug/L					
Styrene			U	ND	ug/L					
Tetrachloroethylene			U	ND	ug/L					
Toluene			U	ND	ug/L					
Trichloroethylene			U	ND	ug/L					
Vinyl acetate			U	ND	ug/L					
Vinyl chloride			U	ND	ug/L					
Xylenes (total)			U	ND	ug/L					
cis-1,2-Dichloroethylene			U	ND	ug/L					
cis-1,3-Dichloropropylene			U	ND	ug/L					
trans-1,2-Dichloroethylene			U	ND	ug/L					
trans-1,3-Dichloropropylene			U	ND	ug/L					
**1,2-Dichloroethane-d4	50.0			50.4	ug/L		101	(59%-130%)		
**Bromofluorobenzene	50.0			46.1	ug/L		92.3	(71%-126%)		
**Toluene-d8	50.0			53.2	ug/L		106	(76%-129%)		
QC1201984938 241781001 PS										

QC Summary

Workorder: 241350

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS											
Batch 928279											
1,1,1-Trichloroethane	50.0	U	ND		43.9	ug/L		87.8	(66%-132%)		12/03/09 11:46
1,1,2,2-Tetrachloroethane	50.0	U	ND		51.3	ug/L		103	(66%-128%)	RXM4	
1,1,2-Trichloroethane	50.0	U	ND		46.9	ug/L		93.9	(71%-125%)		
1,1-Dichloroethane	50.0	U	ND		45.0	ug/L		90	(69%-125%)		
1,1-Dichloroethylene	50.0	U	ND		42.9	ug/L		85.8	(61%-129%)		
1,2-Dichloroethane	50.0	U	ND		37.1	ug/L		74.2	(65%-129%)		
1,2-Dichloropropane	50.0	U	ND		49.8	ug/L		99.5	(71%-125%)		
2-Butanone	250	U	ND		125	ug/L		50.1	(11%-151%)		
2-Hexanone	250	U	ND		135	ug/L		53.9	(28%-143%)		
4-Methyl-2-pentanone	250	U	ND		206	ug/L		82.5	(64%-133%)		
Acetone	250	U	ND		77.8	ug/L		31.1	(14%-150%)		
Benzene	50.0	U	ND		49.6	ug/L		99.2	(66%-121%)		
Bromodichloromethane	50.0	U	ND		43.4	ug/L		86.8	(72%-134%)		
Bromoform	50.0	U	ND		50.6	ug/L		101	(72%-143%)		
Bromomethane	50.0	U	ND		54.2	ug/L		108	(54%-136%)		
Carbon disulfide	250	U	ND		281	ug/L		112	(57%-129%)		
Carbon tetrachloride	50.0	U	ND		44.7	ug/L		89.4	(66%-138%)		
Chlorobenzene	50.0	U	ND		48.5	ug/L		97.1	(69%-120%)		
Chloroethane	50.0	U	ND		54.1	ug/L		108	(60%-129%)		
Chloroform	50.0	U	ND		43.4	ug/L		86.8	(70%-126%)		
Chloromethane	50.0	U	ND		42.8	ug/L		85.6	(47%-140%)		
Dibromochloromethane	50.0	U	ND		47.7	ug/L		95.5	(76%-135%)		
Ethylbenzene	50.0	U	ND		44.9	ug/L		89.8	(65%-123%)		
Methylene chloride	50.0	U	ND		49.9	ug/L		99.9	(68%-134%)		
Styrene	50.0	U	ND		50.3	ug/L		101	(66%-131%)		
Tetrachloroethylene	50.0	U	ND		50.8	ug/L		102	(63%-126%)		
Toluene	50.0	U	ND		47.6	ug/L		95.3	(65%-124%)		
Trichloroethylene	50.0	U	ND		49.1	ug/L		98.1	(66%-127%)		
Vinyl acetate	250	U	ND		304	ug/L		122	(41%-140%)		
Vinyl chloride	50.0	U	ND		45.0	ug/L		90	(51%-134%)		
Xylenes (total)	150	U	ND		147	ug/L		97.7	(65%-125%)		
cis-1,2-Dichloroethylene	50.0				51.0	ug/L		102	(71%-128%)		
cis-1,3-Dichloropropylene	50.0	U	ND		48.6	ug/L		97.1	(71%-129%)		
trans-1,2-Dichloroethylene	50.0	U	ND		51.8	ug/L		104	(64%-126%)		
trans-1,3-Dichloropropylene	50.0	U	ND		43.5	ug/L		87.1	(73%-130%)		
**1,2-Dichloroethane-d4	50.0		57.6		47.5	ug/L		94.9	(59%-130%)		
**Bromofluorobenzene	50.0		47.8		45.2	ug/L		90.4	(71%-126%)		
**Toluene-d8	50.0		55.2		52.9	ug/L		106	(76%-129%)		
QC1201984939 241781001 PSD											
1,1,1-Trichloroethane	50.0	U	ND		43.3	ug/L	1.47	86.5	(0%-20%)		12/03/09 12:16
1,1,2,2-Tetrachloroethane	50.0	U	ND		54.6	ug/L	6.25	109	(0%-20%)		
1,1,2-Trichloroethane	50.0	U	ND		50.1	ug/L	6.56	100	(0%-20%)		

QC Summary

Workorder: 241350

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS											
Batch 928279											
1,1-Dichloroethane	50.0	U	ND		45.5	ug/L	1.16	91.1	(0%-20%)		
1,1-Dichloroethylene	50.0	U	ND		42.9	ug/L	0.0441	85.8	(0%-20%)	RXM4	12/03/09 12:16
1,2-Dichloroethane	50.0	U	ND		38.4	ug/L	3.45	76.8	(0%-20%)		
1,2-Dichloropropane	50.0	U	ND		51.3	ug/L	3.01	103	(0%-20%)		
2-Butanone	250	U	ND		130	ug/L	4.03	52.1	(0%-20%)		
2-Hexanone	250	U	ND		141	ug/L	4.74	56.5	(0%-20%)		
4-Methyl-2-pentanone	250	U	ND		223	ug/L	7.88	89.3	(0%-20%)		
Acetone	250	U	ND		78.4	ug/L	0.837	31.4	(0%-20%)		
Benzene	50.0	U	ND		52.3	ug/L	5.23	105	(0%-20%)		
Bromodichloromethane	50.0	U	ND		45.3	ug/L	4.24	90.6	(0%-20%)		
Bromoform	50.0	U	ND		53.4	ug/L	5.28	107	(0%-20%)		
Bromomethane	50.0	U	ND		55.6	ug/L	2.54	111	(0%-20%)		
Carbon disulfide	250	U	ND		289	ug/L	2.91	116	(0%-20%)		
Carbon tetrachloride	50.0	U	ND		45.2	ug/L	1.16	90.5	(0%-20%)		
Chlorobenzene	50.0	U	ND		52.0	ug/L	6.93	104	(0%-20%)		
Chloroethane	50.0	U	ND		55.5	ug/L	2.38	111	(0%-20%)		
Chloroform	50.0	U	ND		45.5	ug/L	4.73	91	(0%-20%)		
Chloromethane	50.0	U	ND		42.9	ug/L	0.223	85.8	(0%-20%)		
Dibromochloromethane	50.0	U	ND		50.8	ug/L	6.33	102	(0%-20%)		
Ethylbenzene	50.0	U	ND		46.8	ug/L	4.14	93.6	(0%-20%)		
Methylene chloride	50.0	U	ND		52.2	ug/L	4.53	104	(0%-20%)		
Styrene	50.0	U	ND		52.2	ug/L	3.68	104	(0%-20%)		
Tetrachloroethylene	50.0	U	ND		53.1	ug/L	4.56	106	(0%-20%)		
Toluene	50.0	U	ND		49.0	ug/L	2.74	97.9	(0%-20%)		
Trichloroethylene	50.0	U	ND		49.8	ug/L	1.51	99.6	(0%-20%)		
Vinyl acetate	250	U	ND		308	ug/L	1.03	123	(0%-20%)		
Vinyl chloride	50.0	U	ND		47.0	ug/L	4.31	94	(0%-20%)		
Xylenes (total)	150	U	ND		151	ug/L	2.99	101	(0%-20%)		
cis-1,2-Dichloroethylene	50.0				53.8	ug/L	N/A	108	(0%-20%)		
cis-1,3-Dichloropropylene	50.0	U	ND		50.9	ug/L	4.65	102	(0%-20%)		
trans-1,2-Dichloroethylene	50.0	U	ND		52.1	ug/L	0.707	104	(0%-20%)		
trans-1,3-Dichloropropylene	50.0	U	ND		45.9	ug/L	5.18	91.7	(0%-20%)		
**1,2-Dichloroethane-d4	50.0		57.6		47.4	ug/L		94.9	(59%-130%)		
**Bromofluorobenzene	50.0		47.8		45.0	ug/L		90.1	(71%-126%)		
**Toluene-d8	50.0		55.2		52.7	ug/L		105	(76%-129%)		
Batch 930872											
QC1201991001 LCS											
1,1,1-Trichloroethane	50.0				43.3	ug/L		86.6	(73%-132%)	RXY1	12/09/09 08:39
1,1,2,2-Tetrachloroethane	50.0				47.8	ug/L		95.6	(71%-121%)		
1,1,2-Trichloroethane	50.0				46.5	ug/L		93.1	(76%-120%)		
1,1-Dichloroethane	50.0				46.8	ug/L		93.5	(75%-121%)		
1,1-Dichloroethylene	50.0				46.4	ug/L		92.7	(70%-128%)		

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS										
Batch 930872										
1,2-Dichloroethane	50.0			46.7	ug/L		93.4	(70%-123%)		
1,2-Dichloropropane	50.0			48.1	ug/L		96.2	(75%-121%)	RXY1	12/09/09 08:39
2-Butanone	250			266	ug/L		106	(31%-160%)		
2-Hexanone	250			239	ug/L		95.8	(34%-162%)		
4-Methyl-2-pentanone	250			246	ug/L		98.4	(68%-132%)		
Acetone	250			276	ug/L		110	(28%-157%)		
Benzene	50.0			45.2	ug/L		90.5	(72%-120%)		
Bromodichloromethane	50.0			45.0	ug/L		90	(77%-130%)		
Bromoform	50.0			43.4	ug/L		86.9	(77%-139%)		
Bromomethane	50.0			52.1	ug/L		104	(63%-131%)		
Carbon disulfide	250			239	ug/L		95.5	(63%-129%)		
Carbon tetrachloride	50.0			45.3	ug/L		90.5	(75%-139%)		
Chlorobenzene	50.0			45.7	ug/L		91.5	(76%-120%)		
Chloroethane	50.0			50.8	ug/L		102	(67%-126%)		
Chloroform	50.0			45.0	ug/L		89.9	(76%-121%)		
Chloromethane	50.0			46.5	ug/L		93	(52%-139%)		
Dibromochloromethane	50.0			44.7	ug/L		89.3	(82%-131%)		
Ethylbenzene	50.0			43.9	ug/L		87.8	(75%-120%)		
Methylene chloride	50.0			41.7	ug/L		83.4	(72%-131%)		
Styrene	50.0			44.0	ug/L		88.1	(76%-126%)		
Tetrachloroethylene	50.0			45.0	ug/L		90.1	(72%-126%)		
Toluene	50.0			43.9	ug/L		87.9	(74%-120%)		
Trichloroethylene	50.0			46.3	ug/L		92.6	(76%-123%)		
Vinyl acetate	250			302	ug/L		121	(61%-134%)		
Vinyl chloride	50.0			50.2	ug/L		100	(61%-131%)		
Xylenes (total)	150			135	ug/L		90.3	(75%-121%)		
cis-1,2-Dichloroethylene	50.0			45.0	ug/L		90	(77%-124%)		
cis-1,3-Dichloropropylene	50.0			45.9	ug/L		91.9	(79%-127%)		
trans-1,2-Dichloroethylene	50.0			45.4	ug/L		90.7	(71%-124%)		
trans-1,3-Dichloropropylene	50.0			45.5	ug/L		90.9	(81%-127%)		
**1,2-Dichloroethane-d4	50.0			47.3	ug/L		94.7	(59%-130%)		
**Bromofluorobenzene	50.0			41.5	ug/L		83	(71%-126%)		
**Toluene-d8	50.0			45.3	ug/L		90.6	(76%-129%)		
QC1201990998 MB										
1,1,1-Trichloroethane			U	ND	ug/L					12/09/09 11:26
1,1,2,2-Tetrachloroethane			U	ND	ug/L					
1,1,2-Trichloroethane			U	ND	ug/L					
1,1-Dichloroethane			U	ND	ug/L					
1,1-Dichloroethylene			U	ND	ug/L					
1,2-Dichloroethane			U	ND	ug/L					
1,2-Dichloropropane			U	ND	ug/L					
2-Butanone			U	ND	ug/L					

QC Summary

Workorder: 241350

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS											
Batch 930872											
2-Hexanone				U	ND	ug/L					
4-Methyl-2-pentanone				U	ND	ug/L				RXY1	12/09/09 11:26
Acetone				U	ND	ug/L					
Benzene				U	ND	ug/L					
Bromodichloromethane				U	ND	ug/L					
Bromoform				U	ND	ug/L					
Bromomethane				U	ND	ug/L					
Carbon disulfide				U	ND	ug/L					
Carbon tetrachloride				U	ND	ug/L					
Chlorobenzene				U	ND	ug/L					
Chloroethane				U	ND	ug/L					
Chloroform				U	ND	ug/L					
Chloromethane				U	ND	ug/L					
Dibromochloromethane				U	ND	ug/L					
Ethylbenzene				U	ND	ug/L					
Methylene chloride				U	ND	ug/L					
Styrene				U	ND	ug/L					
Tetrachloroethylene				U	ND	ug/L					
Toluene				U	ND	ug/L					
Trichloroethylene				U	ND	ug/L					
Vinyl acetate				U	ND	ug/L					
Vinyl chloride				U	ND	ug/L					
Xylenes (total)				U	ND	ug/L					
cis-1,2-Dichloroethylene				U	ND	ug/L					
cis-1,3-Dichloropropylene				U	ND	ug/L					
trans-1,2-Dichloroethylene				U	ND	ug/L					
trans-1,3-Dichloropropylene				U	ND	ug/L					
**1,2-Dichloroethane-d4	50.0				47.5	ug/L		94.9	(59%-130%)		
**Bromofluorobenzene	50.0				42.6	ug/L		85.1	(71%-126%)		
**Toluene-d8	50.0				44.8	ug/L		89.6	(76%-129%)		
QC1201990999 241350021 PS											
1,1,1-Trichloroethane	50.0	U	ND		37.7	ug/L		75.4	(66%-132%)		12/09/09 14:40
1,1,2,2-Tetrachloroethane	50.0	U	ND		43.6	ug/L		87.3	(66%-128%)		
1,1,2-Trichloroethane	50.0	U	ND		42.7	ug/L		85.4	(71%-125%)		
1,1-Dichloroethane	50.0	U	ND		42.1	ug/L		84.2	(69%-125%)		
1,1-Dichloroethylene	50.0	U	ND		38.0	ug/L		76	(61%-129%)		
1,2-Dichloroethane	50.0	U	ND		43.4	ug/L		86.8	(65%-129%)		
1,2-Dichloropropane	50.0	U	ND		44.4	ug/L		88.9	(71%-125%)		
2-Butanone	250	U	ND		171	ug/L		68.3	(11%-151%)		
2-Hexanone	250	U	ND		157	ug/L		62.7	(28%-143%)		
4-Methyl-2-pentanone	250	U	ND		209	ug/L		83.5	(64%-133%)		
Acetone	250	U	ND		114	ug/L		45.8	(14%-150%)		

QC Summary

Workorder: 241350

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS											
Batch 930872											
Benzene	50.0	U	ND		41.0	ug/L		81.9	(66%-121%)		
Bromodichloromethane	50.0	U	ND		41.2	ug/L		82.4	(72%-134%)	RXY1	12/09/09 14:40
Bromoform	50.0	U	ND		38.9	ug/L		77.9	(72%-143%)		
Bromomethane	50.0	U	ND		46.5	ug/L		93.1	(54%-136%)		
Carbon disulfide	250	U	ND		209	ug/L		83.7	(57%-129%)		
Carbon tetrachloride	50.0	U	ND		38.1	ug/L		76.2	(66%-138%)		
Chlorobenzene	50.0	U	ND		42.3	ug/L		84.6	(69%-120%)		
Chloroethane	50.0	U	ND		43.1	ug/L		86.3	(60%-129%)		
Chloroform	50.0	U	ND		41.4	ug/L		82.7	(70%-126%)		
Chloromethane	50.0	U	ND		41.4	ug/L		82.9	(47%-140%)		
Dibromochloromethane	50.0	U	ND		41.5	ug/L		82.9	(76%-135%)		
Ethylbenzene	50.0	U	ND		39.7	ug/L		79.4	(65%-123%)		
Methylene chloride	50.0	U	ND		38.6	ug/L		77.2	(68%-134%)		
Styrene	50.0	U	ND		40.8	ug/L		81.6	(66%-131%)		
Tetrachloroethylene	50.0	U	ND		38.8	ug/L		77.6	(63%-126%)		
Toluene	50.0	U	ND		39.1	ug/L		78.1	(65%-124%)		
Trichloroethylene	50.0	U	ND		40.4	ug/L		80.8	(66%-127%)		
Vinyl acetate	250	U	ND		251	ug/L		100	(41%-140%)		
Vinyl chloride	50.0	U	ND		44.0	ug/L		88	(51%-134%)		
Xylenes (total)	150	U	ND		122	ug/L		81.5	(65%-125%)		
cis-1,2-Dichloroethylene	50.0	U	ND		41.7	ug/L		83.4	(71%-128%)		
cis-1,3-Dichloropropylene	50.0	U	ND		40.7	ug/L		81.4	(71%-129%)		
trans-1,2-Dichloroethylene	50.0	U	ND		40.1	ug/L		80.1	(64%-126%)		
trans-1,3-Dichloropropylene	50.0	U	ND		40.9	ug/L		81.9	(73%-130%)		
**1,2-Dichloroethane-d4	50.0		47.0		45.3	ug/L		90.6	(59%-130%)		
**Bromofluorobenzene	50.0		41.4		41.2	ug/L		82.4	(71%-126%)		
**Toluene-d8	50.0		46.3		46.1	ug/L		92.2	(76%-129%)		
QC1201991000 241350021 PSD											
1,1,1-Trichloroethane	50.0	U	ND		44.6	ug/L	16.8	89.2	(0%-20%)		12/09/09 15:08
1,1,2,2-Tetrachloroethane	50.0	U	ND		50.9	ug/L	15.5	102	(0%-20%)		
1,1,2-Trichloroethane	50.0	U	ND		50.2	ug/L	16.1	100	(0%-20%)		
1,1-Dichloroethane	50.0	U	ND		48.9	ug/L	14.9	97.8	(0%-20%)		
1,1-Dichloroethylene	50.0	U	ND		45.0	ug/L	16.9	90	(0%-20%)		
1,2-Dichloroethane	50.0	U	ND		50.3	ug/L	14.8	101	(0%-20%)		
1,2-Dichloropropane	50.0	U	ND		51.4	ug/L	14.5	103	(0%-20%)		
2-Butanone	250	U	ND		199	ug/L	15.3	79.6	(0%-20%)		
2-Hexanone	250	U	ND		179	ug/L	13.2	71.6	(0%-20%)		
4-Methyl-2-pentanone	250	U	ND		246	ug/L	16.5	98.5	(0%-20%)		
Acetone	250	U	ND		135	ug/L	16.7	54.2	(0%-20%)		
Benzene	50.0	U	ND		47.4	ug/L	14.6	94.8	(0%-20%)		
Bromodichloromethane	50.0	U	ND		48.9	ug/L	17.1	97.8	(0%-20%)		
Bromoform	50.0	U	ND		45.9	ug/L	16.4	91.8	(0%-20%)		

QC Summary

Workorder: 241350

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS											
Batch 930872											
Bromomethane	50.0	U	ND		52.9	ug/L	12.8	106	(0%-20%)		
Carbon disulfide	250	U	ND		241	ug/L	14.2	96.5	(0%-20%)	RXY1	12/09/09 15:08
Carbon tetrachloride	50.0	U	ND		44.8	ug/L	16.1	89.5	(0%-20%)		
Chlorobenzene	50.0	U	ND		48.2	ug/L	13.1	96.4	(0%-20%)		
Chloroethane	50.0	U	ND		50.0	ug/L	14.8	100	(0%-20%)		
Chloroform	50.0	U	ND		48.0	ug/L	14.9	96	(0%-20%)		
Chloromethane	50.0	U	ND		48.8	ug/L	16.2	97.5	(0%-20%)		
Dibromochloromethane	50.0	U	ND		47.4	ug/L	13.4	94.8	(0%-20%)		
Ethylbenzene	50.0	U	ND		45.8	ug/L	14.2	91.5	(0%-20%)		
Methylene chloride	50.0	U	ND		45.4	ug/L	16.2	90.9	(0%-20%)		
Styrene	50.0	U	ND		45.7	ug/L	11.2	91.3	(0%-20%)		
Tetrachloroethylene	50.0	U	ND		44.0	ug/L	12.6	88	(0%-20%)		
Toluene	50.0	U	ND		45.2	ug/L	14.6	90.5	(0%-20%)		
Trichloroethylene	50.0	U	ND		47.5	ug/L	16.1	95	(0%-20%)		
Vinyl acetate	250	U	ND		287	ug/L	13.3	115	(0%-20%)		
Vinyl chloride	50.0	U	ND		51.2	ug/L	15.1	102	(0%-20%)		
Xylenes (total)	150	U	ND		139	ug/L	12.9	92.7	(0%-20%)		
cis-1,2-Dichloroethylene	50.0	U	ND		48.2	ug/L	14.5	96.4	(0%-20%)		
cis-1,3-Dichloropropylene	50.0	U	ND		47.8	ug/L	16.0	95.5	(0%-20%)		
trans-1,2-Dichloroethylene	50.0	U	ND		46.4	ug/L	14.6	92.8	(0%-20%)		
trans-1,3-Dichloropropylene	50.0	U	ND		47.8	ug/L	15.4	95.5	(0%-20%)		
**1,2-Dichloroethane-d4	50.0		47.0		53.2	ug/L		106	(59%-130%)		
**Bromofluorobenzene	50.0		41.4		47.7	ug/L		95.4	(71%-126%)		
**Toluene-d8	50.0		46.3		53.1	ug/L		106	(76%-129%)		

Notes:
RER is calculated at the 95% confidence level (2-sigma).
The Qualifiers in this report are defined as follows:

- * Recovery or %RPD not within acceptance limits and/or spike amount not compatible with the sample or the duplicate RPD's are not applicable where the concentration falls below the effective PQL.
- ** Indicates analyte is a surrogate compound.
- B The analyte was found in the blank above the effective MDL.
- H Analytical holding time was exceeded
- J Estimated value, the analyte concentration fell above the effective MDL and below the effective PQL
- P The response between the confirmation column and the primary column is >40%D
- U The analyte was analyzed for but not detected below this concentration. For Organic and Inorganic analytes the result is less than the effective MDL. For radiochemical analytes the result is less than the Decision Level
- X Presumptive evidence that the analyte is not present. Please see narrative for further infromation.
- Z The percent difference is greater than 70%.
- d The 2:1 depletion requirement was not met for this sample
- h Prep holding time exceeded

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

Quality Control Summary for SVOC Analysis

QC Summary

Report Date: December 30, 2009
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Sandia National Laboratories
MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico

Contact: Ms. Pamela M. Puissant

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Semi-Volatile-GC/MS										
Batch 926148										
QC1201980198 LCS										
1,2,4-Trichlorobenzene	50.0			32.6	ug/L		65.3	(40%-91%)	AGS1	12/01/09 19:25
1,2-Dichlorobenzene	50.0			32.1	ug/L		64.2	(39%-91%)		
1,3-Dichlorobenzene	50.0			30.8	ug/L		61.6	(38%-88%)		
1,4-Dichlorobenzene	50.0			31.6	ug/L		63.2	(38%-88%)		
2,4,5-Trichlorophenol	50.0			35.2	ug/L		70.3	(50%-111%)		
2,4,6-Trichlorophenol	50.0			35.5	ug/L		71	(54%-111%)		
2,4-Dichlorophenol	50.0			35.5	ug/L		70.9	(52%-105%)		
2,4-Dimethylphenol	50.0			33.5	ug/L		67	(44%-100%)		
2,4-Dinitrophenol	50.0			30.4	ug/L		60.8	(33%-118%)		
2,4-Dinitrotoluene	50.0			38.4	ug/L		76.8	(55%-108%)		
2,6-Dinitrotoluene	50.0			38.7	ug/L		77.4	(58%-104%)		
2-Chloronaphthalene	50.0			33.5	ug/L		67	(46%-100%)		
2-Chlorophenol	50.0			33.4	ug/L		66.8	(49%-96%)		
2-Methyl-4,6-dinitrophenol	50.0			29.4	ug/L		58.8	(39%-124%)		
2-Methylnaphthalene	50.0			35.1	ug/L		70.2	(42%-97%)		
2-Nitrophenol	50.0			35.6	ug/L		71.2	(52%-104%)		
3,3'-Dichlorobenzidine	50.0			33.2	ug/L		66.3	(41%-107%)		
4-Bromophenylphenylether	50.0			43.5	ug/L		87.1	(56%-108%)		
4-Chloro-3-methylphenol	50.0			36.5	ug/L		73.1	(55%-109%)		
4-Chloroaniline	50.0			38.9	ug/L		77.9	(57%-145%)		
4-Chlorophenylphenylether	50.0			38.7	ug/L		77.5	(57%-106%)		
4-Nitrophenol	50.0			17.1	ug/L		34.1	(19%-56%)		
Acenaphthene	50.0			35.9	ug/L		71.8	(47%-101%)		
Acenaphthylene	50.0			37.7	ug/L		75.5	(58%-99%)		
Anthracene	50.0			39.2	ug/L		78.3	(55%-106%)		
Benzo(a)anthracene	50.0			39.3	ug/L		78.6	(56%-105%)		
Benzo(a)pyrene	50.0			40.7	ug/L		81.5	(58%-111%)		
Benzo(b)fluoranthene	50.0			40.8	ug/L		81.6	(53%-114%)		
Benzo(ghi)perylene	50.0			43.3	ug/L		86.7	(41%-125%)		
Benzo(k)fluoranthene	50.0			39.6	ug/L		79.2	(55%-116%)		
Butylbenzylphthalate	50.0			42.8	ug/L		85.5	(55%-122%)		
Carbazole	50.0			36.5	ug/L		73.1	(52%-124%)		
Chrysene	50.0			37.0	ug/L		74.1	(56%-105%)		
Di-n-butylphthalate	50.0			43.3	ug/L		86.5	(58%-119%)		
Di-n-octylphthalate	50.0			39.2	ug/L		78.4	(41%-136%)		
Dibenzo(a,h)anthracene	50.0			42.9	ug/L		85.9	(44%-126%)		

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Semi-Volatile-GC/MS										
Batch 926148										
Dibenzofuran	50.0			42.7	ug/L		85.5	(54%-108%)		
Diethylphthalate	50.0			42.6	ug/L		85.1	(60%-112%)	AGS1	12/01/09 19:25
Dimethylphthalate	50.0			40.8	ug/L		81.5	(59%-107%)		
Diphenylamine	50.0			38.3	ug/L		76.6	(55%-113%)		
Fluoranthene	50.0			39.7	ug/L		79.4	(57%-114%)		
Fluorene	50.0			35.7	ug/L		71.4	(52%-106%)		
Hexachlorobenzene	50.0			36.3	ug/L		72.7	(53%-115%)		
Hexachlorobutadiene	50.0			28.5	ug/L		57	(33%-98%)		
Hexachlorocyclopentadiene	50.0			40.3	ug/L		80.7	(10%-128%)		
Hexachloroethane	50.0			29.1	ug/L		58.2	(35%-92%)		
Indeno(1,2,3-cd)pyrene	50.0			43.2	ug/L		86.4	(45%-124%)		
Isophorone	50.0			42.2	ug/L		84.4	(52%-113%)		
N-Nitrosodipropylamine	50.0			34.3	ug/L		68.6	(44%-118%)		
Naphthalene	50.0			35.1	ug/L		70.1	(40%-93%)		
Nitrobenzene	50.0			38.5	ug/L		76.9	(48%-112%)		
Pentachlorophenol	50.0			30.9	ug/L		61.9	(44%-121%)		
Phenanthrene	50.0			37.1	ug/L		74.2	(54%-105%)		
Phenol	50.0			14.0	ug/L		28.1	(21%-45%)		
Pyrene	50.0			38.7	ug/L		77.4	(49%-115%)		
bis(2-Chloroethoxy)methane	50.0			36.4	ug/L		72.8	(54%-107%)		
bis(2-Chloroethyl) ether	50.0			35.8	ug/L		71.5	(46%-106%)		
bis(2-Chloroisopropyl)ether	50.0			38.6	ug/L		77.3	(44%-115%)		
bis(2-Ethylhexyl)phthalate	50.0			40.5	ug/L		80.9	(55%-124%)		
m,p-Cresols	50.0			30.0	ug/L		59.9	(38%-96%)		
m-Nitroaniline	50.0			33.6	ug/L		67.3	(58%-125%)		
o-Cresol	50.0			30.2	ug/L		60.5	(41%-94%)		
o-Nitroaniline	50.0			34.6	ug/L		69.2	(50%-120%)		
p-Nitroaniline	50.0			32.3	ug/L		64.7	(48%-135%)		
**2,4,6-Tribromophenol	100			81.8	ug/L		81.8	(39%-115%)		
**2-Fluorobiphenyl	50.0			42.9	ug/L		85.9	(35%-100%)		
**2-Fluorophenol	100			45.0	ug/L		45	(25%-92%)		
**Nitrobenzene-d5	50.0			42.9	ug/L		85.8	(40%-112%)		
**Phenol-d5	100			28.9	ug/L		28.9	(15%-73%)		
**p-Terphenyl-d14	50.0			45.1	ug/L		90.3	(46%-130%)		
QC1201981094 LCSD										
1,2,4-Trichlorobenzene	50.0			36.8	ug/L	12.0	73.6	(0%-20%)		12/01/09 19:45
1,2-Dichlorobenzene	50.0			37.1	ug/L	14.4	74.2	(0%-20%)		
1,3-Dichlorobenzene	50.0			36.0	ug/L	15.6	72	(0%-20%)		
1,4-Dichlorobenzene	50.0			36.9	ug/L	15.4	73.8	(0%-20%)		
2,4,5-Trichlorophenol	50.0			39.6	ug/L	11.9	79.3	(0%-20%)		
2,4,6-Trichlorophenol	50.0			39.4	ug/L	10.3	78.7	(0%-20%)		
2,4-Dichlorophenol	50.0			39.5	ug/L	10.8	79	(0%-20%)		

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Semi-Volatile-GC/MS										
Batch 926148										
2,4-Dimethylphenol	50.0			35.6	ug/L	6.16	71.3	(0%-20%)		
2,4-Dinitrophenol	50.0			36.8	ug/L	19.0	73.5	(0%-20%)	AGS1	12/01/09 19:45
2,4-Dinitrotoluene	50.0			43.4	ug/L	12.3	86.9	(0%-20%)		
2,6-Dinitrotoluene	50.0			43.3	ug/L	11.3	86.7	(0%-20%)		
2-Chloronaphthalene	50.0			37.3	ug/L	10.7	74.5	(0%-20%)		
2-Chlorophenol	50.0			37.5	ug/L	11.5	74.9	(0%-20%)		
2-Methyl-4,6-dinitrophenol	50.0			35.1	ug/L	17.5	70.2	(0%-20%)		
2-Methylnaphthalene	50.0			39.3	ug/L	11.4	78.6	(0%-20%)		
2-Nitrophenol	50.0			39.3	ug/L	9.81	78.5	(0%-20%)		
3,3'-Dichlorobenzidine	50.0			38.5	ug/L	15.0	77	(0%-20%)		
4-Bromophenylphenylether	50.0			47.0	ug/L	7.75	94.1	(0%-20%)		
4-Chloro-3-methylphenol	50.0			40.4	ug/L	10.1	80.8	(0%-20%)		
4-Chloroaniline	50.0			41.4	ug/L	6.07	82.8	(0%-20%)		
4-Chlorophenylphenylether	50.0			42.7	ug/L	9.73	85.4	(0%-20%)		
4-Nitrophenol	50.0			19.6	ug/L	13.7	39.2	(0%-20%)		
Acenaphthene	50.0			39.8	ug/L	10.3	79.6	(0%-20%)		
Acenaphthylene	50.0			41.7	ug/L	10.0	83.4	(0%-20%)		
Anthracene	50.0			40.5	ug/L	3.42	81.1	(0%-20%)		
Benzo(a)anthracene	50.0			42.9	ug/L	8.69	85.7	(0%-20%)		
Benzo(a)pyrene	50.0			44.6	ug/L	9.10	89.2	(0%-20%)		
Benzo(b)fluoranthene	50.0			41.7	ug/L	2.23	83.5	(0%-20%)		
Benzo(ghi)perylene	50.0			52.5	ug/L	19.2	105	(0%-20%)		
Benzo(k)fluoranthene	50.0			43.0	ug/L	8.16	86	(0%-20%)		
Butylbenzylphthalate	50.0			43.1	ug/L	0.819	86.2	(0%-20%)		
Carbazole	50.0			36.5	ug/L	0.0956	73	(0%-20%)		
Chrysene	50.0			41.0	ug/L	10.2	82	(0%-20%)		
Di-n-butylphthalate	50.0			47.3	ug/L	8.97	94.6	(0%-20%)		
Di-n-octylphthalate	50.0			36.1	ug/L	8.28	72.2	(0%-20%)		
Dibenzo(a,h)anthracene	50.0			52.5	ug/L	20.1*	105	(0%-20%)		
Dibenzofuran	50.0			47.0	ug/L	9.46	94	(0%-20%)		
Diethylphthalate	50.0			47.2	ug/L	10.3	94.4	(0%-20%)		
Dimethylphthalate	50.0			45.1	ug/L	10.2	90.3	(0%-20%)		
Diphenylamine	50.0			40.8	ug/L	6.21	81.5	(0%-20%)		
Fluoranthene	50.0			44.5	ug/L	11.3	89	(0%-20%)		
Fluorene	50.0			38.2	ug/L	6.92	76.5	(0%-20%)		
Hexachlorobenzene	50.0			39.0	ug/L	7.10	78	(0%-20%)		
Hexachlorobutadiene	50.0			32.5	ug/L	13.1	65	(0%-20%)		
Hexachlorocyclopentadiene	50.0			47.5	ug/L	16.3	95	(0%-20%)		
Hexachloroethane	50.0			34.4	ug/L	16.8	68.8	(0%-20%)		
Indeno(1,2,3-cd)pyrene	50.0			52.3	ug/L	19.1	105	(0%-20%)		
Isophorone	50.0			48.2	ug/L	13.2	96.4	(0%-20%)		
				40.3						

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Semi-Volatile-GC/MS										
Batch 926148										
N-Nitrosodipropylamine	50.0				ug/L	15.9	80.5	(0%-20%)		
Naphthalene	50.0			39.3	ug/L	11.4	78.6	(0%-20%)	AGS1	12/01/09 19:45
Nitrobenzene	50.0			43.3	ug/L	11.8	86.5	(0%-20%)		
Pentachlorophenol	50.0			36.4	ug/L	16.1	72.7	(0%-20%)		
Phenanthrene	50.0			42.5	ug/L	13.7	85.1	(0%-20%)		
Phenol	50.0			15.8	ug/L	11.8	31.6	(0%-20%)		
Pyrene	50.0			38.0	ug/L	1.77	76.1	(0%-20%)		
bis(2-Chloroethoxy)methane	50.0			41.1	ug/L	12.3	82.3	(0%-20%)		
bis(2-Chloroethyl) ether	50.0			40.9	ug/L	13.3	81.8	(0%-20%)		
bis(2-Chloroisopropyl)ether	50.0			44.9	ug/L	14.9	89.7	(0%-20%)		
bis(2-Ethylhexyl)phthalate	50.0			41.6	ug/L	2.66	83.1	(0%-20%)		
m,p-Cresols	50.0			33.8	ug/L	12.1	67.6	(0%-20%)		
m-Nitroaniline	50.0			36.4	ug/L	7.89	72.8	(0%-20%)		
o-Cresol	50.0			34.1	ug/L	12.0	68.2	(0%-20%)		
o-Nitroaniline	50.0			38.6	ug/L	11.0	77.3	(0%-20%)		
p-Nitroaniline	50.0			36.6	ug/L	12.5	73.3	(0%-20%)		
**2,4,6-Tribromophenol	100			91.6	ug/L		91.6	(39%-115%)		
**2-Fluorobiphenyl	50.0			47.6	ug/L		95.2	(35%-100%)		
**2-Fluorophenol	100			49.6	ug/L		49.6	(25%-92%)		
**Nitrobenzene-d5	50.0			48.0	ug/L		96	(40%-112%)		
**Phenol-d5	100			32.1	ug/L		32.1	(15%-73%)		
**p-Terphenyl-d14	50.0			44.1	ug/L		88.2	(46%-130%)		
QC1201980195 MB										
1,2,4-Trichlorobenzene			U	ND	ug/L					12/01/09 19:04
1,2-Dichlorobenzene			U	ND	ug/L					
1,3-Dichlorobenzene			U	ND	ug/L					
1,4-Dichlorobenzene			U	ND	ug/L					
2,4,5-Trichlorophenol			U	ND	ug/L					
2,4,6-Trichlorophenol			U	ND	ug/L					
2,4-Dichlorophenol			U	ND	ug/L					
2,4-Dimethylphenol			U	ND	ug/L					
2,4-Dinitrophenol			U	ND	ug/L					
2,4-Dinitrotoluene			U	ND	ug/L					
2,6-Dinitrotoluene			U	ND	ug/L					
2-Chloronaphthalene			U	ND	ug/L					
2-Chlorophenol			U	ND	ug/L					
2-Methyl-4,6-dinitrophenol			U	ND	ug/L					
2-Methylnaphthalene			U	ND	ug/L					
2-Nitrophenol			U	ND	ug/L					
3,3'-Dichlorobenzidine			U	ND	ug/L					
4-Bromophenylphenylether			U	ND	ug/L					
4-Chloro-3-methylphenol			U	ND	ug/L					

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
Semi-Volatile-GC/MS											
Batch 926148											
4-Chloroaniline			U	ND	ug/L						
4-Chlorophenylphenylether			U	ND	ug/L				AGS1	12/01/09	19:04
4-Nitrophenol			U	ND	ug/L						
Acenaphthene			U	ND	ug/L						
Acenaphthylene			U	ND	ug/L						
Anthracene			U	ND	ug/L						
Benzo(a)anthracene			U	ND	ug/L						
Benzo(a)pyrene			U	ND	ug/L						
Benzo(b)fluoranthene			U	ND	ug/L						
Benzo(ghi)perylene			U	ND	ug/L						
Benzo(k)fluoranthene			U	ND	ug/L						
Butylbenzylphthalate			U	ND	ug/L						
Carbazole			U	ND	ug/L						
Chrysene			U	ND	ug/L						
Di-n-butylphthalate			U	ND	ug/L						
Di-n-octylphthalate			U	ND	ug/L						
Dibenzo(a,h)anthracene			U	ND	ug/L						
Dibenzofuran			U	ND	ug/L						
Diethylphthalate			U	ND	ug/L						
Dimethylphthalate			U	ND	ug/L						
Diphenylamine			U	ND	ug/L						
Fluoranthene			U	ND	ug/L						
Fluorene			U	ND	ug/L						
Hexachlorobenzene			U	ND	ug/L						
Hexachlorobutadiene			U	ND	ug/L						
Hexachlorocyclopentadiene			U	ND	ug/L						
Hexachloroethane			U	ND	ug/L						
Indeno(1,2,3-cd)pyrene			U	ND	ug/L						
Isophorone			U	ND	ug/L						
N-Nitrosodipropylamine			U	ND	ug/L						
Naphthalene			U	ND	ug/L						
Nitrobenzene			U	ND	ug/L						
Pentachlorophenol			U	ND	ug/L						
Phenanthrene			U	ND	ug/L						
Phenol			U	ND	ug/L						
Pyrene			U	ND	ug/L						
bis(2-Chloroethoxy)methane			U	ND	ug/L						
bis(2-Chloroethyl) ether			U	ND	ug/L						
bis(2-Chloroisopropyl)ether			U	ND	ug/L						
bis(2-Ethylhexyl)phthalate			U	ND	ug/L						
m,p-Cresols			U	ND	ug/L						
			U	ND							

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Semi-Volatile-GC/MS										
Batch 926148										
m-Nitroaniline					ug/L					
o-Cresol			U	ND	ug/L				AGS1	12/01/09 19:04
o-Nitroaniline			U	ND	ug/L					
p-Nitroaniline			U	ND	ug/L					
**2,4,6-Tribromophenol	100			79.9	ug/L		79.9	(39%-115%)		
**2-Fluorobiphenyl	50.0			40.0	ug/L		80	(35%-100%)		
**2-Fluorophenol	100			43.8	ug/L		43.8	(25%-92%)		
**Nitrobenzene-d5	50.0			40.5	ug/L		80.9	(40%-112%)		
**Phenol-d5	100			26.9	ug/L		26.9	(15%-73%)		
**p-Terphenyl-d14	50.0			43.4	ug/L		86.7	(46%-130%)		
Batch 929021										
QC1201986736 LCS										
1,2,4-Trichlorobenzene	50.0			28.3	ug/L		56.7	(40%-91%)	JMB3	12/05/09 12:36
1,2-Dichlorobenzene	50.0			29.8	ug/L		59.5	(39%-91%)		
1,3-Dichlorobenzene	50.0			28.6	ug/L		57.2	(38%-88%)		
1,4-Dichlorobenzene	50.0			30.1	ug/L		60.3	(38%-88%)		
2,4,5-Trichlorophenol	50.0			35.2	ug/L		70.4	(50%-111%)		
2,4,6-Trichlorophenol	50.0			37.2	ug/L		74.5	(54%-111%)		
2,4-Dichlorophenol	50.0			31.3	ug/L		62.5	(52%-105%)		
2,4-Dimethylphenol	50.0			26.8	ug/L		53.7	(44%-100%)		
2,4-Dinitrophenol	50.0			50.7	ug/L		101	(33%-118%)		
2,4-Dinitrotoluene	50.0			36.6	ug/L		73.2	(55%-108%)		
2,6-Dinitrotoluene	50.0			36.2	ug/L		72.4	(58%-104%)		
2-Chloronaphthalene	50.0			30.7	ug/L		61.5	(46%-100%)		
2-Chlorophenol	50.0			31.5	ug/L		62.9	(49%-96%)		
2-Methyl-4,6-dinitrophenol	50.0			40.2	ug/L		80.4	(39%-124%)		
2-Methylnaphthalene	50.0			28.7	ug/L		57.3	(42%-97%)		
2-Nitrophenol	50.0			30.2	ug/L		60.4	(52%-104%)		
3,3'-Dichlorobenzidine	50.0			39.3	ug/L		78.5	(41%-107%)		
4-Bromophenylphenylether	50.0			40.6	ug/L		81.3	(56%-108%)		
4-Chloro-3-methylphenol	50.0			34.1	ug/L		68.2	(55%-109%)		
4-Chloroaniline	50.0			36.3	ug/L		72.6	(57%-145%)		
4-Chlorophenylphenylether	50.0			40.3	ug/L		80.6	(57%-106%)		
4-Nitrophenol	50.0			17.1	ug/L		34.2	(19%-56%)		
Acenaphthene	50.0			36.5	ug/L		73	(47%-101%)		
Acenaphthylene	50.0			34.7	ug/L		69.4	(58%-99%)		
Anthracene	50.0			33.6	ug/L		67.3	(55%-106%)		
Benzo(a)anthracene	50.0			34.6	ug/L		69.1	(56%-105%)		
Benzo(a)pyrene	50.0			37.7	ug/L		75.4	(58%-111%)		
Benzo(b)fluoranthene	50.0			35.4	ug/L		70.8	(53%-114%)		
Benzo(ghi)perylene	50.0			45.2	ug/L		90.3	(41%-125%)		
Benzo(k)fluoranthene	50.0			37.2	ug/L		74.3	(55%-116%)		

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Semi-Volatile-GC/MS										
Batch 929021										
Butylbenzylphthalate	50.0			40.3	ug/L		80.6	(55%-122%)		
Carbazole	50.0			36.0	ug/L		72	(52%-124%)	JMB3	12/05/09 12:36
Chrysene	50.0			35.2	ug/L		70.3	(56%-105%)		
Di-n-butylphthalate	50.0			36.5	ug/L		72.9	(58%-119%)		
Di-n-octylphthalate	50.0			34.1	ug/L		68.1	(41%-136%)		
Dibenzo(a,h)anthracene	50.0			44.8	ug/L		89.7	(44%-126%)		
Dibenzofuran	50.0			39.5	ug/L		78.9	(54%-108%)		
Diethylphthalate	50.0			39.9	ug/L		79.8	(60%-112%)		
Dimethylphthalate	50.0			38.7	ug/L		77.3	(59%-107%)		
Diphenylamine	50.0			35.4	ug/L		70.8	(55%-113%)		
Fluoranthene	50.0			33.7	ug/L		67.4	(57%-114%)		
Fluorene	50.0			29.3	ug/L		58.6	(52%-106%)		
Hexachlorobenzene	50.0			33.6	ug/L		67.2	(53%-115%)		
Hexachlorobutadiene	50.0			22.3	ug/L		44.5	(33%-98%)		
Hexachlorocyclopentadiene	50.0			32.6	ug/L		65.3	(10%-128%)		
Hexachloroethane	50.0			27.1	ug/L		54.3	(35%-92%)		
Indeno(1,2,3-cd)pyrene	50.0			45.0	ug/L		89.9	(45%-124%)		
Isophorone	50.0			36.9	ug/L		73.7	(52%-113%)		
N-Nitrosodipropylamine	50.0			31.8	ug/L		63.7	(44%-118%)		
Naphthalene	50.0			28.6	ug/L		57.2	(40%-93%)		
Nitrobenzene	50.0			33.9	ug/L		67.8	(48%-112%)		
Pentachlorophenol	50.0			37.4	ug/L		74.8	(44%-121%)		
Phenanthrene	50.0			31.1	ug/L		62.2	(54%-105%)		
Phenol	50.0			13.1	ug/L		26.1	(21%-45%)		
Pyrene	50.0			33.9	ug/L		67.8	(49%-115%)		
bis(2-Chloroethoxy)methane	50.0			31.4	ug/L		62.9	(54%-107%)		
bis(2-Chloroethyl) ether	50.0			33.4	ug/L		66.8	(46%-106%)		
bis(2-Chloroisopropyl)ether	50.0			37.2	ug/L		74.5	(44%-115%)		
bis(2-Ethylhexyl)phthalate	50.0			37.6	ug/L		75.1	(55%-124%)		
m,p-Cresols	50.0			25.9	ug/L		51.9	(38%-96%)		
m-Nitroaniline	50.0			34.6	ug/L		69.3	(58%-125%)		
o-Cresol	50.0			27.9	ug/L		55.7	(41%-94%)		
o-Nitroaniline	50.0			33.9	ug/L		67.7	(50%-120%)		
p-Nitroaniline	50.0			38.7	ug/L		77.4	(48%-135%)		
**2,4,6-Tribromophenol	100			79.0	ug/L		79	(39%-115%)		
**2-Fluorobiphenyl	50.0			43.0	ug/L		86.1	(35%-100%)		
**2-Fluorophenol	100			43.2	ug/L		43.2	(25%-92%)		
**Nitrobenzene-d5	50.0			37.5	ug/L		75	(40%-112%)		
**Phenol-d5	100			26.1	ug/L		26.1	(15%-73%)		
**p-Terphenyl-d14	50.0			39.3	ug/L		78.6	(46%-130%)		
QC1201986737 LCSD										
1,2,4-Trichlorobenzene	50.0			30.4	ug/L	6.92	60.7	(0%-20%)		12/05/09 12:58

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Semi-Volatile-GC/MS										
Batch 929021										
1,2-Dichlorobenzene	50.0			31.8	ug/L	6.50	63.5	(0%-20%)		
1,3-Dichlorobenzene	50.0			30.5	ug/L	6.31	60.9	(0%-20%)	JMB3	12/05/09 12:58
1,4-Dichlorobenzene	50.0			31.8	ug/L	5.31	63.6	(0%-20%)		
2,4,5-Trichlorophenol	50.0			37.2	ug/L	5.49	74.3	(0%-20%)		
2,4,6-Trichlorophenol	50.0			38.6	ug/L	3.49	77.1	(0%-20%)		
2,4-Dichlorophenol	50.0			33.9	ug/L	8.28	67.9	(0%-20%)		
2,4-Dimethylphenol	50.0			29.2	ug/L	8.32	58.4	(0%-20%)		
2,4-Dinitrophenol	50.0			56.6	ug/L	10.9	113	(0%-20%)		
2,4-Dinitrotoluene	50.0			39.0	ug/L	6.32	78	(0%-20%)		
2,6-Dinitrotoluene	50.0			39.0	ug/L	7.44	78	(0%-20%)		
2-Chloronaphthalene	50.0			32.5	ug/L	5.43	64.9	(0%-20%)		
2-Chlorophenol	50.0			34.2	ug/L	8.21	68.3	(0%-20%)		
2-Methyl-4,6-dinitrophenol	50.0			44.0	ug/L	9.04	88	(0%-20%)		
2-Methylnaphthalene	50.0			31.0	ug/L	7.76	62	(0%-20%)		
2-Nitrophenol	50.0			35.6	ug/L	16.2	71.1	(0%-20%)		
3,3'-Dichlorobenzidine	50.0			41.5	ug/L	5.49	83	(0%-20%)		
4-Bromophenylphenylether	50.0			42.4	ug/L	4.29	84.9	(0%-20%)		
4-Chloro-3-methylphenol	50.0			35.9	ug/L	5.21	71.9	(0%-20%)		
4-Chloroaniline	50.0			40.4	ug/L	10.6	80.8	(0%-20%)		
4-Chlorophenylphenylether	50.0			42.1	ug/L	4.30	84.1	(0%-20%)		
4-Nitrophenol	50.0			19.3	ug/L	12.4	38.7	(0%-20%)		
Acenaphthene	50.0			37.9	ug/L	3.68	75.7	(0%-20%)		
Acenaphthylene	50.0			35.8	ug/L	3.08	71.6	(0%-20%)		
Anthracene	50.0			33.6	ug/L	0.257	67.1	(0%-20%)		
Benzo(a)anthracene	50.0			35.0	ug/L	1.39	70.1	(0%-20%)		
Benzo(a)pyrene	50.0			38.5	ug/L	2.24	77.1	(0%-20%)		
Benzo(b)fluoranthene	50.0			37.2	ug/L	4.97	74.4	(0%-20%)		
Benzo(ghi)perylene	50.0			45.4	ug/L	0.443	90.7	(0%-20%)		
Benzo(k)fluoranthene	50.0			36.4	ug/L	2.09	72.8	(0%-20%)		
Butylbenzylphthalate	50.0			40.7	ug/L	0.898	81.3	(0%-20%)		
Carbazole	50.0			41.5	ug/L	14.2	83	(0%-20%)		
Chrysene	50.0			37.2	ug/L	5.54	74.3	(0%-20%)		
Di-n-butylphthalate	50.0			37.4	ug/L	2.49	74.8	(0%-20%)		
Di-n-octylphthalate	50.0			33.9	ug/L	0.339	67.9	(0%-20%)		
Dibenzo(a,h)anthracene	50.0			45.8	ug/L	2.17	91.6	(0%-20%)		
Dibenzofuran	50.0			40.8	ug/L	3.31	81.6	(0%-20%)		
Diethylphthalate	50.0			41.3	ug/L	3.44	82.6	(0%-20%)		
Dimethylphthalate	50.0			40.5	ug/L	4.53	80.9	(0%-20%)		
Diphenylamine	50.0			37.6	ug/L	6.00	75.2	(0%-20%)		
Fluoranthene	50.0			35.3	ug/L	4.55	70.5	(0%-20%)		
Fluorene	50.0			30.1	ug/L	2.65	60.2	(0%-20%)		
				34.2						

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Semi-Volatile-GC/MS										
Batch 929021										
Hexachlorobenzene	50.0				ug/L	1.64	68.3	(0%-20%)		
Hexachlorobutadiene	50.0			25.1	ug/L	12.1	50.3	(0%-20%)	JMB3	12/05/09 12:58
Hexachlorocyclopentadiene	50.0			38.9	ug/L	17.5	77.8	(0%-20%)		
Hexachloroethane	50.0			29.2	ug/L	7.16	58.3	(0%-20%)		
Indeno(1,2,3-cd)pyrene	50.0			45.4	ug/L	0.994	90.8	(0%-20%)		
Isophorone	50.0			39.7	ug/L	7.42	79.4	(0%-20%)		
N-Nitrosodipropylamine	50.0			33.7	ug/L	5.82	67.5	(0%-20%)		
Naphthalene	50.0			30.5	ug/L	6.45	61	(0%-20%)		
Nitrobenzene	50.0			37.2	ug/L	9.41	74.4	(0%-20%)		
Pentachlorophenol	50.0			40.1	ug/L	6.91	80.1	(0%-20%)		
Phenanthrene	50.0			33.5	ug/L	7.60	67.1	(0%-20%)		
Phenol	50.0			14.3	ug/L	8.82	28.6	(0%-20%)		
Pyrene	50.0			35.1	ug/L	3.52	70.2	(0%-20%)		
bis(2-Chloroethoxy)methane	50.0			34.7	ug/L	9.81	69.3	(0%-20%)		
bis(2-Chloroethyl) ether	50.0			36.6	ug/L	9.08	73.2	(0%-20%)		
bis(2-Chloroisopropyl)ether	50.0			39.5	ug/L	5.93	79	(0%-20%)		
bis(2-Ethylhexyl)phthalate	50.0			37.7	ug/L	0.432	75.4	(0%-20%)		
m,p-Cresols	50.0			29.6	ug/L	13.4	59.3	(0%-20%)		
m-Nitroaniline	50.0			40.3	ug/L	15.2	80.7	(0%-20%)		
o-Cresol	50.0			30.6	ug/L	9.46	61.3	(0%-20%)		
o-Nitroaniline	50.0			36.4	ug/L	7.19	72.8	(0%-20%)		
p-Nitroaniline	50.0			44.5	ug/L	14.0	89.1	(0%-20%)		
**2,4,6-Tribromophenol	100			80.6	ug/L		80.6	(39%-115%)		
**2-Fluorobiphenyl	50.0			44.4	ug/L		88.8	(35%-100%)		
**2-Fluorophenol	100			46.0	ug/L		46	(25%-92%)		
**Nitrobenzene-d5	50.0			40.8	ug/L		81.6	(40%-112%)		
**Phenol-d5	100			28.1	ug/L		28.1	(15%-73%)		
**p-Terphenyl-d14	50.0			40.1	ug/L		80.2	(46%-130%)		
QC1201986735 MB										
1,2,4-Trichlorobenzene			U	ND	ug/L					12/05/09 12:15
1,2-Dichlorobenzene			U	ND	ug/L					
1,3-Dichlorobenzene			U	ND	ug/L					
1,4-Dichlorobenzene			U	ND	ug/L					
2,4,5-Trichlorophenol			U	ND	ug/L					
2,4,6-Trichlorophenol			U	ND	ug/L					
2,4-Dichlorophenol			U	ND	ug/L					
2,4-Dimethylphenol			U	ND	ug/L					
2,4-Dinitrophenol			U	ND	ug/L					
2,4-Dinitrotoluene			U	ND	ug/L					
2,6-Dinitrotoluene			U	ND	ug/L					
2-Chloronaphthalene			U	ND	ug/L					
2-Chlorophenol			U	ND	ug/L					

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
Semi-Volatile-GC/MS											
Batch 929021											
2-Methyl-4,6-dinitrophenol			U	ND	ug/L						
2-Methylnaphthalene			U	ND	ug/L				JMB3	12/05/09	12:15
2-Nitrophenol			U	ND	ug/L						
3,3'-Dichlorobenzidine			U	ND	ug/L						
4-Bromophenylphenylether			U	ND	ug/L						
4-Chloro-3-methylphenol			U	ND	ug/L						
4-Chloroaniline			U	ND	ug/L						
4-Chlorophenylphenylether			U	ND	ug/L						
4-Nitrophenol			U	ND	ug/L						
Acenaphthene			U	ND	ug/L						
Acenaphthylene			U	ND	ug/L						
Anthracene			U	ND	ug/L						
Benzo(a)anthracene			U	ND	ug/L						
Benzo(a)pyrene			U	ND	ug/L						
Benzo(b)fluoranthene			U	ND	ug/L						
Benzo(ghi)perylene			U	ND	ug/L						
Benzo(k)fluoranthene			U	ND	ug/L						
Butylbenzylphthalate			U	ND	ug/L						
Carbazole			U	ND	ug/L						
Chrysene			U	ND	ug/L						
Di-n-butylphthalate			U	ND	ug/L						
Di-n-octylphthalate			U	ND	ug/L						
Dibenzo(a,h)anthracene			U	ND	ug/L						
Dibenzofuran			U	ND	ug/L						
Diethylphthalate			U	ND	ug/L						
Dimethylphthalate			U	ND	ug/L						
Diphenylamine			U	ND	ug/L						
Fluoranthene			U	ND	ug/L						
Fluorene			U	ND	ug/L						
Hexachlorobenzene			U	ND	ug/L						
Hexachlorobutadiene			U	ND	ug/L						
Hexachlorocyclopentadiene			U	ND	ug/L						
Hexachloroethane			U	ND	ug/L						
Indeno(1,2,3-cd)pyrene			U	ND	ug/L						
Isophorone			U	ND	ug/L						
N-Nitrosodipropylamine			U	ND	ug/L						
Naphthalene			U	ND	ug/L						
Nitrobenzene			U	ND	ug/L						
Pentachlorophenol			U	ND	ug/L						
Phenanthrene			U	ND	ug/L						
Phenol			U	ND	ug/L						
			U	ND							

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Semi-Volatile-GC/MS										
Batch 929021										
Pyrene					ug/L					
bis(2-Chloroethoxy)methane			U	ND	ug/L				JMB3	12/05/09 12:15
bis(2-Chloroethyl) ether			U	ND	ug/L					
bis(2-Chloroisopropyl)ether			U	ND	ug/L					
bis(2-Ethylhexyl)phthalate			U	ND	ug/L					
m,p-Cresols			U	ND	ug/L					
m-Nitroaniline			U	ND	ug/L					
o-Cresol			U	ND	ug/L					
o-Nitroaniline			U	ND	ug/L					
p-Nitroaniline			U	ND	ug/L					
**2,4,6-Tribromophenol	100			71.7	ug/L		71.7	(39%-115%)		
**2-Fluorobiphenyl	50.0			41.3	ug/L		82.7	(35%-100%)		
**2-Fluorophenol	100			41.9	ug/L		41.9	(25%-92%)		
**Nitrobenzene-d5	50.0			36.0	ug/L		72	(40%-112%)		
**Phenol-d5	100			25.4	ug/L		25.4	(15%-73%)		
**p-Terphenyl-d14	50.0			40.3	ug/L		80.6	(46%-130%)		
Batch 932173										
QC1201993984 LCS										
1,2,4-Trichlorobenzene	50.0			32.6	ug/L		65.2	(40%-91%)	AMY	12/15/09 12:23
1,2-Dichlorobenzene	50.0			31.0	ug/L		61.9	(39%-91%)		
1,3-Dichlorobenzene	50.0			29.2	ug/L		58.4	(38%-88%)		
1,4-Dichlorobenzene	50.0			29.5	ug/L		59.1	(38%-88%)		
2,4,5-Trichlorophenol	50.0			46.8	ug/L		93.5	(50%-111%)		
2,4,6-Trichlorophenol	50.0			45.1	ug/L		90.2	(54%-111%)		
2,4-Dichlorophenol	50.0			38.3	ug/L		76.7	(52%-105%)		
2,4-Dimethylphenol	50.0			38.8	ug/L		77.5	(44%-100%)		
2,4-Dinitrophenol	50.0			35.8	ug/L		71.6	(33%-118%)		
2,4-Dinitrotoluene	50.0			37.3	ug/L		74.7	(55%-108%)		
2,6-Dinitrotoluene	50.0			37.9	ug/L		75.9	(58%-104%)		
2-Chloronaphthalene	50.0			34.2	ug/L		68.5	(46%-100%)		
2-Chlorophenol	50.0			35.9	ug/L		71.8	(49%-96%)		
2-Methyl-4,6-dinitrophenol	50.0			34.8	ug/L		69.5	(39%-124%)		
2-Methylnaphthalene	50.0			34.8	ug/L		69.6	(42%-97%)		
2-Nitrophenol	50.0			37.7	ug/L		75.3	(52%-104%)		
3,3'-Dichlorobenzidine	50.0			39.8	ug/L		79.7	(41%-107%)		
4-Bromophenylphenylether	50.0			48.7	ug/L		97.4	(56%-108%)		
4-Chloro-3-methylphenol	50.0			41.3	ug/L		82.6	(55%-109%)		
4-Chloroaniline	50.0			42.0	ug/L		84	(57%-145%)		
4-Chlorophenylphenylether	50.0			43.2	ug/L		86.5	(57%-106%)		
4-Nitrophenol	50.0			15.6	ug/L		31.2	(19%-56%)		
Acenaphthene	50.0			38.3	ug/L		76.6	(47%-101%)		
Acenaphthylene	50.0			39.8	ug/L		79.6	(58%-99%)		

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Semi-Volatile-GC/MS										
Batch 932173										
Anthracene	50.0			39.3	ug/L		78.6	(55%-106%)		
Benzo(a)anthracene	50.0			40.5	ug/L		81.1	(56%-105%)	AMY	12/15/09 12:23
Benzo(a)pyrene	50.0			42.3	ug/L		84.5	(58%-111%)		
Benzo(b)fluoranthene	50.0			41.3	ug/L		82.5	(53%-114%)		
Benzo(ghi)perylene	50.0			33.2	ug/L		66.5	(41%-125%)		
Benzo(k)fluoranthene	50.0			47.3	ug/L		94.6	(55%-116%)		
Butylbenzylphthalate	50.0			48.5	ug/L		97	(55%-122%)		
Carbazole	50.0			38.3	ug/L		76.6	(52%-124%)		
Chrysene	50.0			41.7	ug/L		83.4	(56%-105%)		
Di-n-butylphthalate	50.0			48.4	ug/L		96.9	(58%-119%)		
Di-n-octylphthalate	50.0			49.6	ug/L		99.2	(41%-136%)		
Dibenzo(a,h)anthracene	50.0			33.3	ug/L		66.5	(44%-126%)		
Dibenzofuran	50.0			47.0	ug/L		93.9	(54%-108%)		
Diethylphthalate	50.0			46.7	ug/L		93.4	(60%-112%)		
Dimethylphthalate	50.0			43.2	ug/L		86.3	(59%-107%)		
Diphenylamine	50.0			41.2	ug/L		82.4	(55%-113%)		
Fluoranthene	50.0			43.7	ug/L		87.5	(57%-114%)		
Fluorene	50.0			39.4	ug/L		78.8	(52%-106%)		
Hexachlorobenzene	50.0			44.1	ug/L		88.2	(53%-115%)		
Hexachlorobutadiene	50.0			32.5	ug/L		65.1	(33%-98%)		
Hexachlorocyclopentadiene	50.0			42.1	ug/L		84.2	(10%-128%)		
Hexachloroethane	50.0			29.3	ug/L		58.5	(35%-92%)		
Indeno(1,2,3-cd)pyrene	50.0			33.0	ug/L		66	(45%-124%)		
Isophorone	50.0			47.5	ug/L		95.1	(52%-113%)		
N-Nitrosodipropylamine	50.0			38.6	ug/L		77.2	(44%-118%)		
Naphthalene	50.0			34.3	ug/L		68.6	(40%-93%)		
Nitrobenzene	50.0			43.8	ug/L		87.6	(48%-112%)		
Pentachlorophenol	50.0			43.6	ug/L		87.2	(44%-121%)		
Phenanthrene	50.0			39.4	ug/L		78.7	(54%-105%)		
Phenol	50.0			16.5	ug/L		33	(21%-45%)		
Pyrene	50.0			45.5	ug/L		90.9	(49%-115%)		
bis(2-Chloroethoxy)methane	50.0			40.7	ug/L		81.5	(54%-107%)		
bis(2-Chloroethyl) ether	50.0			39.7	ug/L		79.5	(46%-106%)		
bis(2-Chloroisopropyl)ether	50.0			38.1	ug/L		76.1	(44%-115%)		
bis(2-Ethylhexyl)phthalate	50.0			44.3	ug/L		88.5	(55%-124%)		
m,p-Cresols	50.0			33.2	ug/L		66.3	(38%-96%)		
m-Nitroaniline	50.0			36.4	ug/L		72.8	(58%-125%)		
o-Cresol	50.0			35.3	ug/L		70.6	(41%-94%)		
o-Nitroaniline	50.0			39.8	ug/L		79.5	(50%-120%)		
p-Nitroaniline	50.0			33.5	ug/L		67	(48%-135%)		
**2,4,6-Tribromophenol	100			104	ug/L		104	(39%-115%)		
				46.2						

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Semi-Volatile-GC/MS										
Batch 932173										
**2-Fluorobiphenyl	50.0				ug/L		92.3	(35%-100%)		
**2-Fluorophenol	100			51.0	ug/L		51	(25%-92%)	AMY	12/15/09 12:23
**Nitrobenzene-d5	50.0			44.8	ug/L		89.6	(40%-112%)		
**Phenol-d5	100			32.3	ug/L		32.3	(15%-73%)		
**p-Terphenyl-d14	50.0			52.6	ug/L		105	(46%-130%)		
QC1201993992 LCSD										
1,2,4-Trichlorobenzene	50.0			32.9	ug/L	0.888	65.8	(0%-20%)		12/15/09 12:47
1,2-Dichlorobenzene	50.0			31.7	ug/L	2.21	63.3	(0%-20%)		
1,3-Dichlorobenzene	50.0			29.7	ug/L	1.55	59.3	(0%-20%)		
1,4-Dichlorobenzene	50.0			30.1	ug/L	1.91	60.2	(0%-20%)		
2,4,5-Trichlorophenol	50.0			49.3	ug/L	5.19	98.5	(0%-20%)		
2,4,6-Trichlorophenol	50.0			46.6	ug/L	3.19	93.2	(0%-20%)		
2,4-Dichlorophenol	50.0			39.7	ug/L	3.58	79.5	(0%-20%)		
2,4-Dimethylphenol	50.0			40.1	ug/L	3.46	80.3	(0%-20%)		
2,4-Dinitrophenol	50.0			40.8	ug/L	13.1	81.6	(0%-20%)		
2,4-Dinitrotoluene	50.0			39.5	ug/L	5.63	79	(0%-20%)		
2,6-Dinitrotoluene	50.0			40.1	ug/L	5.63	80.3	(0%-20%)		
2-Chloronaphthalene	50.0			34.6	ug/L	1.05	69.2	(0%-20%)		
2-Chlorophenol	50.0			36.3	ug/L	1.06	72.5	(0%-20%)		
2-Methyl-4,6-dinitrophenol	50.0			38.2	ug/L	9.41	76.4	(0%-20%)		
2-Methylnaphthalene	50.0			35.2	ug/L	1.16	70.5	(0%-20%)		
2-Nitrophenol	50.0			38.6	ug/L	2.42	77.1	(0%-20%)		
3,3'-Dichlorobenzidine	50.0			38.8	ug/L	2.73	77.5	(0%-20%)		
4-Bromophenylphenylether	50.0			49.4	ug/L	1.38	98.8	(0%-20%)		
4-Chloro-3-methylphenol	50.0			42.3	ug/L	2.46	84.6	(0%-20%)		
4-Chloroaniline	50.0			43.3	ug/L	3.00	86.6	(0%-20%)		
4-Chlorophenylphenylether	50.0			44.2	ug/L	2.27	88.4	(0%-20%)		
4-Nitrophenol	50.0			16.8	ug/L	7.84	33.7	(0%-20%)		
Acenaphthene	50.0			38.8	ug/L	1.27	77.6	(0%-20%)		
Acenaphthylene	50.0			40.4	ug/L	1.46	80.8	(0%-20%)		
Anthracene	50.0			40.8	ug/L	3.84	81.7	(0%-20%)		
Benzo(a)anthracene	50.0			41.8	ug/L	3.09	83.6	(0%-20%)		
Benzo(a)pyrene	50.0			44.9	ug/L	6.05	89.8	(0%-20%)		
Benzo(b)fluoranthene	50.0			42.6	ug/L	3.20	85.2	(0%-20%)		
Benzo(ghi)perylene	50.0			33.8	ug/L	1.55	67.5	(0%-20%)		
Benzo(k)fluoranthene	50.0			50.4	ug/L	6.30	101	(0%-20%)		
Butylbenzylphthalate	50.0			48.8	ug/L	0.697	97.7	(0%-20%)		
Carbazole	50.0			38.8	ug/L	1.21	77.5	(0%-20%)		
Chrysene	50.0			44.1	ug/L	5.47	88.1	(0%-20%)		
Di-n-butylphthalate	50.0			48.5	ug/L	0.166	97	(0%-20%)		
Di-n-octylphthalate	50.0			51.1	ug/L	3.05	102	(0%-20%)		
Dibenzo(a,h)anthracene	50.0			34.5	ug/L	3.59	69	(0%-20%)		

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Semi-Volatile-GC/MS										
Batch 932173										
Dibenzofuran	50.0			48.1	ug/L	2.46	96.3	(0%-20%)		
Diethylphthalate	50.0			49.1	ug/L	4.91	98.1	(0%-20%)	AMY	12/15/09 12:47
Dimethylphthalate	50.0			45.2	ug/L	4.56	90.4	(0%-20%)		
Diphenylamine	50.0			42.0	ug/L	1.86	84	(0%-20%)		
Fluoranthene	50.0			45.2	ug/L	3.21	90.3	(0%-20%)		
Fluorene	50.0			40.8	ug/L	3.48	81.6	(0%-20%)		
Hexachlorobenzene	50.0			44.3	ug/L	0.393	88.6	(0%-20%)		
Hexachlorobutadiene	50.0			33.4	ug/L	2.62	66.8	(0%-20%)		
Hexachlorocyclopentadiene	50.0			44.4	ug/L	5.18	88.7	(0%-20%)		
Hexachloroethane	50.0			30.3	ug/L	3.51	60.6	(0%-20%)		
Indeno(1,2,3-cd)pyrene	50.0			34.4	ug/L	4.17	68.8	(0%-20%)		
Isophorone	50.0			48.6	ug/L	2.18	97.2	(0%-20%)		
N-Nitrosodipropylamine	50.0			39.6	ug/L	2.68	79.3	(0%-20%)		
Naphthalene	50.0			34.7	ug/L	1.00	69.3	(0%-20%)		
Nitrobenzene	50.0			44.2	ug/L	0.891	88.4	(0%-20%)		
Pentachlorophenol	50.0			46.0	ug/L	5.45	92	(0%-20%)		
Phenanthrene	50.0			40.9	ug/L	3.82	81.8	(0%-20%)		
Phenol	50.0			16.6	ug/L	0.530	33.2	(0%-20%)		
Pyrene	50.0			47.6	ug/L	4.66	95.3	(0%-20%)		
bis(2-Chloroethoxy)methane	50.0			41.8	ug/L	2.48	83.5	(0%-20%)		
bis(2-Chloroethyl) ether	50.0			40.6	ug/L	2.15	81.2	(0%-20%)		
bis(2-Chloroisopropyl)ether	50.0			38.6	ug/L	1.48	77.3	(0%-20%)		
bis(2-Ethylhexyl)phthalate	50.0			44.0	ug/L	0.548	88.1	(0%-20%)		
m,p-Cresols	50.0			33.2	ug/L	0.0564	66.3	(0%-20%)		
m-Nitroaniline	50.0			39.7	ug/L	8.65	79.4	(0%-20%)		
o-Cresol	50.0			34.5	ug/L	2.16	69.1	(0%-20%)		
o-Nitroaniline	50.0			42.0	ug/L	5.54	84.1	(0%-20%)		
p-Nitroaniline	50.0			36.5	ug/L	8.71	73.1	(0%-20%)		
**2,4,6-Tribromophenol	100			107	ug/L		107	(39%-115%)		
**2-Fluorobiphenyl	50.0			46.6	ug/L		93.3	(35%-100%)		
**2-Fluorophenol	100			51.2	ug/L		51.2	(25%-92%)		
**Nitrobenzene-d5	50.0			45.6	ug/L		91.1	(40%-112%)		
**Phenol-d5	100			32.3	ug/L		32.3	(15%-73%)		
**p-Terphenyl-d14	50.0			53.7	ug/L		107	(46%-130%)		
QC1201993983 MB										
1,2,4-Trichlorobenzene			U	ND	ug/L					12/15/09 12:00
1,2-Dichlorobenzene			U	ND	ug/L					
1,3-Dichlorobenzene			U	ND	ug/L					
1,4-Dichlorobenzene			U	ND	ug/L					
2,4,5-Trichlorophenol			U	ND	ug/L					
2,4,6-Trichlorophenol			U	ND	ug/L					
2,4-Dichlorophenol			U	ND	ug/L					

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
Semi-Volatile-GC/MS											
Batch 932173											
2,4-Dimethylphenol			U	ND	ug/L						
2,4-Dinitrophenol			U	ND	ug/L				AMY	12/15/09	12:00
2,4-Dinitrotoluene			U	ND	ug/L						
2,6-Dinitrotoluene			U	ND	ug/L						
2-Chloronaphthalene			U	ND	ug/L						
2-Chlorophenol			U	ND	ug/L						
2-Methyl-4,6-dinitrophenol			U	ND	ug/L						
2-Methylnaphthalene			U	ND	ug/L						
2-Nitrophenol			U	ND	ug/L						
3,3'-Dichlorobenzidine			U	ND	ug/L						
4-Bromophenylphenylether			U	ND	ug/L						
4-Chloro-3-methylphenol			U	ND	ug/L						
4-Chloroaniline			U	ND	ug/L						
4-Chlorophenylphenylether			U	ND	ug/L						
4-Nitrophenol			U	ND	ug/L						
Acenaphthene			U	ND	ug/L						
Acenaphthylene			U	ND	ug/L						
Anthracene			U	ND	ug/L						
Benzo(a)anthracene			U	ND	ug/L						
Benzo(a)pyrene			U	ND	ug/L						
Benzo(b)fluoranthene			U	ND	ug/L						
Benzo(ghi)perylene			U	ND	ug/L						
Benzo(k)fluoranthene			U	ND	ug/L						
Butylbenzylphthalate			U	ND	ug/L						
Carbazole			U	ND	ug/L						
Chrysene			U	ND	ug/L						
Di-n-butylphthalate			U	ND	ug/L						
Di-n-octylphthalate			U	ND	ug/L						
Dibenzo(a,h)anthracene			U	ND	ug/L						
Dibenzofuran			U	ND	ug/L						
Diethylphthalate			U	ND	ug/L						
Dimethylphthalate			U	ND	ug/L						
Diphenylamine			U	ND	ug/L						
Fluoranthene			U	ND	ug/L						
Fluorene			U	ND	ug/L						
Hexachlorobenzene			U	ND	ug/L						
Hexachlorobutadiene			U	ND	ug/L						
Hexachlorocyclopentadiene			U	ND	ug/L						
Hexachloroethane			U	ND	ug/L						
Indeno(1,2,3-cd)pyrene			U	ND	ug/L						
Isophorone			U	ND	ug/L						
			U	ND							

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Semi-Volatile-GC/MS										
Batch 932173										
N-Nitrosodipropylamine					ug/L					
Naphthalene			U	ND	ug/L				AMY	12/15/09 12:00
Nitrobenzene			U	ND	ug/L					
Pentachlorophenol			U	ND	ug/L					
Phenanthrene			U	ND	ug/L					
Phenol			U	ND	ug/L					
Pyrene			U	ND	ug/L					
bis(2-Chloroethoxy)methane			U	ND	ug/L					
bis(2-Chloroethyl) ether			U	ND	ug/L					
bis(2-Chloroisopropyl)ether			U	ND	ug/L					
bis(2-Ethylhexyl)phthalate			U	ND	ug/L					
m,p-Cresols			U	ND	ug/L					
m-Nitroaniline			U	ND	ug/L					
o-Cresol			U	ND	ug/L					
o-Nitroaniline			U	ND	ug/L					
p-Nitroaniline			U	ND	ug/L					
**2,4,6-Tribromophenol	100			106	ug/L		106	(39%-115%)		
**2-Fluorobiphenyl	50.0			47.8	ug/L		95.6	(35%-100%)		
**2-Fluorophenol	100			58.0	ug/L		58	(25%-92%)		
**Nitrobenzene-d5	50.0			50.5	ug/L		101	(40%-112%)		
**Phenol-d5	100			39.9	ug/L		39.9	(15%-73%)		
**p-Terphenyl-d14	50.0			57.1	ug/L		114	(46%-130%)		

Notes:
RER is calculated at the 95% confidence level (2-sigma).
The Qualifiers in this report are defined as follows:

- * Recovery or %RPD not within acceptance limits and/or spike amount not compatible with the sample or the duplicate RPD's are not applicable where the concentration falls below the effective PQL.
- ** Indicates analyte is a surrogate compound.
- B The analyte was found in the blank above the effective MDL.
- H Analytical holding time was exceeded
- J Estimated value, the analyte concentration fell above the effective MDL and below the effective PQL
- P The response between the confirmation column and the primary column is >40%D
- U The analyte was analyzed for but not detected below this concentration. For Organic and Inorganic analytes the result is less than the effective MDL. For radiochemical analytes the result is less than the Decision Level
- X Presumptive evidence that the analyte is not present. Please see narrative for further infromation.
- Z The percent difference is greater than 70%.
- d The 2:1 depletion requirement was not met for this sample
- h Prep holding time exceeded

QC Summary

Workorder: 241350

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

Volume VIII

TAB 24

NOD: Mixed Waste Landfill Toluene Investigation Report August 2010

From: NMED/Bearzi
To: SNL/Wagner

Back of Tab 24

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

SARAH COTTRELL
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

September 28, 2010

rec-d
SEP 30 2010

Patty Wagner
Manager
U.S. Department of Energy
NNSA / Sandia Site Office
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Dr. Marianne C. Walck
Director
Nuclear Energy & Global Security Technologies
Sandia Corporation
P.O. Box 5800, MS 0701
Albuquerque, NM 87185-0701

cc: David Mille
John Cochra
Mike Mitchell

RE: NOTICE OF DISAPPROVAL
MIXED WASTE LANDFILL TOLUENE INVESTIGATION REPORT
AUGUST 2010
SANDIA NATIONAL LABORATORIES
EPA ID# NM5890110518, HWB-SNL-10-011

Dear Ms. Wagner and Dr. Walck:

The New Mexico Environment Department (NMED) has reviewed the *Mixed Waste Landfill Toluene Investigation Report* (Report) dated August 2010 with cover letter dated August 18, 2010. The Report was submitted by the U. S. Department of Energy (DOE) on behalf of itself and Sandia Corporation (collectively, the Permittees) regarding the Sandia National Laboratories Mixed Waste Landfill (MWL). The NMED finds the Report deficient, and thus issues this Notice of Disapproval.

Comments

1. Section 2.3.3.1, end of Page 2-12 – The last sentence on the page is incomplete. The Permittees must complete the sentence and also provide any other information that may be missing, if any.

2. Section 2.3.3.1 – This Section discusses results obtained from groundwater sampling conducted at the MWL in April 2010 related to the Purging/Sampling Study. The Permittees must provide the laboratory data sheets reporting the results for all

environmental samples, and all field and laboratory quality control samples associated with this sampling event related to the analysis of toluene.

The Permittees must address the deficiencies identified above in a written response to the NMED by **October 29, 2010**. If you have any questions, please contact Mr. William Moats of my staff at 505-222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
J. Cochran, SNL, MS-0719
J. Gould, SNL, MS-0184
File: SNL 2010 and Reading
SNL-10-011

Volume VIII

TAB 25

Response to September 28, 2010, NMED comments on the
Mixed Waste Landfill Toluene Investigation Report

From: SNL/Wagner
To: NMED/Bearzi

Back of Tab 25

Notes for Volume VIII, Tab 25:

The document included herein contains only the DOE/SNL response to comments received in the NMED Notice of Disapproval (NOD) dated September 28, 2010 (Justification Binder Volume 8, Tab 24). The "Mixed Waste Landfill Toluene Investigation Report, Revised October 2010," referenced in the response can be found in Justification Binder Volume VIII, Tab 23.

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

ENTERED

OCT 14 2010

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

RECEIVED
OCT 2010
NMED Hazardous Waste Bureau

James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive, Bldg. 1
Santa Fe, New Mexico 87505

Subject: Response to September 28, 2010, New Mexico Environment Department comments on the Mixed Waste Landfill (MWL) Toluene Investigation Report

Dear Mr. Bearzi:

On behalf of the Department of Energy/National Nuclear Security Administration (DOE/NNSA), and Sandia Corporation (Sandia), DOE/NNSA is submitting responses to the comments provided in your September 28, 2010 letter entitled, *"Notice of Disapproval: Mixed Waste Landfill Toluene Investigation Report, August 2010, Sandia National Laboratories,"* Environmental Protection Agency Identification Number NM5890110518, HWB-SNL-10-011. The report presents an evaluation of MWL and Sandia National Laboratories/New Mexico site wide groundwater monitoring toluene results. Results of the recent purging/sampling study conducted at all of the MWL groundwater monitoring wells, and other studies designed to determine the source(s) of the toluene detected in groundwater samples.

The comment responses and a revised version of the report are provided as enclosures. The revised report includes corrected pages and is being issued with *"Revised October 2010"* on the cover, along with a brief note added to the Executive Summary explaining the reason for the revision. The report is being distributed to all who received the August 2010 report.

Should you have any questions regarding this report, please feel free to contact me at (505) 845-6036, or John Gould of my staff at (505) 845-6089.

Sincerely,

Patty Wagner

Patty Wagner
Manager

Enclosures

cc w/enclosures:
W. Moats, NMED-HWB (Via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
T. Skibitski, NMED-OB, MS-1396
B. Birch, NMED-OB, MS-1396
Records Center, SNL/NM, Org. 06765, MS-0718
Zimmerman Library, UNM

cc w/o enclosures:
A. Blumberg, SNL/NM, Org. 11100, MS-0141
M. Walck, SNL/NM, Org. 06700, MS-0701
D. Miller, SNL/NM, Org. 06765, MS-0718
M. Mitchell, SNL/NM, Org. 06765, MS-0718
P. Puissant, SNL/NM, Org. 04133, MS-0729
J. Cochran, SNL/NM, Org. 06765, MS-0719
S. Saltzstein, SNL/NM, Org. 06702, MS-0701
B. Langkopf, SNL/NM, Org. 06765, MS-0718
C. Daniel, SNL/NM, Org. 06765, MS-0718
J. Estrada, SSO, MS-0184
J. Gould, SSO, MS-0184

AOP 95-45, 06

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **DOE/Sandia Responses to NMED's Comments in "Notice of Disapproval: Mixed Waste Landfill Toluene Investigation Report, August 2010"**

Document author: **Mike Mitchell, Department 06765**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 10/13/10

Marianne Walck, Director Date
Nuclear Energy & Global Security Technologies
Center 6700
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ 10-14-10

Ms. Patty Wagner, Manager Date
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Sandia National Laboratories
Albuquerque, New Mexico
October 2010

DOE/Sandia Responses to NMED's "Notice of Disapproval: Mixed Waste Landfill Toluene Investigation Report, August 2010"

INTRODUCTION

This document responds to the comments received in a letter from the New Mexico Environment Department (NMED) to the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia) dated September 28th, 2010 regarding the Mixed Waste Landfill (MWL) Toluene Investigation Report for Sandia National Laboratories (SNL). The letter is entitled "Notice of Disapproval: Mixed Waste Landfill Toluene Investigation Report, August 2010, Sandia National Laboratories", EPA ID NM5890110518, HWB-SNL-10-011.

The NMED letter contains two comments. This document provides the DOE/Sandia response for each of the comments.

This document lists each NMED comment, and DOE/Sandia's response to that comment. The NMED comment is listed in boldface, followed by the DOE/Sandia response, written in normal font under "Response".

The revised report, dated October 2010, is provided as a separate enclosure. It includes corrected pages along with a brief note added to the Executive Summary explaining the reason for the revision.

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.

Comments on the MWL Toluene Investigation Report

1. Section 2.3.3.1, end of Page 2-12 - The last sentence on the page is incomplete. The Permittees must complete the sentence and also provide any other information that may be missing, if any.

Response: The missing part of the last sentence at the end of page 2-12 is included in italics below. It was accidently truncated by a page break inserted for Table 2.3-3. There was no other missing information.

> Two toluene detections for samples from MWL-BW2 (0.310 and 0.570 µg/L), three for samples from MWL-MW8 (0.260 to 0.660 µg/L), two for TB samples (0.630 and 0.660 µg/L), and one for an EB sample (0.330 µg/L) were qualified with "U" as not *detected during data validation because of laboratory contamination identified in the laboratory method blank samples*.

During preparation of these comment responses a minor error in Table 2.4-2 (page 2-21) and Figure 2.4-5 (page 2-22) was also noted. The information in this table and figure summarizing field quality control (QC) blank sample results did not include the April 2010 MWL field QC blank samples. The corrected Table 2.4-2 is provided below in redline-strikeout format. This same information is repeated in the text box in the upper part of Figure 2.4-5. There were no changes to the corresponding text in the report.

Table 2.4-2
Summary of Toluene Results for Field QC Blank Samples

Field QC Blank Samples	Number of Detections	Number of Samples	% Detections	Number of DV-Qualified Detections	% Detections Including DV-Qualified Data	Concentration Range in µg/L
Equipment Blanks	19	~~269~~ 271	7%	~~8~~9	10%	0.194–10.6[a]
Field Blanks	6	~~122~~ 124	5%	5	9%	0.272–0.7
Trip Blanks	126	~~1453~~ 1463	9%	~~29~~31	11%	0.184–1.21
TOTAL	**151**	**~~1,844~~1,858**	—	**~~42~~45**	—	

[a]Two EB sample results exceeded 1 µg/L from CWL (5.16 µg/L, June 2008) and TA-V (10.6 µg/L, March 2005). All other EB results ~~≥~~≤ 0.882 µg/L.

CWL = Chemical Waste Landfill.
DV = Data Validation.
EB = Equipment blank.
µg/L = Microgram(s) per liter.
QC = Quality Control
TA = Technical Area.

A revised version of the report is provided as a separate enclosure that incorporates the changes noted above and a brief note added to the Executive Summary explaining the reason for the revision. This report is being issued with "Revised October 2010" on the cover and is being distributed to all who received the August 2010 report.

2. Section 2.3.3.1 - This Section discusses results obtained from groundwater sampling conducted at the MWL in April 2010 related to the Purging/Sampling Study. The Permittees must provide the laboratory data sheets reporting the results for all environmental samples, and all field and laboratory quality control samples associated with this sampling event related to the analysis of toluene.

Response: The laboratory data sheets (i.e., Certificates of Analysis) that contain the volatile organic compound (VOC) laboratory results for all environmental samples, field quality control samples (i.e., trip blanks [TB], field blanks [FB], and equipment blanks [EB]), and laboratory quality control samples for the April 2010 sampling event are provided as Attachment 1. The page numbering in the lower left corner of the data sheets reflects the page numbering in the final laboratory report; only requested data sheets are provided in Attachment 1.

Attachment 1

April 2010 MWL Groundwater Sampling Results

Laboratory Certificates of Analysis for VOC Samples

Attachment 1

April 2010 MWL Groundwater Sampling Results
Laboratory Certificates of Analysis for VOC Samples

<u>MWL Groundwater samples</u>:
MWL-BW2, MWL-MW4, and MWL-MW8

<u>MWL Field Quality Control Samples</u>:
MWL-FB2, MWL-EB2, and MWL-TB6 through 10

GC/MS Volatiles Sample and QC Summary Data

GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 − (843) 556−8171 − www.gel.com

Qualifier Definition Report
for

SNLS003 Sandia National Labs (691436)

Client SDG: 251783 GEL Work Order: 251783

The Qualifiers in this report are defined as follows:

* Recovery or %RPD not within acceptance limits and/or spike amount not compatible with the sample or the duplicate RPD's are not applicable where the concentration falls below the effective PQL.

** Indicates analyte is a surrogate compound.

B The analyte was found in the blank above the effective MDL.

J Estimated value, the analyte concentration fell above the effective MDL and below the effective PQL

U Analyzed for but undetected

U The analyte was analyzed for but not detected below this concentration. For Organic and Inorganic analytes the result is less than the effective MDL. For radiochemical analytes the result is less than the Decision Level

DL Indicates that sample is diluted.

RA Indicates that sample is re−analyzed without re−extraction.

RE Indicates that sample is re−extracted.

Review/Validation

GEL requires all analytical data to be verified by a qualified data reviewer. In addition, all CLP−like deliverables receive a third level review of the fractional data package.

The following data validator verified the information presented in this case narrative:

Signature: Erin Haubert **Name: Erin Haubert**

Date: 25 MAY 2010 **Title: Data Validator**

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Certificate of Analysis

Company : Sandia National Laboratories
Address : MS−0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088936−001
Sample ID: 251783014
Matrix: AQUEOUS
Collect Date: 19−APR−10 14:32
Receive Date: 28−APR−10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL−EB2
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1−Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 05/01/10	1224	980118	1
1,1,2,2−Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2−Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1−Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2−Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2−Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2−Butanone	U	ND	1.25	5.00	ug/L	1				
2−Hexanone	U	ND	1.25	5.00	ug/L	1				
4−Methyl−2−pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane		2.66	0.250	1.00	ug/L	1				
Bromoform		1.28	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform		1.47	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane		3.69	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	BJ	0.330	0.250	1.00	ug/L	1				
Trichloroethylene	J	0.350	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Certificate of Analysis

Company : Sandia National Laboratories
Address : MS−0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088936−001
Sample ID: 251783014

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE−AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2−Dichloroethane−d4	8260B TCL Liquid "As Received"	46.6 ug/L	50.0	93.2	(72%−132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	50.2 ug/L	50.0	100	(77%−123%)
Toluene−d8	8260B TCL Liquid "As Received"	50.3 ug/L	50.0	101	(76%−122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088937−001
Sample ID: 251783022
Matrix: AQUEOUS
Collect Date: 26−APR−10 14:37
Receive Date: 28−APR−10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL−TB7
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1−Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 05/01/10	1252	980118	1
1,1,2,2−Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2−Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1−Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2−Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2−Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2−Butanone	U	ND	1.25	5.00	ug/L	1				
2−Hexanone	U	ND	1.25	5.00	ug/L	1				
4−Methyl−2−pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	BJ	0.630	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Certificate of Analysis

Company : Sandia National Laboratories
Address : MS−0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088937−001
Sample ID: 251783022

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE−AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2−Dichloroethane−d4	8260B TCL Liquid "As Received"	45.4 ug/L	50.0	90.7	(72%−132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	48.7 ug/L	50.0	97.4	(77%−123%)
Toluene−d8	8260B TCL Liquid "As Received"	50.5 ug/L	50.0	101	(76%−122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088938−001
Sample ID: 251783023
Matrix: AQUEOUS
Collect Date: 27−APR−10 08:08
Receive Date: 28−APR−10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL−BW2
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1−Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 05/01/10	1319	980118	1
1,1,2,2−Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2−Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1−Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2−Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2−Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2−Butanone	U	ND	1.25	5.00	ug/L	1				
2−Hexanone	U	ND	1.25	5.00	ug/L	1				
4−Methyl−2−pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Certificate of Analysis

Company : Sandia National Laboratories
Address : MS−0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088938−001
Sample ID: 251783023

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE−AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2−Dichloroethane−d4	8260B TCL Liquid "As Received"	46.3 ug/L	50.0	92.6	(72%−132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	50.2 ug/L	50.0	100	(77%−123%)
Toluene−d8	8260B TCL Liquid "As Received"	50.2 ug/L	50.0	100	(76%−122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088939−001
Sample ID: 251783024
Matrix: AQUEOUS
Collect Date: 27−APR−10 08:32
Receive Date: 28−APR−10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003
Client Desc.: MWL−BW2
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1−Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 05/01/10	1347	980118	1
1,1,2,2−Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2−Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1−Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2−Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2−Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2−Butanone	U	ND	1.25	5.00	ug/L	1				
2−Hexanone	U	ND	1.25	5.00	ug/L	1				
4−Methyl−2−pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	BJ	0.310	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Certificate of Analysis

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088939−001
Sample ID: 251783024

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE−AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2−Dichloroethane−d4	8260B TCL Liquid "As Received"	41.0 ug/L	50.0	81.9	(72%−132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	42.5 ug/L	50.0	84.9	(77%−123%)
Toluene−d8	8260B TCL Liquid "As Received"	45.4 ug/L	50.0	90.9	(76%−122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088940−001
Sample ID: 251783025
Matrix: AQUEOUS
Collect Date: 27−APR−10 08:56
Receive Date: 28−APR−10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL−BW2
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1−Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 05/01/10	1414	980118	1
1,1,2,2−Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2−Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1−Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2−Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2−Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2−Butanone	U	ND	1.25	5.00	ug/L	1				
2−Hexanone	U	ND	1.25	5.00	ug/L	1				
4−Methyl−2−pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	BJ	0.570	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088940−001
Sample ID: 251783025

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE−AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2−Dichloroethane−d4	8260B TCL Liquid "As Received"	44.9 ug/L	50.0	89.7	(72%−132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	49.1 ug/L	50.0	98.2	(77%−123%)
Toluene−d8	8260B TCL Liquid "As Received"	49.6 ug/L	50.0	99.1	(76%−122%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088941−001
Sample ID: 251783026
Matrix: AQUEOUS
Collect Date: 27−APR−10 09:22
Receive Date: 28−APR−10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL−BW2
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1−Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 05/01/10	1441	980118	1
1,1,2,2−Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2−Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1−Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2−Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2−Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2−Butanone	U	ND	1.25	5.00	ug/L	1				
2−Hexanone	U	ND	1.25	5.00	ug/L	1				
4−Methyl−2−pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088941−001
Sample ID: 251783026

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE−AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2−Dichloroethane−d4	8260B TCL Liquid "As Received"	45.0 ug/L	50.0	89.9	(72%−132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	45.3 ug/L	50.0	90.6	(77%−123%)
Toluene−d8	8260B TCL Liquid "As Received"	49.1 ug/L	50.0	98.2	(76%−122%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088942−001
Sample ID: 251783027
Matrix: AQUEOUS
Collect Date: 27−APR−10 09:48
Receive Date: 28−APR−10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL−BW2
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1−Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 05/01/10	1509	980118	1
1,1,2,2−Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2−Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1−Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2−Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2−Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2−Butanone	U	ND	1.25	5.00	ug/L	1				
2−Hexanone	U	ND	1.25	5.00	ug/L	1				
4−Methyl−2−pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088942−001
Sample ID: 251783027

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE−AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2−Dichloroethane−d4	8260B TCL Liquid "As Received"	44.3 ug/L	50.0	88.5	(72%−132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	46.9 ug/L	50.0	93.9	(77%−123%)
Toluene−d8	8260B TCL Liquid "As Received"	48.9 ug/L	50.0	97.7	(76%−122%)

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088943−001
Sample ID: 251783035
Matrix: AQUEOUS
Collect Date: 27−APR−10 09:48
Receive Date: 28−APR−10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL−BW2
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1−Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 05/01/10	1537	980118	1
1,1,2,2−Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2−Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1−Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2−Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2−Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2−Butanone	U	ND	1.25	5.00	ug/L	1				
2−Hexanone	U	ND	1.25	5.00	ug/L	1				
4−Methyl−2−pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088943−001
Sample ID: 251783035

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE−AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2−Dichloroethane−d4	8260B TCL Liquid "As Received"	45.1 ug/L	50.0	90.2	(72%−132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	47.7 ug/L	50.0	95.4	(77%−123%)
Toluene−d8	8260B TCL Liquid "As Received"	49.3 ug/L	50.0	98.7	(76%−122%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088944−001
Sample ID: 251783043
Matrix: AQUEOUS
Collect Date: 27−APR−10 08:08
Receive Date: 28−APR−10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL−TB8
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1−Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 05/01/10	1604	980118	1
1,1,2,2−Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2−Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1−Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2−Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2−Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2−Butanone	U	ND	1.25	5.00	ug/L	1				
2−Hexanone	U	ND	1.25	5.00	ug/L	1				
4−Methyl−2−pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088944−001
Sample ID: 251783043

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE−AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2−Dichloroethane−d4	8260B TCL Liquid "As Received"	45.3 ug/L	50.0	90.5	(72%−132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	49.3 ug/L	50.0	98.5	(77%−123%)
Toluene−d8	8260B TCL Liquid "As Received"	50.4 ug/L	50.0	101	(76%−122%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088932−001
Sample ID: 251783002
Matrix: AQUEOUS
Collect Date: 26−APR−10 08:19
Receive Date: 27−APR−10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL−MW8
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1−Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 05/01/10	1033	980118	1
1,1,2,2−Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2−Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1−Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2−Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2−Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2−Butanone	U	ND	1.25	5.00	ug/L	1				
2−Hexanone	U	ND	1.25	5.00	ug/L	1				
4−Methyl−2−pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	BJ	0.260	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088932−001
Sample ID: 251783002

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE−AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2−Dichloroethane−d4	8260B TCL Liquid "As Received"	44.9 ug/L	50.0	89.8	(72%−132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	48.8 ug/L	50.0	97.7	(77%−123%)
Toluene−d8	8260B TCL Liquid "As Received"	49.2 ug/L	50.0	98.3	(76%−122%)

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088933−001
Sample ID: 251783003
Matrix: AQUEOUS
Collect Date: 26−APR−10 08:31
Receive Date: 27−APR−10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL−MW8
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1−Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 05/01/10	1100	980118	1
1,1,2,2−Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2−Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1−Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2−Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2−Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2−Butanone	U	ND	1.25	5.00	ug/L	1				
2−Hexanone	U	ND	1.25	5.00	ug/L	1				
4−Methyl−2−pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088933−001
Sample ID: 251783003

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE−AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2−Dichloroethane−d4	8260B TCL Liquid "As Received"	40.4 ug/L	50.0	80.9	(72%−132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	43.1 ug/L	50.0	86.1	(77%−123%)
Toluene−d8	8260B TCL Liquid "As Received"	45.4 ug/L	50.0	90.7	(76%−122%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088934−001
Sample ID: 251783004
Matrix: AQUEOUS
Collect Date: 26−APR−10 13:17
Receive Date: 27−APR−10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL−MW8
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1−Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 05/01/10	1128	980118	1
1,1,2,2−Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2−Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1−Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2−Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2−Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2−Butanone	U	ND	1.25	5.00	ug/L	1				
2−Hexanone	U	ND	1.25	5.00	ug/L	1				
4−Methyl−2−pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	BJ	0.260	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088934−001
Sample ID: 251783004

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE−AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2−Dichloroethane−d4	8260B TCL Liquid "As Received"	45.6 ug/L	50.0	91.2	(72%−132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	47.2 ug/L	50.0	94.3	(77%−123%)
Toluene−d8	8260B TCL Liquid "As Received"	49.9 ug/L	50.0	99.8	(76%−122%)

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088931−001
Sample ID: 251783001
Matrix: AQUEOUS
Collect Date: 26−APR−10 08:10
Receive Date: 27−APR−10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL−MW8
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1−Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 05/01/10	1005	980118	1
1,1,2,2−Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2−Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1−Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2−Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2−Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2−Butanone	U	ND	1.25	5.00	ug/L	1				
2−Hexanone	U	ND	1.25	5.00	ug/L	1				
4−Methyl−2−pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	BJ	0.600	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088931−001
Sample ID: 251783001

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE−AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2−Dichloroethane−d4	8260B TCL Liquid "As Received"	45.8 ug/L	50.0	91.7	(72%−132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	49.0 ug/L	50.0	98.0	(77%−123%)
Toluene−d8	8260B TCL Liquid "As Received"	49.6 ug/L	50.0	99.1	(76%−122%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088935−001
Sample ID: 251783013
Matrix: AQUEOUS
Collect Date: 26−APR−10 13:17
Receive Date: 27−APR−10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL−TB6
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1−Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXY1 05/01/10	1156	980118	1
1,1,2,2−Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2−Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1−Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2−Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2−Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2−Butanone	U	ND	1.25	5.00	ug/L	1				
2−Hexanone	U	ND	1.25	5.00	ug/L	1				
4−Methyl−2−pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	BJ	0.660	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans−1,2−Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans−1,3−Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088935−001
Sample ID: 251783013

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE−AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2−Dichloroethane−d4	8260B TCL Liquid "As Received"	44.1 ug/L	50.0	88.3	(72%−132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	48.3 ug/L	50.0	96.6	(77%−123%)
Toluene−d8	8260B TCL Liquid "As Received"	49.0 ug/L	50.0	97.9	(76%−122%)

QC Summary

Report Date: May 11, 2010

Sandia National Laboratories
MS−0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico

Contact: **Ms. Pamela M. Puissant**

Workorder: **251783**

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	T
Volatile−GC/MS											
Batch 980118											
QC1202107279 LCS											
1,1,1−Trichloroethane	50.0			44.5	ug/L		88.9	(73%−132%)	RXY1	05/01/10	
1,1,2,2−Tetrachloroethane	50.0			46.7	ug/L		93.4	(69%−120%)			
1,1,2−Trichloroethane	50.0			43.9	ug/L		87.9	(74%−120%)			
1,1−Dichloroethane	50.0			42.7	ug/L		85.5	(75%−121%)			
1,1−Dichloroethylene	50.0			43.1	ug/L		86.2	(71%−130%)			
1,2−Dichloroethane	50.0			42.1	ug/L		84.2	(66%−123%)			
1,2−Dichloropropane	50.0			43.5	ug/L		87	(75%−120%)			
2−Butanone	250			204	ug/L		81.7	(30%−145%)			
2−Hexanone	250			223	ug/L		89.2	(30%−149%)			
4−Methyl−2−pentanone	250			237	ug/L		94.7	(57%−132%)			
Acetone	250			226	ug/L		90.4	(30%−152%)			
Benzene	50.0			42.8	ug/L		85.7	(74%−120%)			
Bromodichloromethane	50.0			44.5	ug/L		89	(76%−129%)			
Bromoform	50.0			51.7	ug/L		103	(67%−134%)			
Bromomethane	50.0			42.7	ug/L		85.3	(70%−129%)			
Carbon disulfide	250			224	ug/L		89.5	(74%−137%)			
Carbon tetrachloride	50.0			47.2	ug/L		94.4	(73%−139%)			
Chlorobenzene	50.0			43.9	ug/L		87.8	(77%−120%)			
Chloroethane	50.0			42.5	ug/L		84.9	(69%−128%)			
Chloroform	50.0			42.3	ug/L		84.6	(75%−120%)			
Chloromethane	50.0			42.0	ug/L		84	(57%−131%)			
Dibromochloromethane	50.0			46.9	ug/L		93.7	(74%−128%)			
Ethylbenzene	50.0			43.2	ug/L		86.4	(74%−120%)			
Methylene chloride	50.0			44.8	ug/L		89.5	(70%−124%)			
Styrene	50.0			45.2	ug/L		90.5	(74%−128%)			
Tetrachloroethylene	50.0			42.6	ug/L		85.2	(73%−124%)			
Toluene	50.0		B	43.8	ug/L		87.7	(74%−120%)			
Trichloroethylene	50.0			44.1	ug/L		88.2	(78%−123%)			
Vinyl acetate	250			255	ug/L		102	(62%−143%)			
Vinyl chloride	50.0			44.5	ug/L		88.9	(68%−129%)			
Xylenes (total)	150			133	ug/L		88.4	(76%−122%)			
cis−1,2−Dichloroethylene	50.0			42.7	ug/L		85.4	(76%−125%)			
cis−1,3−Dichloropropylene	50.0			45.4	ug/L		90.7	(78%−129%)			
trans−1,2−Dichloroethylene	50.0			41.8	ug/L		83.5	(73%−122%)			
trans−1,3−Dichloropropylene	50.0			47.6	ug/L		95.2	(77%−126%)			
**1,2−Dichloroethane−d4	50.0			44.3	ug/L		88.5	(72%−132%)			

QC Summary

Workorder: 251783

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	T
Volatile−GC/MS											
Batch 980118											
**Bromofluorobenzene	50.0			48.7	ug/L		97.4	(77%−123%)			
**Toluene−d8	50.0			49.1	ug/L		98.3	(76%−122%)	RXY1	05/01/10	
QC1202107276 MB											
1,1,1−Trichloroethane			U	ND	ug/L					05/01/10	
1,1,2,2−Tetrachloroethane			U	ND	ug/L						
1,1,2−Trichloroethane			U	ND	ug/L						
1,1−Dichloroethane			U	ND	ug/L						
1,1−Dichloroethylene			U	ND	ug/L						
1,2−Dichloroethane			U	ND	ug/L						
1,2−Dichloropropane			U	ND	ug/L						
2−Butanone			U	ND	ug/L						
2−Hexanone			U	ND	ug/L						
4−Methyl−2−pentanone			U	ND	ug/L						
Acetone			U	ND	ug/L						
Benzene			U	ND	ug/L						
Bromodichloromethane			U	ND	ug/L						
Bromoform			U	ND	ug/L						
Bromomethane			U	ND	ug/L						
Carbon disulfide			U	ND	ug/L						
Carbon tetrachloride			U	ND	ug/L						
Chlorobenzene			U	ND	ug/L						
Chloroethane			U	ND	ug/L						
Chloroform			U	ND	ug/L						
Chloromethane			U	ND	ug/L						
Dibromochloromethane			U	ND	ug/L						
Ethylbenzene			U	ND	ug/L						
Methylene chloride			U	ND	ug/L						
Styrene			U	ND	ug/L						
Tetrachloroethylene			U	ND	ug/L						
Toluene			J	0.350	ug/L						
Trichloroethylene			U	ND	ug/L						
Vinyl acetate			U	ND	ug/L						
Vinyl chloride			U	ND	ug/L						
Xylenes (total)			U	ND	ug/L						
cis−1,2−Dichloroethylene			U	ND	ug/L						
cis−1,3−Dichloropropylene			U	ND	ug/L						
trans−1,2−Dichloroethylene			U	ND	ug/L						
trans−1,3−Dichloropropylene			U	ND	ug/L						
**1,2−Dichloroethane−d4	50.0			47.0	ug/L		94	(72%−132%)			
**Bromofluorobenzene	50.0			50.4	ug/L		101	(77%−123%)			
**Toluene−d8	50.0			51.3	ug/L		103	(76%−122%)			
QC1202107277 251783001 PS											

QC Summary

Workorder: 251783

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	T
Volatile−GC/MS												
Batch 980118												
1,1,1−Trichloroethane	50.0	U	ND		41.5	ug/L		83.1	(66%−132%)		05/01/10	
1,1,2,2−Tetrachloroethane	50.0	U	ND		46.5	ug/L		93.1	(65%−124%)	RXY1		
1,1,2−Trichloroethane	50.0	U	ND		45.1	ug/L		90.3	(66%−123%)			
1,1−Dichloroethane	50.0	U	ND		42.6	ug/L		85.1	(58%−132%)			
1,1−Dichloroethylene	50.0	U	ND		40.8	ug/L		81.6	(59%−128%)			
1,2−Dichloroethane	50.0	U	ND		42.2	ug/L		84.4	(60%−127%)			
1,2−Dichloropropane	50.0	U	ND		45.2	ug/L		90.4	(69%−122%)			
2−Butanone	250	U	ND		161	ug/L		64.3	(11%−118%)			
2−Hexanone	250	U	ND		164	ug/L		65.5	(25%−125%)			
4−Methyl−2−pentanone	250	U	ND		219	ug/L		87.6	(52%−130%)			
Acetone	250	U	ND		119	ug/L		47.6	(15%−142%)			
Benzene	50.0	U	ND		44.4	ug/L		88.7	(65%−119%)			
Bromodichloromethane	50.0	U	ND		46.4	ug/L		92.8	(67%−134%)			
Bromoform	50.0	U	ND		48.5	ug/L		97.1	(59%−140%)			
Bromomethane	50.0	U	ND		43.7	ug/L		87.3	(50%−140%)			
Carbon disulfide	250	U	ND		225	ug/L		90.1	(62%−135%)			
Carbon tetrachloride	50.0	U	ND		44.5	ug/L		89	(61%−137%)			
Chlorobenzene	50.0	U	ND		45.1	ug/L		90.2	(74%−116%)			
Chloroethane	50.0	U	ND		40.6	ug/L		81.2	(60%−125%)			
Chloroform	50.0	U	ND		43.6	ug/L		87.3	(68%−130%)			
Chloromethane	50.0	U	ND		40.3	ug/L		80.7	(47%−135%)			
Dibromochloromethane	50.0	U	ND		47.6	ug/L		95.1	(66%−132%)			
Ethylbenzene	50.0	U	ND		43.7	ug/L		87.3	(59%−125%)			
Methylene chloride	50.0	U	ND		45.8	ug/L		91.6	(63%−122%)			
Styrene	50.0	U	ND		46.1	ug/L		92.1	(54%−138%)			
Tetrachloroethylene	50.0	U	ND		40.8	ug/L		81.7	(63%−121%)			
Toluene	50.0	BJ	0.600	B	44.4	ug/L		87.5	(64%−116%)			
Trichloroethylene	50.0	U	ND		44.2	ug/L		88.5	(68%−121%)			
Vinyl acetate	250	U	ND		216	ug/L		86.2	(56%−151%)			
Vinyl chloride	50.0	U	ND		41.4	ug/L		82.8	(51%−136%)			
Xylenes (total)	150	U	ND		135	ug/L		90.1	(47%−144%)			
cis−1,2−Dichloroethylene	50.0	U	ND		42.5	ug/L		85	(63%−132%)			
cis−1,3−Dichloropropylene	50.0	U	ND		45.4	ug/L		90.7	(64%−133%)			
trans−1,2−Dichloroethylene	50.0	U	ND		40.4	ug/L		80.7	(64%−120%)			
trans−1,3−Dichloropropylene	50.0	U	ND		44.9	ug/L		89.8	(63%−133%)			
**1,2−Dichloroethane−d4	50.0		45.8		44.0	ug/L		88	(72%−132%)			
**Bromofluorobenzene	50.0		49.0		44.3	ug/L		88.5	(77%−123%)			
**Toluene−d8	50.0		49.6		48.1	ug/L		96.1	(76%−122%)			
QC1202107278 251783001 PSD												
1,1,1−Trichloroethane	50.0	U	ND		42.3	ug/L	1.88	84.7	(0%−20%)		05/01/10	
1,1,2,2−Tetrachloroethane	50.0	U	ND		47.5	ug/L	2.10	95.1	(0%−20%)			
1,1,2−Trichloroethane	50.0	U	ND		45.1	ug/L	0.0443	90.2	(0%−20%)			

QC Summary

Workorder: 251783

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	T
Volatile−GC/MS												
Batch 980118												
1,1−Dichloroethane	50.0	U	ND		43.0	ug/L	0.912	85.9	(0%−20%)			
1,1−Dichloroethylene	50.0	U	ND		40.1	ug/L	1.66	80.3	(0%−20%)	RXY1	05/01/10	
1,2−Dichloroethane	50.0	U	ND		43.5	ug/L	2.97	86.9	(0%−20%)			
1,2−Dichloropropane	50.0	U	ND		45.2	ug/L	0.0885	90.3	(0%−20%)			
2−Butanone	250	U	ND		182	ug/L	12.3	72.8	(0%−20%)			
2−Hexanone	250	U	ND		181	ug/L	10.3	72.6	(0%−20%)			
4−Methyl−2−pentanone	250	U	ND		244	ug/L	10.9	97.7	(0%−20%)			
Acetone	250	U	ND		133	ug/L	11.2	53.3	(0%−20%)			
Benzene	50.0	U	ND		43.4	ug/L	2.14	86.8	(0%−20%)			
Bromodichloromethane	50.0	U	ND		47.1	ug/L	1.48	94.2	(0%−20%)			
Bromoform	50.0	U	ND		50.1	ug/L	3.12	100	(0%−20%)			
Bromomethane	50.0	U	ND		43.5	ug/L	0.390	87	(0%−20%)			
Carbon disulfide	250	U	ND		219	ug/L	2.62	87.8	(0%−20%)			
Carbon tetrachloride	50.0	U	ND		43.7	ug/L	1.86	87.3	(0%−20%)			
Chlorobenzene	50.0	U	ND		44.9	ug/L	0.489	89.8	(0%−20%)			
Chloroethane	50.0	U	ND		42.0	ug/L	3.37	84	(0%−20%)			
Chloroform	50.0	U	ND		43.0	ug/L	1.57	85.9	(0%−20%)			
Chloromethane	50.0	U	ND		41.5	ug/L	2.93	83.1	(0%−20%)			
Dibromochloromethane	50.0	U	ND		49.4	ug/L	3.73	98.7	(0%−20%)			
Ethylbenzene	50.0	U	ND		42.3	ug/L	3.19	84.6	(0%−20%)			
Methylene chloride	50.0	U	ND		45.3	ug/L	1.14	90.6	(0%−20%)			
Styrene	50.0	U	ND		45.0	ug/L	2.42	89.9	(0%−20%)			
Tetrachloroethylene	50.0	U	ND		39.3	ug/L	3.89	78.6	(0%−20%)			
Toluene	50.0	BJ	0.600	B	43.3	ug/L	2.51	85.3	(0%−20%)			
Trichloroethylene	50.0	U	ND		43.3	ug/L	2.26	86.5	(0%−20%)			
Vinyl acetate	250	U	ND		228	ug/L	5.75	91.3	(0%−20%)			
Vinyl chloride	50.0	U	ND		41.6	ug/L	0.362	83.1	(0%−20%)			
Xylenes (total)	150	U	ND		130	ug/L	3.69	86.8	(0%−20%)			
cis−1,2−Dichloroethylene	50.0	U	ND		42.2	ug/L	0.827	84.3	(0%−20%)			
cis−1,3−Dichloropropylene	50.0	U	ND		46.3	ug/L	2.14	92.7	(0%−20%)			
trans−1,2−Dichloroethylene	50.0	U	ND		40.6	ug/L	0.593	81.2	(0%−20%)			
trans−1,3−Dichloropropylene	50.0	U	ND		46.0	ug/L	2.49	92	(0%−20%)			
**1,2−Dichloroethane−d4	50.0		45.8		45.0	ug/L		90.1	(72%−132%)			
**Bromofluorobenzene	50.0		49.0		45.4	ug/L		90.8	(77%−123%)			
**Toluene−d8	50.0		49.6		48.3	ug/L		96.5	(76%−122%)			

Notes:
RER is calculated at the 95% confidence level (2−sigma).
The Qualifiers in this report are defined as follows:

* Recovery or %RPD not within acceptance limits and/or spike amount not compatible with the sample or the duplicate RPD's are not applicable where the concentration falls below the effective PQL.

** Indicates analyte is a surrogate compound.

QC Summary

Workorder: **251783**

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	T

<	For less than value for Flashpoint
B	The analyte was found in the blank above the effective MDL.
H	Analytical holding time was exceeded
J	Estimated value, the analyte concentration fell above the effective MDL and below the effective PQL
L	Low Abundance Qualifier
P	The response between the confirmation column and the primary column is >40%D
U	The analyte was analyzed for but not detected below this concentration. For Organic and Inorganic analytes the result is less than the effective MDL. For radiochemical analytes the result is less than the Decision Level
X	Data rejected due to interference.
X	Data rejected due to low abundance.
X	Data rejected due to peak not meeting identification criteria.
X	Presumptive evidence that the analyte is not present. Please see narrative for further information.
X	Presumptive evidence that the analyte is not present. Please see narrative for further infromation.
X	Uncertain identification for gamma spectroscopy.
Z	Paint Filter Test−−Particulates passed through the filter, however no free liquids were observed.
Z	The percent difference is greater than 70%.
d	The 2:1 depletion requirement was not met for this sample
h	Prep holding time exceeded

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater tha five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/− the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

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Qualifier Definition Report
for

SNLS003 Sandia National Labs (691436)

Client SDG: 251783-1 GEL Work Order: 252009

The Qualifiers in this report are defined as follows:

* Recovery or %RPD not within acceptance limits and/or spike amount not compatible with the sample or the duplicate RPD's are not applicable where the concentration falls below the effective PQL.

** Indicates analyte is a surrogate compound.

U Analyzed for but undetected

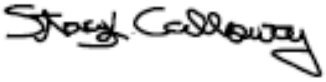
U The analyte was analyzed for but not detected below this concentration. For Organic and Inorganic analytes the result is less than the effective MDL. For radiochemical analytes the result is less than the Decision Level

DL Indicates that sample is diluted.
RA Indicates that sample is re-analyzed without re-extraction.
RE Indicates that sample is re-extracted.

Review/Validation

GEL requires all analytical data to be verified by a qualified data reviewer. In addition, all CLP-like deliverables receive a third level review of the fractional data package.

The following data validator verified the information presented in this case narrative:

Signature:  **Name: Stacy Calloway**

Date: 25 MAY 2010 **Title: Data Validator**

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Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 19, 2010

Client Sample ID: 088945-001
Sample ID: 252009001
Matrix: AQUEOUS
Collect Date: 28-APR-10 08:13
Receive Date: 30-APR-10
Collector: Client

Proiect: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-MW4
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 05/08/10	0022	982228	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 19, 2010

Client Sample ID: 088945-001
Sample ID: 252009001

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	47.9 ug/L	50.0	95.8	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	54.0 ug/L	50.0	108	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.2 ug/L	50.0	100	(76%-122%)

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Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 19, 2010

Client Sample ID: 088946-001
Sample ID: 252009002
Matrix: AQUEOUS
Collect Date: 28-APR-10 08:23
Receive Date: 30-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-MW4
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 05/08/10	0051	982228	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 19, 2010

Client Sample ID: 088946-001
Sample ID: 252009002

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	46.2 ug/L	50.0	92.5	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	53.4 ug/L	50.0	107	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	49.9 ug/L	50.0	99.7	(76%-122%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 19, 2010

Client Sample ID: 088947-001
Sample ID: 252009003
Matrix: AQUEOUS
Collect Date: 28-APR-10 08:34
Receive Date: 30-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-MW4
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 05/08/10	0120	982228	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 19, 2010

Client Sample ID: 088947-001
Sample ID: 252009003

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	47.5 ug/L	50.0	95.0	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	54.2 ug/L	50.0	108	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.0 ug/L	50.0	100	(76%-122%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 19, 2010

Client Sample ID: 088951-001
Sample ID: 252009004
Matrix: AQUEOUS
Collect Date: 28-APR-10 08:13
Receive Date: 30-APR-10
Collector: Client

Proiect: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-TB10
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 05/08/10	0149	982228	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 19, 2010

Client Sample ID: 088951-001
Sample ID: 252009004

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	46.4 ug/L	50.0	92.7	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	54.0 ug/L	50.0	108	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.5 ug/L	50.0	101	(76%-122%)

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 19, 2010

Client Sample ID: 088949-001
Sample ID: 252009005
Matrix: AQUEOUS
Collect Date: 29-APR-10 08:22
Receive Date: 30-APR-10
Collector: Client

Proiect: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-MW4
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 05/08/10	0218	982228	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 19, 2010

Client Sample ID: 088949-001
Sample ID: 252009005

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	45.8 ug/L	50.0	91.6	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	54.3 ug/L	50.0	109	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.2 ug/L	50.0	100	(76%-122%)

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 19, 2010

Client Sample ID: 088950-001
Sample ID: 252009006
Matrix: AQUEOUS
Collect Date: 29-APR-10 08:15
Receive Date: 30-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-FB2
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 05/08/10	0246	982228	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane		3.27	0.250	1.00	ug/L	1				
Bromoform		1.24	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform		1.59	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane		3.70	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 19, 2010

Client Sample ID: 088950-001
Sample ID: 252009006

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	48.4 ug/L	50.0	96.9	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	53.6 ug/L	50.0	107	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.8 ug/L	50.0	102	(76%-122%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 19, 2010

Client Sample ID: 088948-001
Sample ID: 252009007
Matrix: AQUEOUS
Collect Date: 29-APR-10 08:22
Receive Date: 30-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-TB9
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 05/08/10	0315	982228	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 19, 2010

Client Sample ID: 088948-001
Sample ID: 252009007

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	46.7 ug/L	50.0	93.3	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	54.4 ug/L	50.0	109	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.2 ug/L	50.0	100	(76%-122%)

QC Summary

Report Date: May 19, 2010

Sandia National Laboratories
MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico
Contact: **Ms. Pamela M. Puissant**

Workorder: **252009**

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS										
Batch 982228										
QC1202112131 LCS										
1,1,1-Trichloroethane	50.0			56.2	ug/L		112	(73%-132%)	KXO1	05/07/10 19:03
1,1,2,2-Tetrachloroethane	50.0			52.3	ug/L		105	(69%-120%)		
1,1,2-Trichloroethane	50.0			51.2	ug/L		102	(74%-120%)		
1,1-Dichloroethane	50.0			52.3	ug/L		105	(75%-121%)		
1,1-Dichloroethylene	50.0			52.6	ug/L		105	(71%-130%)		
1,2-Dichloroethane	50.0			53.7	ug/L		107	(66%-123%)		
1,2-Dichloropropane	50.0			50.6	ug/L		101	(75%-120%)		
2-Butanone	250			264	ug/L		105	(30%-145%)		
2-Hexanone	250			268	ug/L		107	(30%-149%)		
4-Methyl-2-pentanone	250			266	ug/L		106	(57%-132%)		
Acetone	250			303	ug/L		121	(30%-152%)		
Benzene	50.0			50.8	ug/L		102	(74%-120%)		
Bromodichloromethane	50.0			53.7	ug/L		107	(76%-129%)		
Bromoform	50.0			51.9	ug/L		104	(67%-134%)		
Bromomethane	50.0			52.8	ug/L		106	(70%-129%)		
Carbon disulfide	250			276	ug/L		110	(74%-137%)		
Carbon tetrachloride	50.0			57.9	ug/L		116	(73%-139%)		
Chlorobenzene	50.0			49.8	ug/L		99.7	(77%-120%)		
Chloroethane	50.0			53.3	ug/L		107	(69%-128%)		
Chloroform	50.0			53.6	ug/L		107	(75%-120%)		
Chloromethane	50.0			44.7	ug/L		89.4	(57%-131%)		
Dibromochloromethane	50.0			53.4	ug/L		107	(74%-128%)		
Ethylbenzene	50.0			52.2	ug/L		104	(74%-120%)		
Methylene chloride	50.0			52.7	ug/L		105	(70%-124%)		
Styrene	50.0			49.0	ug/L		98	(74%-128%)		
Tetrachloroethylene	50.0			53.2	ug/L		106	(73%-124%)		
Toluene	50.0			51.2	ug/L		102	(74%-120%)		
Trichloroethylene	50.0			54.4	ug/L		109	(78%-123%)		
Vinyl acetate	250			271	ug/L		108	(62%-143%)		
Vinyl chloride	50.0			50.9	ug/L		102	(68%-129%)		
Xylenes (total)	150			149	ug/L		99.2	(76%-122%)		
cis-1,2-Dichloroethylene	50.0			52.2	ug/L		104	(76%-125%)		
cis-1,3-Dichloropropylene	50.0			52.6	ug/L		105	(78%-129%)		
trans-1,2-Dichloroethylene	50.0			53.3	ug/L		107	(73%-122%)		
trans-1,3-Dichloropropylene	50.0			55.4	ug/L		111	(77%-126%)		
**1,2-Dichloroethane-d4	50.0			48.0	ug/L		96	(72%-132%)		

QC Summary

Workorder: 252009

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS										
Batch 982228										
**Bromofluorobenzene	50.0			51.0	ug/L		102	(77%-123%)		
**Toluene-d8	50.0			49.4	ug/L		98.8	(76%-122%)	KXO1	05/07/10 19:03
QC1202112128 MB										
1,1,1-Trichloroethane			U	ND	ug/L					05/07/10 20:30
1,1,2,2-Tetrachloroethane			U	ND	ug/L					
1,1,2-Trichloroethane			U	ND	ug/L					
1,1-Dichloroethane			U	ND	ug/L					
1,1-Dichloroethylene			U	ND	ug/L					
1,2-Dichloroethane			U	ND	ug/L					
1,2-Dichloropropane			U	ND	ug/L					
2-Butanone			U	ND	ug/L					
2-Hexanone			U	ND	ug/L					
4-Methyl-2-pentanone			U	ND	ug/L					
Acetone			U	ND	ug/L					
Benzene			U	ND	ug/L					
Bromodichloromethane			U	ND	ug/L					
Bromoform			U	ND	ug/L					
Bromomethane			U	ND	ug/L					
Carbon disulfide			U	ND	ug/L					
Carbon tetrachloride			U	ND	ug/L					
Chlorobenzene			U	ND	ug/L					
Chloroethane			U	ND	ug/L					
Chloroform			U	ND	ug/L					
Chloromethane			U	ND	ug/L					
Dibromochloromethane			U	ND	ug/L					
Ethylbenzene			U	ND	ug/L					
Methylene chloride			U	ND	ug/L					
Styrene			U	ND	ug/L					
Tetrachloroethylene			U	ND	ug/L					
Toluene			U	ND	ug/L					
Trichloroethylene			U	ND	ug/L					
Vinyl acetate			U	ND	ug/L					
Vinyl chloride			U	ND	ug/L					
Xylenes (total)			U	ND	ug/L					
cis-1,2-Dichloroethylene			U	ND	ug/L					
cis-1,3-Dichloropropylene			U	ND	ug/L					
trans-1,2-Dichloroethylene			U	ND	ug/L					
trans-1,3-Dichloropropylene			U	ND	ug/L					
**1,2-Dichloroethane-d4	50.0			48.7	ug/L		97.5	(72%-132%)		
**Bromofluorobenzene	50.0			54.5	ug/L		109	(77%-123%)		
**Toluene-d8	50.0			50.3	ug/L		101	(76%-122%)		
QC1202112129 252009001 PS										

QC Summary

Workorder: 252009

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS											
Batch 982228											
1,1,1-Trichloroethane	50.0	U	ND		52.6	ug/L		105	(66%-132%)		05/08/10 03:44
1,1,2,2-Tetrachloroethane	50.0	U	ND		49.9	ug/L		99.8	(65%-124%)	KXO1	
1,1,2-Trichloroethane	50.0	U	ND		51.1	ug/L		102	(66%-123%)		
1,1-Dichloroethane	50.0	U	ND		50.7	ug/L		101	(58%-132%)		
1,1-Dichloroethylene	50.0	U	ND		46.7	ug/L		93.4	(59%-128%)		
1,2-Dichloroethane	50.0	U	ND		55.3	ug/L		111	(60%-127%)		
1,2-Dichloropropane	50.0	U	ND		49.6	ug/L		99.3	(69%-122%)		
2-Butanone	250	U	ND		150	ug/L		60.2	(11%-118%)		
2-Hexanone	250	U	ND		177	ug/L		70.9	(25%-125%)		
4-Methyl-2-pentanone	250	U	ND		174	ug/L		69.4	(52%-130%)		
Acetone	250	U	ND		120	ug/L		48.2	(15%-142%)		
Benzene	50.0	U	ND		48.1	ug/L		96.3	(65%-119%)		
Bromodichloromethane	50.0	U	ND		52.9	ug/L		106	(67%-134%)		
Bromoform	50.0	U	ND		50.6	ug/L		101	(59%-140%)		
Bromomethane	50.0	U	ND		57.1	ug/L		114	(50%-140%)		
Carbon disulfide	250	U	ND		259	ug/L		103	(62%-135%)		
Carbon tetrachloride	50.0	U	ND		54.7	ug/L		109	(61%-137%)		
Chlorobenzene	50.0	U	ND		48.3	ug/L		96.5	(74%-116%)		
Chloroethane	50.0	U	ND		50.2	ug/L		100	(60%-125%)		
Chloroform	50.0	U	ND		52.3	ug/L		105	(68%-130%)		
Chloromethane	50.0	U	ND		42.2	ug/L		84.3	(47%-135%)		
Dibromochloromethane	50.0	U	ND		53.8	ug/L		108	(66%-132%)		
Ethylbenzene	50.0	U	ND		49.1	ug/L		98.2	(59%-125%)		
Methylene chloride	50.0	U	ND		52.0	ug/L		104	(63%-122%)		
Styrene	50.0	U	ND		42.6	ug/L		85.1	(54%-138%)		
Tetrachloroethylene	50.0	U	ND		48.8	ug/L		97.6	(63%-121%)		
Toluene	50.0	U	ND		48.6	ug/L		97.2	(64%-116%)		
Trichloroethylene	50.0	U	ND		50.3	ug/L		101	(68%-121%)		
Vinyl acetate	250	U	ND		203	ug/L		81.3	(56%-151%)		
Vinyl chloride	50.0	U	ND		49.4	ug/L		98.9	(51%-136%)		
Xylenes (total)	150	U	ND		139	ug/L		92.8	(47%-144%)		
cis-1,2-Dichloroethylene	50.0	U	ND		49.7	ug/L		99.4	(63%-132%)		
cis-1,3-Dichloropropylene	50.0	U	ND		48.8	ug/L		97.6	(64%-133%)		
trans-1,2-Dichloroethylene	50.0	U	ND		49.4	ug/L		98.8	(64%-120%)		
trans-1,3-Dichloropropylene	50.0	U	ND		52.6	ug/L		105	(63%-133%)		
**1,2-Dichloroethane-d4	50.0		47.9		47.5	ug/L		95	(72%-132%)		
**Bromofluorobenzene	50.0		54.0		50.3	ug/L		101	(77%-123%)		
**Toluene-d8	50.0		50.2		49.7	ug/L		99.3	(76%-122%)		
QC1202112130 252009001 PSD											
1,1,1-Trichloroethane	50.0	U	ND		51.4	ug/L	2.31	103	(0%-20%)		05/08/10 04:13
1,1,2,2-Tetrachloroethane	50.0	U	ND		50.2	ug/L	0.480	100	(0%-20%)		
1,1,2-Trichloroethane	50.0	U	ND		50.3	ug/L	1.52	101	(0%-20%)		

QC Summary

Workorder: 252009

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS											
Batch 982228											
1,1-Dichloroethane	50.0	U	ND		50.3	ug/L	0.773	101	(0%-20%)		
1,1-Dichloroethylene	50.0	U	ND		46.8	ug/L	0.278	93.7	(0%-20%)	KXO1	05/08/10 04:13
1,2-Dichloroethane	50.0	U	ND		53.9	ug/L	2.71	108	(0%-20%)		
1,2-Dichloropropane	50.0	U	ND		49.6	ug/L	0.0403	99.2	(0%-20%)		
2-Butanone	250	U	ND		147	ug/L	2.33	58.8	(0%-20%)		
2-Hexanone	250	U	ND		175	ug/L	1.43	69.9	(0%-20%)		
4-Methyl-2-pentanone	250	U	ND		173	ug/L	0.312	69.2	(0%-20%)		
Acetone	250	U	ND		119	ug/L	1.47	47.5	(0%-20%)		
Benzene	50.0	U	ND		47.4	ug/L	1.57	94.8	(0%-20%)		
Bromodichloromethane	50.0	U	ND		53.5	ug/L	1.13	107	(0%-20%)		
Bromoform	50.0	U	ND		51.1	ug/L	1.02	102	(0%-20%)		
Bromomethane	50.0	U	ND		57.6	ug/L	0.906	115	(0%-20%)		
Carbon disulfide	250	U	ND		251	ug/L	3.15	100	(0%-20%)		
Carbon tetrachloride	50.0	U	ND		53.5	ug/L	2.24	107	(0%-20%)		
Chlorobenzene	50.0	U	ND		47.2	ug/L	2.16	94.5	(0%-20%)		
Chloroethane	50.0	U	ND		47.7	ug/L	4.96	95.5	(0%-20%)		
Chloroform	50.0	U	ND		51.5	ug/L	1.52	103	(0%-20%)		
Chloromethane	50.0	U	ND		41.3	ug/L	1.94	82.7	(0%-20%)		
Dibromochloromethane	50.0	U	ND		52.8	ug/L	1.88	106	(0%-20%)		
Ethylbenzene	50.0	U	ND		48.0	ug/L	2.27	96	(0%-20%)		
Methylene chloride	50.0	U	ND		50.9	ug/L	2.23	102	(0%-20%)		
Styrene	50.0	U	ND		45.3	ug/L	6.28	90.7	(0%-20%)		
Tetrachloroethylene	50.0	U	ND		47.9	ug/L	1.80	95.9	(0%-20%)		
Toluene	50.0	U	ND		47.9	ug/L	1.41	95.9	(0%-20%)		
Trichloroethylene	50.0	U	ND		49.5	ug/L	1.54	99	(0%-20%)		
Vinyl acetate	250	U	ND		202	ug/L	0.528	80.8	(0%-20%)		
Vinyl chloride	50.0	U	ND		47.6	ug/L	3.84	95.1	(0%-20%)		
Xylenes (total)	150	U	ND		139	ug/L	0.0647	92.7	(0%-20%)		
cis-1,2-Dichloroethylene	50.0	U	ND		49.2	ug/L	1.03	98.4	(0%-20%)		
cis-1,3-Dichloropropylene	50.0	U	ND		49.0	ug/L	0.388	98	(0%-20%)		
trans-1,2-Dichloroethylene	50.0	U	ND		48.8	ug/L	1.34	97.5	(0%-20%)		
trans-1,3-Dichloropropylene	50.0	U	ND		52.9	ug/L	0.626	106	(0%-20%)		
**1,2-Dichloroethane-d4	50.0		47.9		46.9	ug/L		93.9	(72%-132%)		
**Bromofluorobenzene	50.0		54.0		51.8	ug/L		104	(77%-123%)		
**Toluene-d8	50.0		50.2		50.6	ug/L		101	(76%-122%)		

Notes:
RER is calculated at the 95% confidence level (2-sigma).
The Qualifiers in this report are defined as follows:

* Recovery or %RPD not within acceptance limits and/or spike amount not compatible with the sample or the duplicate RPD's are not applicable where the concentration falls below the effective PQL.

** Indicates analyte is a surrogate compound.

QC Summary

Workorder: **252009**

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time

B The analyte was found in the blank above the effective MDL.

H Analytical holding time was exceeded

J Estimated value, the analyte concentration fell above the effective MDL and below the effective PQL

P The response between the confirmation column and the primary column is >40%D

U The analyte was analyzed for but not detected below this concentration. For Organic and Inorganic analytes the result is less than the effective MDL. For radiochemical analytes the result is less than the Decision Level

X Presumptive evidence that the analyte is not present. Please see narrative for further infromation.

Z The percent difference is greater than 70%.

d The 2:1 depletion requirement was not met for this sample

h Prep holding time exceeded

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

Attachment 1

April 2010 MWL Groundwater Sampling Results
Laboratory Certificates of Analysis for VOC Samples

<u>MWL Groundwater samples</u>:
MWL-MW5, MWL-MW6, MWL-MW7, and MWL-MW9

<u>MWL Field Quality Control Samples</u>:
MWL-FB1, MWL-EB1, and MWL-TB1 through 5

GC/MS Volatiles Sample and QC Summary Data

GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Qualifier Definition Report
for

SNLS003 Sandia National Labs (691436)

Client SDG: 251426 GEL Work Order: 251426

The Qualifiers in this report are defined as follows:

* Recovery or %RPD not within acceptance limits and/or spike amount not compatible with the sample or the duplicate RPD's are not applicable where the concentration falls below the effective PQL.

** Indicates analyte is a surrogate compound.

B The analyte was found in the blank above the effective MDL.

J Estimated value, the analyte concentration fell above the effective MDL and below the effective PQL

U Analyzed for but undetected

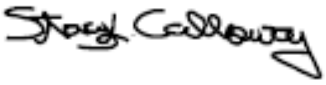
U The analyte was analyzed for but not detected below this concentration. For Organic and Inorganic analytes the result is less than the effective MDL. For radiochemical analytes the result is less than the Decision Level

DL Indicates that sample is diluted.
RA Indicates that sample is re-analyzed without re-extraction.
RE Indicates that sample is re-extracted.

Review/Validation

GEL requires all analytical data to be verified by a qualified data reviewer. In addition, all CLP-like deliverables receive a third level review of the fractional data package.

The following data validator verified the information presented in this case narrative:

Signature:  **Name: Stacy Calloway**

Date: 21 MAY 2010 **Title: Data Validator**

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Report Date: May 11, 2010
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Client Sample ID: 088919-001
Sample ID: 251426036
Matrix: AQUEOUS
Collect Date: 20-APR-10 10:13
Receive Date: 21-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003
Client Desc.: MWL-MW5
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 04/30/10	0305	979196	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	BJ	3.95	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088919-001
Sample ID: 251426036

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	51.7 ug/L	50.0	103	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	50.0 ug/L	50.0	100	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.4 ug/L	50.0	101	(76%-122%)

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Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088920-001
Sample ID: 251426044
Matrix: AQUEOUS
Collect Date: 20-APR-10 10:13
Receive Date: 21-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-TB3
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 04/30/10	0333	979196	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	BJ	3.95	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088920-001
Sample ID: 251426044

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	51.4 ug/L	50.0	103	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	50.2 ug/L	50.0	100	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.6 ug/L	50.0	101	(76%-122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088912-001
Sample ID: 251426015
Matrix: AQUEOUS
Collect Date: 19-APR-10 11:45
Receive Date: 21-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-EB1
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 04/28/10	2327	979196	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane		2.67	0.250	1.00	ug/L	1				
Bromoform		1.63	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform		1.52	0.250	1.00	ug/L	1				
Chloromethane	J	0.300	0.300	1.00	ug/L	1				
Dibromochloromethane		3.79	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088912-001
Sample ID: 251426015

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	46.9 ug/L	50.0	93.8	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	61.2 ug/L	50.0	122	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	51.6 ug/L	50.0	103	(76%-122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Report Date: May 11, 2010
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Client Sample ID: 088913-001
Sample ID: 251426023
Matrix: AQUEOUS
Collect Date: 19-APR-10 11:45
Receive Date: 21-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003
Client Desc.: MWL-TB2
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 04/30/10	0019	979196	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	BJ	3.87	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088913-001
Sample ID: 251426023

Proiect: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	52.8 ug/L	50.0	106	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	52.0 ug/L	50.0	104	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	51.6 ug/L	50.0	103	(76%-122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088914-001
Sample ID: 251426024
Matrix: AQUEOUS
Collect Date: 20-APR-10 08:17
Receive Date: 21-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-MW5
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 04/30/10	0047	979196	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	BJ	3.75	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088914-001
Sample ID: 251426024

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	50.9 ug/L	50.0	102	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	51.0 ug/L	50.0	102	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.3 ug/L	50.0	101	(76%-122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Report Date: May 11, 2010
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Client Sample ID: 088915-001
Sample ID: 251426025
Matrix: AQUEOUS
Collect Date: 20-APR-10 08:41
Receive Date: 21-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003
Client Desc.: MWL-MW5
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 04/30/10	0114	979196	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	BJ	3.81	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088915-001
Sample ID: 251426025

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	52.7 ug/L	50.0	105	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	51.2 ug/L	50.0	102	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.7 ug/L	50.0	101	(76%-122%)

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Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088916-001
Sample ID: 251426026
Matrix: AQUEOUS
Collect Date: 20-APR-10 09:11
Receive Date: 21-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-MW5
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 04/30/10	0142	979196	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	BJ	3.88	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088916-001
Sample ID: 251426026

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	51.8 ug/L	50.0	104	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	50.8 ug/L	50.0	102	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.8 ug/L	50.0	102	(76%-122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Report Date: May 11, 2010
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Client Sample ID: 088917-001
Sample ID: 251426027
Matrix: AQUEOUS
Collect Date: 20-APR-10 09:42
Receive Date: 21-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003
Client Desc.: MWL-MW5
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 04/30/10	0210	979196	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	BJ	3.80	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Report Date: May 11, 2010
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Client Sample ID: 088917-001
Sample ID: 251426027
Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	52.4 ug/L	50.0	105	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	50.3 ug/L	50.0	101	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.4 ug/L	50.0	101	(76%-122%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088918-001
Sample ID: 251426028
Matrix: AQUEOUS
Collect Date: 20-APR-10 10:13
Receive Date: 21-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-MW5
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 04/30/10	0238	979196	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	BJ	3.95	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088918-001
Sample ID: 251426028

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	53.6 ug/L	50.0	107	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	51.7 ug/L	50.0	103	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	51.2 ug/L	50.0	102	(76%-122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088907-001
Sample ID: 251426003
Matrix: AQUEOUS
Collect Date: 19-APR-10 09:10
Receive Date: 20-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-MW6
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 04/28/10	2103	979196	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	J	0.680	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088907-001
Sample ID: 251426003

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	46.0 ug/L	50.0	92.0	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	60.0 ug/L	50.0	120	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	52.2 ug/L	50.0	104	(76%-122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Report Date: May 11, 2010
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Client Sample ID: 088908-001
Sample ID: 251426004
Matrix: AQUEOUS
Collect Date: 19-APR-10 09:40
Receive Date: 20-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003
Client Desc.: MWL-MW6
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 04/28/10	2132	979196	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088908-001
Sample ID: 251426004

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	46.3 ug/L	50.0	92.7	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	59.3 ug/L	50.0	119	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.3 ug/L	50.0	101	(76%-122%)

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Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088909-001
Sample ID: 251426005
Matrix: AQUEOUS
Collect Date: 19-APR-10 10:10
Receive Date: 20-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-MW6
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 04/29/10	2323	979196	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	J	7.91	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

Certificate of Analysis

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Albuquerque, New Mexico 87123
Report Date: May 11, 2010
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Client Sample ID: 088909-001
Sample ID: 251426005
Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	50.2 ug/L	50.0	100	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	50.1 ug/L	50.0	100	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.6 ug/L	50.0	101	(76%-122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088910-001
Sample ID: 251426013
Matrix: AQUEOUS
Collect Date: 19-APR-10 09:45
Receive Date: 20-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-FB1
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 04/29/10	2351	979196	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane		3.18	0.250	1.00	ug/L	1				
Bromoform		1.16	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform		1.74	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane		3.64	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	BJ	3.66	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088910-001
Sample ID: 251426013

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	51.5 ug/L	50.0	103	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	50.4 ug/L	50.0	101	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.2 ug/L	50.0	100	(76%-122%)

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Albuquerque, New Mexico 87123
Report Date: May 11, 2010
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Client Sample ID: 088911-001
Sample ID: 251426014
Matrix: AQUEOUS
Collect Date: 19-APR-10 10:10
Receive Date: 20-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003
Client Desc.: MWL-TB1
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 04/28/10	2259	979196	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088911-001
Sample ID: 251426014

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	45.7 ug/L	50.0	91.4	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	60.6 ug/L	50.0	121	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.8 ug/L	50.0	102	(76%-122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088905-001
Sample ID: 251426001
Matrix: AQUEOUS
Collect Date: 19-APR-10 08:16
Receive Date: 20-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-MW6
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 04/28/10	2006	979196	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088905-001
Sample ID: 251426001

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	49.3 ug/L	50.0	98.5	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	60.0 ug/L	50.0	120	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.7 ug/L	50.0	101	(76%-122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Report Date: May 11, 2010
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Client Sample ID: 088906-001
Sample ID: 251426002
Matrix: AQUEOUS
Collect Date: 19-APR-10 08:40
Receive Date: 20-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003
Client Desc.: MWL-MW6
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	KXO1 04/28/10	2034	979196	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 11, 2010

Client Sample ID: 088906-001
Sample ID: 251426002

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	47.7 ug/L	50.0	95.4	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	59.7 ug/L	50.0	119	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	51.0 ug/L	50.0	102	(76%-122%)

QC Summary

Report Date: May 11, 2010

Sandia National Laboratories
MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico
Contact: **Ms. Pamela M. Puissant**

Workorder: **251426**

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS										
Batch 979196										
QC1202105073 LCS										
1,1,1-Trichloroethane	50.0			51.3	ug/L		103	(73%-132%)	KXO1	04/28/10 18:11
1,1,2,2-Tetrachloroethane	50.0			56.6	ug/L		113	(69%-120%)		
1,1,2-Trichloroethane	50.0			52.8	ug/L		106	(74%-120%)		
1,1-Dichloroethane	50.0			48.2	ug/L		96.4	(75%-121%)		
1,1-Dichloroethylene	50.0			50.3	ug/L		101	(71%-130%)		
1,2-Dichloroethane	50.0			46.3	ug/L		92.6	(66%-123%)		
1,2-Dichloropropane	50.0			49.0	ug/L		97.9	(75%-120%)		
2-Butanone	250			230	ug/L		91.9	(30%-145%)		
2-Hexanone	250			248	ug/L		99.2	(30%-149%)		
4-Methyl-2-pentanone	250			239	ug/L		95.5	(57%-132%)		
Acetone	250			201	ug/L		80.3	(30%-152%)		
Benzene	50.0			48.9	ug/L		97.9	(74%-120%)		
Bromodichloromethane	50.0			48.3	ug/L		96.5	(76%-129%)		
Bromoform	50.0			54.7	ug/L		109	(67%-134%)		
Bromomethane	50.0			48.4	ug/L		96.8	(70%-129%)		
Carbon disulfide	250			254	ug/L		102	(74%-137%)		
Carbon tetrachloride	50.0			52.1	ug/L		104	(73%-139%)		
Chlorobenzene	50.0			50.7	ug/L		101	(77%-120%)		
Chloroethane	50.0			53.0	ug/L		106	(69%-128%)		
Chloroform	50.0			46.7	ug/L		93.5	(75%-120%)		
Chloromethane	50.0			52.0	ug/L		104	(57%-131%)		
Dibromochloromethane	50.0			51.8	ug/L		104	(74%-128%)		
Ethylbenzene	50.0			57.7	ug/L		115	(74%-120%)		
Methylene chloride	50.0			42.6	ug/L		85.1	(70%-124%)		
Styrene	50.0			53.1	ug/L		106	(74%-128%)		
Tetrachloroethylene	50.0			52.2	ug/L		104	(73%-124%)		
Toluene	50.0			54.3	ug/L		109	(74%-120%)		
Trichloroethylene	50.0			49.3	ug/L		98.6	(78%-123%)		
Vinyl acetate	250			300	ug/L		120	(62%-143%)		
Vinyl chloride	50.0			59.6	ug/L		119	(68%-129%)		
Xylenes (total)	150			179	ug/L		119	(76%-122%)		
cis-1,2-Dichloroethylene	50.0			51.3	ug/L		103	(76%-125%)		
cis-1,3-Dichloropropylene	50.0			51.5	ug/L		103	(78%-129%)		
trans-1,2-Dichloroethylene	50.0			50.5	ug/L		101	(73%-122%)		
trans-1,3-Dichloropropylene	50.0			58.3	ug/L		117	(77%-126%)		
**1,2-Dichloroethane-d4	50.0			45.7	ug/L		91.4	(72%-132%)		

QC Summary

Workorder: 251426

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS										
Batch 979196										
**Bromofluorobenzene	50.0			55.3	ug/L		111	(77%-123%)		
**Toluene-d8	50.0			52.0	ug/L		104	(76%-122%)	KXO1	04/28/10 18:11
QC1202106379 LCS										
1,1,1-Trichloroethane	50.0			55.6	ug/L		111	(73%-132%)		04/29/10 22:00
1,1,2,2-Tetrachloroethane	50.0			52.7	ug/L		105	(69%-120%)		
1,1,2-Trichloroethane	50.0			53.3	ug/L		107	(74%-120%)		
1,1-Dichloroethane	50.0			55.7	ug/L		111	(75%-121%)		
1,1-Dichloroethylene	50.0			53.8	ug/L		108	(71%-130%)		
1,2-Dichloroethane	50.0			53.3	ug/L		107	(66%-123%)		
1,2-Dichloropropane	50.0			55.6	ug/L		111	(75%-120%)		
2-Butanone	250			226	ug/L		90.3	(30%-145%)		
2-Hexanone	250			187	ug/L		74.9	(30%-149%)		
4-Methyl-2-pentanone	250			282	ug/L		113	(57%-132%)		
Acetone	250			245	ug/L		98	(30%-152%)		
Benzene	50.0			53.6	ug/L		107	(74%-120%)		
Bromodichloromethane	50.0			54.1	ug/L		108	(76%-129%)		
Bromoform	50.0			53.9	ug/L		108	(67%-134%)		
Bromomethane	50.0			50.4	ug/L		101	(70%-129%)		
Carbon disulfide	250			285	ug/L		114	(74%-137%)		
Carbon tetrachloride	50.0			57.2	ug/L		114	(73%-139%)		
Chlorobenzene	50.0			52.5	ug/L		105	(77%-120%)		
Chloroethane	50.0			53.3	ug/L		107	(69%-128%)		
Chloroform	50.0			53.6	ug/L		107	(75%-120%)		
Chloromethane	50.0			49.7	ug/L		99.5	(57%-131%)		
Dibromochloromethane	50.0			54.2	ug/L		108	(74%-128%)		
Ethylbenzene	50.0			53.2	ug/L		106	(74%-120%)		
Methylene chloride	50.0		B	57.1	ug/L		114	(70%-124%)		
Styrene	50.0			51.7	ug/L		103	(74%-128%)		
Tetrachloroethylene	50.0			52.1	ug/L		104	(73%-124%)		
Toluene	50.0			50.0	ug/L		100	(74%-120%)		
Trichloroethylene	50.0			53.1	ug/L		106	(78%-123%)		
Vinyl acetate	250			324	ug/L		130	(62%-143%)		
Vinyl chloride	50.0			48.1	ug/L		96.1	(68%-129%)		
Xylenes (total)	150			158	ug/L		105	(76%-122%)		
cis-1,2-Dichloroethylene	50.0			55.3	ug/L		111	(76%-125%)		
cis-1,3-Dichloropropylene	50.0			57.1	ug/L		114	(78%-129%)		
trans-1,2-Dichloroethylene	50.0			55.4	ug/L		111	(73%-122%)		
trans-1,3-Dichloropropylene	50.0			59.2	ug/L		118	(77%-126%)		
**1,2-Dichloroethane-d4	50.0			50.7	ug/L		101	(72%-132%)		
**Bromofluorobenzene	50.0			48.5	ug/L		97	(77%-123%)		
**Toluene-d8	50.0			50.0	ug/L		100	(76%-122%)		
QC1202105070 MB										

QC Summary

Workorder: 251426

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS										
Batch 979196										
1,1,1-Trichloroethane			U	ND	ug/L					04/28/10 19:37
1,1,2,2-Tetrachloroethane			U	ND	ug/L				KXO1	
1,1,2-Trichloroethane			U	ND	ug/L					
1,1-Dichloroethane			U	ND	ug/L					
1,1-Dichloroethylene			U	ND	ug/L					
1,2-Dichloroethane			U	ND	ug/L					
1,2-Dichloropropane			U	ND	ug/L					
2-Butanone			U	ND	ug/L					
2-Hexanone			U	ND	ug/L					
4-Methyl-2-pentanone			U	ND	ug/L					
Acetone			U	ND	ug/L					
Benzene			U	ND	ug/L					
Bromodichloromethane			U	ND	ug/L					
Bromoform			U	ND	ug/L					
Bromomethane			U	ND	ug/L					
Carbon disulfide			U	ND	ug/L					
Carbon tetrachloride			U	ND	ug/L					
Chlorobenzene			U	ND	ug/L					
Chloroethane			U	ND	ug/L					
Chloroform			U	ND	ug/L					
Chloromethane			U	ND	ug/L					
Dibromochloromethane			U	ND	ug/L					
Ethylbenzene			U	ND	ug/L					
Methylene chloride			U	ND	ug/L					
Styrene			U	ND	ug/L					
Tetrachloroethylene			U	ND	ug/L					
Toluene			U	ND	ug/L					
Trichloroethylene			U	ND	ug/L					
Vinyl acetate			U	ND	ug/L					
Vinyl chloride			U	ND	ug/L					
Xylenes (total)			U	ND	ug/L					
cis-1,2-Dichloroethylene			U	ND	ug/L					
cis-1,3-Dichloropropylene			U	ND	ug/L					
trans-1,2-Dichloroethylene			U	ND	ug/L					
trans-1,3-Dichloropropylene			U	ND	ug/L					
**1,2-Dichloroethane-d4	50.0			46.6	ug/L		93.1	(72%-132%)		
**Bromofluorobenzene	50.0			55.5	ug/L		111	(77%-123%)		
**Toluene-d8	50.0			49.4	ug/L		98.8	(76%-122%)		
QC1202106378 MB										
1,1,1-Trichloroethane			U	ND	ug/L					04/29/10 22:55
1,1,2,2-Tetrachloroethane			U	ND	ug/L					
1,1,2-Trichloroethane			U	ND	ug/L					

QC Summary

Workorder: 251426

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS										
Batch 979196										
1,1-Dichloroethane			U	ND	ug/L					
1,1-Dichloroethylene			U	ND	ug/L				KXO1	04/29/10 22:55
1,2-Dichloroethane			U	ND	ug/L					
1,2-Dichloropropane			U	ND	ug/L					
2-Butanone			U	ND	ug/L					
2-Hexanone			U	ND	ug/L					
4-Methyl-2-pentanone			U	ND	ug/L					
Acetone			U	ND	ug/L					
Benzene			U	ND	ug/L					
Bromodichloromethane			U	ND	ug/L					
Bromoform			U	ND	ug/L					
Bromomethane			U	ND	ug/L					
Carbon disulfide			U	ND	ug/L					
Carbon tetrachloride			U	ND	ug/L					
Chlorobenzene			U	ND	ug/L					
Chloroethane			U	ND	ug/L					
Chloroform			U	ND	ug/L					
Chloromethane			U	ND	ug/L					
Dibromochloromethane			U	ND	ug/L					
Ethylbenzene			U	ND	ug/L					
Methylene chloride			J	4.00	ug/L					
Styrene			U	ND	ug/L					
Tetrachloroethylene			U	ND	ug/L					
Toluene			U	ND	ug/L					
Trichloroethylene			U	ND	ug/L					
Vinyl acetate			U	ND	ug/L					
Vinyl chloride			U	ND	ug/L					
Xylenes (total)			U	ND	ug/L					
cis-1,2-Dichloroethylene			U	ND	ug/L					
cis-1,3-Dichloropropylene			U	ND	ug/L					
trans-1,2-Dichloroethylene			U	ND	ug/L					
trans-1,3-Dichloropropylene			U	ND	ug/L					
**1,2-Dichloroethane-d4	50.0			50.8	ug/L		102	(72%-132%)		
**Bromofluorobenzene	50.0			50.0	ug/L		100	(77%-123%)		
**Toluene-d8	50.0			50.5	ug/L		101	(76%-122%)		
QC1202105071 251426005 PS										
1,1,1-Trichloroethane	50.0	U	ND	53.7	ug/L		107	(66%-132%)		04/30/10 04:01
1,1,2,2-Tetrachloroethane	50.0	U	ND	55.5	ug/L		111	(65%-124%)		
1,1,2-Trichloroethane	50.0	U	ND	55.0	ug/L		110	(66%-123%)		
1,1-Dichloroethane	50.0	U	ND	54.9	ug/L		110	(58%-132%)		
1,1-Dichloroethylene	50.0	U	ND	51.6	ug/L		103	(59%-128%)		
1,2-Dichloroethane	50.0	U	ND	54.9	ug/L		110	(60%-127%)		

QC Summary

Workorder: 251426

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS											
Batch 979196											
1,2-Dichloropropane	50.0	U	ND		55.7	ug/L		111	(69%-122%)		
2-Butanone	250	U	ND		217	ug/L		86.7	(11%-118%)	KXO1	04/30/10 04:01
2-Hexanone	250	U	ND		208	ug/L		83.3	(25%-125%)		
4-Methyl-2-pentanone	250	U	ND		287	ug/L		115	(52%-130%)		
Acetone	250	J	7.91		186	ug/L		71.1	(15%-142%)		
Benzene	50.0	U	ND		52.2	ug/L		104	(65%-119%)		
Bromodichloromethane	50.0	U	ND		54.7	ug/L		109	(67%-134%)		
Bromoform	50.0	U	ND		55.1	ug/L		110	(59%-140%)		
Bromomethane	50.0	U	ND		48.4	ug/L		96.8	(50%-140%)		
Carbon disulfide	250	U	ND		278	ug/L		111	(62%-135%)		
Carbon tetrachloride	50.0	U	ND		55.9	ug/L		112	(61%-137%)		
Chlorobenzene	50.0	U	ND		52.7	ug/L		105	(74%-116%)		
Chloroethane	50.0	U	ND		51.6	ug/L		103	(60%-125%)		
Chloroform	50.0	U	ND		53.5	ug/L		107	(68%-130%)		
Chloromethane	50.0	U	ND		48.5	ug/L		97	(47%-135%)		
Dibromochloromethane	50.0	U	ND		55.3	ug/L		111	(66%-132%)		
Ethylbenzene	50.0	U	ND		53.6	ug/L		107	(59%-125%)		
Methylene chloride	50.0	U	ND	B	57.3	ug/L		109	(63%-122%)		
Styrene	50.0	U	ND		50.0	ug/L		99.9	(54%-138%)		
Tetrachloroethylene	50.0	U	ND		51.3	ug/L		103	(63%-121%)		
Toluene	50.0	U	ND		49.8	ug/L		99.7	(64%-116%)		
Trichloroethylene	50.0	U	ND		51.7	ug/L		103	(68%-121%)		
Vinyl acetate	250	U	ND		286	ug/L		114	(56%-151%)		
Vinyl chloride	50.0	U	ND		47.7	ug/L		95.3	(51%-136%)		
Xylenes (total)	150	U	ND		158	ug/L		105	(47%-144%)		
cis-1,2-Dichloroethylene	50.0	U	ND		54.4	ug/L		109	(63%-132%)		
cis-1,3-Dichloropropylene	50.0	U	ND		53.8	ug/L		108	(64%-133%)		
trans-1,2-Dichloroethylene	50.0	U	ND		54.3	ug/L		109	(64%-120%)		
trans-1,3-Dichloropropylene	50.0	U	ND		58.7	ug/L		117	(63%-133%)		
**1,2-Dichloroethane-d4	50.0		50.2		51.7	ug/L		103	(72%-132%)		
**Bromofluorobenzene	50.0		50.1		48.7	ug/L		97.3	(77%-123%)		
**Toluene-d8	50.0		50.6		50.4	ug/L		101	(76%-122%)		
QC1202105072 251426005 PSD											
1,1,1-Trichloroethane	50.0	U	ND		53.9	ug/L	0.334	108	(0%-20%)		04/30/10 04:29
1,1,2,2-Tetrachloroethane	50.0	U	ND		55.9	ug/L	0.862	112	(0%-20%)		
1,1,2-Trichloroethane	50.0	U	ND		55.0	ug/L	0.109	110	(0%-20%)		
1,1-Dichloroethane	50.0	U	ND		55.0	ug/L	0.182	110	(0%-20%)		
1,1-Dichloroethylene	50.0	U	ND		51.4	ug/L	0.311	103	(0%-20%)		
1,2-Dichloroethane	50.0	U	ND		54.8	ug/L	0.237	110	(0%-20%)		
1,2-Dichloropropane	50.0	U	ND		56.2	ug/L	0.893	112	(0%-20%)		
2-Butanone	250	U	ND		214	ug/L	1.51	85.5	(0%-20%)		
2-Hexanone	250	U	ND		202	ug/L	2.94	80.9	(0%-20%)		

QC Summary

Workorder: **251426**

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS											
Batch 979196											
4-Methyl-2-pentanone	250	U	ND		283	ug/L	1.46	113	(0%-20%)		
Acetone	250	J	7.91		184	ug/L	1.06	70.3	(0%-20%)	KXO1	04/30/10 04:29
Benzene	50.0	U	ND		52.3	ug/L	0.0766	105	(0%-20%)		
Bromodichloromethane	50.0	U	ND		55.1	ug/L	0.620	110	(0%-20%)		
Bromoform	50.0	U	ND		56.3	ug/L	2.15	113	(0%-20%)		
Bromomethane	50.0	U	ND		48.0	ug/L	0.767	96.1	(0%-20%)		
Carbon disulfide	250	U	ND		276	ug/L	0.736	110	(0%-20%)		
Carbon tetrachloride	50.0	U	ND		56.4	ug/L	0.927	113	(0%-20%)		
Chlorobenzene	50.0	U	ND		52.7	ug/L	0.00	105	(0%-20%)		
Chloroethane	50.0	U	ND		51.2	ug/L	0.779	102	(0%-20%)		
Chloroform	50.0	U	ND		53.7	ug/L	0.392	107	(0%-20%)		
Chloromethane	50.0	U	ND		47.3	ug/L	2.55	94.6	(0%-20%)		
Dibromochloromethane	50.0	U	ND		55.5	ug/L	0.506	111	(0%-20%)		
Ethylbenzene	50.0	U	ND		53.5	ug/L	0.187	107	(0%-20%)		
Methylene chloride	50.0	U	ND	B	57.9	ug/L	1.16	111	(0%-20%)		
Styrene	50.0	U	ND		50.0	ug/L	0.00	99.9	(0%-20%)		
Tetrachloroethylene	50.0	U	ND		50.6	ug/L	1.34	101	(0%-20%)		
Toluene	50.0	U	ND		49.8	ug/L	0.0201	99.6	(0%-20%)		
Trichloroethylene	50.0	U	ND		51.3	ug/L	0.816	103	(0%-20%)		
Vinyl acetate	250	U	ND		282	ug/L	1.16	113	(0%-20%)		
Vinyl chloride	50.0	U	ND		46.6	ug/L	2.29	93.1	(0%-20%)		
Xylenes (total)	150	U	ND		158	ug/L	0.0316	105	(0%-20%)		
cis-1,2-Dichloroethylene	50.0	U	ND		54.7	ug/L	0.587	109	(0%-20%)		
cis-1,3-Dichloropropylene	50.0	U	ND		54.6	ug/L	1.31	109	(0%-20%)		
trans-1,2-Dichloroethylene	50.0	U	ND		54.0	ug/L	0.646	108	(0%-20%)		
trans-1,3-Dichloropropylene	50.0	U	ND		59.4	ug/L	1.22	119	(0%-20%)		
**1,2-Dichloroethane-d4	50.0		50.2		51.3	ug/L		103	(72%-132%)		
**Bromofluorobenzene	50.0		50.1		49.6	ug/L		99.3	(77%-123%)		
**Toluene-d8	50.0		50.6		50.6	ug/L		101	(76%-122%)		

Notes:
RER is calculated at the 95% confidence level (2-sigma).
The Qualifiers in this report are defined as follows:

- * Recovery or %RPD not within acceptance limits and/or spike amount not compatible with the sample or the duplicate RPD's are not applicable where the concentration falls below the effective PQL.
- ** Indicates analyte is a surrogate compound.
- < For less than value for Flashpoint
- B The analyte was found in the blank above the effective MDL.
- H Analytical holding time was exceeded
- J Estimated value, the analyte concentration fell above the effective MDL and below the effective PQL
- L Low Abundance Qualifier

QC Summary

Workorder: **251426**

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time

P The response between the confirmation column and the primary column is >40%D

U The analyte was analyzed for but not detected below this concentration. For Organic and Inorganic analytes the result is less than the effective MDL. For radiochemical analytes the result is less than the Decision Level

X Data rejected due to interference.

X Data rejected due to low abundance.

X Data rejected due to peak not meeting identification criteria.

X Presumptive evidence that the analyte is not present. Please see narrative for further information.

X Presumptive evidence that the analyte is not present. Please see narrative for further infromation.

X Uncertain identification for gamma spectroscopy.

Z Paint Filter Test--Particulates passed through the filter, however no free liquids were observed.

Z The percent difference is greater than 70%.

d The 2:1 depletion requirement was not met for this sample

h Prep holding time exceeded

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Qualifier Definition Report
for

SNLS003 Sandia National Labs (691436)

Client SDG: 251426-1 GEL Work Order: 251644

The Qualifiers in this report are defined as follows:

* Recovery or %RPD not within acceptance limits and/or spike amount not compatible with the sample or the duplicate RPD's are not applicable where the concentration falls below the effective PQL.

** Indicates analyte is a surrogate compound.

U Analyzed for but undetected

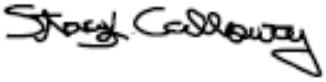
U The analyte was analyzed for but not detected below this concentration. For Organic and Inorganic analytes the result is less than the effective MDL. For radiochemical analytes the result is less than the Decision Level

DL Indicates that sample is diluted.
RA Indicates that sample is re-analyzed without re-extraction.
RE Indicates that sample is re-extracted.

Review/Validation

GEL requires all analytical data to be verified by a qualified data reviewer. In addition, all CLP-like deliverables receive a third level review of the fractional data package.

The following data validator verified the information presented in this case narrative:

Signature:  **Name: Stacy Calloway**

Date: 21 MAY 2010 **Title: Data Validator**

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Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 18, 2010

Client Sample ID: 088930-001
Sample ID: 251644011
Matrix: AQUEOUS
Collect Date: 22-APR-10 09:02
Receive Date: 23-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-TB5
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM405/04/10	1259	980470	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 18, 2010

Client Sample ID: 088930-001
Sample ID: 251644011

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	55.1 ug/L	50.0	110	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	47.4 ug/L	50.0	94.8	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	48.7 ug/L	50.0	97.4	(76%-122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Report Date: May 18, 2010
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Client Sample ID: 088921-001
Sample ID: 251644001
Matrix: AQUEOUS
Collect Date: 21-APR-10 08:18
Receive Date: 23-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003
Client Desc.: MWL-MW9
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 05/03/10	2012	980470	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 18, 2010

Client Sample ID: 088921-001
Sample ID: 251644001

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	51.0 ug/L	50.0	102	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	49.0 ug/L	50.0	98.0	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	47.1 ug/L	50.0	94.2	(76%-122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Report Date: May 18, 2010
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Client Sample ID: 088922-001
Sample ID: 251644002
Matrix: AQUEOUS
Collect Date: 21-APR-10 08:21
Receive Date: 23-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003
Client Desc.: MWL-MW9
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Volatile Organics											
8260B TCL Liquid "As Received"											
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4	05/03/10	2042	980470	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1					
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1					
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1					
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1					
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1					
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1					
2-Butanone	U	ND	1.25	5.00	ug/L	1					
2-Hexanone	U	ND	1.25	5.00	ug/L	1					
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1					
Acetone	U	ND	3.50	10.0	ug/L	1					
Benzene	U	ND	0.300	1.00	ug/L	1					
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1					
Bromoform	U	ND	0.250	1.00	ug/L	1					
Bromomethane	U	ND	0.300	1.00	ug/L	1					
Carbon disulfide	U	ND	1.25	5.00	ug/L	1					
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1					
Chlorobenzene	U	ND	0.250	1.00	ug/L	1					
Chloroethane	U	ND	0.300	1.00	ug/L	1					
Chloroform	U	ND	0.250	1.00	ug/L	1					
Chloromethane	U	ND	0.300	1.00	ug/L	1					
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1					
Ethylbenzene	U	ND	0.250	1.00	ug/L	1					
Methylene chloride	U	ND	3.00	10.0	ug/L	1					
Styrene	U	ND	0.250	1.00	ug/L	1					
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1					
Toluene	U	ND	0.250	1.00	ug/L	1					
Trichloroethylene	U	ND	0.250	1.00	ug/L	1					
Vinyl acetate	U	ND	1.50	5.00	ug/L	1					
Vinyl chloride	U	ND	0.500	1.00	ug/L	1					
Xylenes (total)	U	ND	0.300	1.00	ug/L	1					
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1					
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1					
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1					
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1					

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 18, 2010

Client Sample ID: 088922-001
Sample ID: 251644002

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	51.2 ug/L	50.0	102	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	48.0 ug/L	50.0	96.0	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	48.0 ug/L	50.0	96.0	(76%-122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Report Date: May 18, 2010
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Client Sample ID: 088923-001
Sample ID: 251644003
Matrix: AQUEOUS
Collect Date: 21-APR-10 08:33
Receive Date: 23-APR-10
Collector: Client

Proiect: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-MW9
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 05/03/10	2113	980470	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 18, 2010

Client Sample ID: 088923-001
Sample ID: 251644003

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	51.5 ug/L	50.0	103	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	48.3 ug/L	50.0	96.7	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	47.6 ug/L	50.0	95.2	(76%-122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Report Date: May 18, 2010
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Client Sample ID: 088924-001
Sample ID: 251644004
Matrix: AQUEOUS
Collect Date: 21-APR-10 13:46
Receive Date: 23-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003
Client Desc.: MWL-MW9
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 05/03/10	2143	980470	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 18, 2010

Client Sample ID: 088924-001
Sample ID: 251644004

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	54.0 ug/L	50.0	108	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	49.7 ug/L	50.0	99.4	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	49.2 ug/L	50.0	98.5	(76%-122%)

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Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 18, 2010

Client Sample ID:	088925-001	Project:	SNLSGWater
Sample ID:	251644005	Client ID:	SNLS003
Matrix:	AQUEOUS		
Collect Date:	21-APR-10 13:46		
Receive Date:	23-APR-10	Client Desc.:	MWL-TB4
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 05/03/10	2213	980470	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 18, 2010

Client Sample ID: 088925-001
Sample ID: 251644005

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	53.0 ug/L	50.0	106	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	49.4 ug/L	50.0	98.8	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	48.3 ug/L	50.0	96.6	(76%-122%)

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 18, 2010

Client Sample ID: 088926-001
Sample ID: 251644006
Matrix: AQUEOUS
Collect Date: 22-APR-10 08:21
Receive Date: 23-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003
Client Desc.: MWL-MW7
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 05/03/10	2244	980470	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 18, 2010

Client Sample ID: 088926-001
Sample ID: 251644006

Proiect: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	52.4 ug/L	50.0	105	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	48.6 ug/L	50.0	97.2	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	47.5 ug/L	50.0	95.0	(76%-122%)

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Albuquerque, New Mexico 87123
Report Date: May 18, 2010
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Client Sample ID: 088927-001
Sample ID: 251644007
Matrix: AQUEOUS
Collect Date: 22-APR-10 08:25
Receive Date: 23-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003
Client Desc.: MWL-MW7
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Volatile Organics											
8260B TCL Liquid "As Received"											
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4	05/03/10	2314	980470	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1					
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1					
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1					
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1					
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1					
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1					
2-Butanone	U	ND	1.25	5.00	ug/L	1					
2-Hexanone	U	ND	1.25	5.00	ug/L	1					
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1					
Acetone	U	ND	3.50	10.0	ug/L	1					
Benzene	U	ND	0.300	1.00	ug/L	1					
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1					
Bromoform	U	ND	0.250	1.00	ug/L	1					
Bromomethane	U	ND	0.300	1.00	ug/L	1					
Carbon disulfide	U	ND	1.25	5.00	ug/L	1					
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1					
Chlorobenzene	U	ND	0.250	1.00	ug/L	1					
Chloroethane	U	ND	0.300	1.00	ug/L	1					
Chloroform	U	ND	0.250	1.00	ug/L	1					
Chloromethane	U	ND	0.300	1.00	ug/L	1					
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1					
Ethylbenzene	U	ND	0.250	1.00	ug/L	1					
Methylene chloride	U	ND	3.00	10.0	ug/L	1					
Styrene	U	ND	0.250	1.00	ug/L	1					
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1					
Toluene	U	ND	0.250	1.00	ug/L	1					
Trichloroethylene	U	ND	0.250	1.00	ug/L	1					
Vinyl acetate	U	ND	1.50	5.00	ug/L	1					
Vinyl chloride	U	ND	0.500	1.00	ug/L	1					
Xylenes (total)	U	ND	0.300	1.00	ug/L	1					
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1					
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1					
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1					
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1					

The following Analytical Methods were performed

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Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 18, 2010

Client Sample ID: 088927-001
Sample ID: 251644007

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	51.3 ug/L	50.0	103	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	48.9 ug/L	50.0	97.8	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	47.8 ug/L	50.0	95.5	(76%-122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 18, 2010

Client Sample ID: 088928-001
Sample ID: 251644008
Matrix: AQUEOUS
Collect Date: 22-APR-10 08:33
Receive Date: 23-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-MW7
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 05/04/10	1126	980470	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 18, 2010

Client Sample ID: 088928-001
Sample ID: 251644008

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	52.8 ug/L	50.0	106	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	46.6 ug/L	50.0	93.3	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	48.3 ug/L	50.0	96.5	(76%-122%)

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 18, 2010

Client Sample ID: 088958-001
Sample ID: 251644009
Matrix: AQUEOUS
Collect Date: 22-APR-10 08:41
Receive Date: 23-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003

Client Desc.: MWL-MW7
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Volatile Organics										
8260B TCL Liquid "As Received"										
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4 05/04/10	1156	980470	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1				
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1				
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1				
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1				
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1				
2-Butanone	U	ND	1.25	5.00	ug/L	1				
2-Hexanone	U	ND	1.25	5.00	ug/L	1				
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1				
Acetone	U	ND	3.50	10.0	ug/L	1				
Benzene	U	ND	0.300	1.00	ug/L	1				
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1				
Bromoform	U	ND	0.250	1.00	ug/L	1				
Bromomethane	U	ND	0.300	1.00	ug/L	1				
Carbon disulfide	U	ND	1.25	5.00	ug/L	1				
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1				
Chlorobenzene	U	ND	0.250	1.00	ug/L	1				
Chloroethane	U	ND	0.300	1.00	ug/L	1				
Chloroform	U	ND	0.250	1.00	ug/L	1				
Chloromethane	U	ND	0.300	1.00	ug/L	1				
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1				
Ethylbenzene	U	ND	0.250	1.00	ug/L	1				
Methylene chloride	U	ND	3.00	10.0	ug/L	1				
Styrene	U	ND	0.250	1.00	ug/L	1				
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1				
Toluene	U	ND	0.250	1.00	ug/L	1				
Trichloroethylene	U	ND	0.250	1.00	ug/L	1				
Vinyl acetate	U	ND	1.50	5.00	ug/L	1				
Vinyl chloride	U	ND	0.500	1.00	ug/L	1				
Xylenes (total)	U	ND	0.300	1.00	ug/L	1				
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1				
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1				

The following Analytical Methods were performed

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Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 18, 2010

Client Sample ID: 088958-001
Sample ID: 251644009

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	56.6 ug/L	50.0	113	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	48.1 ug/L	50.0	96.2	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	50.0 ug/L	50.0	100	(76%-122%)

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2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Company : Sandia National Laboratories
Address : MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico 87123
Report Date: May 18, 2010
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Client Sample ID: 088929-001
Sample ID: 251644010
Matrix: AQUEOUS
Collect Date: 22-APR-10 09:02
Receive Date: 23-APR-10
Collector: Client

Project: SNLSGWater
Client ID: SNLS003
Client Desc.: MWL-MW7
Vol. Recv.:

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Volatile Organics											
8260B TCL Liquid "As Received"											
1,1,1-Trichloroethane	U	ND	0.325	1.00	ug/L	1	RXM4	05/04/10	1228	980470	1
1,1,2,2-Tetrachloroethane	U	ND	0.250	1.00	ug/L	1					
1,1,2-Trichloroethane	U	ND	0.250	1.00	ug/L	1					
1,1-Dichloroethane	U	ND	0.300	1.00	ug/L	1					
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/L	1					
1,2-Dichloroethane	U	ND	0.250	1.00	ug/L	1					
1,2-Dichloropropane	U	ND	0.250	1.00	ug/L	1					
2-Butanone	U	ND	1.25	5.00	ug/L	1					
2-Hexanone	U	ND	1.25	5.00	ug/L	1					
4-Methyl-2-pentanone	U	ND	1.25	5.00	ug/L	1					
Acetone	U	ND	3.50	10.0	ug/L	1					
Benzene	U	ND	0.300	1.00	ug/L	1					
Bromodichloromethane	U	ND	0.250	1.00	ug/L	1					
Bromoform	U	ND	0.250	1.00	ug/L	1					
Bromomethane	U	ND	0.300	1.00	ug/L	1					
Carbon disulfide	U	ND	1.25	5.00	ug/L	1					
Carbon tetrachloride	U	ND	0.300	1.00	ug/L	1					
Chlorobenzene	U	ND	0.250	1.00	ug/L	1					
Chloroethane	U	ND	0.300	1.00	ug/L	1					
Chloroform	U	ND	0.250	1.00	ug/L	1					
Chloromethane	U	ND	0.300	1.00	ug/L	1					
Dibromochloromethane	U	ND	0.300	1.00	ug/L	1					
Ethylbenzene	U	ND	0.250	1.00	ug/L	1					
Methylene chloride	U	ND	3.00	10.0	ug/L	1					
Styrene	U	ND	0.250	1.00	ug/L	1					
Tetrachloroethylene	U	ND	0.300	1.00	ug/L	1					
Toluene	U	ND	0.250	1.00	ug/L	1					
Trichloroethylene	U	ND	0.250	1.00	ug/L	1					
Vinyl acetate	U	ND	1.50	5.00	ug/L	1					
Vinyl chloride	U	ND	0.500	1.00	ug/L	1					
Xylenes (total)	U	ND	0.300	1.00	ug/L	1					
cis-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1					
cis-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1					
trans-1,2-Dichloroethylene	U	ND	0.300	1.00	ug/L	1					
trans-1,3-Dichloropropylene	U	ND	0.250	1.00	ug/L	1					

The following Analytical Methods were performed

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Certificate of Analysis

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1515 Eubank SE
Albuquerque, New Mexico 87123
Contact: Ms. Pamela M. Puissant
Project: **Level C, Groundwater Monitoring**

Report Date: May 18, 2010

Client Sample ID: 088929-001
Sample ID: 251644010

Project: SNLSGWater
Client ID: SNLS003

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 8260B DOE-AL	

Surrogate/Tracer recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4	8260B TCL Liquid "As Received"	54.4 ug/L	50.0	109	(72%-132%)
Bromofluorobenzene	8260B TCL Liquid "As Received"	47.5 ug/L	50.0	95.0	(77%-123%)
Toluene-d8	8260B TCL Liquid "As Received"	49.0 ug/L	50.0	97.9	(76%-122%)

QC Summary

Report Date: May 18, 2010

Sandia National Laboratories
MS-0756, Org. 06765, Bldg. 823/Rm. 4276
1515 Eubank SE
Albuquerque, New Mexico
Contact: **Ms. Pamela M. Puissant**

Workorder: **251644**

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
Volatile-GC/MS											
Batch 980470											
QC1202108099 LCS											
1,1,1-Trichloroethane	50.0			51.0	ug/L		102	(73%-132%)	RXM4	05/03/10	13:21
1,1,2,2-Tetrachloroethane	50.0			42.1	ug/L		84.2	(69%-120%)			
1,1,2-Trichloroethane	50.0			41.5	ug/L		82.9	(74%-120%)			
1,1-Dichloroethane	50.0			49.2	ug/L		98.4	(75%-121%)			
1,1-Dichloroethylene	50.0			49.1	ug/L		98.1	(71%-130%)			
1,2-Dichloroethane	50.0			43.9	ug/L		87.7	(66%-123%)			
1,2-Dichloropropane	50.0			47.5	ug/L		95	(75%-120%)			
2-Butanone	250			227	ug/L		90.8	(30%-145%)			
2-Hexanone	250			208	ug/L		83.1	(30%-149%)			
4-Methyl-2-pentanone	250			207	ug/L		82.9	(57%-132%)			
Acetone	250			253	ug/L		101	(30%-152%)			
Benzene	50.0			50.0	ug/L		99.9	(74%-120%)			
Bromodichloromethane	50.0			46.1	ug/L		92.3	(76%-129%)			
Bromoform	50.0			42.7	ug/L		85.3	(67%-134%)			
Bromomethane	50.0			49.7	ug/L		99.3	(70%-129%)			
Carbon disulfide	250			276	ug/L		110	(74%-137%)			
Carbon tetrachloride	50.0			52.8	ug/L		106	(73%-139%)			
Chlorobenzene	50.0			45.6	ug/L		91.2	(77%-120%)			
Chloroethane	50.0			45.8	ug/L		91.7	(69%-128%)			
Chloroform	50.0			47.6	ug/L		95.1	(75%-120%)			
Chloromethane	50.0			38.7	ug/L		77.5	(57%-131%)			
Dibromochloromethane	50.0			41.8	ug/L		83.6	(74%-128%)			
Ethylbenzene	50.0			45.3	ug/L		90.5	(74%-120%)			
Methylene chloride	50.0			51.2	ug/L		102	(70%-124%)			
Styrene	50.0			42.4	ug/L		84.9	(74%-128%)			
Tetrachloroethylene	50.0			47.2	ug/L		94.5	(73%-124%)			
Toluene	50.0			44.9	ug/L		89.7	(74%-120%)			
Trichloroethylene	50.0			52.0	ug/L		104	(78%-123%)			
Vinyl acetate	250			238	ug/L		95.2	(62%-143%)			
Vinyl chloride	50.0			46.3	ug/L		92.6	(68%-129%)			
Xylenes (total)	150			136	ug/L		90.8	(76%-122%)			
cis-1,2-Dichloroethylene	50.0			50.4	ug/L		101	(76%-125%)			
cis-1,3-Dichloropropylene	50.0			46.0	ug/L		92.1	(78%-129%)			
trans-1,2-Dichloroethylene	50.0			51.7	ug/L		103	(73%-122%)			
trans-1,3-Dichloropropylene	50.0			41.4	ug/L		82.8	(77%-126%)			
**1,2-Dichloroethane-d4	50.0			58.1	ug/L		116	(72%-132%)			

QC Summary

Workorder: 251644

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS										
Batch 980470										
**Bromofluorobenzene	50.0			50.4	ug/L		101	(77%-123%)		
**Toluene-d8	50.0			48.6	ug/L		97.2	(76%-122%)	RXM4	05/03/10 13:21
QC1202108767 LCS										
1,1,1-Trichloroethane	50.0			50.4	ug/L		101	(73%-132%)		05/04/10 08:22
1,1,2,2-Tetrachloroethane	50.0			37.6	ug/L		75.2	(69%-120%)		
1,1,2-Trichloroethane	50.0			38.5	ug/L		77	(74%-120%)		
1,1-Dichloroethane	50.0			48.9	ug/L		97.7	(75%-121%)		
1,1-Dichloroethylene	50.0			47.9	ug/L		95.9	(71%-130%)		
1,2-Dichloroethane	50.0			43.8	ug/L		87.6	(66%-123%)		
1,2-Dichloropropane	50.0			45.7	ug/L		91.3	(75%-120%)		
2-Butanone	250			214	ug/L		85.8	(30%-145%)		
2-Hexanone	250			196	ug/L		78.4	(30%-149%)		
4-Methyl-2-pentanone	250			184	ug/L		73.5	(57%-132%)		
Acetone	250			242	ug/L		96.9	(30%-152%)		
Benzene	50.0			49.1	ug/L		98.2	(74%-120%)		
Bromodichloromethane	50.0			45.8	ug/L		91.7	(76%-129%)		
Bromoform	50.0			39.7	ug/L		79.5	(67%-134%)		
Bromomethane	50.0			50.0	ug/L		99.9	(70%-129%)		
Carbon disulfide	250			265	ug/L		106	(74%-137%)		
Carbon tetrachloride	50.0			53.1	ug/L		106	(73%-139%)		
Chlorobenzene	50.0			44.2	ug/L		88.4	(77%-120%)		
Chloroethane	50.0			43.2	ug/L		86.5	(69%-128%)		
Chloroform	50.0			47.2	ug/L		94.4	(75%-120%)		
Chloromethane	50.0			36.1	ug/L		72.1	(57%-131%)		
Dibromochloromethane	50.0			39.5	ug/L		78.9	(74%-128%)		
Ethylbenzene	50.0			43.9	ug/L		87.9	(74%-120%)		
Methylene chloride	50.0			51.9	ug/L		104	(70%-124%)		
Styrene	50.0			40.6	ug/L		81.1	(74%-128%)		
Tetrachloroethylene	50.0			45.9	ug/L		91.9	(73%-124%)		
Toluene	50.0			42.7	ug/L		85.5	(74%-120%)		
Trichloroethylene	50.0			52.0	ug/L		104	(78%-123%)		
Vinyl acetate	250			218	ug/L		87.3	(62%-143%)		
Vinyl chloride	50.0			42.9	ug/L		85.8	(68%-129%)		
Xylenes (total)	150			131	ug/L		87.3	(76%-122%)		
cis-1,2-Dichloroethylene	50.0			49.9	ug/L		99.8	(76%-125%)		
cis-1,3-Dichloropropylene	50.0			44.1	ug/L		88.2	(78%-129%)		
trans-1,2-Dichloroethylene	50.0			50.8	ug/L		102	(73%-122%)		
trans-1,3-Dichloropropylene	50.0			38.0	ug/L		75.9 *	(77%-126%)		
**1,2-Dichloroethane-d4	50.0			61.0	ug/L		122	(72%-132%)		
**Bromofluorobenzene	50.0			46.6	ug/L		93.1	(77%-123%)		
**Toluene-d8	50.0			48.8	ug/L		97.6	(76%-122%)		
QC1202108096 MB										

QC Summary

Workorder: **251644**

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
Volatile-GC/MS											
Batch 980470											
1,1,1-Trichloroethane			U	ND	ug/L					05/03/10	16:10
1,1,2,2-Tetrachloroethane			U	ND	ug/L				RXM4		
1,1,2-Trichloroethane			U	ND	ug/L						
1,1-Dichloroethane			U	ND	ug/L						
1,1-Dichloroethylene			U	ND	ug/L						
1,2-Dichloroethane			U	ND	ug/L						
1,2-Dichloropropane			U	ND	ug/L						
2-Butanone			U	ND	ug/L						
2-Hexanone			U	ND	ug/L						
4-Methyl-2-pentanone			U	ND	ug/L						
Acetone			U	ND	ug/L						
Benzene			U	ND	ug/L						
Bromodichloromethane			U	ND	ug/L						
Bromoform			U	ND	ug/L						
Bromomethane			U	ND	ug/L						
Carbon disulfide			U	ND	ug/L						
Carbon tetrachloride			U	ND	ug/L						
Chlorobenzene			U	ND	ug/L						
Chloroethane			U	ND	ug/L						
Chloroform			U	ND	ug/L						
Chloromethane			U	ND	ug/L						
Dibromochloromethane			U	ND	ug/L						
Ethylbenzene			U	ND	ug/L						
Methylene chloride			U	ND	ug/L						
Styrene			U	ND	ug/L						
Tetrachloroethylene			U	ND	ug/L						
Toluene			U	ND	ug/L						
Trichloroethylene			U	ND	ug/L						
Vinyl acetate			U	ND	ug/L						
Vinyl chloride			U	ND	ug/L						
Xylenes (total)			U	ND	ug/L						
cis-1,2-Dichloroethylene			U	ND	ug/L						
cis-1,3-Dichloropropylene			U	ND	ug/L						
trans-1,2-Dichloroethylene			U	ND	ug/L						
trans-1,3-Dichloropropylene			U	ND	ug/L						
**1,2-Dichloroethane-d4	50.0			49.1	ug/L		98.2	(72%-132%)			
**Bromofluorobenzene	50.0			49.1	ug/L		98.2	(77%-123%)			
**Toluene-d8	50.0			47.3	ug/L		94.5	(76%-122%)			
QC1202108766 MB											
1,1,1-Trichloroethane			U	ND	ug/L					05/04/10	10:55
1,1,2,2-Tetrachloroethane			U	ND	ug/L						
1,1,2-Trichloroethane			U	ND	ug/L						

QC Summary

Workorder: 251644

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS											
Batch 980470											
1,1-Dichloroethane				U	ND	ug/L					
1,1-Dichloroethylene				U	ND	ug/L				RXM4	05/04/10 10:55
1,2-Dichloroethane				U	ND	ug/L					
1,2-Dichloropropane				U	ND	ug/L					
2-Butanone				U	ND	ug/L					
2-Hexanone				U	ND	ug/L					
4-Methyl-2-pentanone				U	ND	ug/L					
Acetone				U	ND	ug/L					
Benzene				U	ND	ug/L					
Bromodichloromethane				U	ND	ug/L					
Bromoform				U	ND	ug/L					
Bromomethane				U	ND	ug/L					
Carbon disulfide				U	ND	ug/L					
Carbon tetrachloride				U	ND	ug/L					
Chlorobenzene				U	ND	ug/L					
Chloroethane				U	ND	ug/L					
Chloroform				U	ND	ug/L					
Chloromethane				U	ND	ug/L					
Dibromochloromethane				U	ND	ug/L					
Ethylbenzene				U	ND	ug/L					
Methylene chloride				U	ND	ug/L					
Styrene				U	ND	ug/L					
Tetrachloroethylene				U	ND	ug/L					
Toluene				U	ND	ug/L					
Trichloroethylene				U	ND	ug/L					
Vinyl acetate				U	ND	ug/L					
Vinyl chloride				U	ND	ug/L					
Xylenes (total)				U	ND	ug/L					
cis-1,2-Dichloroethylene				U	ND	ug/L					
cis-1,3-Dichloropropylene				U	ND	ug/L					
trans-1,2-Dichloroethylene				U	ND	ug/L					
trans-1,3-Dichloropropylene				U	ND	ug/L					
**1,2-Dichloroethane-d4	50.0				53.8	ug/L		108	(72%-132%)		
**Bromofluorobenzene	50.0				47.2	ug/L		94.4	(77%-123%)		
**Toluene-d8	50.0				47.6	ug/L		95.2	(76%-122%)		
QC1202108097 251644001 PS											
1,1,1-Trichloroethane	50.0	U	ND		55.0	ug/L		110	(66%-132%)		05/04/10 14:30
1,1,2,2-Tetrachloroethane	50.0	U	ND		47.3	ug/L		94.6	(65%-124%)		
1,1,2-Trichloroethane	50.0	U	ND		47.5	ug/L		94.9	(66%-123%)		
1,1-Dichloroethane	50.0	U	ND		54.8	ug/L		110	(58%-132%)		
1,1-Dichloroethylene	50.0	U	ND		50.3	ug/L		101	(59%-128%)		
1,2-Dichloroethane	50.0	U	ND		52.6	ug/L		105	(60%-127%)		

QC Summary

Workorder: 251644

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS											
Batch 980470											
1,2-Dichloropropane	50.0	U	ND		54.3	ug/L		109	(69%-122%)		
2-Butanone	250	U	ND		148	ug/L		59.3	(11%-118%)	RXM4	05/04/10 14:30
2-Hexanone	250	U	ND		159	ug/L		63.6	(25%-125%)		
4-Methyl-2-pentanone	250	U	ND		219	ug/L		87.6	(52%-130%)		
Acetone	250	U	ND		107	ug/L		42.6	(15%-142%)		
Benzene	50.0	U	ND		55.7	ug/L		111	(65%-119%)		
Bromodichloromethane	50.0	U	ND		54.1	ug/L		108	(67%-134%)		
Bromoform	50.0	U	ND		48.7	ug/L		97.4	(59%-140%)		
Bromomethane	50.0	U	ND		56.7	ug/L		113	(50%-140%)		
Carbon disulfide	250	U	ND		288	ug/L		115	(62%-135%)		
Carbon tetrachloride	50.0	U	ND		56.4	ug/L		113	(61%-137%)		
Chlorobenzene	50.0	U	ND		51.8	ug/L		104	(74%-116%)		
Chloroethane	50.0	U	ND		48.8	ug/L		97.7	(60%-125%)		
Chloroform	50.0	U	ND		54.1	ug/L		108	(68%-130%)		
Chloromethane	50.0	U	ND		41.4	ug/L		82.8	(47%-135%)		
Dibromochloromethane	50.0	U	ND		48.3	ug/L		96.6	(66%-132%)		
Ethylbenzene	50.0	U	ND		49.3	ug/L		98.6	(59%-125%)		
Methylene chloride	50.0	U	ND		62.1	ug/L		124*	(63%-122%)		
Styrene	50.0	U	ND		47.9	ug/L		95.8	(54%-138%)		
Tetrachloroethylene	50.0	U	ND		50.4	ug/L		101	(63%-121%)		
Toluene	50.0	U	ND		49.2	ug/L		98.3	(64%-116%)		
Trichloroethylene	50.0	U	ND		56.9	ug/L		114	(68%-121%)		
Vinyl acetate	250	U	ND		261	ug/L		105	(56%-151%)		
Vinyl chloride	50.0	U	ND		47.6	ug/L		95.1	(51%-136%)		
Xylenes (total)	150	U	ND		149	ug/L		99.6	(47%-144%)		
cis-1,2-Dichloroethylene	50.0	U	ND		57.4	ug/L		115	(63%-132%)		
cis-1,3-Dichloropropylene	50.0	U	ND		52.7	ug/L		105	(64%-133%)		
trans-1,2-Dichloroethylene	50.0	U	ND		55.9	ug/L		112	(64%-120%)		
trans-1,3-Dichloropropylene	50.0	U	ND		46.7	ug/L		93.4	(63%-133%)		
**1,2-Dichloroethane-d4	50.0		51.0		59.9	ug/L		120	(72%-132%)		
**Bromofluorobenzene	50.0		49.0		47.1	ug/L		94.2	(77%-123%)		
**Toluene-d8	50.0		47.1		49.0	ug/L		97.9	(76%-122%)		
QC1202108098 251644001 PSD											
1,1,1-Trichloroethane	50.0	U	ND		56.3	ug/L	2.25	113	(0%-20%)		05/04/10 15:00
1,1,2,2-Tetrachloroethane	50.0	U	ND		46.8	ug/L	1.15	93.5	(0%-20%)		
1,1,2-Trichloroethane	50.0	U	ND		48.0	ug/L	1.24	96.1	(0%-20%)		
1,1-Dichloroethane	50.0	U	ND		56.3	ug/L	2.75	113	(0%-20%)		
1,1-Dichloroethylene	50.0	U	ND		52.7	ug/L	4.68	105	(0%-20%)		
1,2-Dichloroethane	50.0	U	ND		52.6	ug/L	0.00855	105	(0%-20%)		
1,2-Dichloropropane	50.0	U	ND		55.9	ug/L	2.88	112	(0%-20%)		
2-Butanone	250	U	ND		144	ug/L	2.67	57.7	(0%-20%)		
2-Hexanone	250	U	ND		153	ug/L	4.02	61.1	(0%-20%)		

QC Summary

Workorder: **251644**

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
Volatile-GC/MS												
Batch 980470												
4-Methyl-2-pentanone	250	U	ND		213	ug/L	2.66	85.3	(0%-20%)			
Acetone	250	U	ND		105	ug/L	1.56	42	(0%-20%)	RXM4	05/04/10	15:00
Benzene	50.0	U	ND		56.7	ug/L	1.77	113	(0%-20%)			
Bromodichloromethane	50.0	U	ND		54.9	ug/L	1.53	110	(0%-20%)			
Bromoform	50.0	U	ND		47.8	ug/L	1.93	95.6	(0%-20%)			
Bromomethane	50.0	U	ND		58.4	ug/L	3.01	117	(0%-20%)			
Carbon disulfide	250	U	ND		299	ug/L	4.02	120	(0%-20%)			
Carbon tetrachloride	50.0	U	ND		58.4	ug/L	3.52	117	(0%-20%)			
Chlorobenzene	50.0	U	ND		52.2	ug/L	0.797	104	(0%-20%)			
Chloroethane	50.0	U	ND		50.0	ug/L	2.33	100	(0%-20%)			
Chloroform	50.0	U	ND		56.0	ug/L	3.47	112	(0%-20%)			
Chloromethane	50.0	U	ND		43.3	ug/L	4.38	86.5	(0%-20%)			
Dibromochloromethane	50.0	U	ND		48.2	ug/L	0.283	96.4	(0%-20%)			
Ethylbenzene	50.0	U	ND		50.5	ug/L	2.43	101	(0%-20%)			
Methylene chloride	50.0	U	ND		63.1	ug/L	1.58	126*	(0%-20%)			
Styrene	50.0	U	ND		48.4	ug/L	1.07	96.8	(0%-20%)			
Tetrachloroethylene	50.0	U	ND		50.9	ug/L	1.08	102	(0%-20%)			
Toluene	50.0	U	ND		50.2	ug/L	2.06	100	(0%-20%)			
Trichloroethylene	50.0	U	ND		58.9	ug/L	3.41	118	(0%-20%)			
Vinyl acetate	250	U	ND		256	ug/L	1.94	103	(0%-20%)			
Vinyl chloride	50.0	U	ND		50.0	ug/L	4.99	100	(0%-20%)			
Xylenes (total)	150	U	ND		151	ug/L	0.805	100	(0%-20%)			
cis-1,2-Dichloroethylene	50.0	U	ND		59.3	ug/L	3.29	119	(0%-20%)			
cis-1,3-Dichloropropylene	50.0	U	ND		53.2	ug/L	0.875	106	(0%-20%)			
trans-1,2-Dichloroethylene	50.0	U	ND		57.8	ug/L	3.31	116	(0%-20%)			
trans-1,3-Dichloropropylene	50.0	U	ND		46.7	ug/L	0.128	93.3	(0%-20%)			
**1,2-Dichloroethane-d4	50.0		51.0		61.3	ug/L		123	(72%-132%)			
**Bromofluorobenzene	50.0		49.0		47.9	ug/L		95.9	(77%-123%)			
**Toluene-d8	50.0		47.1		49.8	ug/L		99.6	(76%-122%)			

Notes:
RER is calculated at the 95% confidence level (2-sigma).
The Qualifiers in this report are defined as follows:

- * Recovery or %RPD not within acceptance limits and/or spike amount not compatible with the sample or the duplicate RPD's are not applicable where the concentration falls below the effective PQL.
- ** Indicates analyte is a surrogate compound.
- B The analyte was found in the blank above the effective MDL.
- H Analytical holding time was exceeded
- J Estimated value, the analyte concentration fell above the effective MDL and below the effective PQL
- P The response between the confirmation column and the primary column is >40%D
- U The analyte was analyzed for but not detected below this concentration. For Organic and Inorganic analytes the result is less than the effective MDL. For radiochemical analytes the result is less than the Decision Level

QC Summary

Workorder: **251644**

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time

X Presumptive evidence that the analyte is not present. Please see narrative for further infromation.

Z The percent difference is greater than 70%.

d The 2:1 depletion requirement was not met for this sample

h Prep holding time exceeded

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

Volume VIII

TAB 26

Notice of Approval: Mixed Waste Landfill Toluene Investigation Report, Revised October 2010

From: NMED/Bearzi
To: SNL/Wagner

Back of Tab 26

SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lieutenant Governor

NEW MEXICO ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

DAVE MARTIN
Cabinet Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

January 13, 2011

Patty Wagner
Manager
U.S. Department of Energy
NNSA / Sandia Site Office
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Jill M. Hruby
Vice President
Energy, Non-Proliferation, and High-Consequence Security
Sandia National Laboratories
P.O. Box 5800, MS 0701
Albuquerque, NM 87185-0701

RE: NOTICE OF APPROVAL
MIXED WASTE LANDFILL TOLUENE INVESTIGATION REPORT, REVISED OCTOBER 2010
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-10-011

Dear Mmes. Wagner and Hruby:

The New Mexico Environment Department (NMED) has reviewed the Mixed Waste Landfill Toluene Investigation Report (revised) dated October 2010. The revised report was submitted by the U. S. Department of Energy (DOE) on behalf of itself and Sandia Corporation (collectively, the Permittees) in response to the Notice of Disapproval issued by the NMED on September 28, 2010, for the original version of the report dated August 2010. The subject report, as revised in October 2010, is hereby approved.

NMED is confident that the Mixed Waste Landfill (MWL) is likely not the source of the low levels of toluene detected in groundwater samples from the new monitoring wells installed in 2008. The likely source or sources are laboratory contamination or error, sampling equipment, drilling equipment, or a combination of these potential sources. The best management practices proposed in the report to promote awareness of quality control issues should reduce occurrences of false positive data.

In accordance with Section VI.A, *Investigation Work Plan*, of the Sandia National Laboratories Compliance Order on Consent (April 29, 2004), if the NMED determines that further investigation is needed based on new information or if subsequent analysis indicates a release or likelihood of a release from the MWL, the NMED will notify the Permittees in writing that additional investigation is required. If so notified by the NMED, the Permittees shall submit to the NMED for approval an investigation work plan prepared in accordance with Section X.B of the Consent Order by the date specified by the NMED.

Should you have any questions regarding this letter please contact William Moats of my staff at (505) 222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE-OB
L. King, EPA-6
J. Cochran, SNL, MS 0719
J. Gould, SNL, MS 0184
File: SNL 2011 and Reading
SNL-10-011

Volume VIII

TAB 27

Mixed Waste Landfill Groundwater Monitoring Report - Monitoring Well MWL -MW4 Metals Data – Calendar Year 2013

From: SNL/Todd
To: NMED/Kieling

Back of Tab 27

SWL MWL

Department of Energy
National Nuclear Security Administration
Sandia Field Office
P. O. Box 5400
Albuquerque, NM 87185

ENTERED

MAY 2 0 2014

RECEIVED

MAY 2 9 2014

NMED
Hazardous Waste Bureau

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. John E. Kieling
Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Bldg. 1
Santa Fe, NM 87505

Subject: Department of Energy/National Nuclear Security Administration Sandia National Laboratories Environmental Restoration Operations Mixed Waste Landfill Groundwater Monitoring Report -Monitoring Well MWL-MW4 Metals Data -Calendar Year 2013

Dear Mr. Kieling:

The Department of Energy/National Nuclear Security Administration (DOE/NNSA) and Sandia Corporation (Sandia) are submitting the *Mixed Waste Landfill Groundwater Monitoring Report -Monitoring Well MWL-MW4 Metals Data - Calendar Year 2013* as requested by the New Mexico Environment Department (NMED), Hazardous Waste Bureau (HWB) staff on April 16, 2014. The enclosed report presents unfiltered and filtered metals results for groundwater samples collected from monitoring well MWL-MW4 and includes recommendations. The DOE/NNSA and Sandia are requesting NMED HWB input on this report and the proposed recommendations prior to taking any additional actions with regards to monitoring well MWL-MW4. In accordance with the January 8, 2014, NMED approval of the Mixed Waste Landfill (MWL) Long-Term Monitoring and Maintenance Plan, semiannual groundwater monitoring is being conducted at monitoring wells MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9.

If you should have any questions, please contact me at (505) 845-6036 or John Weckerle of my staff at (505) 845-6026.

Sincerely,

James W. Todd
Assistant Manager for
Engineering

Enclosure

cc w/enclosure **(Certified Mail)**:
William Moats, NMED-HWB
5500 San Antonio Dr., NE
Albuquerque, NM 87109

Laurie King, EPA, Region 6
1445 Ross Ave., Ste. 1200
Dallas, TX 75202

cc w/enclosure:
Dave Cobrain, NMED-HWB
2905 Rodeo Park Drive East, Bldg. 1
Santa Fe, NM 87505

Thomas Skibitski, NMED-OB, MS-1396
SNL ES&H Records Center, SNL/NM, MS-0718

Zimmerman Library, UNM
MSC05 3020
1 University of New Mexico
Albuquerque, NM 87101-0001

cc w/o enclosure:
Sujita Pierpoint, HQ/FORS, NA-00-50
Amy Blumberg, SNL/NM, MS-0141
John Cochran, SNL/NM, MS-0719
Peter Davies SNL/NM, MS-0721
David Miller, SNL/NM, MS-0718
Mike Mitchell, SNL/NM, MS-0718
Pam Puissant, SNL/NM, MS-0729
Sandra Sedillo, SNL/NM, MS-0727
Joe Estrada, SFO/ENG, MS-0184
Cynthia Wimberly, SFO/OOM, MS-0184
John Weckerle, SFO/ENG, MS-0184
14-434-574860

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **Environmental Restoration Operations Mixed Waste Landfill Groundwater Monitoring Report – Monitoring Well MWL-MW4 Metals Data - Calendar Year 2013**

Document author: **Mike Mitchell, Department 06234**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: _____ 5/16/14
Date

Peter Davies, Director
Nuclear Energy & Fuel Cycle Programs
Center 6200
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature: _____ 5/21/14
Date

James W. Todd
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

Sandia National Laboratories

Sandia National Laboratories, New Mexico

Environmental Restoration Operations

A U.S. Department of Energy Environmental Cleanup Program

MIXED WASTE LANDFILL
GROUNDWATER MONITORING REPORT
MONITORING WELL MWL-MW4 METALS DATA
CALENDAR YEAR 2013

U.S. DEPARTMENT OF ENERGY

United States Department of Energy
Sandia Field Office

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000

1.0 Introduction

This groundwater monitoring report provides information on metals results for recent samples collected from the Mixed Waste Landfill (MWL) monitoring well MWL-MW4 at Sandia National Laboratories, New Mexico (SNL/NM). Unfiltered and filtered nickel concentrations have increased in groundwater samples from this well since 2011. In 2013 additional metals (chromium, cobalt, copper, and iron) have also shown a significant increase in concentration, but only in the unfiltered samples. This report includes information that will be presented in the SNL/NM Calendar Year (CY) 2013 Annual Groundwater Monitoring Report (anticipated submittal in June 2014), but is being provided in advance to the New Mexico Environment Department (NMED). Recommendations for additional actions and monitoring of MWL-MW4 are also provided in light of the transition to groundwater monitoring at the MWL under the Long-Term Monitoring and Maintenance Plan (LTMMP) (SNL March 2012) that was approved by the NMED in January 2014 (Blaine January 2014).

The MWL is a 2.6-acre site in the north-central portion of Technical Area III at SNL/NM (Figure 1). The MWL consists of two distinct disposal areas: the classified area (occupying 0.6 acres) and the unclassified area (occupying 2.0 acres). Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies of activity (at the time of disposal) were disposed of in the MWL from March 1959 through December 1988. Classified wastes were buried in cylindrical pits in the classified area and unclassified wastes were buried in shallow trenches in the unclassified area. Construction of the MWL evapotranspirative (ET) Cover was completed in September 2009 and was approved by the NMED in October 2011 (Kieling October 2011).

1.1 Groundwater Monitoring Network and History

Groundwater monitoring has been conducted at the MWL since 1990. The original groundwater monitoring well network at the MWL (monitoring wells MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) was installed in 1988 and 1989. In 1993, monitoring well MWL-MW4 was completed at an angle of 6 degrees from vertical and was screened at two discrete intervals, 20 feet (ft) apart, to evaluate vertical potentiometric gradients and changes in aquifer parameters with depth. The well is constructed with schedule 80 polyvinyl chloride casing and screen intervals. Because of the two screen intervals and orientation, MWL-MW4 is equipped with an inflatable packer (pressurized by nitrogen-gas) separating the two screen intervals and a dedicated sampling system (Bennett™ stainless steel sampling pump, connecting rods, mounting bracket, lifting cable, and tubing). Machined stainless steel pipe connects the bottom of the sampling pump to the packer, and the entire assembly is held in the well by one-inch diameter metal rods and centralizers. MWL-MW4 is the only MWL monitoring well that contains a packer and dedicated stainless steel sampling equipment. Monitoring wells MWL-MW5 and MWL-MW6 were installed in 2000 at a distance of approximately 200 and 500 ft west of the MWL, respectively, with the screened intervals placed below the top of the regional water table in the coarse-grained Ancestral Rio Grande (ARG) deposits.

The MWL groundwater monitoring network was modified in 2008 (SNL May 2009). Due to the declining water table and corrosion of stainless-steel well screens, four monitoring wells were plugged and abandoned (MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3) and four new monitoring wells were installed (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) (SNL April 2008 and September 2008). The four wells installed in 2008 comprise the MWL groundwater monitoring network for the uppermost part of the regional aquifer and were approved by the NMED (Bearzi October 2008 and January 2009). In accordance with the NMED-approved MWL LTMMP that became effective January 8, 2014, sampling and analysis of these four wells is required for all future MWL groundwater monitoring. Sampling and analysis of other MWL monitoring wells, including MWL-MW4, is not required but they will be retained for other information (i.e., groundwater elevation data).

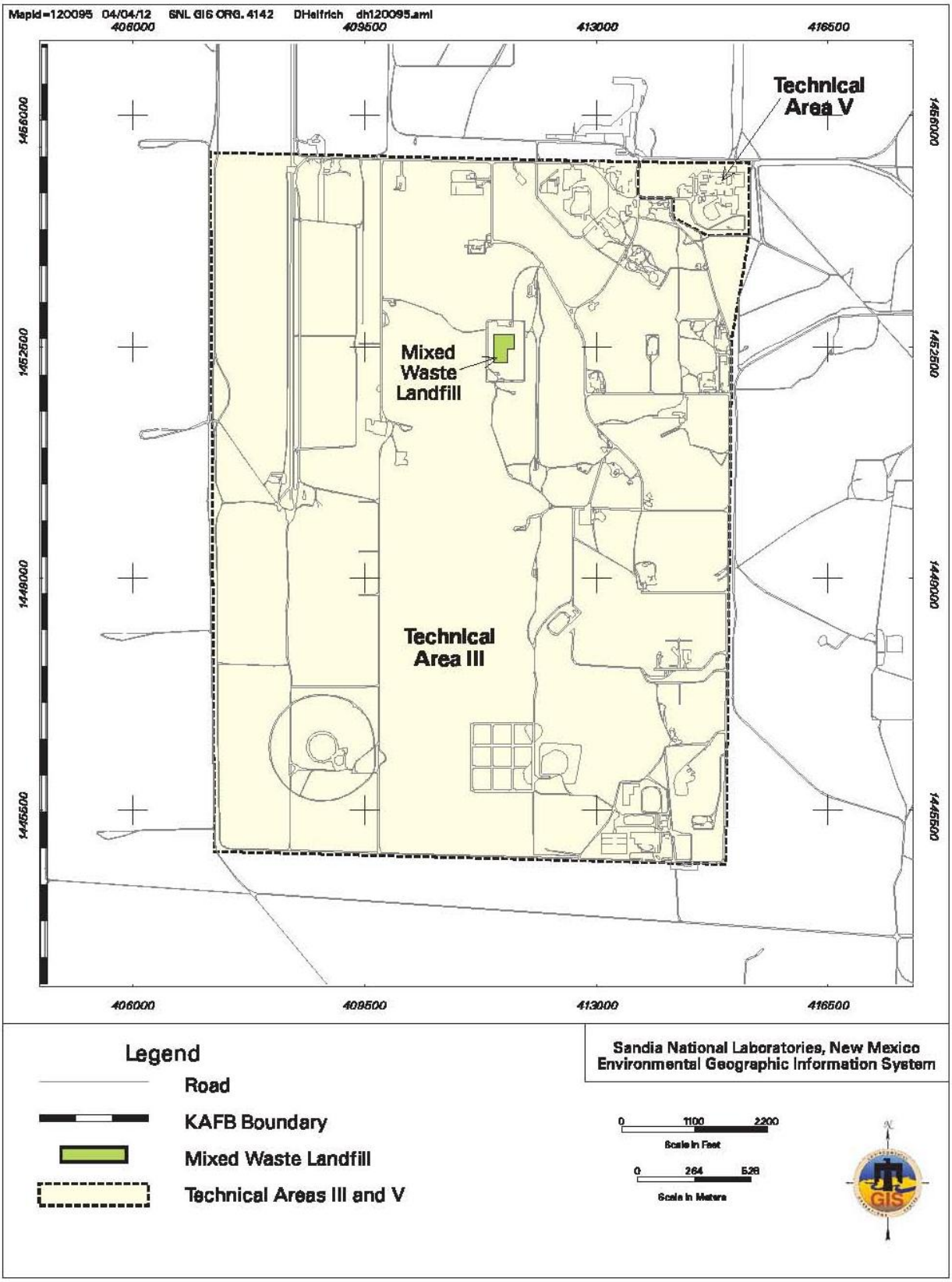

Figure 1. Location of the Mixed Waste Landfill within Technical Area III

Groundwater at the MWL has been extensively characterized and monitored since 1990 for major ion chemistry, volatile organic compounds (VOCs), semivolatile organic compounds, nitrate, metals, radionuclides, and perchlorate. More than twenty years of data indicate that groundwater has not been contaminated by the MWL (Goering et al. 2002; SNL December 2001, January 2002, July 2002, October 2002, June 2003, September 2003, July 2004; Lyon and Goering 2006; SNL November 2006, January 2008, May 2009, June 2010, October 2010, September 2011, June 2012, and June 2013).

1.2 Groundwater Monitoring Well Network

The current groundwater monitoring network at the MWL consists of seven wells, as shown on Figure 2 and listed in Table 1. Of the seven wells, four have screen intervals across the upper surface of the regional aquifer (MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9) and are considered compliance wells that monitor the top of the regional water table. Monitoring well MWL-MW4 has two screen intervals separated by an inflatable packer; the upper interval is completed across the regional aquifer water table within the interfingering, fine-grained, Santa Fe Group alluvial-fan deposits. The deeper screen interval is completed within the coarse-grained ARG deposits that underlie the Santa Fe Group alluvial sediments. References in this report to groundwater samples and water levels from monitoring well MWL-MW4 refer to groundwater withdrawn or measured from the upper screened interval, and references made to the bottom of this well refer to the depth to the top of the packer. The lower screen interval of MWL-MW4 is completed within the coarse-grained ARG deposits, but is isolated by an inflatable packer and not monitored in CY 2013 (i.e., not sampled or used for groundwater elevation measurements).

Table 1. MWL Monitoring Well Network and Calendar Year 2013 Compliance Activities

Well ID	Installation Year	WQ [a]	WL [a]	Comment [b]
MWL-BW2	2008	✓	✓	Annual
MWL-MW4 [c]	1993	✓	✓	Annual
MWL-MW5	2000	✓	✓	Annual
MWL-MW6	2000	✓	✓	Annual
MWL-MW7	2008	✓	✓	Annual
MWL-MW8	2008	✓	✓	Annual
MWL-MW9	2008	✓	✓	Annual

NOTES:
[a]Check marks in the WQ and WL columns indicate WQ sampling and WL measurements were completed.
[b]Annual groundwater monitoring of all wells was conducted in January and February.
[c]Upper screen of monitoring well MWL-MW4 is monitored and represents uppermost portion of regional aquifer.
BW = Background Well.
ID = Identification.
MW = Monitoring Well.
MWL = Mixed Waste Landfill.
WL = Water level.
WQ = Water quality.

1.2.1 Conceptual Site Model

A detailed conceptual site model is provided in the *MWL Phase 2 RFI Report* (Peace et al. 2002) and the *Mixed Waste Landfill Groundwater Report, 1990 through 2001, Sandia National Laboratories, Albuquerque, New Mexico* (Goering et al. 2002). An update to the conceptual site model integrating the findings from the four monitoring wells installed in 2008 is presented in the *Mixed Waste Landfill Annual Groundwater Monitoring Report, Calendar Year 2009* (SNL June 2010) and the *Annual Groundwater Monitoring Report, Calendar Year 2012* (SNL June 2013).

Figure 2. Location of Groundwater Monitoring Wells at the Mixed Waste Landfill

The upper surface of the regional aquifer at the MWL is contained within the unconsolidated, fine-grained alluvial-fan deposits of the Santa Fe Group. The depth to water is approximately 500 ft below the ground surface and groundwater flows generally westward away from the Manzanita Mountains and towards the Rio Grande. Several water-supply wells operated by Kirtland Air Force Base (KAFB) and the Albuquerque Bernalillo County Water Utility Authority have significantly modified the natural groundwater flow regime near the MWL by creating a trough in the water table in the western and northern portions of KAFB. As a result, water levels at the MWL have continued to decline since monitoring began in 1990.

Figure 3 shows the October 2013 potentiometric surface of the regional aquifer beneath the MWL. Groundwater flows towards the west and northwest. Based on the contours, the horizontal gradient varies from approximately 0.02 to 0.08 ft per foot. The map is consistent with the conceptual site model and the base-wide potentiometric surface contours, which generally trend north to south beneath Technical Area III with the inferred groundwater flow direction being westward (SNL June 2013).

1.3 Calendar Year 2013 Groundwater Monitoring Activities

Annual groundwater sampling was conducted in January and February 2013 at the MWL as summarized in Table 1. Groundwater samples were collected from the seven monitoring wells (MWL-BW2, MWL-MW4, MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9) and analyzed for VOCs, Target Analyte List (TAL) metals plus uranium (filtered and unfiltered), anions (as bromide, chloride, fluoride, and sulfate), alkalinity, nitrate plus nitrite, gamma spectroscopy, gross alpha/beta activity, and tritium. Details of the CY 2013 annual groundwater sampling event at the MWL will be provided in the CY 2013 Annual Groundwater Monitoring Report, including field methods, field measurements, field and laboratory quality control (QC) samples, laboratory QC analyses, and data validation results. This report focuses on the 2013 filtered and unfiltered metals results, as well as historic metals results. Attachment A provides summary tables for the CY 2013 metals analytical results.

Groundwater sampling and depth-to-groundwater measurements were conducted in conformance with procedures specified in the *Mixed Waste Landfill Groundwater Monitoring, Mini-Sampling and Analysis Plan for Fiscal Year 2013 Annual Sampling* (SNL January 2013). The minimum purge requirements were not met at monitoring wells MWL-MW4, MWL-MW8, and MWL-MW9. These three monitoring wells were purged to dryness, allowed to recover, and then sampled to collect the most representative groundwater sample possible given the low yield of these wells. Groundwater samples were submitted to the off-site laboratory (GEL) following analysis request/chain-of-custody protocol. All groundwater samples were analyzed by off-site laboratories using U.S. Environmental Protection Agency (EPA)-specified protocols.

1.4 Summary of MWL-MW4 Metals Analytical Results

Metals analysis includes two sets of analyses and results, filtered and unfiltered fractions. Groundwater samples obtained for total metal analyses are collected without filtering. Dissolved metal samples are collected after groundwater is passed through in-line filters of 0.45 micron pore size. The difference in concentrations between the total and dissolved fraction may be attributed to the original metallic ion content of the particles and any sorption of ions to the suspended particles. Samples were analyzed for TAL metals according to EPA Methods 6010, 6020, and 7470 (EPA 1986).

Tables providing CY 2013 metals data for the entire MWL monitoring network are provided in Attachment A at the end of this report. Table A-1 summarizes the CY 2013 unfiltered groundwater metal results and Table A-2 summarizes the CY 2013 filtered metal results. Results are provided for the entire MWL groundwater monitoring network for comparison; however, the following discussion focuses on the sample results for MWL-MW4.

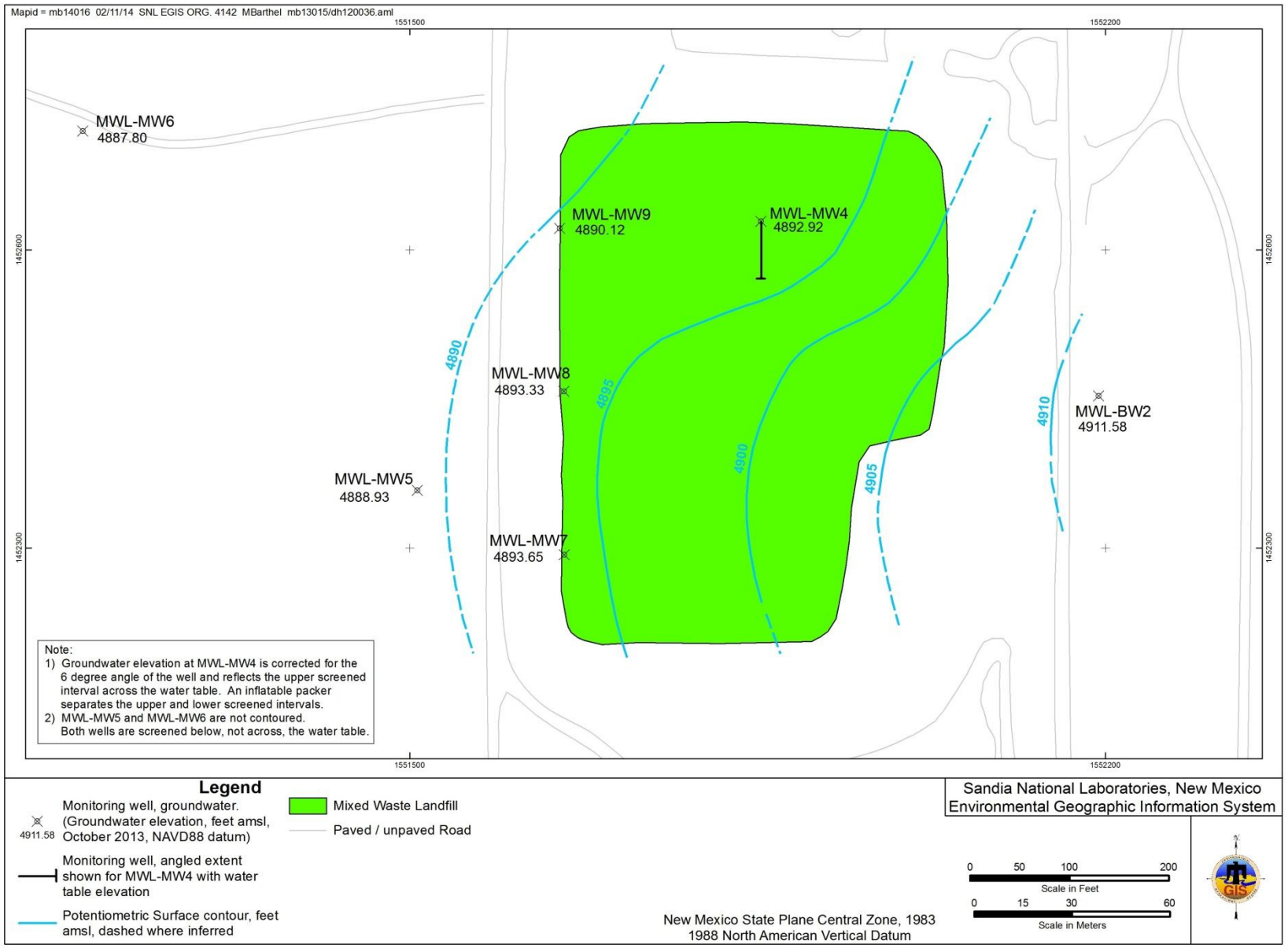

Figure 3. Localized Potentiometric Surface of the Basin Fill Aquifer at the Mixed Waste Landfill, October 2013

Metals results for all MWL monitoring well samples except MWL-MW4 were within the range of historical results and consistent with background concentrations. No metal parameters were detected above established maximum contaminant levels (MCLs) in any groundwater sample, except chromium. Chromium was detected above the MCL of 0.10 mg/L in the unfiltered sample from monitoring well MWL-MW4 at a concentration of 0.112 mg/L, which is the maximum concentration for the MWL-MW4 historic monitoring data set. In the filtered sample from monitoring well MWL-MW4, chromium was not detected above the laboratory method detection limit (MDL) of 0.002 mg/L. Unfiltered MWL-MW4 sample results for chromium, cobalt, copper, iron, and nickel were all significantly elevated relative to historic results. In addition, filtered MWL-MW4 sample results for nickel were elevated above the background concentration of 0.028 mg/L

A trend plot showing unfiltered chromium results for samples from monitoring well MWL-MW4 is provided in Figure 4. This plot includes groundwater elevation data and unfiltered sample results from a total of 19 sampling events conducted from April 1997 through February 2013. The MWL-MW4 unfiltered data set for chromium is dominated by very low detections and non-detections. Prior to CY 2013, the maximum unfiltered chromium concentration was 0.00599 mg/L (April 2001 sample), and from 2008 through 2012 chromium was detected only once in unfiltered samples at a concentration of 0.00259 mg/L (February 2012 sample). The February 2013 unfiltered sample result of 0.112 mg/L represents an unusual increase in chromium concentration (i.e., approximately 2 orders of magnitude), which is 18.7 times higher than the February 2012 result. In contrast, the February 2013 filtered sample result was a non-detection, with a laboratory MDL of 0.002 mg/L.

Other metals results for the February 2013 MWL-MW4 unfiltered sample were reported at concentrations significantly higher than previous maximum concentrations. As summarized in Table 2, cobalt, copper, iron, and nickel were all reported at new maximum concentrations in the February 2013 unfiltered sample. Cobalt, copper, and iron display a similar pattern to the unfiltered chromium results depicted in Figure 4, characterized by a narrow concentration range through 2012, followed by a sharp increase in 2013 concentrations. And similar to the chromium filtered versus unfiltered results, the filtered sample concentrations for cobalt, copper, and iron are much lower and consistent with historical results.

Table 2. MWL-MW4 Unfiltered Metals Results Summary, Calendar Year 2013

Metal	Maximum Concentration 1997 - 2012	February 2013 Concentration
Chromium	0.00559 mg/L (April 2001 sample)	0.112 mg/L
Cobalt	0.000888 mg/L (June 2007 sample)	0.00229 mg/L
Copper	0.00326 mg/L (June 2011 sample)	0.0335 mg/L
Iron	0.569 mg/L (April 2008 sample)	2.92 mg/L
Nickel	0.194 mg/L (February 2013 sample)	0.417 mg/L

mg/L = milligrams per liter. MWL = Mixed Waste Landfill. MW = monitoring well

A trend plot showing unfiltered nickel results for monitoring well MWL-MW4 samples is provided in Figure 5. All unfiltered results through 2010 are below or near the NMED-approved background concentration of 0.028 mg/L. Results from 2011, 2012, and 2013 show an increase in concentration by an order of magnitude, as well as an increasing trend (0.13, 0.194, and 0.417 mg/L, respectively). Although generally similar, there are two differences when comparing the MWL-MW4 nickel results to the MWL-MW4 chromium, cobalt, copper, and iron results. First, the substantial increase in the concentration of nickel occurred two years before the increase was observed for chromium, cobalt, copper, and iron (2011 versus 2013). Second, unfiltered and filtered nickel results are similar and do not show the substantial differences in concentration (i.e., order of magnitude difference) observed in the 2013 results for

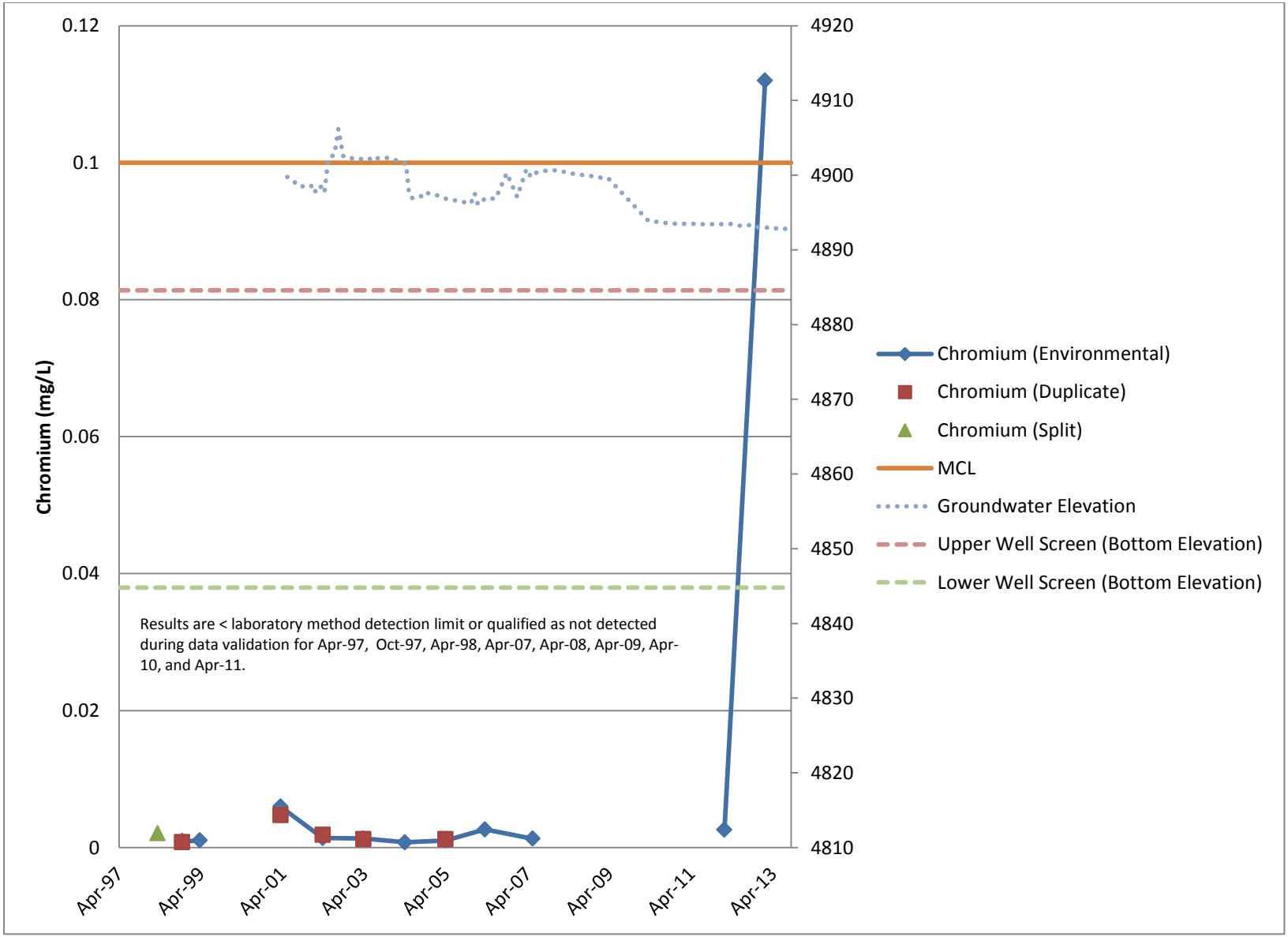

Figure 4. Unfiltered Chromium Concentrations, MWL-MW4 Groundwater Samples

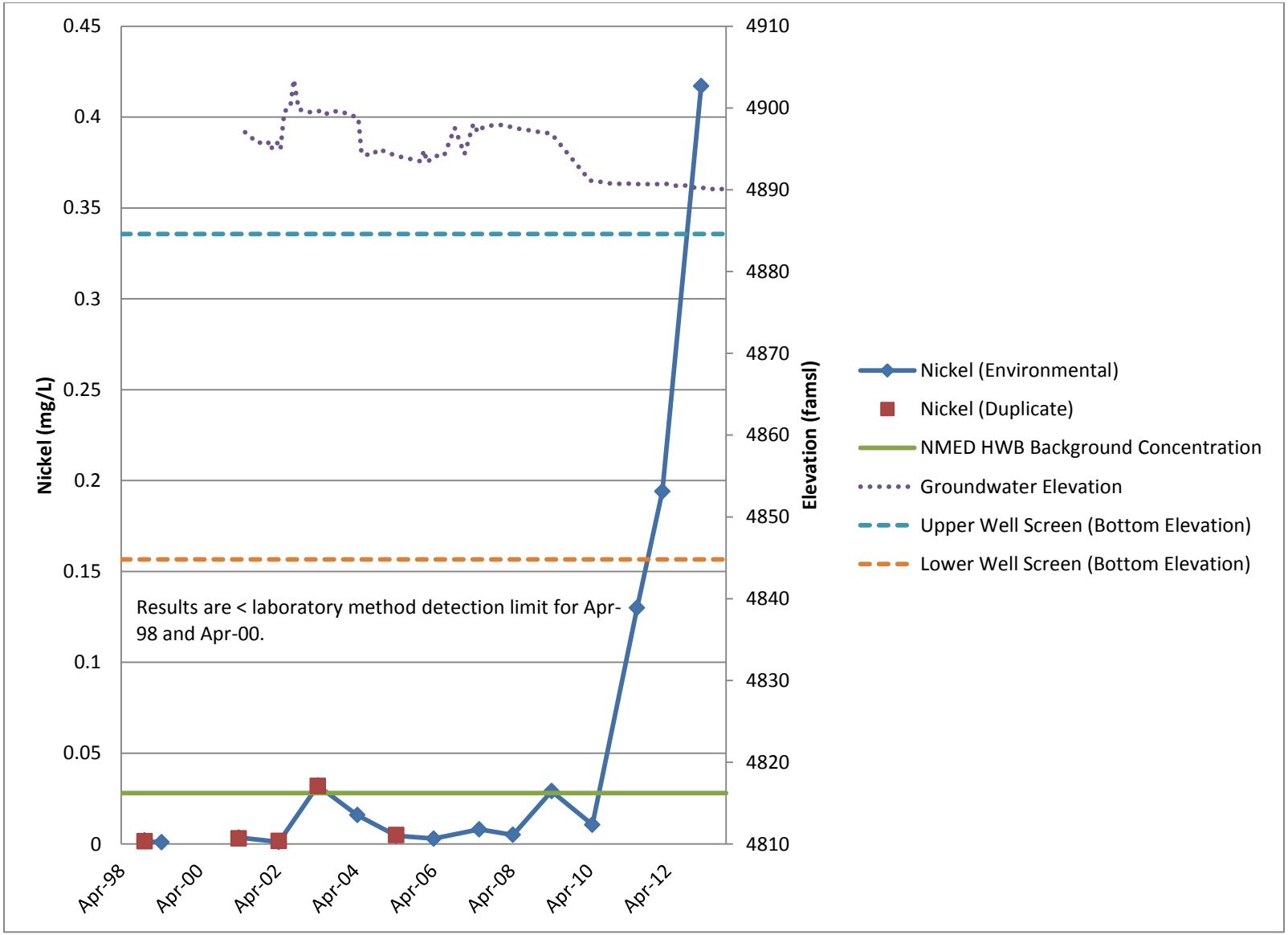

Figure 5. Unfiltered Nickel Concentrations, MWL-MW4 Groundwater Samples

chromium, cobalt, copper, and iron. However, the overall trend for unfiltered nickel results is similar to the trend of unfiltered chromium results, as shown in Figures 4 and 5.

The MWL inventory (Peace et al. September 2002), fate and transport modeling (SNL November 2005), mobility of metals in general, the rapidly increasing trend in concentrations, and the very thick vadose zone beneath the MWL (approximately 500 feet thick) are all factors that support the conclusion that the increased metals concentrations in the recent groundwater samples collected from monitoring well MWL-MW4 are not related to a release from the MWL disposal area. The sharp increases in unfiltered concentrations of chromium, cobalt, copper, iron, and nickel are indicative of a source within the well and are consistent with unfiltered metals results from previous MWL monitoring wells that had stainless steel well screens. The source is most likely corrosion by-products from the dedicated stainless steel sampling pump in monitoring well MWL-MW4. The packer and sampling system were removed in May 2009 prior to construction of the MWL ET Cover to allow the inner and outer well casing to be extended to accommodate the additional height of the ET Cover. Figure 6 is a photograph that was taken in May 2009 after the packer and pump were removed from the well. The stainless steel pump intake (to right of technician's hand) shows visible oxide staining and corrosion. The packer contains less overall metal and based on a visual inspection appeared to be in relatively good shape. The pump and packer were sent to the respective manufacturers for routine maintenance and cleaning prior to the March 2010 re-installation. The packer was refurbished and the pump was replaced. This equipment has not been removed since March 2010.

Figure 6. May 2009 Photograph of the MWL-MW4 Sampling Pump and Inflatable Packer

Table 3 summarizes the maximum filtered and unfiltered metals concentrations from previous MWL groundwater monitoring wells with stainless steel screens, including background monitoring well MWL-BW1. These wells were decommissioned in 2008 due to declining water levels and evidence of stainless steel well screen corrosion (Bearzi March 2007 and July 2007). This table compares unfiltered and filtered maximum concentrations, and demonstrates three relevant points. First, elevated results for chromium, cobalt, copper, iron, and nickel were observed in all four of these wells. Second, maximum unfiltered sample concentrations for chromium, cobalt, copper, iron, and nickel are all similar to (but generally higher) the February 2013 MWL-MW4 sample results (MWL-MW4 results provided at the bottom of Table 3 for comparison). Third, unfiltered samples show maximum concentrations one or more orders of magnitude higher than the filtered results. However, consistent with MWL-MW4 nickel sample results, filtered and unfiltered nickel concentrations are similar (i.e., not substantially different) for samples from MWL-MW1 and MWL-MW3.

Table 3. Summary of Maximum Filtered and Unfiltered Metals Results from Mixed Waste Landfill Monitoring Wells with Stainless Steel Screens[a]

MWL Monitoring Well	Metal	Maximum Filtered Concentration in (mg/L)	Maximum Unfiltered Concentration (mg/L)
MWL-BW1	Chromium	0.002280	0.09420
	Cobalt	0.000220	0.004520
	Copper	0.001940	0.00807
	Iron	0.070900	1.820
	Nickel	0.01280	0.1910
MWL-MW1	Chromium	0.004220	1.1000
	Cobalt	0.000590	0.004040
	Copper	0.003720	0.02440
	Iron	0.2600	6.100
	Nickel	0.4050	0.5380
MWL-MW2	Chromium	0.005530	0.16200
	Cobalt	0.000148	0.000790
	Copper	0.00737	0.01040
	Iron	0.2390	0.3990
	Nickel	0.007110	0.1240
MWL-MW3	Chromium	0.004520	0.1690
	Cobalt	0.000770	0.003310
	Copper	0.00556	0.01360
	Iron	0.1370	4.220
	Nickel	0.1200	0.1570
MWL-MW4	Chromium	0.001620	0.11200
	Cobalt	0.000903	0.002290
	Copper	0.002520	0.03350
	Iron	0.390	2.920
	Nickel	0.1950	0.4170

[a] Monitoring well MWL-MW4 results provided at the bottom of this table for comparison.
BW = Background well.
mg/L = Milligram(s) per liter.
MW = Monitoring well.
MWL = Mixed Waste Landfill

1.4.1 Field and Laboratory Quality Control Sample Results

The QC samples collected during the CY 2013 sampling event that are relevant to the metals sample results include two duplicate samples (collected from monitoring wells MWL-MW5 and MWL-MW8) and two equipment blank (EB) samples (associated with monitoring wells MWL-MW5 and MWL-MW8). Duplicate samples and EB samples were submitted for all analyses.

CY 2013 duplicate environmental sample results show good correlation. Although various constituents were detected in the EB samples at low concentrations, including some metals, for the MWL-MW4 metals sample results only magnesium was qualified as "estimated" based on the EB results.

All environmental sample, field QC sample, and laboratory QC sample results were reviewed and qualified in accordance with AOP 00-03, *Data Validation Procedure for Chemical and Radiochemical Data* (SNL May 2011). Although some analytical results were qualified during the data validation process, no significant data quality problems were noted for any CY 2013 MWL groundwater monitoring samples. The CY 2013 groundwater monitoring data meet data quality objectives and are in compliance with analytical methods and laboratory procedures (i.e., representative and technically defensible).

1.5 Summary and Conclusion

The January-February 2013 unfiltered metals results for chromium, cobalt, copper, iron, and nickel, as well as the 2011 through 2013 unfiltered and filtered nickel results, are anomalous and appear to be related to the corrosion of the stainless steel sampling pump and possibly other metal components associated with the dedicated sampling system in the well (connecting rods, centralizers, etc.). Evidence of corrosion on the sampling pump was observed when the equipment was removed from the well in May 2009 during ET Cover construction. MWL-MW4 is the only groundwater monitoring well at the MWL with dedicated sampling equipment installed in the well, and is the only well showing any indication of elevated metals concentrations. Filtered and unfiltered metals results are consistent with metals results from previous MWL monitoring wells with stainless steel screen sections that were decommissioned in 2008 due to evidence of well screen corrosion and declining water levels.

Previous investigations, fate and transport modeling, and groundwater monitoring results indicated the recent rapid increases in various metal parameters in groundwater samples from monitoring well MWL-MW4 are not related to a release from the MWL.

1.6 Recommendations

In accordance with the NMED-approved MWL LTMMP, groundwater monitoring of MWL-MW4 for metals is no longer required. However, additional information could be acquired to reduce uncertainty about the cause of the rapidly increasing unfiltered metals concentrations in monitoring well MWL-MW4 groundwater samples. The following recommendations are proposed for this purpose.

- Remove the dedicated sampling system from the well; inspect and document the condition of this equipment.
- Return the pump to the manufacturer for maintenance, replace with a new pump or one in good condition. Replace all related tubing.
- Clean the packer in accordance with instructions from the manufacturer, and clean all connecting rods and other components (pressure wash or steam clean). Replace tubing associated with the packer.
- Reinstall the packer, sampling pump, and new tubing to isolate the two screen intervals, and allow for additional sampling.
- Conduct at least one additional MWL-MW4 groundwater sampling event and collect both filtered and unfiltered TAL metals samples.

- Provide NMED with a report that includes the resampling results, and documentation associated with the removal, maintenance-repair-cleaning-replacement of equipment, reinstallation of equipment, and the additional sampling event.
- Continue to use MWL-MW4 for groundwater elevation measurements from the upper screen interval (i.e., maintain the packer in the well) in support of potentiometric surface mapping beneath the MWL.

Prior to taking any additional actions, the Department of Energy/National Nuclear Security Administration/Sandia Field Office and Sandia Corporation are requesting NMED input to this MWL-MW4 Metals Data Report.

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ATTACHMENT A

Mixed Waste Landfill
MWL-MW4 Filtered and Unfiltered Metals Results
Annual Groundwater Monitoring – Calendar Year 2013

Table A-1
Summary of Unfiltered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-BW2	Aluminum	0.173	0.015	0.050	NE			093409-009	SW846 6020
29-Jan-13	Antimony	ND	0.001	0.003	0.006	U		093409-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093409-009	SW846 6020
	Barium	0.0988	0.0006	0.002	2.00		J-	093409-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093409-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093409-009	SW846 6020
	Calcium	74.3	1.20	4.00	NE	B		093409-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093409-009	SW846 6020
	Cobalt	0.000213	0.0001	0.001	NE	J		093409-009	SW846 6020
	Copper	0.00114	0.00035	0.001	NE			093409-009	SW846 6020
	Iron	0.382	0.033	0.100	NE			093409-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093409-009	SW846 6020
	Magnesium	24.7	0.010	0.030	NE			093409-009	SW846 6020
	Manganese	0.0138	0.001	0.005	NE			093409-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		093409-009	SW846 7470
	Nickel	0.00257	0.0005	0.002	NE			093409-009	SW846 6020
	Potassium	4.10	0.080	0.300	NE			093409-009	SW846 6020
	Selenium	0.00256	0.0015	0.005	0.050	J		093409-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093409-009	SW846 6020
	Sodium	62.4	1.60	5.00	NE			093409-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093409-009	SW846 6020
	Uranium	0.00686	0.000067	0.0002	0.030			093409-009	SW846 6020
	Vanadium	0.00616	0.001	0.005	NE			093409-009	SW846 6010
	Zinc	0.0102	0.0035	0.010	NE			093409-009	SW846 6020

Refer to footnotes on page 36.

Table A-1 *(Continued)*
Summary of Unfiltered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW4	Aluminum	0.0284	0.015	0.050	NE	J		093441-009	SW846 6020
11-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093441-009	SW846 6020
	Arsenic	0.00426	0.0017	0.005	0.010	J		093441-009	SW846 6020
	Barium	0.0861	0.0006	0.002	2.00			093441-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093441-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093441-009	SW846 6020
	Calcium	58.9	0.300	1.00	NE			093441-009	SW846 6020
	Chromium	**0.112**	0.002	0.010	0.100			093441-009	SW846 6020
	Cobalt	0.00229	0.0001	0.001	NE			093441-009	SW846 6020
	Copper	0.0335	0.00035	0.001	NE			093441-009	SW846 6020
	Iron	2.92	0.033	0.100	NE			093441-009	SW846 6020
	Lead	0.00126	0.0005	0.002	NE	J		093441-009	SW846 6020
	Magnesium	18.5	0.010	0.030	NE		J	093441-009	SW846 6020
	Manganese	0.0503	0.001	0.005	NE			093441-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093441-009	SW846 7470
	Nickel	0.417	0.0005	0.002	NE			093441-009	SW846 6020
	Potassium	5.10	0.080	0.300	NE		J	093441-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093441-009	SW846 6020
	Silver	0.00236	0.0002	0.001	NE			093441-009	SW846 6020
	Sodium	56.7	0.400	1.25	NE			093441-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093441-009	SW846 6020
	Uranium	0.00455	0.000067	0.0002	0.030			093441-009	SW846 6020
	Vanadium	0.0105	0.001	0.005	NE			093441-009	SW846 6010
	Zinc	0.144	0.0035	0.010	NE			093441-009	SW846 6020

Refer to footnotes on page 36.

Table A-1 *(Continued)*
Summary of Unfiltered Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW5	Aluminum	ND	0.015	0.050	NE	U		093414-009	SW846 6020
30-Jan-13	Antimony	ND	0.001	0.003	0.006	U		093414-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093414-009	SW846 6020
	Barium	0.116	0.0006	0.002	2.00		J-	093414-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093414-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093414-009	SW846 6020
	Calcium	99.9	1.20	4.00	NE	B		093414-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093414-009	SW846 6020
	Cobalt	0.000142	0.0001	0.001	NE	J		093414-009	SW846 6020
	Copper	0.000817	0.00035	0.001	NE	J	0.012UJ	093414-009	SW846 6020
	Iron	0.185	0.033	0.100	NE			093414-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093414-009	SW846 6020
	Magnesium	33.8	0.010	0.030	NE			093414-009	SW846 6020
	Manganese	0.0085	0.001	0.005	NE			093414-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		093414-009	SW846 7470
	Nickel	0.00201	0.0005	0.002	NE		0.0026U	093414-009	SW846 6020
	Potassium	5.71	0.080	0.300	NE			093414-009	SW846 6020
	Selenium	0.00193	0.0015	0.005	0.050	J		093414-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093414-009	SW846 6020
	Sodium	74.9	1.60	5.00	NE			093414-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093414-009	SW846 6020
	Uranium	0.00908	0.000067	0.0002	0.030			093414-009	SW846 6020
	Vanadium	0.00548	0.001	0.005	NE			093414-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093414-009	SW846 6020

Refer to footnotes on page 36.

Table A-1 *(Continued)*
Summary of Unfiltered Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW5 (Duplicate)	Aluminum	ND	0.015	0.050	NE	U		093415-009	SW846 6020
30-Jan-13	Antimony	ND	0.001	0.003	0.006	U		093415-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093415-009	SW846 6020
	Barium	0.114	0.0006	0.002	2.00		J-	093415-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093415-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093415-009	SW846 6020
	Calcium	98.3	1.20	4.00	NE	B		093415-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093415-009	SW846 6020
	Cobalt	0.000139	0.0001	0.001	NE	J		093415-009	SW846 6020
	Copper	0.000619	0.00035	0.001	NE	J	0.012UJ	093415-009	SW846 6020
	Iron	0.182	0.033	0.100	NE			093415-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093415-009	SW846 6020
	Magnesium	33.9	0.010	0.030	NE			093415-009	SW846 6020
	Manganese	0.0086	0.001	0.005	NE			093415-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		093415-009	SW846 7470
	Nickel	0.00208	0.0005	0.002	NE		0.0026U	093415-009	SW846 6020
	Potassium	5.71	0.080	0.300	NE			093415-009	SW846 6020
	Selenium	0.00201	0.0015	0.005	0.050	J		093415-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093415-009	SW846 6020
	Sodium	74.3	1.60	5.00	NE			093415-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093415-009	SW846 6020
	Uranium	0.0093	0.000067	0.0002	0.030			093415-009	SW846 6020
	Vanadium	0.00521	0.001	0.005	NE			093415-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093415-009	SW846 6020

Refer to footnotes on page 36.

Table A-1 *(Continued)*
Summary of Unfiltered Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW6	Aluminum	ND	0.015	0.050	NE	U		093418-009	SW846 6020
31-Jan-13	Antimony	ND	0.001	0.003	0.006	U		093418-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093418-009	SW846 6020
	Barium	0.117	0.0006	0.002	2.00			093418-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093418-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093418-009	SW846 6020
	Calcium	92.4	1.20	4.00	NE			093418-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093418-009	SW846 6020
	Cobalt	0.000115	0.0001	0.001	NE	J		093418-009	SW846 6020
	Copper	0.000849	0.00035	0.001	NE	J		093418-009	SW846 6020
	Iron	0.183	0.033	0.100	NE			093418-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093418-009	SW846 6020
	Magnesium	30.8	0.010	0.030	NE			093418-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		093418-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		093418-009	SW846 7470
	Nickel	0.00228	0.0005	0.002	NE			093418-009	SW846 6020
	Potassium	5.80	0.080	0.300	NE			093418-009	SW846 6020
	Selenium	0.00224	0.0015	0.005	0.050	J		093418-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093418-009	SW846 6020
	Sodium	70.8	1.60	5.00	NE			093418-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093418-009	SW846 6020
	Uranium	0.0102	0.000067	0.0002	0.030			093418-009	SW846 6020
	Vanadium	0.0064	0.001	0.005	NE			093418-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093418-009	SW846 6020

Refer to footnotes on page 36.

Table A-1 *(Continued)*
Summary of Unfiltered Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW7	Aluminum	ND	0.015	0.050	NE	U		093438-009	SW846 6020
07-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093438-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093438-009	SW846 6020
	Barium	0.093	0.0006	0.002	2.00			093438-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093438-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093438-009	SW846 6020
	Calcium	58.3	0.600	2.00	NE	B		093438-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093438-009	SW846 6020
	Cobalt	0.000105	0.0001	0.001	NE	J		093438-009	SW846 6020
	Copper	0.000927	0.00035	0.001	NE	J	J	093438-009	SW846 6020
	Iron	0.115	0.033	0.100	NE			093438-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093438-009	SW846 6020
	Magnesium	18.3	0.010	0.030	NE			093438-009	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		093438-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093438-009	SW846 7470
	Nickel	0.00152	0.0005	0.002	NE	J		093438-009	SW846 6020
	Potassium	4.66	0.080	0.300	NE			093438-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093438-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093438-009	SW846 6020
	Sodium	41.0	0.080	0.250	NE			093438-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093438-009	SW846 6020
	Uranium	0.00747	0.000067	0.0002	0.030			093438-009	SW846 6020
	Vanadium	0.0076	0.001	0.005	NE			093438-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093438-009	SW846 6020

Refer to footnotes on page 36.

Table A-1 *(Continued)*
Summary of Unfiltered Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW8	Aluminum	0.0265	0.015	0.050	NE	J		093429-009	SW846 6020
06-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093429-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093429-009	SW846 6020
	Barium	0.122	0.006	0.020	2.00			093429-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093429-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093429-009	SW846 6020
	Calcium	60.8	0.600	2.00	NE	B		093429-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093429-009	SW846 6020
	Cobalt	0.000135	0.0001	0.001	NE	J		093429-009	SW846 6020
	Copper	0.00182	0.00035	0.001	NE		0.015UJ	093429-009	SW846 6020
	Iron	0.150	0.033	0.100	NE			093429-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093429-009	SW846 6020
	Magnesium	19.1	0.010	0.030	NE			093429-009	SW846 6020
	Manganese	0.0223	0.001	0.005	NE			093429-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093429-009	SW846 7470
	Nickel	0.00215	0.0005	0.002	NE			093429-009	SW846 6020
	Potassium	5.06	0.080	0.300	NE			093429-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093429-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093429-009	SW846 6020
	Sodium	42.3	0.080	0.250	NE			093429-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093429-009	SW846 6020
	Uranium	0.00755	0.000067	0.0002	0.030			093429-009	SW846 6020
	Vanadium	0.00242	0.001	0.005	NE	J		093429-009	SW846 6010
	Zinc	0.00515	0.0035	0.010	NE	J		093429-009	SW846 6020

Refer to footnotes on page 36.

Table A-1 *(Continued)*
Summary of Unfiltered Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW8 (Duplicate)	Aluminum	0.0378	0.015	0.050	NE	J		093430-009	SW846 6020
06-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093430-009	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093430-009	SW846 6020
	Barium	0.120	0.0006	0.002	2.00			093430-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093430-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093430-009	SW846 6020
	Calcium	59.1	0.600	2.00	NE	B		093430-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093430-009	SW846 6020
	Cobalt	0.000144	0.0001	0.001	NE	J		093430-009	SW846 6020
	Copper	0.00195	0.00035	0.001	NE		0.015UJ	093430-009	SW846 6020
	Iron	0.162	0.033	0.100	NE			093430-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093430-009	SW846 6020
	Magnesium	19.2	0.010	0.030	NE			093430-009	SW846 6020
	Manganese	0.0227	0.001	0.005	NE			093430-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093430-009	SW846 7470
	Nickel	0.00218	0.0005	0.002	NE			093430-009	SW846 6020
	Potassium	5.10	0.080	0.300	NE			093430-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093430-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093430-009	SW846 6020
	Sodium	43.2	0.080	0.250	NE			093430-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093430-009	SW846 6020
	Uranium	0.00726	0.000067	0.0002	0.030			093430-009	SW846 6020
	Vanadium	0.00174	0.001	0.005	NE	J		093430-009	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093430-009	SW846 6020

Refer to footnotes on page 36.

Table A-1 *(Concluded)*
Summary of Unfiltered Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW9	Aluminum	0.0358	0.015	0.050	NE	J		093423-009	SW846 6020
04-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093423-009	SW846 6020
	Arsenic	0.00185	0.0017	0.005	0.010	J		093423-009	SW846 6020
	Barium	0.0897	0.0006	0.002	2.00			093423-009	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093423-009	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093423-009	SW846 6020
	Calcium	58.9	0.600	2.00	NE	B		093423-009	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093423-009	SW846 6020
	Cobalt	0.000168	0.0001	0.001	NE	J		093423-009	SW846 6020
	Copper	0.00108	0.00035	0.001	NE		J	093423-009	SW846 6020
	Iron	0.172	0.033	0.100	NE			093423-009	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093423-009	SW846 6020
	Magnesium	18.6	0.010	0.030	NE			093423-009	SW846 6020
	Manganese	0.00862	0.001	0.005	NE			093423-009	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093423-009	SW846 7470
	Nickel	0.00208	0.0005	0.002	NE			093423-009	SW846 6020
	Potassium	4.73	0.080	0.300	NE			093423-009	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093423-009	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093423-009	SW846 6020
	Sodium	40.7	0.080	0.250	NE			093423-009	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093423-009	SW846 6020
	Uranium	0.00923	0.000067	0.0002	0.030			093423-009	SW846 6020
	Vanadium	0.00921	0.001	0.005	NE			093423-009	SW846 6010
	Zinc	0.00376	0.0035	0.010	NE	J		093423-009	SW846 6020

Refer to footnotes on page 36.

Table A-2
Summary of Filtered Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-BW2	Aluminum	ND	0.015	0.050	NE	U		093409-010	SW846 6020
29-Jan-13	Antimony	ND	0.001	0.003	0.006	U		093409-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093409-010	SW846 6020
	Barium	0.0929	0.0006	0.002	2.00		J-	093409-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093409-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093409-010	SW846 6020
	Calcium	72.7	1.20	4.00	NE	B		093409-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093409-010	SW846 6020
	Cobalt	0.000313	0.0001	0.001	NE	J		093409-010	SW846 6020
	Copper	0.000649	0.00035	0.001	NE	J		093409-010	SW846 6020
	Iron	0.135	0.033	0.100	NE			093409-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093409-010	SW846 6020
	Magnesium	24.6	0.010	0.030	NE			093409-010	SW846 6020
	Manganese	0.0093	0.001	0.005	NE			093409-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		093409-010	SW846 7470
	Nickel	0.00218	0.0005	0.002	NE			093409-010	SW846 6020
	Potassium	3.98	0.080	0.300	NE			093409-010	SW846 6020
	Selenium	0.00265	0.0015	0.005	0.050	J		093409-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093409-010	SW846 6020
	Sodium	61.3	1.60	5.00	NE			093409-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093409-010	SW846 6020
	Uranium	0.00679	0.000067	0.0002	0.030			093409-010	SW846 6020
	Vanadium	0.00567	0.001	0.005	NE			093409-010	SW846 6010
	Zinc	0.00979	0.0035	0.010	NE	J		093409-010	SW846 6020

Refer to footnotes on page 36.

Table A-2 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW4	Aluminum	ND	0.015	0.050	NE	U		093441-010	SW846 6020
11-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093441-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093441-010	SW846 6020
	Barium	0.0864	0.0006	0.002	2.00			093441-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093441-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093441-010	SW846 6020
	Calcium	62.1	0.300	1.00	NE			093441-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093441-010	SW846 6020
	Cobalt	0.000296	0.0001	0.001	NE	J		093441-010	SW846 6020
	Copper	0.00213	0.00035	0.001	NE			093441-010	SW846 6020
	Iron	0.137	0.033	0.100	NE			093441-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093441-010	SW846 6020
	Magnesium	18.9	0.010	0.030	NE		J	093441-010	SW846 6020
	Manganese	0.00414	0.001	0.005	NE	J		093441-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093441-010	SW846 7470
	Nickel	0.179	0.0005	0.002	NE			093441-010	SW846 6020
	Potassium	4.48	0.080	0.300	NE		J	093441-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093441-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093441-010	SW846 6020
	Sodium	48.6	0.080	0.250	NE			093441-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093441-010	SW846 6020
	Uranium	0.00549	0.000067	0.0002	0.030			093441-010	SW846 6020
	Vanadium	0.00821	0.001	0.005	NE			093441-010	SW846 6010
	Zinc	0.0462	0.0035	0.010	NE			093441-010	SW846 6020

Refer to footnotes on page 36.

Table A-2 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW5	Aluminum	ND	0.015	0.050	NE	U		093414-010	SW846 6020
30-Jan-13	Antimony	ND	0.001	0.003	0.006	U		093414-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093414-010	SW846 6020
	Barium	0.113	0.0006	0.002	2.00		J-	093414-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093414-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093414-010	SW846 6020
	Calcium	96.0	1.20	4.00	NE	B		093414-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093414-010	SW846 6020
	Cobalt	0.000126	0.0001	0.001	NE	J	0.00064U	093414-010	SW846 6020
	Copper	0.000995	0.00035	0.001	NE	J	0.011UJ	093414-010	SW846 6020
	Iron	0.179	0.033	0.100	NE			093414-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093414-010	SW846 6020
	Magnesium	32.5	0.010	0.030	NE			093414-010	SW846 6020
	Manganese	0.00226	0.001	0.005	NE	J		093414-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		093414-010	SW846 7470
	Nickel	0.00199	0.0005	0.002	NE	J		093414-010	SW846 6020
	Potassium	5.47	0.080	0.300	NE			093414-010	SW846 6020
	Selenium	0.00225	0.0015	0.005	0.050	J		093414-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093414-010	SW846 6020
	Sodium	72.8	1.60	5.00	NE			093414-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093414-010	SW846 6020
	Uranium	0.00914	0.000067	0.0002	0.030			093414-010	SW846 6020
	Vanadium	0.00559	0.001	0.005	NE			093414-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093414-010	SW846 6020

Refer to footnotes on page 36.

Table A-2 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW5 (Duplicate)	Aluminum	ND	0.015	0.050	NE	U		093415-010	SW846 6020
30-Jan-13	Antimony	ND	0.001	0.003	0.006	U		093415-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093415-010	SW846 6020
	Barium	0.107	0.0006	0.002	2.00		J-	093415-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093415-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093415-010	SW846 6020
	Calcium	94.0	1.20	4.00	NE	B		093415-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093415-010	SW846 6020
	Cobalt	0.000128	0.0001	0.001	NE	J	0.00064U	093415-010	SW846 6020
	Copper	0.000713	0.00035	0.001	NE	J	0.011UJ	093415-010	SW846 6020
	Iron	0.178	0.033	0.100	NE			093415-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093415-010	SW846 6020
	Magnesium	31.9	0.010	0.030	NE			093415-010	SW846 6020
	Manganese	0.00217	0.001	0.005	NE	J		093415-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		093415-010	SW846 7470
	Nickel	0.00199	0.0005	0.002	NE	J		093415-010	SW846 6020
	Potassium	5.25	0.080	0.300	NE			093415-010	SW846 6020
	Selenium	0.00236	0.0015	0.005	0.050	J		093415-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093415-010	SW846 6020
	Sodium	70.2	1.60	5.00	NE			093415-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093415-010	SW846 6020
	Uranium	0.00876	0.000067	0.0002	0.030			093415-010	SW846 6020
	Vanadium	0.00481	0.001	0.005	NE	J		093415-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093415-010	SW846 6020

Refer to footnotes on page 36.

Table A-2 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW6	Aluminum	ND	0.015	0.050	NE	U		093418-010	SW846 6020
31-Jan-13	Antimony	ND	0.001	0.003	0.006	U		093418-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093418-010	SW846 6020
	Barium	0.114	0.0006	0.002	2.00			093418-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093418-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093418-010	SW846 6020
	Calcium	97.6	1.20	4.00	NE			093418-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093418-010	SW846 6020
	Cobalt	0.000124	0.0001	0.001	NE	J		093418-010	SW846 6020
	Copper	0.000678	0.00035	0.001	NE	J		093418-010	SW846 6020
	Iron	0.178	0.033	0.100	NE			093418-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093418-010	SW846 6020
	Magnesium	30.8	0.010	0.030	NE			093418-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		093418-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U		093418-010	SW846 7470
	Nickel	0.00191	0.0005	0.002	NE	J		093418-010	SW846 6020
	Potassium	5.68	0.080	0.300	NE			093418-010	SW846 6020
	Selenium	0.00202	0.0015	0.005	0.050	J		093418-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093418-010	SW846 6020
	Sodium	72.6	1.60	5.00	NE			093418-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093418-010	SW846 6020
	Uranium	0.0101	0.000067	0.0002	0.030			093418-010	SW846 6020
	Vanadium	0.00713	0.001	0.005	NE			093418-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093418-010	SW846 6020

Refer to footnotes on page 36.

Table A-2 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW7	Aluminum	ND	0.015	0.050	NE	U		093438-010	SW846 6020
07-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093438-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093438-010	SW846 6020
	Barium	0.0929	0.0006	0.002	2.00			093438-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093438-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093438-010	SW846 6020
	Calcium	56.3	0.600	2.00	NE	B		093438-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093438-010	SW846 6020
	Cobalt	0.000135	0.0001	0.001	NE	J		093438-010	SW846 6020
	Copper	0.00107	0.00035	0.001	NE		J	093438-010	SW846 6020
	Iron	0.105	0.033	0.100	NE			093438-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093438-010	SW846 6020
	Magnesium	18.4	0.010	0.030	NE			093438-010	SW846 6020
	Manganese	ND	0.001	0.005	NE	U		093438-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093438-010	SW846 7470
	Nickel	0.00156	0.0005	0.002	NE	J		093438-010	SW846 6020
	Potassium	4.65	0.080	0.300	NE			093438-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093438-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093438-010	SW846 6020
	Sodium	42.0	0.080	0.250	NE			093438-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093438-010	SW846 6020
	Uranium	0.00761	0.000067	0.0002	0.030			093438-010	SW846 6020
	Vanadium	0.00776	0.001	0.005	NE			093438-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093438-010	SW846 6020

Refer to footnotes on page 36.

Table A-2 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW8	Aluminum	ND	0.015	0.050	NE	U		093429-010	SW846 6020
06-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093429-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093429-010	SW846 6020
	Barium	0.120	0.0006	0.002	2.00			093429-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093429-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093429-010	SW846 6020
	Calcium	62.4	0.600	2.00	NE	B		093429-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093429-010	SW846 6020
	Cobalt	0.000114	0.0001	0.001	NE	J		093429-010	SW846 6020
	Copper	0.00151	0.00035	0.001	NE		0.008UJ	093429-010	SW846 6020
	Iron	0.107	0.033	0.100	NE			093429-010	SW846 6020
	Lead	0.00109	0.0005	0.002	NE	J		093429-010	SW846 6020
	Magnesium	19.3	0.010	0.030	NE			093429-010	SW846 6020
	Manganese	0.0131	0.001	0.005	NE			093429-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093429-010	SW846 7470
	Nickel	0.00196	0.0005	0.002	NE	J		093429-010	SW846 6020
	Potassium	5.11	0.080	0.300	NE			093429-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093429-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093429-010	SW846 6020
	Sodium	43.0	0.080	0.250	NE			093429-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093429-010	SW846 6020
	Uranium	0.00742	0.000067	0.0002	0.030			093429-010	SW846 6020
	Vanadium	0.00191	0.001	0.005	NE	J		093429-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093429-010	SW846 6020

Refer to footnotes on page 36.

Table A-2 *(Continued)*
Summary of Filtered Target Analyte List Metals plus Uranium Results,
Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW8 (Duplicate)	Aluminum	ND	0.015	0.050	NE	U		093430-010	SW846 6020
06-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093430-010	SW846 6020
	Arsenic	ND	0.0017	0.005	0.010	U		093430-010	SW846 6020
	Barium	0.118	0.0006	0.002	2.00			093430-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093430-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093430-010	SW846 6020
	Calcium	60.3	0.600	2.00	NE	B		093430-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093430-010	SW846 6020
	Cobalt	0.000116	0.0001	0.001	NE	J		093430-010	SW846 6020
	Copper	0.00154	0.00035	0.001	NE		0.008UJ	093430-010	SW846 6020
	Iron	0.109	0.033	0.100	NE			093430-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093430-010	SW846 6020
	Magnesium	18.8	0.010	0.030	NE			093430-010	SW846 6020
	Manganese	0.0128	0.001	0.005	NE			093430-010	SW846 6020
	Mercury	ND	0.000067	0.0002	0.002	U	UJ	093430-010	SW846 7470
	Nickel	0.00186	0.0005	0.002	NE	J		093430-010	SW846 6020
	Potassium	4.98	0.080	0.300	NE			093430-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093430-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093430-010	SW846 6020
	Sodium	42.4	0.080	0.250	NE			093430-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093430-010	SW846 6020
	Uranium	0.00737	0.000067	0.0002	0.030			093430-010	SW846 6020
	Vanadium	0.00178	0.001	0.005	NE	J		093430-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093430-010	SW846 6020

Refer to footnotes on page 36.

Table A-2 *(Concluded)*
Summary of Filtered Target Analyte List Metals plus Uranium Results, Mixed Waste Landfill Groundwater Monitoring, Sandia National Laboratories/New Mexico

Calendar Year 2013

Well ID	Analyte	Result[a] (mg/L)	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Laboratory Qualifier[b]	Validation Qualifier[b]	Sample No.	Analytical Method[c]
MWL-MW9	Aluminum	ND	0.015	0.050	NE	U		093423-010	SW846 6020
04-Feb-13	Antimony	ND	0.001	0.003	0.006	U		093423-010	SW846 6020
	Arsenic	0.00307	0.0017	0.005	0.010	J		093423-010	SW846 6020
	Barium	0.0896	0.0006	0.002	2.00			093423-010	SW846 6020
	Beryllium	ND	0.0002	0.0005	0.004	U		093423-010	SW846 6020
	Cadmium	ND	0.00011	0.001	0.005	U		093423-010	SW846 6020
	Calcium	59.1	0.600	2.00	NE	B		093423-010	SW846 6020
	Chromium	ND	0.002	0.010	0.100	U		093423-010	SW846 6020
	Cobalt	0.00018	0.0001	0.001	NE	J		093423-010	SW846 6020
	Copper	0.00134	0.00035	0.001	NE		J	093423-010	SW846 6020
	Iron	0.108	0.033	0.100	NE			093423-010	SW846 6020
	Lead	ND	0.0005	0.002	NE	U		093423-010	SW846 6020
	Magnesium	18.7	0.010	0.030	NE			093423-010	SW846 6020
	Manganese	0.00225	0.001	0.005	NE	J		093423-010	SW846 6020
	Mercury	0.0003	0.000067	0.0002	0.002		NJ-	093423-010	SW846 7470
	Nickel	0.00174	0.0005	0.002	NE	J		093423-010	SW846 6020
	Potassium	4.73	0.080	0.300	NE			093423-010	SW846 6020
	Selenium	ND	0.0015	0.005	0.050	U		093423-010	SW846 6020
	Silver	ND	0.0002	0.001	NE	U		093423-010	SW846 6020
	Sodium	40.6	0.080	0.250	NE			093423-010	SW846 6020
	Thallium	ND	0.00045	0.002	0.002	U		093423-010	SW846 6020
	Uranium	0.00911	0.000067	0.0002	0.030			093423-010	SW846 6020
	Vanadium	0.00975	0.001	0.005	NE			093423-010	SW846 6010
	Zinc	ND	0.0035	0.010	NE	U		093423-010	SW846 6020

Refer to footnotes on page 36.

Footnotes for Tables A-1 and A-2

Notes

[a]Values in bold exceed the established MCL.

[b]Laboratory/Validation Qualifier – Blank (--) cell = all quality control samples met acceptance criteria. See explanation for "B" "J" "J-" "NJ-" "U" "UJ" qualifiers below.

[c]U.S. Environmental Protection Agency, 1986 (and updates), "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd edition.

% = percent.
B = Analyte is detected in associated laboratory method blank.
EPA = U.S. Environmental Protection Agency.
ID = Identifier.
J = Estimated value, the analyte concentration is below the PQL.
J- = The associated numerical value is an estimated quantity with a suspected negative bias.
MCL = Maximum contaminant level. MCLs were established by the EPA Office of Water, National Primary Water Regulations (EPA May 2009).
MDL = Method detection limit. The minimum concentration or activity that can be measured and reported with 99% confidence that the analyte is greater than zero, analyte is matrix-specific.
mg/L = milligrams per liter.
ND = Not detected (at MDL). Activities of zero or less are considered to be not detected.
NE = Not established.
NJ- = Presumptive evidence of the presence of the material at an estimated quantity with a suspected negative bias.
No. = Number.
PQL = Practical quantitation limit. The lowest concentration of analytes in a sample that can be reliably determined within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions.
U = Analyte is not present or concentration is below the MDL.
UJ = Analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

Sandia National Laboratories

Volume VIII

TAB 28

Mixed Waste Landfill Groundwater Monitoring Report – Monitoring Well MWL-MW4 Metals Data – Calendar Year 2013, May 2014 (NMED Recommendations Letter)

From: NMED/Kieling
To: SNL/ Beausoleil

Back of Tab 28

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RYAN FLYNN
Secretary
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CERTIFIED MAIL – RETURN RECEIPT REQUESTED

July 24, 2014

Geoffrey L. Beausoleil
Manager
U.S. Department of Energy
P.O. Box 5400, MS-0184
Albuquerque, NM 87185-5400

Peter B. Davies
Director,
Nuclear Energy & Fuel Cycle Programs
P.O. Box 6200, MS-0721
Albuquerque, NM 87185

RE: MIXED WASTE LANDFILL GROUNDWATER MONITORING REPORT – GROUNDWATER MONITORING WELL MWL-MW4 – CALENDAR YEAR 2013, MAY 20, 2014
SANDIA NATIONAL LABORATORIES, EPA ID# NM5890110518
HWB-SNL-14-009

Dear Mr. Beausoleil and Mr. Davies:

The New Mexico Environment Department (NMED) has reviewed the subject report submitted by the U.S. Department of Energy (DOE) on behalf of itself and Sandia Corporation (collectively, the Permittees), with cover letter dated May 20, 2014. The Permittees request recommendations from the NMED concerning the action that may be necessary to address certain elevated metals concentrations detected in groundwater samples obtained from Mixed Waste Landfill (MWL) monitoring well MWL-MW4.

Review of the data in the subject report suggests that the elevated chromium and nickel in water samples are derived from corrosion of stainless-steel components of the dedicated pump and/or packer installed in the well. As the report indicates, chromium, nickel, and the other metals of concern were found in soil in the vadose zone at background levels during the RCRA Facility Investigation, indicating that waste buried in the MWL is likely not the source of these metals. However, NMED believes further investigation is warranted. Below in response to your request are NMED's recommendations regarding this matter.

1. NMED agrees that if the chromium and nickel (and the other metals) are derived from corrosion of the stainless steel packer and/or pump components, then removal of the pump and packer components and replacing/refurbishing them should eliminate the elevated concentrations of metals observed in water samples (however, if the same components are re-installed in the wells, then they would likely eventually corrode and the same issue would arise again at some future date).
2. Groundwater should be pumped from MWL-MW4 to remove contaminated groundwater in and surrounding the well with the intent to expedite the return of metal concentrations in water samples to background levels. Because the upper monitoring interval of MWL-MW4 purges dry, the well should be allowed to recover, and the well purged again. This procedure should be repeated a number of times to ensure that most, if not all, of the contaminated groundwater is removed. Field parameters (like specific conductance), or field analysis of Cr and Ni may be helpful to decide when pumping has adequately accomplished removal of the contaminated groundwater, and thus, can be terminated.
3. Filtered and unfiltered groundwater samples should be collected immediately prior to and after the pumping procedure described above is terminated, and possibly during the pumping of contaminated groundwater from MWL-MW4. The samples should be analyzed in a laboratory for Cr, Ni, and the other metals of concern. In addition, standard field parameters (e.g. turbidity, specific conductance, pH, and temperature) should be measured and recorded each time a groundwater sample is collected.
4. The pumping procedure should be conducted before removal of the packer with the goal of removing as much of the sediment as possible that may have accumulated on top of the packer. This sediment may contain particles bearing Cr and other metals derived from corrosion, and it should be removed to prevent it from sinking into the well's sump.

If you have any questions regarding this matter, please contact Mr. William Moats of my staff at (505) 222-9551.

Sincerely,

John E. Kieling
Chief
Hazardous Waste Bureau

cc: D. Cobrain, NMED HWB
W. Moats, NMED HWB
T. Skibitski, NMED DOE OB
L. King, EPA-6
J. Cochran, SNL/NM, MS-0719
J. Weckerle, SFO/ENG MS-0184
File: SNL 2014 and Reading